INVESTIGATING THE MAINTENANCE OF UNFULFILLED GOALS OVERTIME:

DO THEY OCCUPY EXECUTIVE RESOURCES?

by

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ABSTRACT

Psychological research demonstrates that goals can remain active across time until they are fulfilled, even unconsciously and, presumably, passively. Yet, recent research suggests that unfulfilled goals require effort to maintain, drawing upon the limited pool of executive resources and interfering with executive control. If true, the logic follows that unfulfilled goals should compromise executive control initially following goal activation and after a delay. However, another possibility is that the executive control deficits resulting from an unfulfilled goal are due to the initial mobilization of effort required to activate the goal in the first place, and that executive control is only compromised initially following goal activation and not after a delay. To test these competing predictions, participants in two reported experiments received a goal to form impressions of roommates in an upcoming experimental task, or no goal. Next, participants engaged in an unrelated task that required the inhibition of a prepotent response (i.e., executive control). Performance on this task is dependent on the availability of executive resources, as one needs these resources to successfully inhibit a prepotent response. In addition, participants engaged in this task either immediately after goal (or no goal) activation, or after a few-minute pause. The results of both experiments indicate that the impression formation goal had no effect on executive control immediately or after a pause. The proposition that unfulfilled goals occupy executive resources is likely complicated by moderating variables, as a simple yet effective goal manipulation in the current experiments did not compromise executive resources.

INTRODUCTION

Many dual process models (e.g., Chaiken & Trope, 1999; Sherman, Gawronski, & Trope, 2014) assume that two modes of processing – controlled and automatic – can influence various psychological outcomes. Controlled processes are presumably effortful and deliberate whereas automatic processes are effortless and unintentional. However, this dichotomy between automatic and controlled processes is not actually that simple. Bargh (1994) noted four distinct qualities that characterize a process as automatic. These qualities are a lack of intentionality, a lack of awareness, uncontrollability, and efficiency. Mental processes can vary in the extent to which they are controlled or automatic along these four dimensions. Driving a car, for instance, can be effortful (during a storm) or relatively effortless (taking a regular route home from work). Similarly, the mere presence of another individual can unconsciously activate a concept like a stereotype, which is unintentional, but individuals typically can control the expression of that stereotype (e.g., Devine, 1989). Suffice it to say, psychological processes are complex and involve both controlled and automatic components.

The purpose of this thesis is to examine the relatively automatic and controlled components of one phenomenon in psychology, namely goal pursuit. Goal pursuit is the process by which individuals make progress towards attaining an end state (i.e., academic achievement; making friends). Although people often regard goal pursuit as willful and controlled, decades of psychological literature suggests that goal pursuit can also operate entirely without one's conscious guidance or intention, and can therefore be automatic

(Custers & Aarts, 2010; Bargh, 1990; Bargh, Schwader, Hailey, Dyer, & Boothby, 2012; Förster, Liberman, & Friedman, 2007; Kruglanski, 2002).

Goal priming literature demonstrates that individuals can unwittingly adopt goals by merely perceiving goal-related stimuli in the environment. Further, goals can remain active over time and influence behavioral responses, guiding an individual towards goal-fulfillment entirely without conscious awareness or intention (Bargh, 1990). For example Holland, Hendricks and Aarts (2005) exposed some participants to the scent of an all-purpose cleaner to unconsciously prime them with a “cleanliness” goal. Later in the experiment, participants ate a crumbly cookie in the laboratory, and those who were exposed to the scent unintentionally made more behavioral attempts to avoid making a mess than participants in a control condition. This example illustrates how the entire process of goal activation (“cleanliness”), and goal pursuit through behavioral means (i.e., avoiding a mess) can occur without participants’ awareness or intention.

Although goals can operate without conscious guidance, it is not yet clear if executive resources are necessary in this process. More specifically, if a goal is responsible for psychological and behavioral outcomes, does the maintenance of that goal require executive resources? Certainly the conscious maintenance of a goal requires executive resources. Miller and Cohen (2001) argue that the prefrontal cortex (PFC) actively maintains individuals’ goals and thereby influences behavior in a top-down, goal-directed manner. Someone engaging in a Stroop task, for example, might actively maintain the goal to “say the color, not the word” which would certainly occupy executive resources (i.e., working memory). However, is this also true of goals that are outside the focus of one's attention? Imagine an individual who sets a goal to study for an upcoming exam. Setting a goal like this makes it active and accessible in the individual's awareness, and research suggests that goals remain active until they are fulfilled (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Förster, Liberman, & Higgins, 2005; Marsh, Hicks, & Bink, 1998). If this individual's attention is momentarily captured by, say, meeting a friend on campus, the assumption is that the study goal will remain active because it is not yet fulfilled. But, does maintaining the goal to study whilst talking to a friend require executive resources? That is, will the individual in question suffer from cognitive impairments because the goal is occupying executive resources, or can the goal persist without causing such detrimental effects? This thesis investigates whether the automatic maintenance of a goal, such as in the above scenario, requires executive resources.

An important point to note is that consciously and unconsciously activated goals presumably operate in a similar fashion within an individual, and produce similar outcomes. For example, Chartrand and Bargh (1996) demonstrated that unconsciously activated impression-formation and memorization goals produced outcomes in recall similar to what occurs with explicit goals to "form impressions" or "memorize." The researchers unconsciously primed participants with either an impression-formation goal or a memorization goal by having them unscramble sentences with words embedded in them related to either forming impressions (e.g., *evaluate*, *personality*) or memorization (e.g., *retain*, *recall*). Next, participants received behavioral information to encode. A surprise free-recall test of the behaviors at the end of the experiment demonstrated that those with the unconscious impression-formation goal had higher clustering scores and better overall recall than those with the memorization goal, which matches the effects typically found with the same explicit goals (e.g., Hamilton, Katz, Leirer, 1980). Thus, the unconscious impression-formation and memorization goals influenced the processing of information just as they would have if they were consciously held goals. Many other experiments in the automatic goal-priming literature demonstrate how goals that are activated outside of awareness (e.g., subliminally) produce the same effects as the same goal activated consciously or explicitly (e.g., Bargh et al., 2001; Lakin & Chartrand, 2003).

The current work is less concerned with how the goal is *activated*, and more the *maintenance* of that goal over time. Research demonstrates that goals remain active over time, even despite ongoing unrelated activities. For instance, Bargh et al. (2001) primed participants with a high-achievement goal (or not), and found that the behavioral effects of the goal (e.g., enhanced performance) increased across a delay while participants engaged in an unrelated task. Other work similarly demonstrates that goals remain cognitively accessible (demonstrated via response times on lexical decision tasks, LDT) over time until they are fulfilled, after which they drop in accessibility (Förster et al., 2005; Marsh et al., 1998). This thesis attempts to investigate the process by which a goal is maintained over time, amidst an unrelated activity. Intuitively, if the entire process of goal pursuit can occur without conscious guidance (e.g., Holland et al., 2005) then it makes sense that goal maintenance would not place demands on higher-order executive resources.

However, recent psychological research suggests that unfulfilled goals can disrupt executive functioning during a goal-unrelated task (Marien, Custers, Hassin, & Aarts, 2012; Masicampo & Baumeister, 2011a), even for goals activated without awareness. For instance, Marien et al. (2012) subliminally primed participants with a goal (e.g., socializing) or no goal, and then had them complete a task that required executive resources, namely the inhibition of a prepotent response. Participants primed with the goal (which was left unfulfilled) performed worse on the executive control task than those without a goal. This and similar research suggests that unfulfilled goals – even unconscious goals – draw upon executive resources thereby interfering with executive control.

Overall, then, there are conflicting findings regarding whether automatic goal pursuit – specifically goal maintenance – requires executive resources. However, this conflict might be superficial. Specifically, it is possible that the activation of a goal might require some initial effort mobilization (e.g., Gendolla & Silvestrini, 2010) that *temporarily* reduces executive resources. Thereafter, however, the goal may continue to remain active without drawing upon executive resources. This initial effort mobilization hypothesis could explain the results from recent studies in which executive control deficits resulted *soon after* goal activation (e.g., Marien et al., 2012; Masicampo & Baumeister, 2011a). This is an important point to remedy, specifically because of the research demonstrating that goals remain active for quite a while (up to 5 minutes) and increase in strength over time (Bargh et al., 2001). This would be a problem if goals also interfered with executive functioning during this time. This initial effort-mobilization hypothesis would explain both lines of research in the goal literature, and reveal that automatic goal pursuit only requires executive resources temporarily.

The below sections provide a more thorough theoretical background of automatic goal pursuit which is followed by research suggesting that unfulfilled goals draw upon executive resources. Then, the alternative hypothesis of initial effort mobilization is discussed as it pertains to the current project.

Automatic Goal Pursuit

The Cognitive Structure of Goals

Individuals' cognitive systems consist of knowledge structures that guide their thoughts and behavior (Moskowitz, 2005; Fishbach & Ferguson, 2007). Theoretically, knowledge structures, such as stereotypes and attitudes, consist of associative links between concepts. For example, the concept of "doctor" is likely linked to the concept of "nurse." Further, the activation of one concept can spread to activate other related concepts (Neely, 1977). For example, activating (or priming) the concept "doctor" may temporarily make linked concepts like "nurse" or "medicine" more accessible. Critical to the current thesis, goal structures are similarly represented in the cognitive system, with associative links among a given goal, the end state of that goal, and means to achieve the end-state (Kruglanski, 2002; Fishbach & Ferguson, 2007).

If an individual adopts a goal, even if it is activated without awareness (e.g., via subliminal priming), the activation of that goal may spread to related concepts and means to attain the goal. For example, if one adopts a goal to achieve academic success, the goal may activate concepts such as “library” or “read” that will facilitate goal attainment. Aarts and Dijksterhuis (2000) conducted an experiment to illustrate this automatic link between goals and means. They recruited a sample of participants who either habitually rode bicycles for transportation or did not. The researchers wanted to determine if priming a goal to travel would increase the accessibility of transportation means related to traveling. They primed participants with a travel goal by having them read sentences about traveling, such as attending a lecture at a university or going shopping at a shopping mall. Next, participants engaged in a reaction time (RT) task in which they responded to various travel modes following various locations, and their task was to indicate as quickly and accurately as possible if the presented mode of travel was appropriate for the given location (e.g., some locations were outside the city, and “walking” would be an inappropriate means). When primed with the travel goal, habitual bicyclists responded significantly faster than non-habitual bicyclists to the word “bicycle” when it followed a relevant location (e.g., university). Yet, there was no difference between the two groups when the travel goal was not activated. The goal prime in this experiment (e.g., travel) activated a relevant means (e.g., bicycle) to achieve the goal, which was evident in participants who commonly utilized this means of transportation.

In another demonstration of the cognitive architecture of goals, Fishbach, Friedman, and Kruglanksi (2003) tested the association between higher-order goals and their lower-level temptations. The researchers predicted that exposure to temptation stimuli (e.g., cake) would activate a higher-order goal (e.g., diet), presumably because temptations prompt self-regulation. They also predicted that this relationship would be asymmetrical such that temptation stimuli would facilitate higher-order goals, whereas higher-order goals would inhibit temptations (again for self-regulatory reasons). In their Experiment 1, participants identified a relevant goal for themselves (e.g., studying) and an enjoyable activity that would interfere with the goal (e.g., television). In a subsequent lexical decision task (LDT), participants judged whether a target string of letters was a word or a non-word as quickly and accurately as possible. A prime preceded the target to influence the processing of the target. Importantly, in this case, the stimuli that participants had generated (goals and temptations) were embedded into the LDT as primes and targets. The researchers found what they had predicted – when the prime was a temptation (e.g., television) it facilitated the processing of a goal target (e.g., study), but when the prime was a goal (e.g., study) it inhibited the temptation target (e.g., television) relative to a neutral word. These findings demonstrate the hierarchical nature of goals and their related components.

Such research suggests that goals exist in a cognitive network of associations, much like concepts. There are links between means and end-states related to the goal, and the activation of a goal causes the spreading of activation and inhibition to related concepts (for similar findings see Kruglanski, 2002; Shah, Friedman, & Kruglanski, 2003). This process of spreading activation/inhibition is presumably automatic (i.e., occurs without awareness, is unintentional), and the following section describes how this activity can furthermore lead to perceptions and behaviors that are consistent with goal pursuit.

Psychological and Behavioral
Manifestations of Goals

Goals can cause downstream perceptual and behavioral consequences that occur without an individual's awareness or intention. For instance, Aarts, Dijksterhuis, and DeVries (2001) made some participants feel thirsty in the laboratory by giving them a salty treat, thereby activating a goal to drink, and discovered that these participants responded faster to drinking-related words on an LDT (e.g., juice, water) compared to those who were not thirsty. In another demonstration, Balcetis and Dunning (2006) were able to alter the way participants' perceived ambiguous experimental stimuli just by manipulating their current motives. In yet another experiment, Bruner and Goodman (1947) had children estimate the size of various coins, and found that poor children made larger estimates than rich children, suggesting that the children's perceptions were influenced by their subjective need. And, much other research similarly converges on this idea that current goals can influence the way individuals process and perceive stimuli (e.g., Moskowitz, 2002; Veltkamp, Aarts, & Custers, 2008; Simon & Chabris, 1999).

More generally, there is evidence that the psychological state of pursuing a reward can narrow one's attentional scope. In an experiment where participants had the opportunity to receive a monetary reward, Gable and Harmon-Jones (2011) manipulated a pre-goal (before reward) and post-goal (after reward) state in participants and measured their attentional scope using a local-global visual-bias task (Navon, 1977). They found that participants in the pre-goal state (i.e., oriented toward the reward) were biased towards the local, small-scale stimuli, whereas those in the post-goal state (i.e., after the reward) were more biased towards global or larger-scale stimuli. A global focus is akin to focusing on the "forest" as opposed to the "trees", which is more of a local focus (Navon, 1977). These results suggest that the psychological state of goal pursuit (as opposed to after goal attainment) might have general perceptual side effects such a narrow, as opposed to broad, scope of attention.

In addition to influencing cognitive processes, goals can also influence behaviors in unintended ways. For example, Lakin and Chartrand (2003) gave participants an affiliation goal (either through explicit instructions or subliminal priming) for an upcoming interaction, or no goal. Next, participants watched a "live" video of the individual with whom they were supposedly going to interact. The individual in the video performed some random tasks (e.g., filing paperwork) and systematically touched her face subtly throughout the video. The dependent variable was the extent that participants touched their own faces, mimicking the behavior of the interaction partner. This behavior constitutes an attempt at affiliation (even if it is unintentional). Results demonstrated that participants who held the affiliation goal (either consciously or unconsciously) mimicked the behavior of the interaction partner to a greater extent, by touching their faces, relative to participants without the affiliation goal. In other words, the goal prime caused downstream behavioral consequences of which the participants were unaware and did not intend. In this way, these effects reflect two of the four qualities Bargh (1944) attributed to automatic processes: occurring without an individuals' awareness or intention.

In one of the most striking examples of automatic goal pursuit, Bargh and colleagues (2001) demonstrated that the activation of a goal construct produced effects consistent with goal striving, and not merely concept activation. The researchers activated a high-performance goal in some participants by exposing them to words related to achievement (e.g., *strive*, *succeed*, *master*) that were embedded in a word-search task. A control group was exposed to neutral words in the same task. The high-performance goal prime manifested in behaviors that are typically associated with high-performance, such as persistence in the face of obstacles, and resumption after task interruption. Specifically, in Experiment 1, participants primed with the high-performance goal successfully found more words in a word-search puzzle than those in the neutral-prime condition. In other words, the goal prime unconsciously enhanced their performance. The goal exerted its effects automatically in the sense that the participants were unaware of the goal and its influence on performance, and they did not intentionally perform "better." Importantly, however, note that the goal did increase participants' performance output. Although this manifestation of the goal is indeed "effortful" (i.e., participants found more words in the puzzle, perhaps by trying harder) the task itself was *goal-relevant*. Goals should, of course, facilitate performance (and effort) when they can operate in a goal-relevant domain. However, when a goal is active and an individual engages in a *goal-irrelevant* task, performance should not be enhanced (it may even be hindered). The current project investigates the consequences of active goals during a *goal-irrelevant* task, where the goal in question cannot manifest into behavior.

In another experiment conducted by Bargh et al. (2001, Experiment 4) the researchers interrupted participants while they were engaging in word-search by telling them to "stop," and measured whether the participants continued to work on the task or not. Those who had been primed with the high-performance goal persisted in the task more often than controls. This is important because it demonstrates the persisting effects of a goal – participants sustained their engagement with the task even after the experimenter told them to stop. Lastly, Experiment 5 measured participants' willingness to resume a task after an interruption. Participants worked on a word-completion task (like Scrabble) but were prevented from completing the task due to experimental malfunctions. After a few minutes of fixing the problem, the experimenter gave participants the option to continue working on the word-completion task or do a different, more enjoyable, task of judging cartoons (pilot tested for enjoyment). Participants primed with the high-performance goal chose to resume the word-completion task significantly more often than participants in the control group. Again, these results demonstrate the persistence of goals over time; they continue to influence behavior long after the prime activation. Importantly, in all cases, the goal prime was activated outside of participants' awareness, and the resulting behaviors occurred unintentionally. In other words, participants did not realize they were pursuing a goal to perform highly, but their behavior suggested otherwise.

Another experiment conducted by Bargh et al. (2001) is especially crucial for this thesis. Again the researchers primed participants with a high-performance goal (as before) and measured performance in a word-search puzzle. However, some participants engaged in the word-search puzzle immediately after goal activation whereas others experienced a 5-minute delay during which they drew their family tree in as much detail as possible. For participants primed with the goal, performance actually improved after the delay, suggesting that the goal increased in strength over time, even amidst the ongoing and unrelated activity. This reflects many of the features of automaticity in goal pursuit (e.g., lack of awareness, intent, and control) but it is not clear whether the goal was maintained/pursued *efficiently*, or without executive resources. Did it require effort for participants to maintain the high-performance goal while they engaged the unrelated activity? This is presumably not the case. Taken together, these experiments demonstrate how goals can persist over time and continue to influence one's behavior, even without intention or awareness. In contrast to semantic primes, which decay over time (Neely, 1977), goal primes seem to increase in strength over time and can unwittingly influence behavior in accordance with goal pursuit (see also Förster et al., 2007).

Efficiency in Automatic Goal Pursuit

The existing research on automatic goal pursuit clearly demonstrates that individuals can adopt, maintain, pursue, and fulfill goals entirely without awareness or intent. However, the extent to which these phases of goal pursuit require executive resources, or effort, is less clear. It makes intuitive sense that the activation and maintenance of a goal would not require or hinder one's executive resources, especially if the goal was triggered outside of awareness, or if it persisted across time and simultaneously with another task. Furthermore, a primary advantage of automating processes (like driving home, tying shoelaces), including goal pursuit, is that doing so arguably frees limited executive resources for other tasks (i.e., assists in overall mental efficiency). If aspects of goal pursuit, like the maintenance of a goal over time, recruit executive resources, then individuals' processing capacity would likely be taxed by goals much of the time, as individuals continuously pursue goals.

The Bargh et al. (2001) experiments demonstrate that goals persist across time, but it is not clear if that persistence occupies executive resources. If goal maintenance requires executive resources, then one might expect differences in completion of the family-tree exercise in their Experiment 3 because participants without the goal would have more resources to engage in this task. Unfortunately the researchers did not present this data. If we assume that performance was equal across groups, it would suggest that the goal was maintained effortlessly. In this respect, the current thesis is specifically concerned with the cognitive consequences of maintaining a goal during a *goal-irrelevant* task.

There is some theoretical logic and empirical evidence from Unconscious Thought Theory (UTT; Dijksterhuis & Nordgren, 2006) suggesting that individuals might be able to maintain and, furthermore, pursue goals over time without requiring executive resources. For instance, in a typical UTT experiment, participants receive a large amount of information to encode and ultimately form a judgment based on that information. A critical experimental group (the unconscious thought group, UT) has a goal to process the information, but is distracted from consciously thinking about the information before making a judgment (as opposed to a conscious thought, or deliberation, condition). The distraction task is usually cognitively demanding, requiring executive control (e.g., *n*-back; Jonides et al., 1997). Often times, the UT groups' eventual judgments are compared to the judgments from a control group that is also distracted from thinking about the information, but the critical difference is this control group is *merely distracted* without a processing goal (i.e., they don't know they will eventually be making judgments), whereas the UT group does have a goal to process the information and form judgments. So, these two experimental conditions both receive a complex set of information, both are distracted with a cognitively demanding task, and both make eventual judgments on the information. The only difference is the UT group has a goal to process this information whereas the *mere distraction* (MD) group does not. The typical finding is that the UT group performs better on the judgment outcome than the MD group (Bos, Dijksterhuis, & van Baaren, 2008), suggesting that the outcome was partially driven by the goal. Importantly for the current thesis, the processing goal (for the UT group) is presumably maintained for the duration of this unrelated distraction task. If the maintenance of this goal required executive resources then performance on the distraction task should suffer, especially if the task was cognitively demanding and required executive control, like the *n*-back task.

Although performance on the distraction task is not usually reported from these studies, research conducted by Garrison and Handley (2015) do report those results. Specifically, the researchers conducted an experiment in which participants received information about a complex logical reasoning problem, and were distracted with the *n*-back task before being able to solve it. The UT group had a goal to solve the problem at a later time, whereas the MD group did not. Eventual performance on the logical reasoning problem reflected goal-driven processes, as the UT group outperformed the MD group. However, both groups performed equally on the *n*-back distraction task, suggesting that whatever goal-driven process occurred in the UT group did so without the recruitment of executive resources. The interpretation of these results rests on assumptions about the

Unconscious Thought Theory, however they do illustrate – both theoretically and empirically – a potential scenario in which goals are maintained, and potentially pursued, while one's executive resources are fully occupied.

Despite all the research supporting unconscious and automatic goal pursuit, it is still not clear whether the maintenance of a goal over time, amidst unrelated activities, requires executive resources. Fairly new research suggests that goals may occupy executive resources while they are unfulfilled, regardless of whether they are conscious or unconscious. This possibility is at odds with the idea that goals operate automatically and are maintained without demanding executive resources. Such research may be critical in advancing theoretical developments on automatic goal pursuit – and more generally what it means for a process to be automatic. The following section discusses research indicating that unfulfilled goals draw upon executive resources, and the problem (or potential contribution) that poses for theorists' current thinking about goal pursuit.

Unfulfilled Goals

Generally, goals remain mentally active until they are fulfilled. The previous review reports that an active goal can shift one's cognitive processes and behavior towards goal fulfillment. As such, an active, but unfulfilled, goal might have unintended psychological consequences (cognitively or behaviorally) for the individual. Indeed, Zeigarnik (1927) investigated the psychological outcomes of an unfulfilled goal. In her experiments, children engaged in a variety of tasks that were either completed or left incomplete due to an interruption. The main result of her experiments was that the children had better memory for the incomplete tasks than the completed ones (Zeigarnik, 1927). Her description of why this occurred is as follows:

> When the subject sets out to perform the operations required by one of these tasks there develops within him a quasi-need for completion of that task. This is like the occurrence of a tension system which tends towards resolution. Completing the task means resolving the tension system, or discharging the quasi-need. If a task is not completed, a state of tension remains and the quasi-need is unstilled. The memorial advantage enjoyed by interrupted tasks must be due to this continuation of the quasi-need (p.7).

This description illustrates the phenomenon of an unfulfilled goal. Goals, like quasi-needs, persist in one's mind until they are fulfilled, causing this same *tension* described by Zeigarnik (1927), and likely influencing one's thoughts and behaviors accordingly (e.g., Bargh et al., 2001).

More recent research is also consistent with the phenomenon Zeigarnik describes. A series of experiments conducted by Marsh, Hicks and Bink (1998) demonstrated that to-be-performed actions were highly accessible in a person's mind, compared to completed actions, which became temporarily inhibited. The researchers used a lexical decision task (LDT) to measure the accessibility of concepts related to these actions. Specifically, they gave participants procedural scripts (e.g., how to make a cup of coffee) and told them they would either perform the action sequence later or observe someone else perform the action sequence. Before acting out or observing the procedures, participants engaged in an LDT with procedure-related and unrelated words embedded in it. Those who expected to perform the action sequence (as opposed to observe it) had reliably faster responses to words related to the procedure (rather than unrelated), and no differences emerged for the group expecting to observe the action sequences (Experiment

1). In a follow-up experiment, participants engaged in the LDT directly after performing or observing the action sequence. This time, participants who completed the action had *slower* responses for procedure-related compared to unrelated words, and no differences in response times emerged for individuals observing the action (Experiment 2). The results of these experiments suggest that the to-be-performed (as opposed to observed) actions remained highly accessible in a persons mind until they were completed, at which point they became temporarily inaccessible. This is an important theoretical point for automatic goal pursuit because it demonstrates how unfulfilled goals continue to operate and remain accessible, whereas fulfilled goals go not.

In a similar demonstration, Förster and colleagues (2005) gave participants a goal to search for a target item in a series of pictures and measured goal accessibility with an LDT intermittently throughout the task. They found that goal-related words were highly accessible before participants found the target, and inhibited right after they found the target. Thus, goals that remain unfulfilled persist in one's mind and continue to influence psychological processing, presumably in automatic ways given the research discussed in the previous section (e.g., Bargh et al., 2001; Lakin & Chartrand, 2003).

However, recent theorizing and empirical evidence suggests that unfulfilled goals actually draw upon the limited pool of executive resources. In a striking example of this, Marien and colleagues (2012) subliminally primed participants with a goal and then immediately measured executive resources via performance on a task that requires executive control. The researchers reasoned that if the unconscious (subliminally primed) goal occupied executive resources while it remain unfulfilled, then executive control should suffer in a subsequent task. Specifically, the researchers primed participants with a socializing goal by exposing them to words such as *socializing*, *celebrating*, *dancing,* and *partying*, or no goal by exposing them to neutral words (control). Next participants engaged in a memory-probe reaction time task in which they had to detect quickly and accurately whether a target letter matches a set of letters preceding it. Some of the trials on this task require the use of executive control to inhibit a familiar, but incorrect, response. The results demonstrated that participants holding the socializing goal were slower to respond on these trials than participants without a goal, likely indicating that the goal occupied or hindered executive resources. The authors concluded that unfulfilled goals "hijack" executive resources, which paints a very clear picture of goals persisting over time and drawing from the limited pool of executive resources. If goals place such a heavy burden on one's cognitive system, then they are clearly not automatic in the efficient sense (Bargh, 1994).

In similar demonstrations of this idea, Masicampo and Baumeister (2011a) conducted a series of experiments testing the effects of unfulfilled goals on executive control, specifically fluid intelligence and impulse control. To manipulate an unfulfilled goal, the researchers created a sense of unfulfillment in participants by activating the concept of honesty (subliminally) and then having them write about a time when they were dishonest (Experiment 1). Others have used this manipulation before (e.g., Moskowitz, 2002) to instill a sense of incompleteness, or unfulfillment, in participants. Masicampo and Baumeister (2011a) demonstrated that the participants who held the unfulfilled honesty goal subsequently solved fewer anagrams (a task of fluid intelligence) than controls, and displayed greater accessibility of goal-related words. Presumably, the unfulfilled goal remained active in the minds of the participants, and interfered with their ability to manipulate items in working memory. In follow-up experiments, Masicampo and Baumeister (2011a) activated unfulfilled goals by priming the concept of *achievement* and manipulating failure (Experiment 2), or simply by having participants reflect on an important personal goal that was not yet fulfilled (Experiment 3). Results revealed that the unfulfilled goals interfered with impulse control (Experiment 2) and logical reasoning (Experiment 3), which specifically involve executive resources (e.g., inhibition and manipulation of contents in working memory, respectively). From these studies, it seems that unfulfilled goals do indeed recruit executive resources, and perhaps are not as efficient as the automatic goal pursuit literature would suggest. Furthermore, looking across the research presented by Marien et al. (2012) and Masicampo and Baumeister (2011a), it seems that the maintenance of unfulfilled goals “hijack” executive resources regardless of whether researchers activate the goals consciously (e.g., explicit instructions) or unconsciously (e.g., primes).

Overall, much research suggests that people pursue active (unfulfilled) goals automatically – without awareness and presumably without executive resources. Indeed, if the entire process of goal pursuit – from activation, to maintenance, to fulfillment – can occur outside of one’s awareness and intent, it stands to reason that the maintenance of a goal over time would not require executive resources. Yet, new research suggests that goal maintenance does require executive resources, even for unconsciously activated goals. Clearly, then, there is an inconsistency in the literature regarding whether or not goal maintenance requires executive control. That is, does the maintenance of a goal (even an unconscious goal) “hijack” the limited pool of executive resources (as Marien et al., 2012 suggest), or can the cognitive system maintain goals over time in an automatic and efficient manner? One possibility is that one of these perspectives is correct, and the other is incorrect. But, I address another possibility below, that the issue is less about *if* goal maintenance require executive resources, but *when*.

Initial Effort Mobilization

As just noted, it is possible that goal activation, maintenance, and pursuit occur without conscious guidance, but is marked by a deficit in executive resources depending on when researchers measure executive control. There is some research in “conditional automaticity” suggesting that it takes some attention (i.e., executive resources) to activate knowledge structures, even unconsciously. For instance, in one experiment Gilbert and Hixon (1991) exposed participants to an Asian target while they either held an 8-digit number in working memory (requiring executive resources) or not. They then measured the activation of the Asian stereotype with a word-completion task in which participants could complete a word fragment in a stereotype consistent or neutral way (e.g., S_Y: SHY versus SAY). Results demonstrated that participants who were not rehearsing the number (with free executive resources) completed the fragments with more stereotypical words than did those who were rehearsing the number (Experiment 1). This suggests that stereotype activation, which theorists typically considered an effortless and automatic process up to this point, requires some executive resources. In a follow up experiment, participants viewed the same Asian target and then formed and reported an impression of the target while under cognitive load or not. In this experiment, participants applied the stereotype in their impressions to a *greater* extent when they were under cognitive load (Experiment 2). Unlike stereotype activation, then, stereotype application in impression formation occurred automatically, and even more so while participants experienced cognitive load. These experiments are important because they demonstrate that individuals might need executive resources initially to activate a cognitive construct, but not at later stages in information processing. By implication then, it is possible that goal activation, and perhaps early maintenance, requires some initial executive resources, but that a fully active goal could thereafter remain active without taxing executive resources.

Research by Gendolla and Silvestrini (2010) also supports the idea that the initial activation of a goal, per se, requires some executive resources. Gendolla and Silvestrini exposed participants to masked action or inaction primes (which likely activate a related goal, per research by Albarracín et al., 2008) and measured their cardiac reactivity. The researchers found a stronger cardiac response (pre-ejection period, PEP) following action relative to inaction primes, and greater effort exertion on a subsequent memory task. This research is important because it demonstrates the automatic mobilization of one’s effort following an action-prime (see also Silvestrini & Gendolla, 2013; Capa, Cleeremans, Bustin, Bouquet, & Hansenne, 2011). If a masked action prime can mobilize a cardiac response, then it is plausible that goal activation could similarly mobilize cognitive efforts that temporarily reduce executive resources.

Together, the lines of research on conditional automaticity (e.g., Gilbert & Hixon, 1991) and effort mobilization (Gendolla & Silvestrini, 2010) support the possibility that initial goal activation, and perhaps early maintenance, requires executive resources, but that the maintenance of goals over time does not. Importantly, this "initial effort mobilization" (IEM) hypothesis I propose here could explain the conflicting results from previous research demonstrating that active goals sometimes do, and sometimes do not, disrupt executive functioning. According to this hypothesis, goals require executive resources initially to become active, but goals may remain active and operate without executive resources at later stages in goal pursuit. Thus, the IEM hypothesis predicts that soon after a goal-priming procedure, executive resources will be reduced and performance will be hindered on an executive control task (see, e.g., Marien et al., 2012). However, following a slight delay that affords time and resources for goal activation, goal maintenance (i.e., continued activation) can persist without executive resources, and therefore not influence performance on an executive control task (see Bargh et al., 2001; Garrison & Handley, 2015). This hypothesis, if supported, could help reconcile two seemingly incompatible findings in the literature about goals and automaticity. Of course, there remains an alternative possibility; perhaps goal activation and maintenance *do* require executive resources, as argued by Marien et al. (2012) and Masicampo and Baumeister (2011a). This competing hypothesis suggests that regardless of the amount of time a goal is active, it will continue to occupy executive resources and interfere with any unrelated task that requires these resources. The current research aims to clarify the time course of executive functioning in the maintenance of a goal, thereby testing these competing hypotheses.

Overview of Experiments

In two experiments, participants received general experimental instructions and were randomly assigned to receive, or not receive, a goal to form impressions of roommates in an upcoming experimental task. The participants in the goal conditions explicitly acknowledged the goal. Following this, participants engaged in a goal-unrelated task that required executive control, namely the memory probe task used in Marien et al.'s (2012) research. In this task, participants must detect whether a target letter matches a set of letters directly preceding it. When the target matches the preceding set, it requires a positive "YES" response. When the target does not match the preceding set, it requires a negative "NO" response. In some of the trials, the target letter is familiar because it occurred recently (e.g., two trials back). This familiarity competes with the correct response in negative trials (but not positive trials) and requires participants to inhibit the familiarity in order to correctly respond "NO." For example, if a target letter "F" followed the set "PRCL" it would require a negative response, but if the trial right beforehand had a set of "RFGH" then the current letter "F" would be familiar and participants would have to inhibit the prepotent "YES" response to correctly respond "NO." These negative recent trials require executive control to inhibit the familiar response (Smith & Jonides, 1999). On these trials, reaction times and accuracy should be sensitive to the level of one's processing capacity, or executive resources. In contrast, a negative non-recent trial (e.g., "F" target immediately following a "PRCL" set, but preceded recently by the set "RMGH") would not require inhibition because the target "F" was not presented recently and is therefore not familiar. Likewise, a positive non-recent trial (e.g., "F" target immediately following the set "FRCL", and preceded recently by the set "TRGH") would require a "YES" response, and would not require inhibition because the correct response does not need to override another prepotent response. Also, a positive recent trial (e.g., "F" target immediately following the set "”FRCL", and preceded recently by the set "RMGF") would not require inhibition because in this case the familiarity of the target works in harmony (as opposed to in conflict) with the correct response. Thus, the only trials that require executive control are the negative recent trials. If executive resources are taxed, then performance on negative recent trials should suffer in comparison to negative non-recent trials. Performance on positive recent and non-recent trials should not be sensitive to executive resource capacity, as they do not require inhibition to execute a correct response. In sum, performance on the memory probe should be as follows: positive recent and non-recent trials should not differ from one another and should be fairly accurate and fast overall, but performance on negative recent trials should be worse than negative non-recent trials because the former requires executive control. Further, if one's executive resources are taxed, the difference between negative recent and non-recent trials should be even *greater*, due to excessive slowing or errors on the negative recent trials compared to negative non-recent trials. In other words, if one's executive resources are occupied or impaired, the only trials that should suffer are the negative recent trials; this effect should exacerbate the difference between negative recent and non-recent trials.

In addition to the initial goal manipulation, participants were randomly assigned to a pause or no pause before the memory probe task. Participants in the pause condition sat in their chairs for a few minutes simply relaxing and focusing on their breath, whereas participants in the no-pause condition immediately engaged in the memory probe task after goal (vs. no goal) activation. An assumption in the current project, consistent with Bargh et al., 2001, is that the initial goal to form impressions remained active for the duration of the pause and the memory probe task, because it was not yet fulfilled.

The conceptual dependent variable in the current project is the availability of executive resources, which is indicated through executive control. Operationally, this variable is defined by performance in the negative recent trials relative to negative non-recent trials of the memory probe task. Performance is measured in terms of reaction time (RT) and accuracy (correct and incorrect responses). In general, negative recent trials should be slower and contain more errors than negative non-recent trials because participants must inhibit the prepotent response in the former. However, if executive resources are taxed (because of the unfulfilled goal or initial effort mobilization) then the performance differences between negative recent and non-recent trials should be exacerbated. I also investigated performance on positive trials, but given these trials do not require the inhibition of a prepotent response I did not hypothesize that they would be affected by the goal manipulation. When stating the hypotheses, I make predictions for performance on the negative recent versus non-recent trials. Impairments in executive control should result in a greater difference in performance between these two trial types than when executive control is intact. The hypotheses outlined below compare participants with the impression formation goal and those without the goal on the anticipated difference between negative recent and non-recent trials. Each of the critical hypotheses makes specific predictions about this outcome, both initially and after a delay.

Predictions and Hypotheses

The idea that unfulfilled goals occupy executive resources suggests that a goal will disrupt executive functioning for the entire duration that it is active and unfulfilled, by the very nature of the unfulfilled goal. I will refer to this as the “Unfulfilled Goal” (UG) hypothesis, which is consistent with Marien et al.’s (2012) ideas. Alternatively, the Initial Effort Mobilization hypothesis (IEM) predicts that impairments in executive control are not due to the goal per se, but to the initial efforts required to activate the goal construct. These two hypotheses make the same prediction for the executive control immediately after goal activation – that it will suffer – but make divergent predictions for performance after a delay.

Initial Effort Mobilization (IEM) Hypothesis

Hypothesis 1 (Overall). The IEM overall predicts an interaction between goal, pause, and recency within negative trials. Specifically, participants should overall perform more poorly on negative recent relative to negative non-recent trials, but this difference should be greatest amongst individuals in whom a goal was very recently activated (i.e., experienced no pause). The specifics of this interaction pattern are revealed in the sub hypotheses below. Of note, some of these predict null effects for the goal factor or pause factor, but these should be understood in the context of this predicted 3-way interaction.

Hypothesis 1a: IEM Immediately. The IEM hypothesis predicts that initial efforts are needed to activate a goal construct, temporarily reducing executive resources. Thus, individuals should perform worse on negative recent trials relative to non-recent trials immediately following a goal priming procedure relative to no priming procedure. That is, results should indicate an interaction within the negative trials between recency and goal such that the performance difference between recent (slower/less accurate) and non-recent trials is *greater* with an unfulfilled goal than without an unfulfilled goal.

$$H_{a1a}\text{: Goal} > \text{No Goal}$$

$$H_{o1a}\text{: Goal} \leq \text{No Goal}$$

Hypothesis 1b: IEM Delayed. The IEM perspective predicts that once the goal construct is active, the goal can be maintained automatically and efficiently. Thus, following a few-minute pause between the goal prime (or general instructions) and the memory probe task, the performance difference on the negative recent relative to non-recent trials should be comparable to individuals who did not receive a goal prime. Such a finding would suggest that the goal could persist over time without compromising executive resources. That is, results should indicate only a main effect of trial recency that does not interact with goal; the performance difference between recent (slower/less accurate) and non-recent trials is *comparable* across goal and no-goal conditions.

H_{a1b}: Goal = No Goal

H_{o1b}: Goal $\neq$ No Goal

Hypothesis 1c: IEM Goal. The IEM hypothesis predicts that initial efforts are needed to activate a goal construct, temporarily reducing executive resources, but are not required after a brief period at which point the goal is active. Thus, individuals primed with the goal should perform worse on negative recent relative to non-recent trials if they experienced no pause, relative to a pause, following a goal priming procedure. That is, results should indicate an interaction within the negative trials between recency and pause such that the performance difference between recent (slower/less accurate) and non-recent trials is *greater* with a recently activated relative to distally activated goal.

H_{a1a}: Pause < No Pause

H_{o1a}: Pause $\geq$ No Pause

Hypothesis 1d: IEM No-Goal. The IEM hypothesis predicts that, without an unfulfilled goal, participants should have the full use of their executive resources at their disposal regardless of whether they immediately began the executive control task or began it after a brief delay. That is, results should indicate only a main effect of trial recency that does not interact with pause; the performance difference between recent (slower/less accurate) and non-recent trials is *comparable* across pause and no-pause conditions.

H_{a1a}: Pause = No Pause

H_{o1a}: Pause ≠ No Pause

Unfulfilled Goal (UG) Hypothesis

Hypothesis 2 (Overall). The UG overall predicts an interaction between goal and recency within negative trials which will not be moderated by pause (cf., Hypothesis 1). That is, regardless of whether or not participants experienced a pause prior to engaging in the memory probe task, participants will perform more poorly on negative recent relative to negative non-recent trials if they held an unfulfilled goal than if they did not, independent of the pause manipulation. These predictions are specified in detail below.

Hypothesis 2a: UG Immediately. The UG hypothesis predicts that unfulfilled goals draw upon executive resources. Therefore, individuals should perform worse on negative recent relative to non-recent trials following a goal priming (vs. no priming) procedure. That is, participants with the goal should display a *greater* difference between negative recent (slow/less accurate) and non-recent trials, in comparison to participants without a goal. Importantly, this is the same prediction the IEM hypothesis makes initially.

H_{a1a}: Goal > No Goal

H_{o1a}: Goal ≤ No Goal

Hypothesis 2b: UG Delayed. The UG hypothesis predicts that performance in the negative recent trials will continue to suffer after the delay because the goal is still unfulfilled, and presumably still active, therefore still occupying executive resources. Individuals should perform worse on negative recent (slow/less accurate) relative to non-recent trials, particularly following a goal priming relative to no priming procedure. In this way, the UG hypothesis predicts a main effect of goal on performance in the negative recent trials relative to non-recent trials, regardless of delay.

H_{a1a}: Goal > No Goal

H_{o1a}: Goal $\leq$ No Goal

The critical outcome to test the IEM and UG hypotheses, therefore, is performance on the negative recent versus non-recent trials following a delay. IEM predicts a goal x recency x pause interaction, whereas UG only predicts a goal x recency interaction with no effect of the pause.

EXPERIMENT 1

METHOD

Participants and Design

Two hundred fifty undergraduate students from Montana State University (62% female; M_{age} = 19.97 years) participated in this experiment for partial course credit. Upon entering the lab, participants were randomly assigned to receive an impression formation goal or not, and then complete the memory probe task either immediately or after a delay. There were four trial types on the memory probe task, resulting from a cross between two within-subject factors of trial type: probe (positive vs. negative) and recency (recent vs. non-recent). Thus, the experiment was a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(probe: positive vs. negative) x 2(recency: recent vs. non-recent) mixed-model design with the first two factors between subjects, and the last two factors within subjects (corresponding to trial type in the memory probe task).

General Procedure

Participants came into the lab (up to 6 at a time) and were seated at individual computer stations. Computer instructions informed participants that they would complete a series of unrelated short tasks. First, participants practiced the memory probe task for 16 trials (about 1 minute). This was described as a task to get them familiar with the computer settings (they did not know they would be engaging in this task later). Following this, some participants were told that the primary purpose of the experiment was to form impressions of roommates and that they should adopt the goal to consider upcoming roommate information carefully in order to choose the best roommate. Alternatively, other participants merely moved on with the experiment and received no directions on the matter. At this point, therefore, some participants had a goal to form impressions of roommates in an upcoming experimental task, and others did not. After the goal activation (or not), participants engaged in the memory probe task again, this time for a full 5-6 minute length of time. This task requires considerable attention and executive resources. Some participants engaged in the memory probe task immediately whereas others did so after a few-minute pause while they relaxed in their chairs (see details below in *pause* section). In this way I could test the effects of the goal over time. Additionally, participants in the goal conditions engaged in a *fulfillment* exercise after the memory probe task, in the event that the goal did indeed occupy their executive resources and might continue to do so. These individuals took a few minutes to write about their "ideal roommate," to discharge the goal. Finally, participants answered a few demographic questions, were debriefed, thanked and allowed to leave.

The primary dependent variable was performance on the memory probe task, specifically in the negative recent trials relative to non-recent trials, which I hypothesized to vary as a function of the goal and the pause. There were four experimental conditions describing participants' experiences going into the memory probe task: immediately with the goal, immediately without the goal, after a delay with the goal, after a delay without the goal.

Independent Variables

Goal Activation

I chose to activate an impression formation goal because it is likely a commonly held goal in college-aged participants, and would therefore be a good candidate for automatic maintenance. If participants frequently form impressions of others, they likely have a schema for this goal. In addition, impression formation goals are frequently used in social-cognitive literature (e.g., Dijksterhuis, 2004; Chartrand & Bargh, 1996). To activate the goal, a random sample of participants read experimental instructions that they would soon form impressions of 3 candidates as potential roommates in an upcoming experimental task. To make this goal relevant, participants were asked to place themselves in the following scenario:

> Imagine that you are a college student who lives in a nice home. You are seeking a roommate to share your home with, and contribute to the living expense. You really love your home and it is important that you have a good living situation. For this reason, the roommate you choose to live with is an important factor in your wellbeing and the security of your home. You put an advertisement in the local newspaper and you have received THREE interested prospects. You meet with each of them individually and derive quite a bit of information about them each.

Participants learned that they would be presented with information that describes each of the three roommates – Roommate A, Roommate B, and Roommate C – and that their task was to form impressions of each of them and ultimately choose the best roommate. At this point, participants were asked to indicate (in a YES or NO response) if they understood their goal. This entire sequence of events occurred on four instructional computer screens, and lasted roughly 2 min. It is important to note that participants never actually received roommate information, or had to form impressions of roommates. These instructions served merely to activate the goal to do so.

Participants who were not in the goal condition did not receive any of this information. They read instructions that they would complete a series of unrelated short tasks (the beginning instructions everyone received) and they practiced the memory probe task, as everyone did.

Pause

After the goal manipulation (or not), participants were randomly assigned to immediately engage in the critical memory probe task or experience a delay of about 2.5 minutes before engaging in that task. Participants in the delay condition experienced a short break before continuing to the memory probe task. The computer instructed them to sit back in their chairs and relax for the next few minutes. During this time instructions appeared on the computer screen, reminding participants to relax and wait (e.g., *Use this time to rest… The computer will proceed on its own; you may notice how your body is feeling and/or concentrate on your breath… the experiment will proceed shortly*). Instructions remained on the screen for about 30 seconds, and automatically changed so that participants were continually (and gradually) reminded to sit and relax in their chairs. I added this continuous flow of instructions so that participants would remain relatively engaged in the experiment, and not get too off track. This delay lasted for 2 min and 24 s.

It is important to note that participants without the impression formation goal participated in this exercise without any other knowledge about the experiment. If participants were in the no-goal and delay condition, for example, this break occurred almost directly after the beginning instructions. Thus, depending on condition, participants' understandings of the purpose of the experiment were quite different.

Dependent Variables

Memory Probe Task

The primary dependent variable was performance on the memory probe task, which requires executive resources. Participants viewed sequences of consonant letter sets (e.g. "PQNT"), followed by a probe letter (e.g. "V"), and had to indicate as quickly and accurately as possible if the probe letter matched any of the letters in the set immediately preceding it. This sequence repeated 80 times for the full task.

Trials began with a fixation cross (+) in the center of the computer screen for 500 ms. Next, a set of four letters appeared in the center for 500 ms, which was followed by a blank screen for 2700 ms. Finally, the target probe letter appeared in the center of the screen and remained until the participant responded that the letter was ("YES") or was not ("NO") present in the immediately preceding letter string. Corrective feedback ("WRONG") appeared in the center of the screen for 500 ms directly following an incorrect response. There was no feedback for a correct response. Participants responded using the keyboard letters "A" and "L" for a "YES" and "NO" response, respectively. The response keys were distinguished with colored tape (e.g., green and orange) and labeled (e.g., "yes" and "no") to help participants during the task. Response time to the target letter and accuracy were the main dependent variables.

There were four trial types in this task. First, the target probes were either positive or negative, meaning that the target required a “YES” or “NO” response, respectively. Within these positive or negative trial types, there were also recent or non-recent trials. For recent trials, the target letter matched the set on the *previous* trial. For example, a recent trial might have a “T” target following a set “KMWP” (a negative trial) which was immediately preceded by a trial with the set “XCTR”. In this example, the “T” target should be familiar to the participant, because is occurred recently, but this familiarity should conflict with the accurate response. In the example given, the trial is negative and requires a “NO” response, so the familiarity competes with the correct response because it biases a response towards “YES”. Participants must inhibit the familiarity in order to respond correctly. In this way, negative recent trials require executive control (Smith & Jonides, 1999). Performance on negative recent trials should be slower than negative non-recent trials (e.g., a target “T” following the set “KMPW” - a negative trial - which was preceded by a trial with a set “SFGH”), and contain more errors. Positive recent trials, on the other hand, should not elicit executive control because the familiarity from a recent trial is consistent with the accurate response (e.g., “T” target following a “TMWP” set – a positive trial – which was preceded by the set “XCTR”). The familiar response is in harmony with the accurate response, and therefore does not need to be inhibited by the participant.

An important point to note is that recent trials should bias a “YES” response in general, across both positive and negative trial types, due to the familiarity of the target. This will, of course, hurt performance in the negative trials and help performance in the positive trials. Therefore, when analyzing response data, I will have to control for this response bias. In other words, negative recent trials should elicit more errors than negative non-recent trials and positive recent trials should elicit more "correct" responses than positive non-recent trials just because the target is inherently familiar in recent trials, guiding responses towards a "YES". To see if the goal influenced one's accuracy, I will compare accuracy between recent and non-recent trials (collapsed across positive and negative trials). Specifically, if a goal does interfere with executive control, then the discrepancy between accuracy in the recent and non-recent trials should be greater for those with a goal than those without, because the familiarity should have a stronger influence (unopposed by executive control). This is discussed further in the Results section.

The memory probe task consisted of 20 trials for each type (positive, positive recent, negative, negative recent) resulting in 80 total trials. Overall, I analyzed reaction times (RT) and performance separately. RT was standardized and averaged across each trial type. RT should not differ between positive recent and positive non-recent trials because neither requires executive control to inhibit a prepotent response. But, RTs should be slower on the negative recent trials than the negative non-recent trials because the former requires the inhibition of a prepotent response. Therefore, if this task reliably measures executive control and the resources available to use it, I expect a probe (positive vs. negative) X recency (recent vs. non-recent) interaction (as observed by Marien et al., 2012).

Performance accuracy was measured by the frequency of correct and incorrect responses: hits and misses in positive trials, correct rejections (CR) and false alarms (FA) in negative trials. These scores were used to calculate a d prime (d') index for recent and non-recent trials for each participant, representing the overall accuracy level based on frequencies of responding correctly in positive trials (hits) and negative trials (CR). This accuracy measure reflects one's ability to distinguish between response alternatives in memory (i.e., was the target present or not?). Accordingly, d' should be lower on the recent trials compared to the non-recent trials (collapsed across positive and negative trials), because the familiarity of the target should make it harder to distinguish in memory. In addition, I calculated a criterion measure, C, that accounts for response bias. A more liberal response bias towards "YES" will result in a more negative C value, whereas a more conservative bias towards "NO" will result in more positive C values. A criterion value of zero indicates a neutral response bias. Theoretically, recent trials should prompt a reliance on familiarity (and a "YES" response) more so than non-recent trials, and the goal manipulation might increase this tendency.

RESULTS

For the participants with a goal (*n* = 128), all but one indicated that they understood their goal to form impressions in the upcoming task. Because this understanding is necessary for the goal manipulation to be successful, this individual was left out of data analysis.

Memory Probe Data

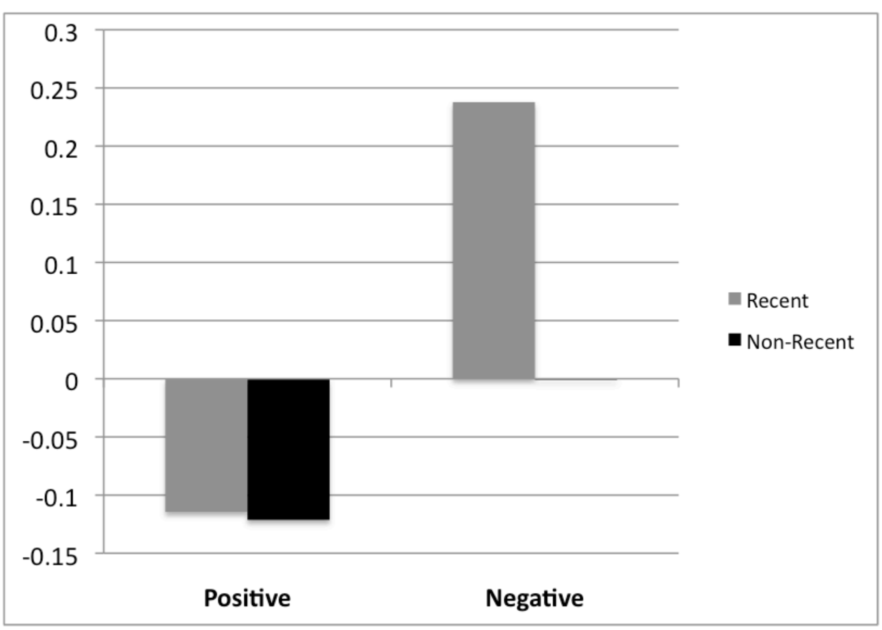
Reaction Time

For the reaction time (RT) data, I used only responses on correct trials. First I separated RT by trial type: positive, positive recent, negative, and negative recent. Then, I trimmed the raw RT scores for outliers within each type. Any response that was more than 3 standard deviations from the mean of the respective trial type was discarded. A total of 1.69% of the correct responses was trimmed for being too slow.

Next, I transformed each participant's trimmed raw RT scores into z-scores based on the participants' RT mean and standard deviation across all trials. This transformation controls for variability in individual response times because it is based on the participants' own RT distribution (see Hutchison, Balota, & Ducheck, 2010 for a similar transformation). I then averaged the RT z-scores across trial type, so that each participant would have a mean RT z-score for each of the four trial types: positive, positive recent, negative, and negative recent. All subsequent analyses are based on these averaged z-scores.

Initial Analysis of Task. To determine if the memory probe task reliably measured executive control, I subjected the RT z-scores to a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(probe: positive vs. negative) x 2(recent vs. non-recent) mixed-model ANOVA, with the first two factors between subjects and the last two factors within subjects. As anticipated, there was a main effect of probe, $F(1, 246) = 137.35$, $p < .001$, such that positive trials were faster than negative trials. There was also a main effect of recency, $F(1, 246) = 73.428$, $p < .001$, such that recent trials were slower than non-recent trials. Most important, the predicted Probe x Recency interaction was significant, $F(1, 246) = 66.059$, $p < .001$, such that negative recent trials were slower than negative non-recent trials, but this difference was much smaller (or non-existent) for positive trials (see Figure 1). This significant interaction demonstrates a *memory probe effect*, likely indicating that negative recent trials required executive control to inhibit the (incorrect) prepotent "YES" response, as indicated in slower RT in comparison to the other trial types. Thus, the memory probe task was a reliable indicator of executive control processes.

Figure 1. Probe x Recency Interaction on RT Z-scores in Memory Probe, Experiment 1



Analysis of Independent Variables. To test more specifically whether the independent variables had an effect on executive control, I analyzed the negative trials separately.[1] I looked at negative trials because the negative recent trials specifically elicit executive control, and the negative non-recent trials serve as a proper control.

I subjected RT z-scores in the negative trials to a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(recent vs. non-recent) mixed-model ANOVA, with the first two factors between subjects and the last factor within subjects. The ANOVA revealed a main effect of recency, $F(1, 246) = 119.383$, $p < .001$, replicating the first analysis that recent trials were slower than non-recent trials. The main effects of goal and pause were non-significant (Fs < 1). Interestingly, there was a significant Goal x Pause interaction, $F(1, 246) = 5.22$, $p < .05$. However this interaction did not depend on recency, indicated by a non-significant three-way interaction among goal, pause and recency ($F < 1$). So, the effect did influence executive control (i.e., an enhanced difference in RT between recent and non-recent trials) and therefore is not relevant to the current hypotheses. Critically, the goal manipulation did not interact with recency, $F(1, 246) = .172$, $p = .679$, indicating that performance in the negative recent trials relative to non-recent trials was comparable across participants with and without a goal. This fails to support Hypothesis 2 (UG). That is, the slowing effect on negative recent (vs. non-recent) trials was the same regardless of whether participants held an unfulfilled goal or not. The mean RT z-scores on negative trials for the goal conditions are presented in Table 1. All other interactions were non-significant.

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[1] The full analysis, including positive trials, does not change the implications of the results.

Table 1. RT z-scores in the Negative Memory Probe Trials for Individuals With and Without a Goal, Experiment 1

	Recent		Non-Recent	
	n	*M* (*SD*)	*n*	*M* (*SD*)
Goal	127	0.2491 (.25)	127	0.0022 (.23)
No Goal	123	0.2261 (.25)	123	- 0.0028 (.21)
Total	250	0.2378 (.25)	250	- 0.0003 (.22)

This experiment did not replicate the findings that an unfulfilled goal occupies executive resources and interferes with executive control. The presence of a goal did not influence the slowing effect on negative recent (vs. non-recent) trials. Further, the analysis did not reveal the 3-way interaction between goal, recency, and pause on RT z-scores predicted by Hypothesis 1 (IEM), $F(1, 246) = .04$, $p = .841$. Together, the non-significance of these interactions means that this experiment did not provide data that could distinguish between the predictions of the UG and IEM hypotheses; the presence of an unfulfilled goal had no influence on participants' performance on the task (inconsistent with Hypothesis 2 [UG]), and the pause manipulation did not moderate the influence of the goal and recency on participants' performance on the task (inconsistent with Hypothesis 1 [IEM]).

Accuracy. Accuracy on the memory probe task was measured in terms of correct responses and errors. Correct responses on the positive trials are "hits" (i.e., responding "YES" when that is the correct response) and incorrect responses are "misses" (i.e., responding "NO" when "YES" is the correct response). Likewise, correct responses on negative trials are "correct rejections" (CR; i.e., responding "NO" when that is the correct response) and incorrect responses are "false alarms" (FA; responding "YES" when "NO" is the correct response). For each trial type (positive, positive recent, negative, negative recent) there were 20 trials, resulting in a total of 80 trials throughout the task. Accuracy was generally high with an average of 74.28 correct out of 80 (*SD* = 3.933; range 57 – 80).

To determine if accuracy differed across the critical trial types, and if the goal or pause manipulation interacted with this effect, I conducted a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(Recency: recent vs. non-recent) mixed-model ANOVA on the number of errors (FA) in negative trials only, with the first two factors between subjects and the last factor within subjects. As expected, the number of FA was higher in negative recent trials ($M = 1.368$, $SD = 1.38$) than negative non-recent trials ($M = .748$, $SD = 1.09$), indicated by a main effect of recency, $F(1, 246) = 54.847$, $p < .001$. However, the analysis revealed neither a significant goal x recency interaction (inconsistent with Hypothesis 2 [UG]), $F(1, 246) = .633$, $p = .427$, nor a significant goal x recency x pause interaction (inconsistent with Hypothesis 1 [IEM]), $F(1, 246) = .145$, $p = .704$. None of the other main effects or interactions were significant (all Fs < 2.6, ps > .11). Thus, although participants were less accurate in the negative recent trials, their performance was not affected by the goal or pause manipulations.

It is important to note that one's responses on a task like the memory probe can be biased towards either a "YES" or "NO" response. For instance, recent trials likely bias a "YES" response in general (i.e., responding that the target was present in the immediately preceding set) because it prompts a feeling of familiarity, which would encourage a "YES" response. Interestingly, in line with this idea, the number of "YES" responses (hits) in the positive trials was significantly higher when the trial was recent (*M* = 18.5, *SD* = 1.24) versus non-recent (*M* = 17.9, *SD* = 1.85), $t(249) = 5.092$, $p < .001$. So overall, participants were responding "YES" more when the trial was recent, and this occurred for positive (hits) and negative (FA) trials. This might indicate a response bias towards "YES" in recent trials in general. That is, because the target is familiar in recent trials, participants may be more biased to respond, "YES." For now, I will state that more errors occurred in the negative recent trials (i.e., those that required executive control) than the non-recent trials, but it is important to note the trial characteristics (such as recency) can lead a person to respond in a certain way.

Although the greater frequency of responding "YES" on recent trials (looking independently at positive and negative trials) is likely due to the characteristics of the memory probe task, the availability of individuals' executive resources could influence this response bias because executive control is needed to inhibit the familiarity of a recent negative target. So for example, an executive control deficit would leave the familiarity of the recent target unopposed, and exacerbate the response bias in both positive and negative trials. As such, I performed an analysis on accuracy in positive and negative trials together. Specifically, I calculated an index of sensitivity, known as d prime (d'), which measures individuals' ability to distinguish the target in memory, and is calculated using all possible response options (hits, misses, CR, FA). For example, when the participant views a target ("T") they must distinguish whether the target was present in the immediately preceding set or not. The d' score reflects an individual's ability to make this distinction. A higher d' score means a greater memory discriminability; and the availability of one's executive resources may influence this index.

First, I calculated a d' score for each participant, using the frequency of correct responses (hits and CR) and incorrect responses (misses and FA). Trial type was collapsed across probe (positive vs. negative) because the d' score is generated using *all* of the participants possible responses. In this way, it is not possible to calculate a d' for negative trials separately. However, I predicted that accuracy would be lower in the recent as compared to non-recent trials because one's memory for the target is clouded with familiarity. I analyzed d' scores in a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(recent vs. non-recent) mixed-model ANOVA with the first two factors between subjects and the last factor within subjects. In this way I could determine whether accuracy, or memory discriminability, differed between recent and non-recent trials, and whether the difference was altered by the goal or pause. There was not a significant main effect of recency, $F(1, 246) = 1.851$, $p = .175$, indicating that memory discriminability was equal across trial types. In addition, there was neither a main effect of goal nor pause (all $Fs < 2.12$, $ps > .146$). The critical Goal x Recency interaction was not significant $F(1, 246) = 1.08$, $p = 0.30$, suggesting that the goal did not have an effect participants' memory discriminability. And again, the pause did not moderate the goal x recency interaction, as indicated by a non-significant three-way goal x recency x pause interaction, $F(1, 246) = .003$, $p = .954$. No other interactions were significant (all Fs < 1).

It is also possible that participants' responses were biased towards responding "YES" or "NO" more generally, as indicated by a liberal or conservative response bias, respectively. To account for this, I calculated a criterion measure (C) using the proportion of hits and false alarms for each participant. A C value of zero reflects no response bias, and an equal tendency to respond “YES” or “NO” across trials. A negative C value indicates a bias towards “YES” whereas a positive C value indicates a bias towards “NO”. I subjected the C values to a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(recent vs. non-recent) mixed-model ANOVA with the first two factors between-subjects. There was a main effect of recency, $F(1, 246) = 60.192$, $p < .001$, such that recent trials had lower C values ($M = .071$, $SD = .551$) than non-recent trials ($M = .422$, $SD = .516$). These numbers indicate that participants responded more conservatively (i.e., towards “NO”) during non-recent trials, and less so during recent trials. There was no main effect of goal, $F(1, 246) = .904$, $p < .001$, and the Goal x Recency interaction was not significant, $F(1, 246) = .034$, $p < .001$. No other effects were significant (all *F*s < 1).

In sum, the memory probe task produced a reliable Probe x Recency interaction on RTs, revealing that negative recent trials were slower than negative non-recent trials, likely reflecting the underlying executive control processes at play. The accuracy data demonstrated that participants’ memory discriminability for targets was not significantly different in recent compared to non-recent trials (e.g., d’). However, responses were generally biased towards a conservative “NO” response in non-recent trials, and less so in recent trials (e.g., C). The goal manipulation had no effect on reaction time or accuracy and, therefore, did not influence executive control; the Goal x Recency interaction in the negative trials was not significant for RT or accuracy.

DISCUSSION

The results of Experiment 1 demonstrate, first and foremost, that that the memory probe task effectively measured executive control. Specifically, participants took longer to respond for negative recent trials—which should require executive control to inhibit a prepotent response—compared to negative non-recent trials. Further, this difference in RT was much larger than that of the positive trials, consistent with the idea that positive trials did not require participants to inhibit a prepotent response.

The accuracy data demonstrated more errors (i.e., “YES” response; a false alarm) in negative recent trials compared to negative non-recent trials. However, recent positive trials also elicited more “YES” responses than non-recent positive trials, suggesting that the recent trials in general encouraged participants to respond, “YES.” To account for this bias, I calculated d’ and C scores and compared them between recent and non-recent trials (collapsing across whether the trial was positive or negative), and found that participants were generally conservative in their responses, but responded more “YES” when the target was familiar.

Overall, the findings in the current experiment are conceptually inconsistent with recent findings that unfulfilled goals occupy executive resources and interfere with executive control (e.g., Masicampo & Baumeister, 2011a; Marien et al., 2012). The current goal manipulation did not influence RT on the negative recent trials compared to non-recent trials, and therefore did not influence executive control processes (inconsistent with Hypothesis 2). In addition, the 3-way interaction among goal, recency, and pause was non-significant looking at negative trials (inconsistent with Hypothesis 1), and so I could not distinguish between the UG and IEM hypotheses.

There are at least two possibilities for why the goal did not influence executive functioning in the current experiment. First, it is possible that unfulfilled goals do not actually interfere with executive control. However, another possibility is that the current goal manipulation was not strong enough to elicit the predicted effect on executive control. In favor of the latter, Experiment 2 attempted to strengthen the goal manipulation by adding a *need* to fulfill the goal. That is, Experiment 2 coupled the goal manipulation with the motivation (need) to fulfill the goal. This was intended to cause initial decrements in executive control following goal activation, and thus allowing for a test of the potential moderating effect of the pause (per the IEM hypothesis).

EXPERIMENT 2

Experiment 2 sought to strengthen the goal manipulation in an attempt to influence executive functioning as demonstrated by previous research (e.g., Marien et al., 2012). All of the procedures were the same as in Experiment 1, except that a *need* exercise was added to the goal manipulation. Specifically, participants in the goal conditions were first asked to write about a time when they misjudged someone, in order to instill in them a need to form an accurate impression. This manipulation has been used by Moskowitz (2002) to create a sense of incompleteness in participants by having them reflect on a personal failure as opposed to a success. Reflecting on failure creates a feeling of incompleteness, and prompts a need to establish completeness – or fulfill a goal – in the relevant domain (Moskowitz, 2002). I adapted this manipulation to create a sense of incompleteness in the impression-formation domain, so that participants in the goal conditions would be motivated to form an accurate impression. This need exercise occurred prior to the goal-activation manipulation, which was almost identical to before. I hypothesized that the goal would be stronger with this additional manipulation, and subsequently interfere with executive control as predicted.

METHOD

Participants and Design

Two hundred forty four undergraduate students from Montana State University participated in this experiment for partial course credit. Unfortunately some of the demographic data was not recorded during the experiment, and so must be estimated based on a portion of the data. Gender data was only included in a portion of the sample (n = 90), but indicated that 45.6% were female. Similarly, age was only recorded for a portion of the sample (n = 149), but the mean of this portion was 21.38 years (SD = 5.08). Upon entering the lab, participants were randomly assigned to receive an impression formation goal with the inclusion of the need exercise, or no goal. Participants then completed the memory probe task either immediately or after a delay. As in Experiment 1, the design was a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(probe: positive vs. negative) x 2(recent vs. non-recent) mixed-model design with the first two factors between subjects, and the last two factors within subjects.

General Procedure

The general procedure was the same as Experiment 1. Participants came into the lab in groups (up to 6) and performed all the procedures on an individual computer. Participants were randomly assigned to receive an impression formation goal or not. The critical difference from Experiment 1 was that the goal activation task further included a writing exercise that was intended to elicit the need to form an impression (a full description of this exercise is described in the *Goal Activation* section below). After the goal activation, all participants engaged in the memory probe task either immediately or after a brief pause. Again, the primary dependent variable was performance on the memory probe task in terms of RT and accuracy, which I hypothesized to vary as a function of goal and pause. The current experiment also included additional exploratory measures beyond those collected from the memory probe task.

Independent Variables

Goal Activation

Need Exercise. To strengthen the impression formation goal, participants randomly assigned to the goal conditions were first asked to engage in an exercise in which they wrote about a time when they misjudged someone (Moskowitz, 2002). Specifically they were instructed: “Please reflect on a time when you misjudged someone. Use the space provided to describe this experience in detail.” Participants were given a black space in which to type their responses, and they could take as much time as they needed. This manipulation occurred right after the beginning instructions and practice with the memory probe, and was described simply as a “writing exercise” that was one of the first experimental tasks.

Goal Activation. The goal activation task was almost identical to that in Experiment 1, with a few minor modifications. Specifically, instead of placing themselves in the roommate-seeking scenario, participants were told more explicitly about the upcoming task in which they would engage. I changed this in order to give participants a more complete understanding of their task, so the goal would be more realistic. After practice with the memory probe, participants randomly assigned to the goal conditions viewed the following instructions:

> In an upcoming task, you will be given a large number of behavioral attributes that describes three different people, such as "Person A volunteers in a homeless shelter" and Person B comes from a middle class family." Your task is to form accurate impressions of these individuals, inferring characteristics about them. Each person will be described by 12 sentences, so you must pay close attention and put forth your best effort. Because you will be presented with such a large amount of information (12 sentences X 3 people) take a few moments to adopt the goal to form an accurate impression of the individuals.

This description matches an impression formation task commonly used by Dijksterhuis and colleagues (e.g., Dijksterhuis, 2004), and should add realism to the manipulation.

In addition, participants were asked to commit to the following statement: "I will try my best to form accurate impressions of the target individuals in the upcoming task" by indicating if they "AGREED" or "DISAGREED" with the statement. I adapted this manipulation from an experiment by Masicampo & Baumeister (2011b, Experiment 4) in which they primed participants with a goal to engage in an upcoming experimental task, as was done here.

Additional Dependent Variables

Word Completion Task

A word completion task was added to Experiment 2 to measure goal accessibility after the memory probe task. After participants finished the memory probe task, they were given word fragments (e.g., JU_ _ _) and asked to complete them with the first word that came to mind. Following Masicampo and Baumeister (2011a; 2011b), I operationalized goal accessibility as completing the fragment with a goal-relevant word (e.g., JUDGE) as opposed to a goal-irrelevant word (e.g., JUICE, JUMPS). There were 14 word fragments in total, presented one at a time. Half of fragments could be completed with goal-relevant words (e.g., FORM, FRIEND, JUDGE, KNOW, PERSON, RATE, TRAIT) and half could only be completed with neutral words (e.g., BIGGER, COULD, ENDED, MIGHT, NUMBER, WATER, SHAWL). The words were identified using the MRC Psycholinguistic Database from the University of Western Australia (Wilson, 1987). Words were matched for frequency based on the Brown Verbal Frequency index. I computed a goal-accessibility measure by adding the total number of goal-related words completed out of the total possible 7. Of course, just by chance, participants could complete one of the 7 items with a goal-related word (not necessarily because the goal was accessible), but the idea was that greater accessibility of the goal construct would make this chance more likely. This variable was added into the experiment after data collection had already begun, and so only a sub-set of the participants (n = 161) received this measure.

Goal Importance

After participants finished the experimental tasks, they answered a few questions about their experiences. One of those questions measured goal importance. Specifically, participants were asked, “When asked to commit to the goal to form accurate impressions of the target individuals, how important was it for you to follow through with this goal?" (1 = *very important*, 5 = *not important*). Only participants in the goal conditions received this question.

Exploratory Measures

Engagement. All participants were asked to indicate on a 5pt. scale how engaged they were in the memory probe task (1 = *very engaged*, 5 = *not at all engaged*).

Thoughts. Participants were also asked what they were thinking about while engaging in the memory probe task: 1 (*the memory task*), 2 (*other parts of the experiment/the upcoming impression formation task*), or 3 (*something unrelated to the experiment*).

Feelings. Lastly, participants were asked to choose the best word to describe how they felt during the memory task (e.g., *energized, bored, frustrated, content,* or *anxious*). Importantly, all of these exploratory measures were presented at the end of the experiment, and so participants had to retrospectively think about their experiences.

RESULTS

All of the participants with a goal (n = 120) followed through with the writing task intended to instill an impression-formation need. Writings included misjudgments of high school friends, stepparents, and taxi drivers, and ranged from misjudgments based on physical appearance, personality, and job occupation (just to name a few). Three people indicated that that they could not remember a time when they misjudged someone, that they do not midjudge people, or something of that nature. However, I kept these 3 individuals in the analysis because they still received the goal-activation manipulation, and by participating in the writing exercise they at least thought of misjudgments in general. In addition, all 120 participants indicated that they “AGREED” to commit to the impression formation goal. So, one can reasonably assume that the participants in the goal conditions did indeed adopt the goal.

Memory Probe Data

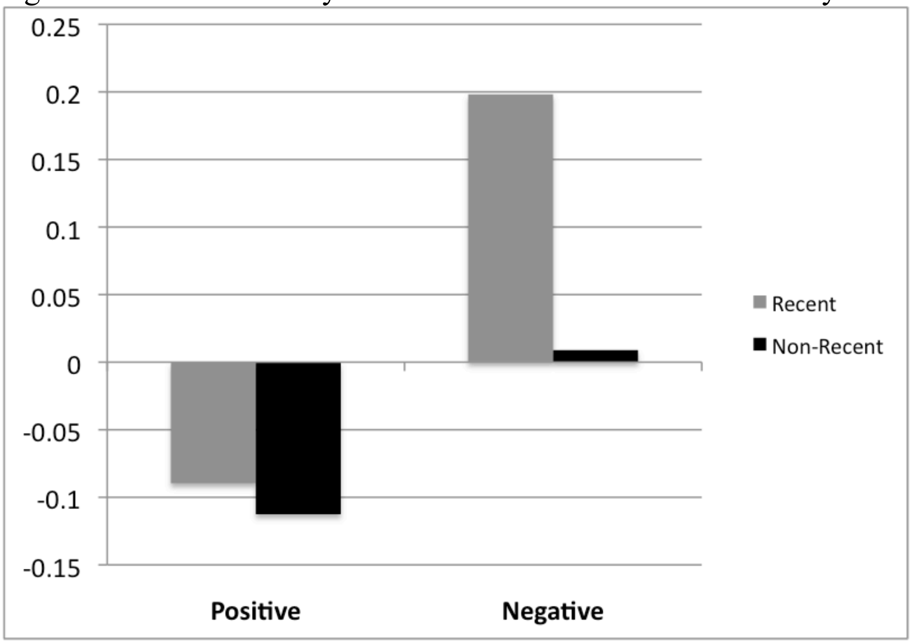
Reaction Time

The RT analysis only included correct responses on the memory probe task. First I separated RT by trial type: positive, positive recent, negative, and negative recent. Then, I trimmed outliers from the raw RT scores within each type. Any response that was more than 3 standard deviations from the mean of the respective trial type was discarded. A total of 1.79% of the correct responses was trimmed for being too slow.

Next, as in Experiment 1, I transformed each participant's trimmed RT scores into z-scores based on the participant's RT mean and standard deviation for each trial type, and then averaged the z-scores across trial type so that each participant would have a mean RT z-score for each of the four trial types: positive, positive recent, negative, and negative recent. All subsequent analyses are based on these averaged z-scores.

Initial Analysis of Task. To determine if the memory probe trials reliably measured the executive control, I subjected the RT z-scores to a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(probe: positive vs. negative) x 2(recent vs. non-recent) mixed-model ANOVA, with the first two factors between subjects and the last two factors within subjects. As anticipated, there was a main effect of probe, $F(1, 240) = 109.715$, $p < .001$, such that positive trials were faster than negative trials. There was also a main effect of recency, $F(1, 240) = 61.019$, $p < .001$, such that recent trials were slower than non-recent trials. More important, the Probe x Recency interaction was significant, $F(1, 240) = 24.477$, $p < .001$, indicating that negative recent trials were slower than negative non-recent trials, but this difference was much smaller for positive trials (see Figure 2). These effects replicated Experiment 1, and reflect the reliability of the memory probe task. The negative recent trials, requiring the inhibition of a prepotent response, were slower than the negative non-recent trials, likely indicating an underlying executive control processes.

Figure 2. Probe x Recency Interaction on RT z-scores in Memory Probe, Experiment 2



Analysis of Independent Variables. To test the specific effects of the goal on participants' executive control, the RT z-scores in negative trials only were subjected to a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(recent vs. non-recent) mixed-model ANOVA, with the first two factors between subjects and the last factor within subjects. The ANOVA revealed a main effect of recency, $F(1, 240) = 68.523$, $p < .001$, indicating that recent trials were slower than non-recent trials. There were no other main effects or interactions (all *Fs* < 1.72, *p*s > .19). Thus, as in Experiment 1, the interaction of goal and recency was non-significant, $F(1, 240) = 1.409$, $p = .236$. The mean RT z-scores are presented in Table 2. Inconsistent with Hypothesis 2, there was virtually no difference between RT z-scores in the recent trials when participants had a goal ($z = .1998$) versus not ($z = .1966$).

Table 2. RT z-scores in the Negative Memory Probe Trials for Individuals with and without a Goal

	Recent		Non-Recent	
	n	*M* (*SD*)	*n*	*M*(*SD*)
Goal	121	0.1998 (.24)	121	- 0.0173 (.25)
No Goal	123	0.1966 (.22)	123	0.0348 (.23)
Total	244	0.1982 (.23)	244	0.0089 (.24)

Thus, even with the additional need to form an impression, the goal did not appear to influence executive control. In addition, the pause did not moderate the goal x recency interaction, which is reflected in a non-significant three-way pause x goal x recency interaction, which fails to support Hypothesis 1, $F(1, 240) = 1.717$, $p = .191$. Together, the non-significance of these interactions means that this experiment, like Experiment 1, did not provide data that could distinguish between the predictions of the UG and IEM hypotheses. The presence of an unfulfilled goal had no influence on participants' performance on the task (inconsistent with Hypothesis 2 [UG]), and the pause manipulation did not moderate the influence of the goal and recency on participants' performance on the task (inconsistent with Hypothesis 1 [IEM]).

Accuracy. Accuracy on the memory probe task was measured in terms of correct responses and errors (e.g., hits, misses, FA, CR). Accuracy was generally high, with an average of 74.22 correct responses out of 80 trials (*SD* = 4.045; range 55 - 80).

To determine if accuracy differed across the critical trial types, and if the goal or pause manipulation interacted with this effect, I conducted a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(recency vs. non-recent) mixed-model ANOVA on the number of errors (FA) in negative trials only, with the first two factors between subjects and the last factor within subjects. As in Experiment 1, the number of FA was significantly higher in negative recent trials ($M = 1.4098$, $SD = 1.455$) compared to negative non-recent trials ($M = .635$, $SD = .904$), $F(1, 240) = 72.541$, $p < .001$. But this difference did not interact with goal, $F(1, 240) = .243$, $p = .627$, and the three-way goal x pause x recency interaction was not significant, $F(1, 240) = .577$, $p = .448$. There were no other significant main effects or interactions (all *F*s < 2.55, *p*s > .11). Thus, the goal manipulation did not have an effect on participants' frequency of errors in the negative trials, and the pause did not alter this relationship (counter to Hypotheses 1 and 2).

In order to get a complete picture of participants' responses I first calculated a d' score for each participant using their frequency of hits, misses, CR, and FA to generate an index of memory discriminability for the target. This score encompassed performance on all the trials together. I analyzed the d' scores in a 2(goal vs. no goal) x 2(pause vs. no pause) x 2(recent vs. non-recent) mixed-model ANOVA with the first two factors between subjects and the last within subjects. Trial type was collapsed across probe (positive vs. negative), as in Experiment 1, because the d' score is generated using all of the participants' possible responses. This time, the main effect of recency was significant, $F(1, 240) = 5.627$, $p < .05$, such that participants were more accurate on non-recent trials ($M = 2.191$, $SD = .391$) than recent trials ($M = 2.123$, $SD = .474$). In other words, participants were better able to distinguish if a target letter matched the immediately preceding set when it was not presented recently (i.e., was not a *recent* trial). This makes sense, given that recent trials are intended to cause a sense of familiarity – which should in principle make it harder to distinguish whether the probe letter was in the memory set or not. Critically, the goal did not interact with recency to influence d' scores, $F(1, 240) = .032$, $p = .858$, and the pause did not alter the goal x recency interaction, $F(1, 240) = .627$, $p = .429$.

To investigate response bias, the criterion measure (C) was analyzed in a 2(goal vs. no-goal) x 2(pause vs. no pause) x 2(recent vs. non-recent) mixed-model ANOVA with the first two factors between-subjects. There was a main effect of recency, $F(1, 240) = 65.648$, $p < .001$, such that non-recent trials had a higher C value ($M = .467$, $SD = .522$) than recent trials ($M = .091$, $SD = .523$), indicating that responses were biased towards "NO" in non-recent trials, but less so (i.e., closer to zero) in recent trials. The goal did not interact with this effect, as indicated by a non-significant Goal x Recency interaction, $F(1, 240) = .025$, $p = .874$, and the Goal x Recency x Pause interaction was also non-significant, $F(1, 240) = .874$, $p = .351$. None of the other main effects or interactions were significant (all *Fs* < 1). So, like Experiment 1, the independent variables had no effect on memory probe performance, and Hypotheses 1 and 2 were not supported.

Word Completion

Goal accessibility was measured after the memory probe task using a word-fragment completion task. The number of goal-related word fragments (e.g., JU_ _ _) that participants completed with goal-related words (e.g., JUDGE), as opposed to goal-unrelated words (e.g., JUICE), was analyzed in a 2(goal vs. no goal) x 2(pause vs. no pause) between subjects factorial ANOVA. The mean number of goal-related words (out of 7) used to complete the fragments was low ($M = .826$ $SD = .818$; range 0 – 3). In addition, there was not a main effect of goal, $F(1, 157) = .030$, $p = .863$; participants with the goal completed an equal number of goal-related word fragments (*M* = .840, *SD* = .887) as participants without the goal (*M* = .813, *SD* = .748). Interestingly, there was a marginal effect of pause, $F(1, 157) = 3.447$, $p = .065$. However, the pause did not interact with goal, $F(1, 157) = 1.265$, $p = .262$, suggesting that this effect was not dependent on whether the participants held the goal or not. The mean word-completions as a function of the goal and pause are presented in Table 3.

Table 3. Number of Goal-Related Words Used to Complete Word Fragments, Experiment 2

	No Pause		Pause		Total	
	n	*M* (*SD*)	*n*	*M* (*SD*)	*n*	*M* (*SD*)
Goal	42	1.02 (.87)	39	0.64 (.87)	81	0.84 (.89)
No Goal	42	0.86 (.65)	38	0.76 (.85)	80	0.81 (.75)
Total	84	0.94 (.77)	77	0.70 (.86)	161	0.83 (.82)

Goal Importance

During data collection, 2 participants' data was lost due to a computer error. Therefore, the following measures represent data from the remaining 242 participants. The importance of committing to the impression formation goal (i.e., committing to the upcoming experimental task) was measured in a self-report question at the end of the experiment (1 = *very important*, 5 = *not important*). This question was only asked of participants who were in the goal conditions. The mean of this rating of goal importance was 1.54 (*SD* = .916), which was significantly different from the midpoint of the scale, $t(119) = -11.464$, $p < .001$, indicating that participants were fairly committed to the goal on average. In fact, of the participants in the goal conditions ($n = 120$), 82 reported that the goal was very important (rating = 1), and the remaining 38 gave ratings of 2, 3, 4, or

5. Marien et al. (2012) found that the unfulfilled goal specifically hindered executive control for those individuals high in goal importance as opposed to low (Experiment 5). Because my sample of participants was predominantly high in goal importance, it is even more perplexing that this goal did not influence executive control in the memory probe task.

Exploratory Measures

Engagement. All participants, regardless of condition, reported how engaged they were in the memory probe task on a 5pt. scale (1 = *very engaged*, 5 = *not at all engaged*). The mean level of engagement was high (M = 1.77, SD = .922; range 1 – 5), and significantly different from the midpoint of the scale, $t(241) = -12.335$, $p < .001$. Engagement did not depend on the goal, $F(1, 240) = .735$, $p = .392$, or the pause, $F(1, 240) = .021$, $p = .884$, and there was no interaction between goal and pause, $F(1, 240) = .255$, $p = .614$. That is, participants were equally engaged in the memory probe task across all experimental conditions.

Thoughts. Participants indicated, out of three options, what their thoughts were during the memory probe task (1 = *the memory task*, 2 = *other parts of the experiment/the upcoming impression formation task* or 3 = *something unrelated to the experiment*). Most participants (67.8%) indicated that they were thinking about the memory probe task. A small number of participants reported thinking about upcoming parts of the experiment (13.2%) or something unrelated to the experiment (19%). A Pearson Chi-Square test indicated that the content of participants' thoughts was marginally dependent on whether they had a goal or not, $x^2(2) = 4.8$, $p = .091$. The frequencies are presented in Table 4.

Table 4.
Frequencies of Self-Reported Content of Thoughts During Memory Probe Task, Experiment 2

	Goal	No Goal	Total
Memory Probe	74	90	164
Upcoming Task	17	15	32
Unrelated	29	17	46
Total	120	122	242

Feelings. Participants chose one word to describe how they felt during the memory probe task out of 5 options (*energized, bored, frustrated, content, anxious*). The frequencies of these choices demonstrate a fairly broad mix of feelings with 38% of participants indicating they felt bored, 24.8% anxious, 20.2% content, 9.9 % energized, and 7% frustrated. A Pearson Chi-Square test indicated that these feelings marginally dependent on whether they held the goal or not, $x^2(2) = 7.829$, $p = .098$. The frequencies of each chosen feeling, crossed by goal condition, is presented in Table 5.

Table 5.
Frequencies of Self-Reported Feelings During Memory Probe Task, Experiment 2

	Feeling					
	Energized	Bored	Frustrated	Content	Anxious	Total
Goal	8	53	11	22	26	120
No Goal	16	39	6	27	34	122
Total	24	92	17	49	60	242

DISCUSSION

Experiment 2 replicated the memory probe effect, validating this task (and the negative recent trials) as a measure of executive control. However, as in Experiment 1, the goal manipulation did not affect executive control. Having an unfulfilled goal did not slow RT in the negative recent (vs. non-recent) trials, nor did it cause more errors. Unfortunately, the test of the IEM hypothesis hinged upon observing this effect immediately, but not after a pause. Yet, the non-significant 3-way interaction indicated that the goal did not slow RTs in the negative recent trials even immediately following goal activation. Thus, this experiment is at odds with the finding that unfulfilled goals occupy executive resources and interfere with executive control (e.g., Masicampo & Baumeister, 2011a; Marien et al., 2012).

Unlike Experiment 1, the d' scores were significantly different between recent and non-recent trials, demonstrating that participants were better able to distinguish target-present from target-absent trials when the target was non-recent (as opposed to recent). This makes sense, because recent trials have the additional element of familiarity, which makes their responses more difficult to distinguish by nature. The goal, however, should have exacerbated this effect if it truly occupied individuals' executive resources, by making it even harder to distinguish target-present from target-absent trials. The results do not indicate this. In addition, participants' responses were generally biased towards a "NO" response (i.e., more conservative), but this was less so in recent trials. However, the goal did not influence this effect.

The goal accessibility data that were collected from the word-completion task are interesting. Theoretically, if the impression-formation goal was active then words related to impression-formation (e.g., judge, person) should have been accessible as well (Aarts & Dijksterhuis, 2010; Fishbach & Ferguson, 2007; Fishbach, Friedman & Kruglanski, 2003; Kruglanski, 2002; Masicampo & Baumeister, 2011a). Having a goal (vs. not) did not effect one's completion of word-fragments with goal-related words, as the frequencies were equal across goal conditions. However, the mean number of goal-words completed overall was low (*M* = .826 out of 7), perhaps indicating an issue with the measure. The pause manipulation had a marginal effect on the number of goal-relevant word completions, but it did not interact with the goal manipulation, so the finding is theoretically irrelevant to the current thesis.

The exploratory questions at the end of Experiment 2 provided some initial information about participants' subjective experience with the memory probe task. Specifically, participants indicated that they were fairly engaged in the task overall, with approximately 81% of the sample choosing a 1 or 2 on the scale (1 = *very engaged*; 5 = *not at all engaged*). In addition, the extent that participants felt engaged did not vary among the conditions. This is consistent with the finding that memory-probe performance did not differ among the groups – they were equally engaged in the task and performed equally well. In contrast, one's thoughts during the memory probe task marginally depended on whether they had a goal or not [$x^2(2) = 4.8$, $p = .091$; See Table 3]. However, the frequencies must be interpreted with caution, as the differences are not significant. Previous research (e.g., Masicampo & Baumeister, 2011b, Experiment 1) does provide evidence that one's thoughts are more likely to wander off task when one has an unfulfilled goal. Future research should explore this issue further. Lastly, the feelings data (See Table 5) demonstrate that participants experienced a wide range of feelings during the memory probe, with each of the 5 options receiving a notable portion of participant recognition.

In sum, Experiment 2 did not find a Goal x Recency interaction on performance in the negative trials of the memory probe task (cf. Marien et al., 2012), indicating that the unfulfilled impression formation goal had no effect on one's executive control capabilities. Potential explanations for these findings are explored in the general discussion.

GENERAL DISCUSSION

The current project investigated when (and if) goals occupy individuals' executive resources. Specifically, the project investigated the maintenance of an unfulfilled goal across time, and whether executive control deficits would ensue only initially after goal activation, or after a delay as well. Previous research (e.g., Marien et al., 2012) demonstrates that the initial activation of a goal (that remains unfulfilled) hampers subsequent executive control in an unrelated task. However, goals remain active over time (Bargh et al., 2001) and can automatically guide individuals' thoughts and behaviors (Custers & Aarts, 2010; Bargh, 1990; Bargh et al., 2012; Förster, Liberman, & Friedman, 2007; Kruglanski, 2002). The persistence of a goal over time, even outside one's awareness, and its subsequent influences on behaviors and thoughts lends support to the idea that the maintenance required to keep a goal active is automatic – without requiring executive resources. Indeed if this process were effortful, individuals' processing capacity would be likely be continually overtaxed, as individuals continuously pursue goals. So, the current project asked the questions: Does the maintenance of an unfulfilled goal continuously draw upon executive resources over time, until the goal in question has been satisfied? Or are executive resources only needed initially to mobilize efforts required to activate the cognitive construct of a goal (e.g., Gendolla & Silvestrini, 2010)? The unfulfilled goal (UG) hypothesis predicts that a goal will continue to draw upon executive resources for the entire duration that it is unfulfilled, immediately and after a delay. Alternatively, the initial effort mobilization (IEM) hypothesis predicts that executive resources are only needed initially to activate a goal, and thereafter goals can remain active automatically, without occupying executive resources.

To test between these competing hypotheses, I conducted two experiments in which participants received a goal to form impressions in an upcoming task, or not. Next, participants engaged in an executive control task (i.e., the memory probe), which measured the availability of their executive resources. Participants either engaged in this task immediately or after a few-minute pause, thereby delaying the time between goal activation (for some) and the measure of executive control. The UG hypothesis predicted that individuals' executive control capabilities would suffer both initially and after a delay if they received the goal (perhaps even more so after the delay, per Bargh et al., 2001), because the goal would remain active and unfulfilled this entire time. Alternatively, the IEM hypothesis predicted that executive control would suffer initially for those with the goal, but not after a delay, because the reduction in executive resources was not due to the goal *per se* but rather the initial effort needed to mobilize the goal construct. Importantly, both hypotheses predicted the same outcome initially – a deficit in executive control for participants who received the goal – but their predictions diverged after the delay; the UG predicted executive control deficits, whereas the IEM predicted normal executive functioning.

Contrary to both hypotheses, the results of two experiments indicate that the goal manipulation had no effect on participants' executive-control capabilities either initially or after a pause. Although the memory probe task reliably elicited executive control on the negative recent (as opposed to non-recent) trials, as reflected in slower response times and more errors (See Figures 1 and 2), there is no evidence that the goal manipulation further exacerbated this effect. In other words, across both experiments, the Goal x Recency interaction on RT and accuracy in negative trials was non-significant. As such, I could not actually test between the competing hypotheses, because they both hinged upon finding goal-related executive control deficits immediately following goal activation, at least.

The current results call into question the generalizability of the finding that unfulfilled goals occupy executive resources and interfere with executive control. Specifically, previous research has found that unfulfilled goals interfere with executive control (e.g., Masicampo & Baumeister, 2011a; Marien et al., 2012), yet the current experiments manipulated an unfulfilled impression-formation goal and found no such effect. The current experiments utilized large sample sizes (n_1 = 250; n_2 = 244) and explicit acknowledgments of the goal from the participants. In addition, Experiment 2 implemented a need exercise to *strengthen* the goal. As such, the goal manipulation in the current experiments should have effectively induced an impression-formation goal (that was left unfulfilled).

One possibility is that the UG hypothesis is simply incorrect, and unfulfilled goals do not actually interfere with executive control. However, previous research (e.g., Masicampo & Baumeister, 2011a; Marien et al., 2012) suggests otherwise. In addition, the theoretical principles in the UG hypothesis – that unfulfilled goals remain active over time and may disrupt cognitive functioning – do align with ideas outside the current discussion. For instance, thought intrusions or depressive rumination could be conceptualized as "unfulfilled goal" intrusions (Kuhl & Helle, 1986; Watkins & Nolen-

Hoeksema, 2014), and can disrupt cognitive functioning (Nolen-Hoeksema, Wisco, Lyubomirsky, 2008). Similarly, the psychological *tension* of leaving a task or goal unfinished (Zeigarnik, 1927), and its resulting persistence in thought, is an experience to which most people can relate. The point is, the hypothesis that unfulfilled goals occupy executive resources is not unreasonable. Therefore, I explore other possible explanations for the current results below.

Was the Goal Active?

An obvious question at this point is whether or not the goal manipulation actually worked, and whether the goal was indeed active during the memory probe task. The goal needed to be active during the memory probe task in order for its (proposed) effects to manifest. This is difficult to determine in Experiment 1, because there was no measure of goal accessibility. The one indication that the goal was activated was that almost all participants (99.2%) indicated that they understood the goal to form impressions in the upcoming task. This acknowledgment presumes that participants adopted the goal initially, and research on automatic goal pursuit demonstrates that activated goals persist across time and guide one's thoughts and behaviors in line with the goal (Bargh et al., 2001; Förster et al., 2007; Holland et al., 2005). So, following that logic, one can assume that the goal was active. However, an obvious weakness in Experiment 1 is the lack of dependent measures to clarify whether the goal was active or not.

In Experiment 2, the evidence for goal activation was stronger. First, the goal manipulation was stronger. Participants learned explicitly what their upcoming impression-formation task would be like (e.g., Dijksterhuis, 2004) and they actually committed to a statement that they would "try [their] best to form accurate impressions of the target individuals in the upcoming task." One hundred percent of participants in the goal conditions agreed with this statement. Further, the need exercise in Experiment 2 likely strengthened the goal manipulation (Moskowitz, 2002). All of the participants in the goal conditions completed this exercise (they had to in order to proceed with the experiment), and only 2.5% wrote that they "could not recall a time when they misjudged someone," or that they "never misjudged people." Those who did recall a time of misjudgment wrote about meaningful experiences such as:

> … I sat next to a boy that was wearing all black and was very quiet. I immediately thought that he was scary, however, when I got to know him he turned out to be the sweetest, kindest person who was just really shy....
>
> A time where I misjudged someone is the first time I met my step mom… somewhere along the way we both opened up to each other and I learned that she is one of the most funny, smart, genuine people I know.
>
> Before I knew much about NFL football, I saw a man on TV that looked very overweight and like he couldn't possible play a sport. Turns out this man, Vince Wilfork, is one of the top defensive lineman in the NFL.

Individuals in the goal conditions (in Experiment 2) appeared to take this manipulation seriously and truly reflect on a time when they misjudged someone. Based on previous research using this manipulation (e.g., Masicampo & Baumeister, 2011a, Experiments 1 & 2; Moskowitz, 2002), the goal should have been active and fairly strong. Indeed, those who have used this manipulation noted attentional capture from goal-related words (Moskowitz, 2002) and goal-related executive control deficits (Masicampo & Baumeister, 2011a).

Lastly, participants in Experiment 2 indicated how important the goal was to them on a 5pt. scale. Specifically, they were asked how important it was for them to follow through with the goal to form accurate impressions of the target individuals (1 = *very important*, 5 = *not important*). Out of the sample of 120 participants in the goal conditions, 68.3% indicated that the goal was very important, and the mean rating of goal importance was 1.54 (*SD* = .916). This is critical because Marien et al. (2012) demonstrated that the effect of the unfulfilled goal on one's executive functioning was moderated by how important the goal was to participants (Experiment 5), with only those "high" in goal importance showing the decrement in executive control following goal activation. The current sample of participants was predominantly "high" in goal importance, which supports the idea the goal was likely active within them, but also draws into question why executive control deficits did not ensue in the current project.

There are a couple pieces of evidence from the current project suggesting that the goal might not have been sufficiently activated. First, in Experiment 2, the word-fragment completion data suggested that goal accessibility did not differ among goal conditions. If the goal was truly active, then participants in the goal conditions should have displayed greater accessibility of goal-related concepts (Aarts & Dijksterhuis, 2010; Fishbach & Ferguson, 2007; Fishbach, Friedman & Kruglanski, 2003; Kruglanski, 2002; Masicampo & Baumeister, 2011a). However, the current results might reflect a floor effect, as the total number of goal-relevant fragments completed with goal-related words was less than one (*M* = .826 *SD* = .818; range 0 – 3). Based on these results, it is likely that the word-completion task used in the current experiment was not sensitive enough to detect group differences.

Perhaps a stronger measure of goal accessibility would allow the (potential) accessibility differences to emerge. Indeed, much of the research on goal-construct accessibility uses a lexical decision task (LDT) to measure goal accessibility (e.g., Aarts & Dijksterhuis, 2000; Förster, Liberman, & Higgins, 2005; Marsh, Hicks, & Bink, 1998) or construct accessibility more generally (Marsh & Landau, 1995). In these studies, participants must identify strings of letters as either "words" or "non words" as quickly and accurately as possible. The idea is that accessible constructs should facilitate the processing of words related to that construct, and participants should identify the letter string as a "word" faster. In future experiments, goal accessibility might be captured better using a more precise RT measure like the LDT.

In addition to the word-completion data, the subjective reports participants provided on where their thoughts were during the memory probe and how engaged they were in the task lend insight into the potential processes under investigation. First, participants who had the unfulfilled goal reported thinking (marginally) less about the memory probe task than those without the goal, and (marginally) more about something unrelated to the experiment. However, the groups did not differ on how much they reported thinking about the upcoming experimental tasks, which would be expected if the unfulfilled goal (of impression formation) were guiding participants' thoughts. Secondly, in contrast to the "thought" data, participants reported being equally engaged in the memory probe task across conditions. The similarities in reported task engagement are at odds with the notion that the unfulfilled goal distracted participants.

Despite the evidence for or against the activation of the impression-formation goal throughout the experimental procedures, there is still the remaining fact that the goal manipulation had no effect on executive control in the memory probe task. If the goal was not active during this time, the manipulation failed. If the goal was active, then it did not appear to occupy executive resources. Because the current goal manipulations were likely effective in inducing a goal to form impressions in an upcoming experimental task, the lack of a deficit in executive control is most likely due to the content of the goal and other potential moderating variables.

Limitations and Future Directions

A main limitation of the current project is that the goal manipulation was different from previous research on this topic. Specifically, Marien et al. (2012) used a subliminal socializing goal (Experiment 1a) or self-described goal (Experiment 1b), and Masicampo & Baumeister (2011a) used a variety of goals related to honesty (Experiment 1), achievement (Experiment 2), and a personal unfulfillment (Experiment 3). Therefore, it is difficult to draw conclusions from the current findings in regards to the unfulfilled goal hypothesis. Specifically, can an impression-formation goal be included in the repertoire of unfulfilled goals that "hijack" executive resources? Unconscious Thought Theory (UTT) proposes that goals – such as impression-formation goals (e.g., Dijksterhuis, 2004) – can operate unconsciously without the aid of executive resources. Yet, the unfulfillment of a goal can disrupt executive functioning (e.g., Masicampo & Baumeister, 2011a; Marien et al., 2012). How generalizable to different kinds of goals is the effect of unfulfillment on executive control deficits? The current results cannot definitively answer this question, but promote future research in this area.

Another limitation is the lack of evidence for goal accessibility. As stated above, there is evidence both for (e.g., self-reported commitment to the goal) and against (e.g., no difference in goal accessibility after the memory probe) the idea that the goal had been active throughout the procedures. The current findings would be stronger if they were validated by a goal-accessibility measure. Future research could use a precise measure of goal-accessibility (such as an LDT) to gain clarity into whether the goal was active throughout the procedures.

In addition, the current experiments could have been stronger if a measure of goal *pursuit* or *attainment* was added after the memory probe task. For instance, if participants actually engaged in the act of impression formation, then possible group differences could emerge between those with the goal and those without. The automatic goal pursuit literature suggests that goals can operate outside one's awareness and produce real psychological and behavioral effects (e.g., Bargh et al., 2001; Lakin & Chartrand, 2003; Holland et al., 2005). An outcome, such as accurately reported impressions of targets, would provide evidence that goal pursuit had *transpired*. That way, the null effects of performance in the memory probe task could be more meaningful. Specifically, with equal memory-probe performance between the goal and no-goal conditions (i.e., the same availability of executive resources) and differences in the downstream consequences of goal pursuit (e.g., impression formation accuracy), one could logically argue that the goal operated without executive resources. This however, cannot be determined in the current study because there was no behavioral measure of goal pursuit. A behavioral measure like the performance measure in Bargh et al.'s (2001) research would be optimal to test this idea because it is empirically valid. A straightforward future experiment could be the simple activation of an achievement goal (or not), followed by a performance measure such as a word search task either immediately or after a distraction task like the memory probe. If Bargh et al.'s (2001) results replicate, performance will be enhanced for those with the achievement goal after a delay as opposed to immediately (because the goal presumably grows in strength over time). In addition, performance on the memory probe task could be analyzed to answer the critical question of whether executive resources were occupied by the goal or not; if word-search performance improves over time for those primed with the achievement goal (as Bargh et al. demonstrate) and memory probe performance is not compromised, the evidence would support the idea that goals do not occupy executive resources while they are maintained, and thus persist automatically. An additional follow up experiment could activate the same achievement goal, but follow it with a failure in achievement (e.g., attempting to solve impossible anagrams). This manipulation of unfulfillment might produce unique results to mere goal activation.

Alternative Explanations

The difference between the current findings and previous research might reflect unknown moderating variables underlying this effect of unfulfilled goals on executive control. Indeed, the idea that unfulfilled goals or intentions occupy one's limited cognitive capacity is not new (e.g., Zeigarnik, 1927); it just might depend on other factors. For instance, individual differences might alter the extent to which goals persist over time and interfere with ongoing activities. Depressed populations, for instance, are prone to rumination (Watkins & Nolen-Hoeksema, 2014) and therefore might be more susceptible than others to perseverate on an unfulfilled goal (Kuhl & Helle, 1986). Individual differences in a reliance on proactive versus reactive cognitive control (Braver, 2012) might also affect the degree that an unfulfilled goal persists in over time and occupy executive resources. Individuals who rely on proactive forms of cognitive control (e.g., anticipatory, top-down) might be less able to “let go” of an unfulfilled goal, as opposed to someone who relies more on reactive (e.g., stimulus-driven) forms control, allowing environmental cues to trigger goal-reactivation.

Along these lines, individuals can use implementation intentions (Gollwitzer, 1993; Gollwitzer, 1999) to relieve themselves of the burden of goal maintenance by delegating control of the goal over to external cues. Indeed, Masicampo and Baumeister (2011b) investigated this very issue in a series of experiments where participants received an unfulfilled goal and were given an opportunity to form an implementation intention or not, prior to engaging in an unrelated executive control task (much like the current experiment). Participants with the unfulfilled goal performed worse in a subsequent executive control task (e.g., anagrams, reading comprehension), but the group that formed a specific implementation intention (e.g., when, where, how the goal will be executed) did not. Making a specific plan to execute the goal transferred control over to the environment, thereby freeing up one’s executive resources to engage in concurrent activities.

In the current experiments, although participants were not instructed to form any specific plan of action to execute the goal (i.e., an implemental intention) they may have done so anyway. That is, I could not control whether participants “held on” to the unfulfilled goal, or delegated control to the environment. The simple knowledge that the experiment would provide them with the information they would need to eventually execute the goal may have allowed them to give up control of the goal to external factors, thereby freeing up their executive resources.

One interesting implication of this is that people may be more likely (or able) to form implementation intentions when they are consciously aware of their goals than when they are not. One could hardly make a specific plan of action for a goal of which they are unaware (e.g., the unconscious activation of an achievement goal via subtle exposure to academic textbooks). A conscious goal, on the other hand, is in one’s awareness and is therefore more susceptible to one’s control. A possible reason the current experiment did not replicate Marien et al.’s (2012) findings could be that their goal manipulation was subliminal and unconscious, whereas mine was conscious. Future research should explore this issue more, as there are instances in which a consciously acknowledged goal disrupts executive functioning (e.g., Masicampo & Baumeister, 2011a; Masicampo & Baumeister, 2011b).

Future work should explore the boundary conditions of when unfulfilled goals impair executive control. Moderating variables, both interpersonal and situational, likely contribute to the degree to which an unfulfilled goal persists in activation over time and draws upon executive resources.

CONCLUSIONS

In conclusion, two reported experiments provided no evidence that an unfulfilled goal to form impressions in an upcoming experimental task interfered with executive control. Despite the strength and apparent effectiveness of the goal manipulation, and the large sample of participants, the research was unable to conceptually replicate the finding that unfulfilled goals occupy executive resources and subsequently interfere with executive control. Instead of concluding that this unfulfilled-goal effect is unreliable, I propose that it is moderated by individual and situational variables. After all, conceptually similar ideas of the cognitive effects of unfulfilled goals are present in psychological literature (e.g, Masicampo & Baumeister, 2011a; Marien et al., 2012; Kuhl & Helle, 1986; Watkins & Nolen-Hoeksema, 2014; Zeigarnik, 1927).

Unfortunately for the current experiments, the unfulfilled goal (UG) hypothesis was not supported, and the initial effort mobilization (IEM) hypothesis could not be sufficiently tested because its critical condition (i.e., after the pause) hinged upon the initial decrement in executive control in the memory probe task. However, the current results are meaningful because they demonstrate the complexities of goal pursuit, and the nuances of goal maintenance. Specifically, if an adequate goal manipulation failed to impair subsequent executive control (as demonstrated in the current experiments) but similar research supports the notion that unfulfilled goals (e.g., intentions, incompleteness) occupy executive resources, there are likely more variables contributing to this phenomenon. Future research can enjoy the challenge of uncovering what these variables might be.

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