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Unfulfilled goals interfere with tasks that require executive functions☆,☆☆

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ABSTRACT

Even after one stops actively pursuing a goal, many mental processes remain focused on the goal (e.g., the Zeigarnik effect), potentially occupying limited attentional and working memory resources. Five studies examined whether the processes associated with unfulfilled goals would interfere with tasks that require the executive function, which has a limited focal capacity and can pursue only one goal at a time. In Studies 1 and 2, activating a goal nonconsciously and then manipulating unfulfillment caused impairments on later tasks requiring fluid intelligence (solving anagrams; Study 1) and impulse control (dieting; Study 2). Study 3 showed that impairments were specific to executive functioning tasks: an unfulfilled goal impaired performance on logic problems but not on a test of general knowledge (only the former requires executive functions). Study 4 found that the effect was moderated by individual differences; participants who reported a tendency to shift readily amongst their various pursuits showed no task interference. Study 5 found that returning to fulfill a previously frustrated goal eliminated the interference effect. These findings provide converging evidence that unfulfilled goals can interfere with later tasks, insofar as they require executive functions.

The behavior of many animals is guided by a few simple goals, the pursuit of which can be managed effectively by rather hard-wired propensities. In contrast, human social life has allowed for the pursuit of a large variety of goals, such that people report pursuing 15 personal goals and strivings on average at any given time (Little, 1989). Some of these goals come and go, while others endure for years. Hence the human psyche requires complex and flexible systems for managing multiple pursuits.

The present research focuses on the idea that while a person may be committed to many goals at once, the conscious executive can strive to satisfy them only one at a time (James, 1890). Hence one's multiple goals effectively compete for access to the executive function, which has limited attentional capacity and working memory resources. Each unfulfilled goal remains active (Lewin, 1935), intruding into one's thoughts and attention (Zeigarnik, 1927), seeking to recapture the executive so as to move toward fulfillment. Because of this competition, the persistent intrusions into attention from unfulfilled goals can impair pursuit of the other, even ostensibly unrelated tasks. Thus, the current work extends previous research on the persistent activation of unfulfilled goals (Lewin, 1935; Klinger, 1975). The central hypothesis of the present investigation was that a prior unfulfilled goal can hamper performance on a subsequent, unrelated task insofar as this second task depends on the limited resources of the executive function.

Cognitive consequences of unfulfilled goals

When a person commences working toward a goal, multiple mental systems are aid in the process. Attention seeks out goal relevant information (Moskowitz, 2002), attitudes favor objects that facilitate success (Ferguson & Bargh, 2004), and perception brings in skewed interpretations that minimize failure (Balcetis & Dunning, 2006; Haselton & Buss, 2000; Maner et al., 2005). Meanwhile, thoughts about irrelevant goals and motivations are shuffled off to the side (Shah, Friedman, & Kruglanski, 2002).

When interruption or failure prevents goal attainment, however, then what happens? The goal can be abandoned, but this is a costly and complex process (Klinger, 1975) and, for particularly important goals, disengagement may require major alterations to the self-concept (see Wrosch, Scheier, Carver, & Schulz, 2003). Until the point of goal disengagement, therefore, the person remains committed to an incomplete endeavor.

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Many processes presumably sustain interest in a goal when it is left unfinished. Automatic processes continue to seek and process goal relevant information (Goschke & Kuhl, 1993; Förster, Liberman, & Higgins, 2005; Klinger, 1975; Rothermund, 2003; Zeigarnik, 1927) and to watch for opportunities to resume pursuit of the goal (Moskowitz, 2002). People also ruminate about goals they have not fulfilled so as to reevaluate how best to pursue them (Martin & Tesser, 1989, 2006). Thus, multiple processes push a person toward focusing on an unfulfilled goal even while the person may attempt to move on to other tasks (e.g., Smallwood & Schooler, 2006).

Could this continued focus on an unfulfilled goal occupy enough attentional resources to interfere with other pursuits? There has long been an assumption that it could, but evidence for such interference is remarkably sparse. Prior work has established that there are performance costs when switching from one task to another (Altmann & Trafton, 2007; Rogers & Monsell, 1995). However, these costs are attributable to a period of reorientation that occurs irrespective of the state of one's goals (for a review, see Monsell, 2003). Another interference effect can occur when two goals are pursued simultaneously (Cohen, Jaudas, & Gollwitzer, 2008; Cook, Marsh, Clark-Foos, & Meeks, 2007; Einstein et al., 2005; Hicks, Marsh, & Cook, 2005). Neither of these effects, however, speaks to the interference that may come from a previously unfulfilled intention. Thus far, our search of the literature has been unable to reveal empirical evidence that activation from prior, unfulfilled goals can reduce behavioral success in other pursuits.

There are reasons to think unfulfilled goals would not interfere. It would be adaptive for people to be able to set aside one goal and pursue another without difficulty. The fact that the unfulfilled goal remains active in memory would not necessarily interfere with other goals, apart from its occupation of a small amount of mental resources. The unconscious has a vast capacity for processing information (Dijksterhuis, Aarts, & Smith, 2005) and can manage and maintain goal pursuit well (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Custers & Aarts, 2007), so one should be able to function effectively on a new task despite the fact that the prior, unfulfilled task remains active in some odd corners of the mind. Indeed, research by Marsh, Hicks, and Cook (2006) has shown that an active goal will interfere only in the most demanding situations, such as when one remains vigilant for opportunities to fulfill the goal while engaged in some other task. When vigilance is not needed during an ongoing task, interference effects are absent. According to those findings, an ongoing task does not incur any meaningful cost from an active goal, except when a person must pursue both the task and goal simultaneously.

Notwithstanding the lack of evidence, there is reason to suspect that prior, unfulfilled goals could interfere with other pursuits. Indeed, research on populations with clinical depression has shown that an unfulfilled intention can be quite detrimental to other tasks, including short-term memory tests and the ability to initiate novel intentions (Kuhl & Helle, 1986). One important caveat about research on non-clinical populations is that it has focused almost exclusively on performance as defined by response times in categorization tasks, which have produced accuracy rates that invariably fall well above 90% (Marsh et al., 2006; Rogers & Monsell, 1995). Arguably, categorization takes extremely little time and effort (Grill-Spector & Kanwisher, 2005), and slight changes in response latencies may not translate into impairment on meaningful, everyday behaviors. If prior, unfulfilled goals pose a problem, it would perhaps be at some bottleneck where resources are limited. The limited capacity of the executive functions (Baddeley, 1986; Miller, 1956) may constitute just such a bottleneck.

Executive functions and goal shielding

The executive functions are a suite of complementary processes that enable control over thoughts and actions (Baddeley, 1986; Norman & Shallice, 1986). These include focusing attention, inhibiting prepotent responses, maintaining information in working memory, manipulating the contents of working memory, and switching from one task to another (Baddeley, 1986; Miyake et al., 2000; Shallice, 1982; Shimamura, 2000). In the current work, we focus on two capacities, each of which relies on multiple executive processes: impulse control and fluid intelligence. Impulse control often involves the selective avoidance of some stimuli while also inhibiting prepotent responses towards them, and tests of fluid intelligence require the active maintenance and manipulation of information in working memory. Together, impulse control and fluid intelligence require most of the executive processes outlined in previous work. Both are also fragile. If executive resources are either temporarily or chronically low, then impulse control (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Lavie, Hirst, de Fockert, & Viding, 2004; Ward & Mann, 2000) and fluid intelligence (DeWall, Baumeister, & Masicampo, 2008; Kane et al., 2004; Schmeichel, Vohs, & Baumeister, 2003) will suffer.

In the present work, we anticipated that tasks requiring executive functions—including impulse control and fluid intelligence—could suffer if a prior goal has been left unfulfilled. Research on goal shielding has indicated that when people work on a task, they automatically inhibit thoughts of information relevant to other tasks and goals (Mayr & Keele, 2000; Shah et al., 2002). The very existence of goal shielding suggests that its purpose is to limit access to some bottleneck that is incapable of feeding resources into multiple tasks at once. Our understanding is that goal shielding is necessary because of the limited focal capacity of the executive function. Executive resources such as working memory and attention can focus only on one thing at a time (James, 1890; Lieberman, Gaunt, Gilbert, & Trope, 2002). Therefore, in order for the executive function to perform one task effectively, it needs to be protected from thoughts of other pursuits.

Despite the goal shielding process that helps to shut out intrusions, executive processes are vulnerable to distraction. Visual reminders of alternative goals can interfere with an ongoing pursuit, even when those reminders are presented at subliminal levels (Shah & Kruglanski, 2002). If subtle cues from the environment can compromise goal shielding and interfere with current tasks, then reminders from internal sources may have a similar effect. Unfulfilled goals remain active in memory, occasionally intruding into one's thoughts and attention (Zeigarnik, 1927). As a result, they may occupy attention and working memory resources and so reduce the availability of executive functions for other pursuits.

Present research

The present research was based on the idea that unfulfilled goals remain highly active in memory, occupying limited attentional resources of the executive function. Even if the person has attempted to stop working toward the unfulfilled goal, incursions by the goal could interfere with the further operations of executive function. As a result, performance on other tasks could be impaired. These impairments should be specific to the executive function and should be largest among people who have difficulty letting go of one task so as to move on to another.

These predictions were tested in a series of experiments. The first two studies used nonconscious priming to activate goals and then created a sense of nonfulfillment, either by having people recall instances of failing to live up to their goal (Study 1) or by manipulating task failure (Study 2). The effects on subsequent goal pursuit were assessed by a test of fluid intelligence (anagrams, Study 1) and by impulse control in the realm of eating (Study 2). Study 3 tested the hypothesis that the impairment would be specific to the executive function: It employed two kinds of intelligence tests, one based on logical reasoning and the other on general knowledge. (Only

the former depends on executive function.) Study 4 tested moderation by individual differences in the capacity to shift attention amongst various pursuits, and Study 5 undertook to show that the effect is eliminated if participants can return to the unfulfilled goal and fulfill it.

Study 1

Study 1 sought initial evidence that unfulfilled goals can interfere with subsequent task performance that requires executive functions. The dependent measure was solving anagrams, which is a frequently used measure of self-regulation and executive function (Baumeister et al., 1998; Gailliot, Plant, Butz, & Baumeister, 2007; Gordijn, Hindriks, Koomen, Dijksterhuis, & Van Knippenberg, 2004). To solve an anagram requires maintaining and manipulating information in working memory, both of which involve executive control (Miyake et al., 2000; Shimamura, 2000).

To manipulate goal (un)fulfillment, we used the goal incompleteness manipulation developed by Moskowitz (2002). It was assumed that most people strive to be honest but that that is not a frequent concern, so the motivation would need to be activated. Therefore the first step was to manipulate activation of the honesty goal using a supraliminal priming procedure (e.g., Bargh et al., 2001). Next, some participants were instructed to write about an experience in which they had been dishonest. The combination of honesty prime (activating the goal) and recalling a dishonest behavior (failing to reach that goal) constituted the unfulfillment condition.

Four control conditions furnished relevant comparisons. One activated the honesty goal but did not require participants to recall a personal episode of dishonesty. Another required people to recall a dishonest episode but skipped the prime. (Our hypothesis was that interference with a subsequent goal would require both the honesty prime and recall of dishonesty.) Another offered a true baseline, with neither the honesty prime nor the recall of dishonesty.

A final condition checked whether the effect depended specifically on one's own failure to fulfill one's goal. Participants were primed with the honesty goal and then recalled an incident in which someone else was dishonest. This condition allowed an evaluation of the alternative explanation that the combination of honesty prime and recall of dishonest behavior stimulated so many thoughts about honesty that they interfered with anagram solving. This alternative explanation assumes there is nothing special about one's own dishonesty—rather, the interference comes merely from the repeated activation of the dimension of honesty. Hence recalling another person's dishonesty should have about the same effect as recalling one's own. Our hypothesis, however, was that the interference comes from the cognitive activity related to one's own failure to fulfill a goal, so recalling someone else's dishonesty would not have the same effect.

Method

Eighty-seven undergraduates (M age = 19.1, SD = .80; 48 females) arrived at the laboratory individually. The study was composed of a 2 (honesty goal vs. no goal) × 2 (dishonest memory vs. no memory) + 1 (honesty goal and dishonest–other memory) between-subjects design, thus comprising a total of 5 conditions, among which participants were randomly assigned. Those who received a combination of the honesty goal and dishonest memory manipulations constituted the unfulfilled goal group.

Manipulation of goal activation (prime)

All participants worked on a sentence construction task that consisted of 25 word lists containing 5 words apiece. The task was to create a complete sentence using four out of the five words in each list. Multiple solutions were possible for each list. Participants were told to write the first solution that came to mind and to work as quickly as possible. Participants in the honesty goal condition received a sentence construction task that contained 13 words related to honesty (e.g., *sincere*, *honest*, and *genuine*). Other participants worked on a task that contained neutral words unrelated to a goal (no goal condition).

Manipulation of nonfulfillment (memory)

Next, some participants were randomly assigned to write about an experience from their own lives (dishonest memory condition) in which they had been dishonest to another person. The rest received no such task (no memory condition). Some participants (in the honesty goal condition only) received instructions similar to those given in the dishonest memory condition, except that they were told to write about an episode in which *someone they knew* was dishonest (dishonest–other memory condition).

Dependent measures

All participants then worked on 25 anagrams. They were told to solve as many as they could in 5 min. After that, persistence in memory of the honesty goal was assessed with a word-completion task. Participants saw incomplete words (e.g., _ *RUST*) with instructions to complete them. Each of the fragments had multiple solutions, and on seven of them one could produce either a word related to honesty or a relatively neutral word (e.g., _ *RUST* could elicit *TRUST* or *CRUST*).

Participants filled out a demographics questionnaire, were probed for suspicion, and were debriefed. No participants reported suspicion of a link between the manipulations and the dependent measure.

Results

Anagrams solved

Performance on the anagram task served as the main dependent measure, with lower numbers of anagrams solved indicating greater interference with the executive function task. A one-way ANOVA yielded a significant effect of the manipulations on anagrams solved $F(4, 82) = 2.66$, $p < .05$, $\eta_p^2 = .12$. A planned contrast revealed that participants in the unfulfilled goal group solved fewer anagrams ($M = 4.00$, $SD = 3.01$) than all other participants ($M = 7.41$, $SD = 3.88$; see Fig. 1), $F(1, 82) = 9.68$, $p < .01$, $\eta_p^2 = .11$, thus supporting the hypothesis that an unfulfilled honesty goal can interfere with later anagram performance.

None of the four control groups differed from any other, $Fs < 1$, *ns*. In particular, the dishonest–other memory condition did not differ from the other three controls, $F < 1$, *ns*. Thus, the detrimental effect of a dishonest memory on the anagram task was specific to the one's own prior dishonesty, not any dishonesty.

Accessibility in memory of honesty-related words

We expected that accessibility of honesty-related words would be highest in the unfulfilled goal condition. A one-way ANOVA showed

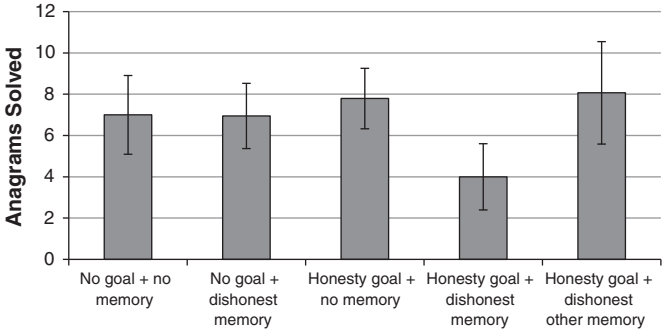

Fig. 1. Number of anagrams solved as a function of condition. Error bars represent standard errors.

that the groups differed on the number of honesty words produced in the word-completion task, $F(4, 82) = 2.78$, $p < .05$, $\eta_p^2 = .12$. A planned contrast indicated that the unfulfilled goal condition produced more honesty words ($M = 3.93$, $SD = 1.64$) than other conditions ($M = 2.86$, $SD = 1.29$; see Fig. 2), $F(1, 82) = 7.29$, $p < .01$, $\eta_p^2 = .09$.

Two effects could have contributed to the high accessibility found in the unfulfilled goal condition. First, the mere priming of honesty could have caused an increase in accessibility. Second, a combination of the honesty prime and the memory of a dishonest behavior (i.e., the goal unfulfillment manipulation) could have caused an increase in accessibility, even over that which was caused by the honesty prime alone. Planned contrasts revealed evidence of both. The honesty prime caused higher accessibility ($M = 3.35$, $SD = 1.42$) than did a neutral prime ($M = 2.64$, $SD = 1.28$), $F(1, 82) = 6.44$, $p < .05$, $\eta_p^2 = .07$. Within the honesty prime condition, participants required to think of a time they were dishonest produced more honesty words ($M = 3.93$, $SD = 1.64$) than did participants in the no memory and dishonest–other memory conditions ($M = 3.12$, $SD = 1.27$), $F(1,82) = 3.75$, $p = .056$, $\eta_p^2 = .04$. Thus, honesty accessibility due to a lack of goal fulfillment was greater than honesty accessibility due to the honesty prime alone.

Accessibility as a predictor of anagram performance

Additional analyses examined the role of goal accessibility in the interference effect of goal unfulfillment. First, a series of regression analyses examined whether goal accessibility mediated the effect of goal unfulfillment on anagram performance. Goal unfulfillment significantly predicted both anagram performance and goal accessibility (the potential mediator) as reviewed above. The next step was therefore to examine whether goal accessibility predicted anagram performance. A regression analysis indicated that the potential mediator did not predict anagram performance, $b = -.35$, $t(85) = -1.17$, $p = .25$, $R^2 = .016$. Moreover, when both goal accessibility and the goal unfulfillment manipulation (which was defined with a contrast code that compared the unfulfilled goal group with the other four groups) were included in the same model, the effect of goal unfulfillment remained significant, $b = -3.30$, $t(84) = -2.87$, $p = .005$, $\Delta R^2 = .088$. A Sobel test (Sobel, 1982) revealed that goal accessibility did not significantly mediate the effect of goal unfulfillment on anagram performance, $z = -1.07$, *ns*.

An additional regression analysis examined whether goal accessibility moderated the effect of goal unfulfillment on anagram performance. A regression analysis included the experimental manipulation (again contrast coded to compare the unfulfilled goal group with the other four groups), goal accessibility, and their interaction term. The two-way interaction was not significant, $b = -.60$, $t(83) = -.82$, $p = .41$, $\Delta R^2 = .007$, and so goal accessibility did not appear to moderate the effect of the unfulfilled goal on anagram performance.

A follow-up regression analysis assessed anagram performance as a function of honesty accessibility, goal priming manipulation (coded so as to compare the no goal condition against the honesty goal condition), and their interaction. Accessibility of honesty words interacted with the goal prime manipulation to predict anagrams solved, $b = -1.59$, $t(83) = -2.55$, $p < .05$, $\Delta R^2 = .072$. We assessed the simple slopes for both the no goal condition and the honesty goal condition. For no goal participants, we found a non-significant relationship between honesty accessibility and anagrams solved, $b = .52$, $t(83) = 1.13$, $p = .25$, $\Delta R^2 = .014$. In the honesty goal condition, we found a significant negative relationship between honesty accessibility and anagrams solved, $b = -1.07$, $t(83) = -2.59$, $p < .05$, $\Delta R^2 = .074$. Thus the two-way interaction between honesty accessibility and goal prime appears to be driven by the effect within the honesty goal condition. For participants who were primed with honesty, greater accessibility of honesty words predicted poor performance on the anagram task (See Fig. 3).

Discussion

Study 1 provided dramatic first evidence that an unfulfilled goal can interfere with performance on a subsequent, unrelated task requiring executive functions. In this case, personal unfulfillment regarding the goal of honesty led to poor performance at solving anagrams, which requires fluid intelligence. The lowest scores on the anagram task were achieved by participants whose goal of honesty was initially activated (by the priming task) and who then recalled a personal experience of being dishonest. Neither the honesty prime alone nor the recall of dishonesty alone caused the decrement in performance. Moreover, no decrements in performance occurred in participants who wrote about a time when someone else was dishonest. Therefore, the goal interference effect was due not to thoughts about dishonesty per se, but to thoughts about dishonesty that were indicative of one's own goal failure.

Goal failure led not only to a decrease in performance on a test of fluid intelligence but an increase in accessibility of the unfulfilled goal. Thus, the interference effect may be due to an inability to ignore the failed goal. In fact, there was a positive relationship between the level of accessibility of the failed goal and degree of goal interference. Among participants primed with an honesty goal, the more active in memory that goal was, the worse they performed at solving anagrams. To be sure, the measure of accessibility could not be simultaneous with the anagram task, and so the data do not establish that the unfulfilled goal was highly active during the anagram task. Still, the most parsimonious explanation is that the unfulfilled goal remained highly accessible from the time of unfulfillment, through the anagram task and the word-stem task.

No participants suspected a link between the priming manipulation, the memory task, and the anagrams. Indeed, when probed for suspicions of a relationship between the tasks, participants did not

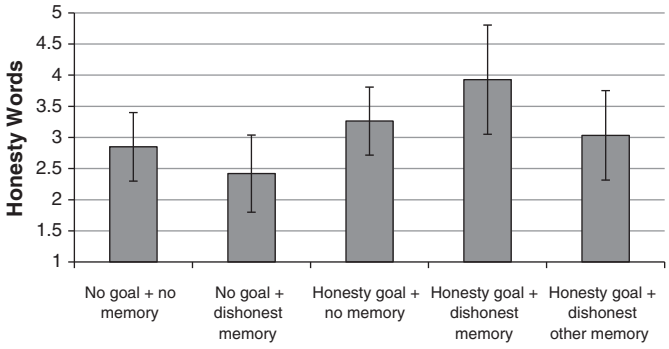

Fig. 2. Number of honesty words given in the word-completion task as a function of condition. Error bars represent standard errors.

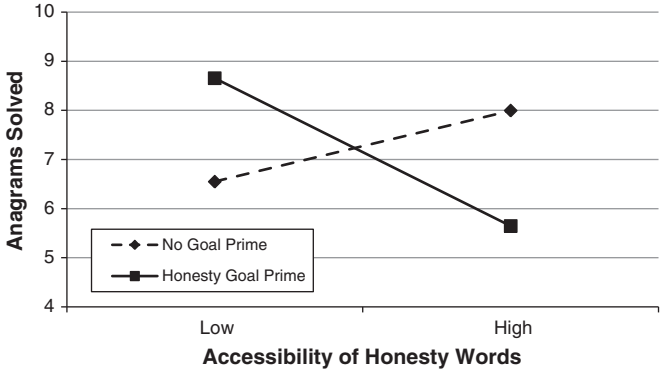

Fig. 3. Number of anagrams solved as a function of honesty accessibility.

report any meaningful link nor did they remark on any experience of an interference effect. Thus, the observed decrements in performance seemed to occur by some mechanism that went largely undetected by participants. While full-blown conscious rumination may result from an unfulfilled goal (Martin & Tesser, 1989), lesser, more subtle effects may also occur—and those can prove detrimental to other tasks.

Study 2

Study 2 provided a more ambitious test of the hypothesis that an unfulfilled goal can interfere with executive functions. Whereas Study 1 assigned the task of solving anagrams, Study 2 relied on individual differences in an important goal involving impulse control, namely restraint of eating. At any given time, many young persons are engaged in dieting, whereas others are not. Our dependent measure consisted of eating cookies. Dieters, by definition, seek to override the impulse to consume such fattening foods. If a prior, unfulfilled goal interferes with the executive function, then dieters should be less able to override their impulsive behaviors and therefore end up eating more cookies than they would otherwise.

In contrast, non-dieters are not normally seeking to restrain their eating, so any interference with their executive function would not necessarily cause them to eat more. In fact, prior work has generally found that non-dieters *reduce* eating under stress (Baucom & Aiken, 1981; Heatherton, Herman, & Polivy, 1991; Polivy & Herman, 1976). The combination of low eating by non-dieters and increased eating by dieters yielded the counterintuitive prediction that, in the unfulfilled goal condition, dieters would actually eat more cookies than non-dieters.

To create the unfulfilled goal condition, we again relied on two manipulations. First, we primed the goal of achievement. Second, failure was manipulated by an anagram procedure used by Chartrand (1999). Some participants were assigned to work on anagrams that were too difficult to solve while others were given a set that they were able to solve. The goal frustration group was comprised of those receiving both the achievement prime and the unsolvable anagrams. For them, the goal of achievement was activated and then left unfulfilled.

To distinguish dieters from non-dieters, we administered the Eating Restraint Scale (ERS; Herman & Polivy, 1975). This is a well-validated measure of dieting motivation and behavior. In the present procedure, we administered it at the end of the study. To be sure, the usual practice is to administer trait measures before behavioral manipulations, so as to avoid possible effects of laboratory procedures on the self-report responses to the trait scale. However, that normative advantage seemed outweighed by the possibility that filling out a self-report questionnaire about one's dieting would activate the goal and motivation, thereby contaminating and possibly altering the outcome of the two competing tasks. The main danger to the present study in administering the restraint scale last was that some participants might be tempted to downplay their dieting motivation after they had just eaten a large quantity of cookies, so as not to depict themselves as inconsistent or self-indulgent. Such a pattern would however work against the hypothesis, insofar as we were predicting relatively high eating precisely among dieters (in the unfulfilled goal condition).

Method

Study 2 had a 2 (no goal vs. achievement goal) × 2 (anagrams: easy vs. difficult) × continuous (Eating Restraint scores) between-subjects design. Participants were 83 undergraduates (58 females; *M* age = 18.6, *SD* = 1.47) who arrived at the laboratory individually. The experimenter told participants that they would first work on some word exercises. The first word exercise was a goal priming procedure adapted from Bargh et al. (2001). Participants worked on a word-search puzzle containing a matrix of letters in which they located 13 words. In the achievement goal condition, 7 of the 13 words were related to achievement (e.g., *achieve*, *strive*, and *master*). In the no goal condition, achievement words were replaced with neutral words with no relation to a specific goal (e.g., *carpet*, *river*, and *hat*). Both the experimenters and the participants were blind to the priming condition.

After the word-search, participants were put to work on a set of ten 5-letter anagrams. By random assignment, participants received a set of either easy or difficult anagrams. The unfulfilled goal condition consisted of the combination of priming the achievement goal and then being given the difficult anagrams, which we anticipated would not be solvable in the allotted time.

When describing the anagram task, the experimenter was careful not to introduce additional incentives for achievement. The experimenter described the task as a "fun and simple word unscrambling game" rather than a difficult or diagnostic test of intelligence. Participants were instructed to notify the experimenter once they had solved all anagrams, and they were allowed to work for a maximum of 5 min. Participants taking the full 5 min period were told, "If you're not done that's fine, we can stop here and move on." Participants then completed the Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988).

Eating behavior was measured with a taste test paradigm adapted from previous work (Herman & Polivy, 1975; Tice, Bratslavsky, & Baumeister, 2001) in which participants were asked to sample chocolate chip cookies for 5 min, ostensibly for the purpose of providing data on taste preferences. The experimenter gave participants a bowl with 25 cookies and a rating sheet. The experimenter surreptitiously weighed the bowl of cookies before and after the task.

Participants then completed the ERS (Herman & Polivy, 1975). The scale consists of 10 items (e.g., "How often are you dieting?") with 4- or 5-point Likert-type scales, with high scores representing high restraint of eating. The scale's reliability was moderately high (Cronbach's $\alpha = .73$), and scores ranged from 2 to 24 with a mean value of 12.76 ($SD = 5.30$). Participants also completed a demographics questionnaire and were probed for suspicion. No participants remarked that the manipulations had an effect on the taste test.

Results

Manipulation check

Analyses confirmed that the difficult anagrams were more difficult to solve in the allotted time than the easy anagrams. ANOVA yielded a significant effect of anagram set on the number of anagrams solved, $F(1,82) = 183.73$, $p < .001$, $\eta_p^2 = .70$, such that individuals in the difficult anagram condition solved fewer anagrams ($M = 5.50$, $SD = 1.99$) than individuals in the easy anagram condition ($M = 9.83$, $SD = 0.65$). No participants solved all of the difficult anagrams, whereas all but three participants solved all of the easy anagrams. Those three participants were excluded from the final analyses.[2]

Main results

Total grams of cookies eaten served as the primary dependent measure. We predicted that dieters would eat more cookies after they worked on difficult rather than easy anagrams, but only when they had first been primed with an achievement goal. Non-dieters would

[2] We intended for these three participants to experience fulfillment of the achievement goal. They were excluded because they were unable to solve the easy set of anagrams on which they worked and thus they experienced goal failure. Treating these participants as if they were a part of the difficult (i.e., unsolvable) anagram condition did not significantly affect our results and the three-way interaction remained significant. However, because these participants did not receive the same manipulation as participants in the difficult anagram condition we decided to exclude them from the analyses.

not show the same increase and in fact might reduce eating in the goal failure condition.

A regression assessed grams of cookies eaten as a function of priming condition, anagram condition, eating restraint scores, and all higher-order interactions. Results revealed the hypothesized three-way interaction, $b = 2.68$, $t(72) = 2.10$, $p < .05$, $\Delta R^2 = .055$, and a significant two-way prime by eating restraint interaction, $b = 1.26$, $t(72) = 1.96$, $p = .05$, $\Delta R^2 = .048$. No other effects were significant, $ts < 1$, *ns*.

Additional regression analyses clarified the nature of the three-way interaction. We expected that cookie intake would be unaffected among participants who received the easy anagram task. Among participants in that condition, we assessed the grams of cookies eaten as a function of goal prime, eating restraint, and their interaction. The results yielded no significant two-way interaction and no significant main effects, $ts \ll 1$, *ns*.

Apparently, then, the three-way interaction (between anagram condition, priming condition, and eating restraint) was driven by effects within the difficult anagram condition, and we analyzed that next. Among participants in that condition, we assessed grams of cookies eaten as a function of goal prime, eating restraint, and their interaction. There were no main effects, $ts < 1$, *ns*, but the goal prime by eating restraint interaction was significant, $b = 2.61$, $t(72) = 3.50$, $p < .001$, $\Delta R^2 = .152$.

Participants at high levels of eating restraint (one SD above the mean) consumed more cookies when the goal to achieve was primed than when it was not, $b = 13.63$, $t(72) = -2.23$, $p < .05$, $\Delta R^2 = .062$. Thus, dieters ate significantly more cookies when in the unfulfilled goal group (achievement/difficult) than when in a control group (no goal/difficult). Participants at low levels of eating restraint (one SD below the mean) showed an opposite effect such that those in the unfulfilled goal group (achievement/difficult) ate significantly fewer cookies than those in the control group (no goal/difficult), $b = -14.03$, $t(72) = -2.38$, $p < .05$, $\Delta R^2 = .071$. As predicted, an unfulfilled goal (an achievement prime paired with the inability to solve anagrams) caused dieters to eat more and non-dieters to eat less (see Fig. 4).

Additional regression analyses focused on the difficult anagram condition, where the goal prime by eating restraint interaction was significant, as reported above. In the no goal condition, highly restrained eaters consumed fewer cookies than the unrestrained eaters, $b = -.624$, $t(72) = -3.08$, $p = .003$, $\Delta R^2 = .118$. In the achievement goal condition, the opposite effect approached significance, $b = .349$, $t(72) = 1.84$, $p = .071$, $\Delta R^2 = .042$, such that participants who reported more restraint ate more cookies. Thus, participants in the unfulfilled goal condition exhibited the counter-intuitive eating pattern: Self-described dieters ate more cookies than non-dieters.

Mood

The BMIS furnishes scores on both mood valence and arousal. Regression analyses on these yielded few significant effects, and controlling for them left the main results essentially unchanged. Thus, neither valence nor arousal mediated the relationship between our manipulations and the dependent measure of cookie consumption.

Discussion

Dieting requires overriding the impulse to eat unhealthy food. We found that frustrating an achievement goal interfered with dieting behavior. Participants who were given difficult anagrams (and so were unable to succeed at solving them) went on to eat more cookies than participants who worked on relatively easy anagrams. This effect occurred only for participants who were first primed with an achievement goal and who also reported a motivation to diet (i.e., participants high in eating restraint). There was no increase in cookie intake among participants with no achievement goal to frustrate (no goal participants), nor among those with no dieting motivation with which to interfere (participants low in eating restraint).

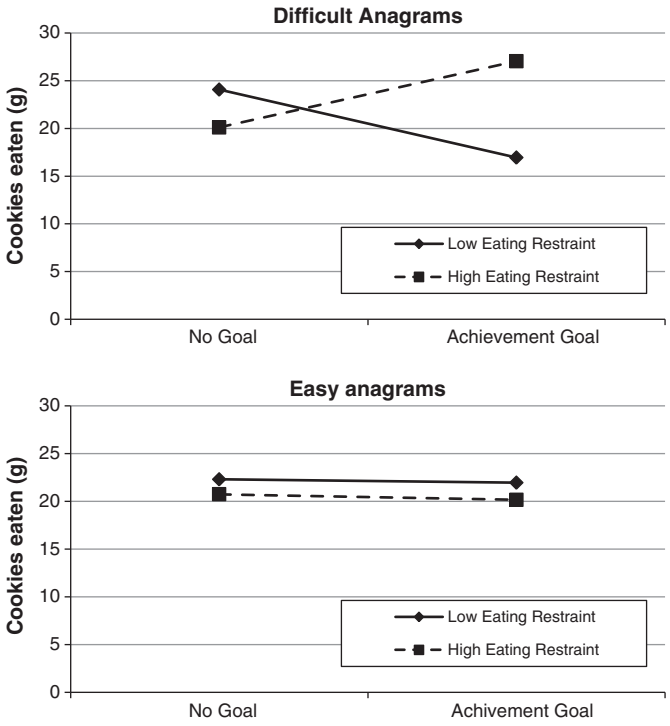

Fig. 4. Two graphs illustrate the three-way interaction between the goal prime manipulation, the anagram manipulation, and eating restraint scores on grams of cookies eaten.

The effect of the unfulfilled goal on dieters was actually reversed among non-dieters, such that non-dieters ate *fewer* cookies when the achievement goal was frustrated than they did when there was no such frustration. This finding is consistent with previous work showing that the conditions that increase eating in dieters tend also to decrease eating in non-dieters (Baucom & Aiken, 1981; Heatherton et al., 1991; Polivy & Herman, 1976). The reduction in eating by non-dieters is thus a standard pattern. It is irrelevant to the present work and will not be discussed further.

As in Study 1, the interference effect appeared to escape participants' awareness. When probed for suspicions of a relationship between the anagrams and the taste preferences task, no participants reported that the former influenced their approach to the latter. The observed effects also appear not to be attributable to differences in mood. We found no evidence that goal frustration caused negative affect or that differences in emotion influenced the goal to diet. Competition between tasks produced the problem of unhealthy eating. People who normally override impulsive eating behavior proved less capable of doing so when an achievement goal had been thwarted.

Study 3

Study 3 addressed a crucial aspect of the theory, namely that interference would occur only for tasks that require executive functions. Participants in Study 3 performed two intelligence tests, but only one depended on fluid intelligence and thus executive functions. That one was a test of logical reasoning, which invokes executive functions insofar as it requires following rules to manipulate information in working memory (De Neys, 2006; Lieberman et al., 2002). Past work has shown that logical reasoning performance is impaired when executive resources have been depleted (Schmeichel et al., 2003), when the capacity to control one's executive attention is

low (Kane et al., 2004), or when conscious processes have been preempted (DeWall et al., 2008). In contrast, the other task used in Study 3 was a test of generalized knowledge, taken from a standard IQ test, the General Mental Abilities Test (GMAT; Janda, 1996). It measures crystallized intelligence, which is to say acquired knowledge. Intelligent people know more than other people, and so such tests are good predictors of IQ, but these tests do not require executive management of active thought processes. Hence performance on such tests has not been affected by manipulations that perturb or deplete the executive function (Schmeichel et al., 2003; see also Baumeister, Twenge, & Nuss, 2002).

Study 3 also sought direct evidence of any conscious experiences of interference (or lack thereof) during the executive functioning task. Specifically, participants rated the difficulty of the tasks, level of distraction during the tasks, and amount of effort they exerted on the tasks. If goal-related rumination, changes in motivation, or an inability to focus are playing key roles in the interference effects observed in these studies, then that would presumably show up in these measures.

Goal (un)fulfillment was manipulated by an autobiographical recall task. Participants in the crucial condition were assigned to write about an important goal they had set for themselves but not yet achieved. Two control conditions were used. One instructed participants to write about a typical day, which should be overall a rather neutral experience. The other assigned participants to write about a frustrating experience. This would allow us to distinguish the effects of recalling any sort of frustration from the effects of focusing specifically on an unfulfilled goal.

Method

Forty-seven undergraduates (27 females; M age = 18.3, SD = .91) arrived in groups of 3 to 10 to a large classroom. Each participant was randomly assigned to one of three conditions: unfulfilled goal, frustrating experience, or typical day. Each participant received a packet that contained all tasks and instructions.

In the unfulfilled goal condition, participants were first instructed to spend a few minutes writing about a goal that they considered very important and that they had not yet achieved. Participants described the goal, indicating when they had set it, when they hoped to achieve it, and what they needed to do to succeed. In the frustrating experience condition, participants wrote about a recent experience in which they were frustrated or annoyed by a person, situation, or event. They described what happened, why the experience was frustrating, and if and how their frustration was resolved. In the typical day condition, participants described what they do in a typical day.

Participants then completed the BMIS mood measure and worked on two cognitive tasks. One of the tasks consisted of general knowledge questions from the GMAT. This task featured 10 items (e.g., "Which city is known as the Windy City?") that were designed to measure crystallized intelligence. The other cognitive task was a set of 8 logical reasoning problems that served as our measure of executive functioning. The order of the two cognitive tasks was counterbalanced across participants, though order had no effect on performance nor did order interact with the manipulations to affect performance, Fs < 1, *ns*.

Next, participants answered questions regarding their experience of the cognitive tasks. Participants indicated on scales from 1 (*not at all*) to 7 (*very much*) how difficult each task was, how distracted they were during each task, and how much effort they put into each task. Last, participants provided demographic information and were debriefed regarding the nature of the study.

Results

Narrative content

Analysis of the autobiographical accounts confirmed that participants in the unfulfilled goal condition wrote about important, unfulfilled goals. The mean score for importance of the goal was 6.63 (SD = .76) on a 7-point Likert-type scale. Most participants (89.5%) wrote about goals that were related to school or careers, including maintaining grade point averages, getting into graduate school, or being competitive for jobs. The remaining participants wrote about acquiring personal skills (e.g., learning a foreign language).

Most participants in the frustrating experience condition (76.9%) wrote about being frustrated by another person's behavior. The remaining participants wrote about being frustrated by responsibilities related to school (e.g., spending a long time on a paper) or work (e.g., staying later than expected). No participants wrote about the inability to fulfill some goal.

Intelligent performance

The main prediction was that participants in the unfulfilled goal condition would perform worse on the logic problems than participants in the other two conditions. A one-way ANOVA indicated marginally significant variation in logic problem performance as a function of condition, $F(2, 44) = 2.91$, $p = .065$, $\eta_p^2 = .12$. A planned contrast indicated that performance in the unfulfilled goal condition ($M = 3.95$, $SD = 1.87$) was significantly lower than in the frustrating experience ($M = 5.15$, $SD = 1.57$) and typical day ($M = 5.13$, $SD = 1.45$) conditions combined, $F(1,44) = 5.81$, $p = .02$, $\eta_p^2 = .12$. The difference between the latter two conditions was not significant, $F < 1$, *ns*.

The corresponding analyses on the GMAT yielded no significant differences. A one-way ANOVA showed no significant variation among the three conditions, $F < 1$, *ns*. The planned contrast between the unfulfilled goal condition ($M = 5.84$, $SD = 1.46$) and the combination of the frustrating experience ($M = 5.46$, $SD = 1.98$) and typical day ($M = 5.80$, $SD = 1.42$) conditions did not approach significance, $F < 1$, *ns*. Thus, the decrement in logic problem performance for participants in the unfulfilled goal condition did not generalize to the measure of crystallized intelligence.

Because our prediction was for a difference between differences, we conducted a further ANOVA that included the within-subjects variable of the measure (i.e., reasoning performance vs. GMAT performance). ANOVA yielded a significant condition by cognitive task interaction, $F(2, 44) = 3.51$, $p = .039$, $\eta_p^2 = .14$, and no significant main effects, Fs < 1.08, *ns*. A planned interaction contrast, which compared the unfulfilled goal group against the other two conditions, revealed a significant condition by cognitive task interaction, $F(1,44) = 6.91$, $p = .012$, $\eta_p^2 = .14$.

ANOVAs assessing perceived difficulty of the logic problems, effort put into the logic problems, and how distracted participants were during the logic problems yielded no significant variation among the three conditions, all Fs < 1, *ns*. The corresponding ratings for the GMAT problems were also not significant, all Fs < 1.7, *ns*.

Participants in the three conditions did not differ in valence or arousal as measured by the BMIS, Fs < 1.6, *ns*. Thus, mood did not appear to mediate the effect of the manipulation on logic problem performance.

Discussion

Reflecting on an important but unfulfilled personal goal caused significant impairments on one kind of intelligence test but not another. Specifically, logical reasoning was impaired whereas recall of general knowledge was unaffected. This pattern of results points toward the importance of the executive function for the goal interference pattern. Logical reasoning requires the executive function to follow rules in moving from one thought to another. In contrast, the recall of general knowledge from memory is a largely automatic process that seems not to require supervision or control by the executive function.

Study 3 also sought to distinguish goal unfulfillment from the broad category of frustration. Participants who wrote about a recent frustrating experience did not show interference on either the logical reasoning test or the general knowledge test. Apparently, interference with subsequent goal pursuit is specifically caused by residual effects from an unfulfilled goal rather than stemming from any sort of frustration.

Despite showing decrements in performance on the logical reasoning task, participants in the unfulfilled goal condition did not report that the task was especially difficult, that they were distracted, or that they put forth any less effort relative to other participants. Thus, conscious rumination related to the goal (e.g., Martin & Tesser, 1989) did not appear to mediate the effect, nor did changes in motivation. To be sure, a person's mind can wander from a task without the person becoming aware of the distraction (Smallwood & Schooler, 2006), and multiple goal-related processes may carry on without influencing conscious experience (Bargh et al., 2001). Thus, multiple goal-related processes may persist and—according to the current work—interfere despite a lack of participants' being aware of the effect.

Study 4

Study 4 employed two additional features to confirm that the attachment to unfulfilled goals interferes with executive functions. First and most important, we added a brief measure of individual differences in goal tenacity, taken from Shah et al. (2002). Goal tenacity refers to how strongly people remain invested in specific goal strivings. If the impairment in executive functions results from processes related to the pursuit of a previous, unfulfilled goal, then impairment should be greatest among people with high goal tenacity. In contrast, people who can relatively easily let go of one goal and move on to something else should exhibit less interference.

The second innovation was that we modified the design of Study 3 to include a fulfilled goal condition. A possible objection to Study 3 was that the unfulfilled goal condition was the only one to emphasize goal pursuit at all, and so in principle the findings could have been obtained on the basis of goal striving per se, regardless of fulfillment. Study 4 had both a fulfilled goal and an unfulfilled goal conditions. Our prediction was that the interference would be specific to the unfulfilled goal condition.

Method

Participants were 38 undergraduates (21 females; M age = 18.9, SD = 2.62) who arrived at a university classroom in groups of 4 to 9. Participants were randomly assigned to one of the three conditions: unfulfilled goal, fulfilled goal, or typical day. Participants received a packet containing all tasks and written instructions.

Participants first completed the items used by Shah et al. (2002) to measure goal tenacity. Participants indicated on a scale from 1 (*never*) to 7 (*all the time*) how often they tended to stop before completing a goal because they had the opportunity to pursue another goal and how often they shifted attention among their various pursuits.

In the unfulfilled goal condition, participants were instructed to think about a goal that they considered very important and that they had not yet achieved. Participants described the goal and indicated on a scale from 1 (*not at all*) to 7 (*very*) how important they considered the goal. They then described what they would have to do to achieve the goal. Participants also indicated the goal's level of fulfillment on a scale from 1 (*mostly unfulfilled*) to 7 (*mostly fulfilled*) and how confident they were that they would achieve the goal on a scale from 1 (*not at all*) to 7 (*very*). In the fulfilled goal condition, participants thought of a goal they considered very important and that they had already achieved. As in the unfulfilled goal condition, participants described the goal, rated how important they considered the goal, described what they had to do to achieve the goal, and rated to what extent they considered the goal to be fulfilled. In the typical day condition, participants were asked to describe what they do in a typical day.

Participants then worked on a set of 8 logic problems similar to those used in Study 3. Upon completion of the problems, participants indicated how difficult the logic problems were, how much effort they put into them, and how distracted they were while working on them. Participants then provided demographic information and were debriefed.

Results

Narrative content and manipulation check

An independent samples t-test indicated that participants in the unfulfilled goal condition rated their goals as less fulfilled (M = 2.84, SD = 1.21) than did participants in the fulfilled goal condition (M = 6.23, SD = 1.01), $t(24) = 7.72$, $p < .001$, $d = 3.04$. There was no difference between the unfulfilled goal condition (M = 6.77, SD = .43) and the fulfilled goal condition (M = 6.77, SD = .43) in how important they considered their goal, $t \ll 1$, *ns*. Most participants in both goal conditions wrote about school or career related goals (e.g., maintaining grade point averages, gaining acceptance to major programs or graduate programs). The rest wrote about personal goals (e.g., losing weight).

Replication of interference effect

A one-way ANOVA yielded marginal evidence of significant variation among the three conditions, $F(2, 35) = 3.18$, $p = .054$, $\eta_p^2 = .15$. A planned contrast indicated that participants in the unfulfilled goal condition solved significantly fewer logic problems (M = 5.42, SD = 1.58) than participants in the fulfilled goal (M = 6.62, SD = 0.96) and typical day (M = 6.25, SD = 1.06) conditions combined, $F(1, 35) = 5.73$, $p = .022$, $\eta_p^2 = .14$. Participants in the fulfilled goal condition did not differ significantly from those in the typical day condition in logic problem performance, $F < 1$, *ns*.

Participants' level of confidence that they would eventually reach the unfulfilled goal was unrelated to their performance on logic problems, $r(12) = -.27$, $p = .36$. Furthermore, as in Study 3, the experimental manipulation had no effect on perceived difficulty of the logic problems, amount of effort given to the logic problems, or level of distraction while working on the logic problems, all Fs < 1.14, *ns*.

Moderation by goal tenacity

The role of individuals' goal tenacity was assessed for participants within the unfulfilled goal and fulfilled goal conditions. A regression assessing logic problem performance as a function of condition, goal tenacity, and their interaction yielded the hypothesized condition by tenacity interaction, $b = -.77$, $t(22) = -2.45$, $p = .023$, $\Delta R^2 = .12$, and a main effect of condition, $b = 5.30$, $t(22) = 2.05$, $p = .05$, $\Delta R^2 = .08$. Planned regression analyses clarified the nature of the two-way interaction. We assessed the interaction at high (one SD above the mean) and low (one SD below the mean) levels of goal tenacity. For participants high in goal tenacity, the effect of condition was significant, $b = -1.92$, $t(22) = -3.48$, $p = .002$, $\Delta R^2 = .24$, such that participants in the unfulfilled goal condition solved significantly fewer logic problems than those in the fulfilled goal condition. For participants low in goal tenacity, the effect of condition was not significant, $t < .14$, $p > .89$.

Discussion

Once again, the activation of an unfulfilled goal led to subsequent impairment of performance on a task sensitive to executive function. Not all thoughts of past goal strivings produced the impairment. Participants who recalled a personal goal that they had fulfilled

performed quite well on the subsequent task. Only the memory of an unfulfilled goal caused impairments.

Our theory has emphasized that the interference with subsequent executive functions comes about because some share of those functions remain committed to the previous goal. This analysis was supported by the goal tenacity findings. Participants low in goal tenacity, which means they report being generally able to let go of one goal and move on to something else, did not show significant impairments. Only participants high in goal tenacity showed impairments (and then only when recalling an unfulfilled goal).

Study 5

Thus far we have shown that an experience of unfulfilled goals can impair subsequent tasks that require executive functions. There are however two different types of process that could yield such an effect. We have favored the theory that processes continue to draw on limited attentional resources so as to remind the executive function to complete unfinished business. An alternative theory, however, would be that the experience of unfulfillment itself is exhausting and can leave residual effects that would impair subsequent work. For instance, experience of the unfulfilled goal may be depleting of the self's limited resources (Baumeister et al., 1998), including at a physiological level (Gailliot, Baumeister, et al., 2007; Gailliot, Plant, et al., 2007). The former theory could arguably be more adaptive, insofar as it is pragmatically oriented toward getting the job done. The latter depicts the impairments as an unfortunate byproduct of the experience of failing to reach a goal.

The two theories make different predictions as to what would happen if the experience of unfulfillment were followed by an opportunity to return and complete the goal striving. Byproducts of unfulfillment might well remain. Depleted resources would remain depleted, and so impairments would persist. However, the pragmatic, attentional processes aimed at getting the job done would presumably be satisfied, in which case there would be no interference with subsequent processes.

Study 5 therefore tested the hypothesis that, while goal frustration can interfere with later tasks, returning to fulfill the goal would eliminate the effect. Participants were given a goal, and the pursuit of that goal was then frustrated. We later allowed some of these participants to fulfill the frustrated goal. We hypothesized that fulfillment after a period of frustration would reduce the interference effect.

To manipulate goal frustration, we asked some participants to engage in thought suppression. Previous work has shown that asking people to suppress thoughts of a topic activates the motivation to think about that topic (Liberman & Förster, 2000). We instructed participants to suppress thoughts of a topic under the assumption that this would frustrate their motivation to indulge in such thoughts. We hypothesized that this frustration would interfere with a subsequent pursuit that required executive functions, but that returning to fulfill the frustrated motivation would reduce that effect.

We used a thought suppression task adapted from Wegner, Schneider, Carter, and White (1987) that required participants to suppress thoughts of a white bear. In a control condition, participants did not suppress any thoughts. In the crucial third condition, we instructed participants to first suppress thoughts of a white bear and then later to spend time having precisely those same thoughts, thereby fulfilling the goal to think about the suppressed topic. Following the experimental manipulation, participants worked on the same anagram task used in Study 1, which served as our measure of interference.

Method

Fifty-four undergraduates (41 females; *M* age = 18.3 years, *SD* = .51) arrived at the lab individually. First, all participants performed a stream of thought warm-up exercise that required them think aloud into a tape recorder for 3 min. Participants in the control condition performed a second stream of thought session for 6 min, with instructions to use as their starting point the topic of a white bear. Participants in the frustrated goal condition were told to think aloud for 6 min but to suppress all thoughts of a white bear for the entire session. Finally, participants in the fulfilled goal condition were given the same instructions as participants in the frustrated goal condition. However, fulfilled goal participants were assigned the extra task of indulging in thoughts of a white bear during a final 2 min session, thereby fulfilling the goal to think of the initially suppressed construct.

To be sure, goal fulfillment in the crucial condition was confounded by a 2 min delay prior to the dependent measure. Some may suspect this is ample time for depleted resources to be replenished. If it is, then the fulfilled goal condition does not do an adequate job of distinguishing between a goal (un)fulfillment explanation and a resource depletion explanation. However, an abundance of evidence suggests that a 2 min delay alone should not counteract the effects of depletion. Depletion effects have been found to persist after 5 min of quiet rest (Tice, Baumeister, Shmueli, & Muraven, 2007; Study 3), 6 min of writing (Schmeichel & Vohs, 2009; Studies 1 and 3), 9 min of a multiple choice test (Schmeichel et al., 2003; Study 2), and 12 min of filler questionnaires (Gailliot, Baumeister, et al., 2007; Gailliot, Plant, et al., 2007). Together, these findings provide strong evidence that depletion effects should persist in the fulfilled goal condition despite the brief delay. Thus the hypothesized pattern of effects would be consistent with a goal fulfillment explanation and not a depletion explanation.

After the stream of thought portion of the study, participants completed the BMIS and then worked on a set of 25 anagrams for 5 min. Then they completed a demographics questionnaire, were probed for suspicion, and were debriefed. Three participants who experienced difficulties with instructions and with the recording equipment during the thought suppression task were excluded, thereby leaving a total of fifty-one participants in the final analyses.

Results

A one-way ANOVA yielded a significant effect of the experimental manipulation on anagrams solved, $F(2, 48) = 3.25$, $p < .05$, $\eta_p^2 = .12$. Planned comparisons indicated that participants who suppressed thoughts of a white bear (those in the frustrated goal condition) solved fewer anagrams ($M = 6.00$; $SD = 2.69$) than participants in the control condition ($M = 8.47$; $SD = 3.73$), $F(1, 48) = 3.97$, $p = .052$, $\eta_p^2 = .08$. More importantly, participants in the fulfilled goal condition solved more anagrams ($M = 8.94$; $SD = 4.25$) than participants in the frustrated goal condition, $F(1, 48) = 5.63$, $p < .05$, $\eta_p^2 = .11$, and a comparison of the fulfilled goal condition with the control condition yielded no significant difference, $F \ll 1$, *ns*. Thus, fulfilling the previously frustrated goal to think of a white bear restored performance on the anagram task to a level comparable to that of controls (see Fig. 5).

Participants' scores on the BMIS yielded no differences in arousal or valence as a result of the manipulations, $Fs \ll 1$, *ns*. Thus the effects of the experimental manipulation on anagrams solved do not appear to be caused by differences in mood.

Discussion

The findings of Study 5 provide yet another conceptual replication of the finding that an unfulfilled goal can interfere with executive functions. Participants who suppressed thoughts of a white bear went on to perform significantly worse than control participants on a measure of executive functioning. However, and crucially, participants who first suppressed thoughts of a white bear but then indulged in such thoughts showed no decrements in performance. These

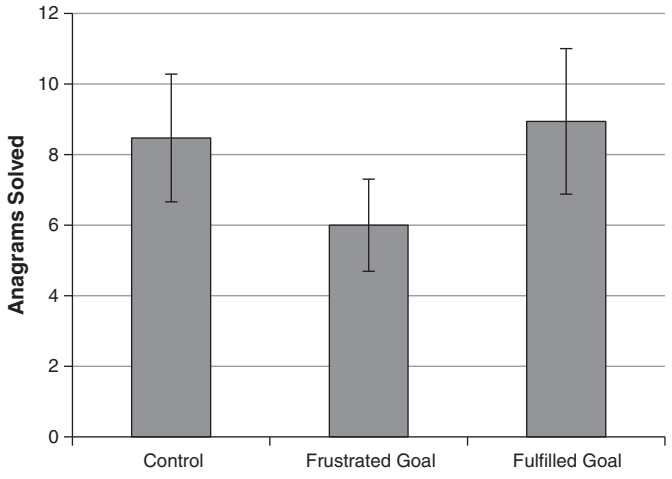

Fig. 5. Number of anagrams solved as a function of condition. Error bars represent standard errors.

participants solved just as many anagrams as participants who were never required to suppress thoughts in the first place.

Fulfilling a goal after a period of initial frustration eliminated the interference effect. It is thus not simply a matter of any experience of goal nonfulfillment that impairs subsequent efforts on other tasks. If the effect were caused by the depletion of limited resources, then those effects would presumably have persisted regardless of the fulfillment manipulation. Rather, only a goal that remains unfulfilled will interfere with subsequent pursuit of new task that requires executive functions. Apparently, leaving a task unfinished causes sustained focus on the task. In principle, that could continue indefinitely. But if the person returns to the task and then completes it, the focus on the goal (or at least the tendency for the task to impinge on the executive function and impair its work on other tasks) is terminated, and a new task can be tackled with full resources.

General discussion

Prior work has hinted that failure to fulfill a goal could have consequences that would be detrimental to subsequent tasks, but it has generally stopped far short of demonstrating any actual performance impairment. The present findings provide multiple kinds of evidence that leaving one goal unfulfilled can cause poor performance on subsequent tasks, insofar as those require executive functions. The executive processing tasks that showed impairment included solving anagrams, restraining eating behavior, and solving logic problems.

The present studies sought to shed light on the inner processes that accompany and may help cause interference. There was no sign that mood or emotion mediated the effects or even that unfulfilled goals caused much in the way of emotion or mood change. Nor was there evidence that unfulfilled goals were distracting, reduced effort, or increased subjective reports of difficulty on subsequent tasks. There was, however, evidence of cognitive activity. The unfulfilled goal was found to be highly accessible in memory even after the second task (Study 1), and indeed, the more accessible it was, the greater the interference as indicated by poor performance on the second task. Apparently, the unfulfilled goal remains accessible, subtly drawing on attentional resources (Zeigarnik, 1927), and thus can interfere with subsequent tasks.

Why should the continued mental activity relevant to an unfulfilled goal interfere with subsequent goal pursuits? The vast processing capacity of automatic, unconscious processes would seemingly suggest that it should be easy for the person to work on one task while still partly attuned to a previous one (Dijksterhuis et al., 2005). The answer apparently lies in the limited focal capacity of the executive function. Indeed, the importance of executive function was evident in our dependent measures. Self-regulation of eating, solving anagrams, and logical reasoning all depend on the executive function, and all have been shown in prior work to suffer when the resources of the executive are depleted or occupied. Crucially, Study 3 included two measures of intelligent performance, only one of which involved executive functioning. In that study, the unfulfilled goal impaired performance on the executive task (logical reasoning) but not on the other (general knowledge).

Further evidence that the interference stemmed from remaining focused on the unfulfilled goal was provided in Study 4. The interference effect was limited to participants who scored high on the trait of goal tenacity. In contrast, participants with low scores—who are presumably quite willing to let go of one goal in order to focus on something else—showed no impairment.

The interference effect appeared to be specific to unfulfilled goals. The effect was limited to people who personally embraced the goals (Study 2) or who had the goals personally activated (Studies 1, 2, and 5). Reflecting on an important but fulfilled goal did not cause the effect (Study 4), and returning to a frustrated goal to fulfill it removed the effect (Study 5). Mere frustration also did not cause task interference (Study 3), nor did reflecting on someone else's failure to fulfill a goal (Study 1). All these point toward the importance of having one's mind continue to attend to a personal goal that has been left unfulfilled. When this happens, subsequent tasks that are dependent on executive functions are impaired.

The observed interference effects were due essentially to competing motivations, and the strength of those motivations should moderate the interference effect. A goal's influence is usually proportional to how much the goal is valued (for a review, see Förster, Liberman, & Friedman, 2007). Hence, the more important an unfulfilled goal is, the more it will demand attention and interfere with subsequent tasks. Indeed, interference effects in Studies 1 and 2 were found only when the interfering goal was made temporarily active. When those goals were not made active (and thus their current value was low), interference effects were absent. One could likewise speculate that if the subsequent tasks were made more important (e.g., by providing some incentive), interference from prior goals would have been reduced. That remains to be tested in future work. Otherwise, when a prior goal is a relatively important one (and thus is not overshadowed by later tasks), leaving it unfulfilled may prove detrimental to subsequent pursuits.

Prior, unfulfilled goals appear to distract in a manner similar to that of a cognitive load, though perhaps not to that full extent. Cognitive load interferes with dieting (Ward & Mann, 2000) and logic problem performance (DeWall et al., 2008), and we found unfulfilled goals to have the same effects. Still, we did not find wholesale impairment of executive functions, as has been found with manipulations of cognitive load. Prior work, for example, has found that a cognitive load reduces performance on logic problems to chance levels (DeWall et al., 2008). In contrast, in the present Study 3, logic problem performance dropped from 5.1 ($SD = 1.5$) to 3.9 ($SD = 1.9$) out of 8 as a result of an unfulfilled goal. In Study 4, it dropped from 6.4 ($SD = 1.0$) to 5.4 ($SD = 1.6$). Participants in the unfulfilled goal conditions were still effective at solving logic problems, having performed significantly above chance, $ts > 4.5$, $ps < .001$. (Participants selected among four possible answers, so random guessing would have yielded 2 out of 8 correct in both studies.) Whereas a full cognitive load incapacitates the executive function, an unfulfilled goal causes only partial loss when working on another task.

The difference between cognitive load effects and the present findings is also apparent in participants' descriptions of their performance. One defining feature of a cognitive load is that it consumes a person's conscious attention. A standard procedure for manipulating cognitive load is to have participants privately rehearse

a string of numbers. The present effects seemed not to be accompanied by such conscious distraction. Despite the interference from a prior goal, self-reports of distraction in Studies 3 and 4 were not greater among participants in unfulfilled goal conditions than in control conditions. Similarly, participants in Studies 1 and 2 noted no links between the initial goals and the subsequent tasks when questioned about their performance. Thus, participants with an unfulfilled goal showed decrements on executive functioning tasks even though they did not report being distracted from them. While cognition and attention were preoccupied enough by prior unfulfilled goals to interfere, conscious awareness of that burden was absent.

The present effects thus seem qualitatively and subjectively different than those from a cognitive load. That participants were unaware of any distraction despite the significant decrement in performance is consistent with recent work showing that people may be distracted from a current task without realizing it (Smallwood & Schooler, 2006). While previous theories have equated executive resources, including working memory, with conscious awareness (Baars & Franklin, 2003; Baddeley, 1993), that view may be inaccurate. Working memory capacity may sometimes be occupied by processes of which a person is not aware (Hassin, Bargh, Engell, & McCulloch, 2009).

Implications and future directions

While dual process theories have assumed that executive processes are largely under conscious control (Epstein, 1994; Kahneman, 2003), the current work contributes to a more nuanced picture of executive functions. Despite one's best efforts, executive processes are often difficult to consciously control. To avoid focusing on a particular topic is difficult, mostly due to unconscious processes that bring the unwanted topic into awareness (Wegner, 1997). Even focusing one's efforts on a task is difficult, as the mind tends to wander faster than a person can keep track of it (Schooler, Reichle, & Halpern, 2004). Indeed, the present work found that, despite no apparent effects on self-reports of attention paid to the task, effort exerted on the task, or task importance, tasks that depended on the executive were consistently impaired by prior, unfulfilled goals. Apparently, executive processes are frequently at the beck and call of goal-related processes, including those that elude conscious awareness (Hassin et al., 2009).

Another issue concerns the matter of how goals interface with the conscious executive. We have endorsed the notion that people are capable of maintaining knowledge of their many goals, while the conscious executive contributes efforts to satisfy them one at a time. Crucially, the conscious executive does not attend to goals at random, but rather it is biased in favor of those goals that have remained unfulfilled. This pattern of results is consistent with dual process models suggesting the role of the conscious, effortful process is to monitor the automatic process and intervene when an error has been detected (Kahneman, 2003). In Studies 1 and 2, unfulfilled goals were initially activated nonconsciously. Previous theories have argued that nonconscious goals operate under the radar, preserving the limited resources of the executive function for other, more effortful tasks (Bargh & Chartrand, 1999). Yet in our studies, when those nonconscious goals were frustrated, executive functions were impaired. Thus, goals that tend to operate outside of awareness may begin to draw on other, more conscious processes when they have been left unfulfilled (e.g., Bongers, Dijksterhuis, & Spears, 2010).

The current data have important implications for performance on tasks that require executive functions, and these are quite common. Many institutions employ tests that evaluate people on their problem solving ability or on other tasks that rely on fluid intelligence. Some such tests claim to measure learning, as in the case of school exams. Others claim to measure competence for a desired position, as in the case of job evaluations or school admissions. Such tests, however, may be highly sensitive to factors that are irrelevant to the advertised dimension of interest. According to the current pattern of results, tasks requiring executive functions are easily affected by peripheral matters, such as one's prior goals. How to limit such influences is one area for future inquiry.

Crucially, individual differences in self-regulatory style may determine one's ability to engage the executive. Previous work has found that clinically depressed people may be especially susceptible to interference from unfulfilled goals (Kuhl & Helle, 1986). According to the present work, those who simply tend to stick with their goals through completion may have also have difficult time transitioning from one unfinished task to a new one, particularly when the latter is dependent on executive functions. For them, interference from unfulfilled tasks may be a frequent obstacle. Future work should address the extent of this interference, in terms of how it evolves over the span of minutes, hours, or more. Research may also reveal important trade-offs in this dimension. Although high goal tenacity may prove a hindrance in the context of switching from one task to another, it may benefit an individual when engaged in more focused, enduring pursuits.

Concluding remarks

The mind can keep many separate processes going at once—perhaps with the help of many automatic, nonconscious processes (Bargh et al., 2001)—but the conscious executive has limited resources and mainly does one thing at a time (e.g., Lieberman et al., 2002). If goals could be achieved thoroughly by nonconscious processes alone, all might be well with having multiple goals, given the vast parallel capacity of the unconscious. But apparently many goal pursuit processes depend on getting the conscious executive to contribute its full resources to them (Baumeister, Masicampo, & Vohs, 2011). The main finding of the present work is that an unfulfilled goal can impair the capability of the conscious executive to focus single-mindedly on pursuing other, unrelated goals.

Having the mind focus on unfulfilled goals may be adaptive in many cases. Otherwise, how would one ever resume any activity that is interrupted? Efficiency could be promoted by allowing the conscious mind to roam among goals. While driving the familiar route to work, for example, one's mind may wander from the present moment so as to rehearse plans for the family vacation (Smallwood & Schooler, 2006). However, if thoughts about the family vacation intrude while one is performing surgery or negotiating with a business client, the result may be counterproductive. The present findings indicate that such interference is not only possible but can be reliably produced in the laboratory. Juggling multiple goals is therefore likely to remain an important challenge in human social life.

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