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# Why is it so hard to do my work? The challenge of attention residue when switching between work tasks

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ABSTRACT

In many jobs, employees must manage multiple projects or tasks at the same time. A typical workday often entails switching between several work activities, including projects, tasks, and meetings. This paper explores how such work design affects individual performance by focusing on the challenge of switching attention from one task to another. As revealed by two experiments, people need to stop thinking about one task in order to fully transition their attention and perform well on another. Yet, results indicate it is difficult for people to transition their attention away from an unfinished task and their subsequent task performance suffers. Being able to finish one task before switching to another is, however, not enough to enable effective task transitions. Time pressure while finishing a prior task is needed to disengage from the first task and thus move to the next task and it contributes to higher performance on the next task.



"The only factor becoming scarce in a world of abundance is human attention" – Kevin Kelly *in* '*Wired*'

In today's organizations, more and more employees are expected to perform in work environments characterized by multiple projects, shifting priorities, and time pressure (Mark, Gonzalez, & Harris, 2005; Perlow, 1999; Tetard, 1999; Tetard, 2000). Scholars have been interested in understanding how people are affected by, and navigate, such environments (Gonzalez & Mark, 2004; Jett & George, 2003; Perlow, 1999; Speier, Valacich, & Vessey, 1999; Tetard, 1999). To meet all their demands, people may perform multiple tasks simultaneous (i.e. talking to a client, while writing an email to another person) – thus engaging in multi-tasking – as they hope to advance work on several tasks at the same time. However, schedules, priorities, as well as large, demanding tasks often require employees to dedicate their full attention to the work at hand without being distracted by other unrelated tasks or projects. People must then allocate their attention sequentially as opposed to simultaneously. Yet, in order to make enough progress on each project, meet their deadlines, and respect their schedule, time must be shared and people must regularly transition among their projects. That is, they must frequently stop working on one task, finished or unfinished, to switch to and fully focus on another. In fact, going from one meeting to the next, starting to work on one project and soon after have to transition to another is just part of life in organizations. While the existing literature has explored the effect of multi-tasking on task performance (e.g. Rubinstein, Meyer, & Evans, 2001), research has not addressed how having to transition between sequential tasks affects people's ability to dedicate their full attention to and perform well on a given task.

Regardless of the pattern or cause of task transitions, transitioning sequentially among tasks requires actors to reduce or eliminate cognitions about one task to fully focus on another. While research on task completion has shown that not having finished a task makes it difficult to end one's cognitions about that task (e.g. Johnson, Chang, & Lord, 2006; Marsh, Hicks, & Bink, 1998; Martin & Tesser, 1996), it has not considered whether such cognitions persist once people engage in and start working on another task. Therefore, it is still an open question whether people systematically transition their attention as they move from one task to another and whether their subsequent task performance is affected. To address these questions, I introduce the concept of attention residue. Attention residue refers to cognitions about a Task A that persist even though one has stopped working on Task A, transitioned to Task B, and is now working on Task B. Understanding the cause and consequences of attention residue is important because people who experience attention residue while performing another task operate under cognitive load due to the lingering cognitive activity. Since working under cognitive load tends to hurt performance (Kanfer & Ackerman, 1989), people experiencing attention residue after switching tasks are likely to demonstrate poor performance on that next task.

The main contributions of this paper are twofold. The first contribution is to show that people do not systematically transition their attention as they move from one task to another. They often

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experience attention residue and their subsequent task performance tends to suffer. The second contribution is to uncover some of the factors that affect the occurrence of attention residue. If people switching tasks sequentially are at risk of experiencing attention residue, such that their task performance suffers, it is also important to understand how to reduce or eliminate attention residue. Prior research argues that task completion allows people to end their cognitions about completed tasks through goal attainment (Martin & Tesser, 1996; Rothermund, 2003). This research stream, however, does not account for the fact that people may keep thinking about even *completed* activities. For example, while people find it difficult to stop thinking about their past failures (Martin & Tesser, 1996), they also easily reminisce about their past achievements, prior actions, or others' glory (Cialdini, Borden, Thorne, & Walker, 1976; Clark, Collins, & Henry, 1994). This suggests that task completion is not enough to end such cognitions. Little is known, however, about what may help. The present paper addresses this gap in the context of task transitions by showing that finishing a task *under time pressure* facilitates the ending of cognitions associated with the completed task, preventing attention residue once people start working on a next task, and contributing to higher subsequent performance.

This paper reports two experiments exploring how task completion and time pressure experienced on one task affect (a) attention residue and (b) performance once people switch to a next task. More specifically, this paper is divided into two parts, with each part developing a set of propositions and presenting one of the two experiments testing those propositions. The first part focuses on the effect of task completion and time pressure associated with one task on *attention residue on a next task*. The second part focuses on the effect of task completion and time pressure associated with one task on *performance on a next task*. Contributions to both the task completion and time pressure literatures are developed.

The following section begins by introducing the concept of attention residue in more detail. It situates this concept within a broader theoretical context while distinguishing it from existing constructs (i.e. ruminations, psychological presence, attentional focus). The paper then proceeds with the development of propositions and presentation of experiments, focusing first on attention residue and then on task performance.

## Attention residue

Attention residue reflects the *persistence* of cognitive activity about a Task A even though one stopped working on Task A and currently performs a Task B. The persistence of thoughts has attracted some research interest (e.g. Clark, 1996; Uleman & Bargh, 1989; Wegner, Schneirder, Carter, & White, 1987), especially in relation to ruminations. Ruminations refer to thoughts that are repetitive, intrusive, and aversive (McIntosh & Martin, 1992). Attention residue and ruminations are related in that they both represent persisting thoughts that are not required by the immediate environment (Martin & Tesser, 1996). Yet, these two constructs differ in that attention residue is not limited to any *specific type* of thoughts, whereas ruminations specifically represent cyclic, self-focused thoughts that tend to be triggered by failure, depressed mood, or traumatic events (Nolen-Hoeksema, 1991). Attention residue is, on the other hand, a broader concept that could involve, but is not limited to, ruminations. Linear processing such as evaluative, reflective, or problem solving thoughts (Koss, Ayduk, & Mischel, 2005; Nolen-Hoeksema, 1996) about one task that occur while working on another task may also be considered attention residue.

Attention residue is also related to but distinct from other existing constructs, such as attentional focus, psychological presence, and cognitive load. Attentional focus reflects the extent to which all resources are directed toward task accomplishment (Beal, Weiss, Barros, & MacDermid, 2005, p. 1056). Psychological presence represents placing oneself fully into one's task performance (Kahn, 1992, p. 322). When people experience attention residue, part of their attention is focused on a prior task, and, as a result, their attentional focus and psychological presence are likely to be reduced. In that respect, attention residue is likely to be one of the antecedents (negative correlations) of attentional focus and psychological presence. In addition, maintaining multiple goals on one's mind at the same time creates cognitive load (Kanfer & Ackerman, 1989). Because people who experience attention residue have cognitions associated with different tasks simultaneously, attention residue is likely to lead to cognitive load. Note, however, that attention residue is distinct from and only one potential source of cognitive load, as many factors (e.g. noise, daydreaming, etc.) can also contribute to cognitive load.

The following sections introduce the reasons why people may experience attention residue despite the need to focus and work on another task. The first section focuses on completion theory and how task completion (or lack thereof) on one task affects attention residue once people move to a next task. The second section explores in more detail the cognitive implications of having finished one task before moving to another on attention residue. More specifically, this section reveals that the cognitive processes triggered after task completion, and the extent to which people can end their cognitions about the finished task, vary depending upon whether the task was finished under high or low time pressure. The role of time pressure and its cognitive implications when associated with task completion are then explored.

### *Task completion*

Theories of completion have linked nonattainment of goals to the persistence of related cognitions, especially ruminations (Gold & Wegner, 1995; Marsh et al., 1998; Martin & Tesser, 1996). Lewin (1926, 1935) originally argued that once a person begins work on a task, s/he has a drive to finish it (i.e. reach the task goal). Further, that drive or motivation does not necessarily end when people stop pursuing a goal or stop working on a task. Rather, it persists as long as a goal is unattained or a task is left unfinished, even if people are not working toward reaching that goal or finishing that task (e.g. Martin & Tesser, 1996). Because attention is driven by motivation (Pashler, 1998), unattained goals attract attention and thus stay active on people's minds (Moskowitz, 2002; Rothermund, 2003; for review see Johnson et al., 2006), even in the absence of relevant external cues (e.g. Klinger, 1975; Wicklund & Gollwitzer, 1982). Further, since unmet goals stay active, related cognitions are believed to be easily triggered (e.g. Martin & Tesser, 1996). Because these thoughts are automatic and unintentional, they are also difficult to prevent (Martin & Tesser, 1996; Moskowitz, 2002) and to suppress, as the suppression process heightens their accessibility (Wegner et al., 1987). To summarize, it is difficult to stop thinking about a goal, or by extension a task, when completion is thwarted.

Existing research is, however, unclear as to whether the activation of a task goal that is left unmet is likely to persist in the presence of a subsequent task and whether such activation is likely to lead to attention residue after people transition to another task. The goal shielding theory argues that goals compete for attentional resources, such that "attention devoted to one area creates inhibition of attention elsewhere" (Carver & Scheier, 1990). That is, focusing on one goal leads to a reduced activation of alternative goals (Shah & Kruglanski, 2002). As a result, one could predict that engaging in a new/subsequent task would reduce the activation of a prior unfinished task by forcing attention forward. Further, while people find it difficult to suppress thoughts through unfocussed self-distractions, focused distraction strategies tend to be more effective as they prevent unwanted thoughts from becoming

highly accessible (Wegner et al., 1987). Engaging in a new task may then serve as distraction away from the prior task and thus facilitate the suppression of unwanted thoughts while providing an incentive for disengagement (e.g. Carver & Scheier, 1990, p. 202).

Building upon completion theories, this paper argues, however, that people will find it difficult to end their cognitions associated with a task that is left unfinished even though they must focus on another, and thus are likely to experience attention residue. Indeed, goals whose pursuit is thwarted are believed to gain cognitive priority (Klinger, 1975). Because goal activation does not require the presence of relevant cues (e.g. Martin & Tesser, 1996), it is likely to be unaffected by a change in task context like switching rooms or files when people transition between tasks. A task that is unfinished before switching to another is then likely to stay active, attract attention, and trigger attention residue despite the need to focus on another task. In addition, thinking about one task while trying to perform another creates a cognitive load that reduces self-regulatory resources and diminishes the ability to suppress unwanted thoughts (Wegner & Erber, 1992). So as people start working on the next task, they will find it difficult to suppress the thoughts associated with the prior task, thus reinforcing the experience of attention residue.

By contrast, finishing a task terminates the motivation to keep working on that task (Lewin, 1926; Lewin, 1935). The release of motivational resources is likely to facilitate a release in cognitive resources due to the effect of motivation on attention (e.g. Pashler, 1998). In other words, once a task is finished, the mental activation of the goal is likely to diminish, enabling people to more easily switch their attention. Consequently, switching away from an *unfinished* as opposed to *finished* task is likely to be more difficult, and induce more attention residue once people switch to another task. This theoretical development leads me to state the following research proposition, which is tested in Study 1:

> RP1: People who do not finish Task A before switching to Task B experience more attention residue from Task A while working on Task B than do people who finish Task A prior to switching to Task B.

### *Cognitive closure and the important role of time pressure*

While not having finished a task before moving to another is likely to create attention residue, reaching task completion before transitioning tasks does not guarantee the absence of attention residue. Indeed, task completion is often followed by a post-actional evaluative phase (Gollwitzer, 1990), during which people keep processing information about the finished task and evaluate, revise, or perfect their position (Mayseless & Kruglanski, 1987). In other words, task completion ends one's goal-directed behaviors (Gollwitzer, 1990), but does not necessarily end one's cognitions. The following paragraphs explore what may then help people who *finished* a task end their cognitions about the completed task and more fully transition their attention to the next task.

It is important to differentiate task completion from cognitive closure. Cognitive closure represents the end of cognitive processing and is obtained through the psychological experience of closure or resolve that emanates from having reached an end point subjectively evaluated as satisfactory (e.g. Kruglanski, 2004). It represents a state where people have cognitively closed on the situation or task they just worked on and have stopped thinking about it. As suggested by Gollwitzer (1990) and Mayseless and Kruglanski (1987), it is possible for people to reach task completion without experiencing cognitive closure (e.g. having solved and written down the solution to a math problem but still wondering whether a more elegant solution exists). When this happens, cognitions about the completed task are likely to persist and people are likely to experience attention residue when moving to a next task. On the other hand, attention residue is likely to be prevented when people finish a task and reach cognitive closure before moving to another task. Little research, however, has explored what helps people reach cognitive closure *once they have finished a task*.

Current research indicates that contextual factors, such as time pressure, increases the desirability of reaching cognitive closure when people are *in the process* of negotiating with someone (Carnevale, O'Connor, & McCusker, 1993; De Dreu, 2003; Lim & Murnighan, 1994; Yukl, 1974), making a decision, or forming a judgment (Heaton & Kruglanski, 1991; Kruglanski & Webster, 1991). While these results suggest that time pressure may trigger relevant cognitive processes, research has only studied the effects of time pressure *during the performance* of a task and has not explored its lasting effects *once a task is finished* – the latter of which is explored in this paper.

I argue that because time pressure affects people's cognitive processes during the performance of a task, it is also likely to have cognitive implications when that task is finished. People who make a decision under high as opposed to low time pressure react to time pressure by narrowing down the number of alternatives they actually consider (e.g. Ben Zur & Breznitz, 1981; Kruglanski, 2004; Weening & Maarleveld, 2002). More generally, time pressure tends to undermine exploratory behaviors (e.g. Amabile et al., 2002) and motivates people to narrowly focus their attention on the fastest way to get the work done (Karau & Kelly, 1992). By contrast, low time pressure predisposes people to engage in exploratory cognitive processes and behaviors (e.g. Amabile et al., 2002). Under low time pressure, people spontaneously generate and stay cognitively open to a larger set of alternatives, preferring to delay their final choice (Chakravarti & Janiszewski, 2003) and keep their options open as long as they can (Ben Zur & Breznitz, 1981; Weening & Maarleveld, 2002). Building upon those findings, it can be argued that when people are working under high as opposed to low time pressure, they are more likely to quickly and narrowly focus their attention on a single path to completion as opposed to carefully consider a larger set of alternatives.

I argue that these "during performance" effects are likely to have cognitive implications once people actually finish their task. Indeed, research on discounting (Kelley, 1971) and research on choice (Iyengar & Lepper, 2000) have shown that the fewer options people consider when making a decision or a choice, the more confident they are in their choice once it is made. Further, confidence in one's decision or performance leads to the cessation of one's cognitive effort (Metcalfe, 1998). People who consider fewer alternatives when performing a task are then more likely to stop thinking about their performance once the task is finished. By contrast, insufficient judgmental confidence triggers continued systematic processing (Chaiken, Liberman, & Eagly, 1989). In fact, people who choose among a larger set of alternatives report to experience higher levels of regret (Iyengar, 2000), even if they had carefully elaborated on their options before completing their choice (Chernev, 2003; Iyengar, Wells, & Schwartz, 2006). Regret represents the persistence of one's cognitions after completing a choice. As such, because high as opposed to low time pressure makes people consider fewer possible ways of performing a task, it also helps them end their cognitions about that task as soon as it is finished. They are then less likely to experience attention residue when working on a next task. This theoretical development leads me to state the following research proposition, which is tested in Study 1.

> RP 2: People who finish Task A under high time pressure exhibit less attention residue from Task A while working on Task B than do people who finish Task A under low time pressure.

## Study 1

Research propositions 1 and 2 are tested using an experimental design in which participants work on one task [Task A] and then switch to another [Task B]. Task completion and time pressure on the first task [Task A] are manipulated to understand their effects on attention residue once people switch to the next task [Task B]. As articulated in the theory development, the present research focuses on the main effect of task completion and the interaction effect between task completion and time pressure on attention residue.

The extent to which people have specific thoughts depends upon the degree to which related concepts are active on their minds – the more active a concept is, the more it attracts attention and triggers cognitions (e.g. Carver & Sheier, 1998, p. 202). Attention residue, which are cognitions related to Task A occurring during the performance of Task B, can be then measured behaviorally by recording the extent to which both the goal and content of Task A are active on people's minds once they switched to Task B. In the present experiment, a lexical decision task is used to measure attention residue. Lexical decision tasks are commonly used to identify what is most active in people's minds. They do so by recording how fast people recognize whether a stimulus (i.e. a letter string) presented on a computer screen is a real word or a non-word (e.g. Martin & Tesser, 1996; Moskowitz, 2002). The premise of that task, and more generally reaction time tasks, is that the more active a concept is in a person's mind, the more accessible it is and the faster people will respond to stimuli related to that concept. In other words, attention residue is captured by the reaction times to stimuli associated the goal or content of Task A once people have switched to Task B.

### *Participants and design*

Eighty-four undergraduate students (26 men; 58 women) from an Eastern university were randomly assigned to the 2 (completion: finished/unfinished) × 2 (time pressure: high/low) factorial between-participants design. Participants received $10 for their participation and the experiment was conducted in individual sessions of approximately 25 min each.

### *Procedure and materials*

Upon arrival at the laboratory, participants were told that they would participate in two unrelated studies that were designed by two different researchers. The first study [Task A] focused on intelligence while the second study [Task B] focused on understanding what people value in others. Participants were asked to work on Task A for 5 min, after which they had to answer three manipulation check questions. Note that the completion and time pressure manipulations were introduced in the instructions for Task A and the completion manipulation was reinforced at the end of Task A. The manipulations are described in the next section. Next, Task B was introduced. Participants were shown the materials for Task B and were explained what they needed to accomplish on that task. They were then told that before starting the second study [Task B], they needed to perform a short task on the computer. That task was the lexical decision task, which measures attention residue. After working on the lexical decision task, participants were stopped and debriefed. The debriefing indicated that none of the participants realized the true nature of the experiment. In addition, they were not aware of the relationship between the tasks and did not guess the task completion/incompletion manipulation.

#### *Task A*

Task A was a word task, asking participants to solve 17 clues in a fixed number of one-word answers (see Appendix A). Participants were told that completion of the task had been shown to correlate with intelligence. This framing has been commonly used to make participants more motivated to finish a task (e.g. Martin & Tesser, 1996). Participants were given 5 min to work on Task A. Pre-tests were conducted to verify that the experimental story presenting Task A, as related to intelligence, did not affect participants' self-efficacy. It was found that task incompletion did not lower participants' subsequent self-efficacy.[1]

#### *Task B*

Task B was presented as a study of how people evaluate job candidates. Participants were told that would have 5 min to review four resumes that were then given to them. They were also told that after the 5 min,[2] they would be given a job description and would be asked to indicate which candidate they preferred for the position.

#### *Lexical decision task*

After Task B was introduced but before participants started reading the resumes, they were asked to perform a lexical decision task on a computer. They were told that letter strings would appear on the computer screen and that they would have to decide, as fast as they could, whether these letter strings were real words or not. They were asked to press on a keyboard the letter "P" when the letter strings were real words and the letter "Q" when the letter strings were non-word. Participants were first given six practice trials, after which they were reminded to respond as quickly and as accurately as possible. They then started the actual task. 60 letter strings were presented to them on the computer and had to be identified as real word or non-word.

### *Manipulations*

#### *Completion manipulations*

Completion on Task A was manipulated by influencing whether or not participants could finish Task A. When Task A was introduced, participants were randomly assigned to one of two types of task instructions, which manipulated their ability to finish Task A. Participants assigned to the finished-task condition were told that Task A would be completed only if they could solve all 17 clues in no more than 13 unique words. Based on pre-testing, this allowed everyone to finish the task within 5 min without making the task too easy or boring. Participants assigned to the unfinished-task condition were told that Task A would be completed only if they could solve all 17 clues in no more than five words. Note that the task was not solvable using only five words. All participants were given 5 min to work on Task A.

Because of the design of the task, everyone handled the same amount of information and solved the task in 11–13 words in

[1] 30 participants were randomly assigned to one of the two finished-task/unfinished-task conditions under high time pressure. After working on Task A, participants were asked to answer two questions tapping into their self-efficacy beliefs in relation to Task B: (1) "How capable do you think you are to carry out the next task?" and (2) "How confident are you that you will perform well on the next task?." Given their low inter-item correlation (0.12), these two questions were analyzed separately. A $t$-test on the first question revealed that participants in the finished-task condition reported a marginally lower level of self-efficacy ($M = 4.01$, $SD = 1.14$) than did participants in the unfinished-task condition ($M = 4.75$, $SD = 0.93$), $F(1, 28) = 3.22$, $p = 0.08$. A $t$-test analysis on the second question revealed no significant main effect of completion, $p > 0.83$. The two self-efficacy questions were taken out in the Study 1 so as not to artificially increase participants' focus on the performance goal of Task B.

[2] Pretest indicated that 5 min was enough time for participants to read the four resumes without being bored or feeling under time pressure.

5 min, regardless of the completion condition. Only the meaning of participants' performance varied across conditions (i.e. 13 words or less represented a finished task in the finished-task condition whereas it represented an unfinished task in the unfinished-task condition). After the allotted 5 min, the experimenter asked the participants whether they completed the task, checked their performance and wrote on the participants' paper: "task complete" or "task incomplete" depending upon their condition, which matched with their actual performance.

*Time pressure manipulations*

Following the recommendation of De Dreu (2003) and Karau and Kelly (1992), time pressure was manipulated based on perceptions of time pressure as opposed to the actual time available, so that people would have and spend the same amount of time working on Task A. Participants' perceptions of time pressure were primed prior to engagement in Task A by eliciting expectations of having either too little or, on the contrary, adequate time for completion. When Task A was introduced, participants were randomly assigned to one of two types of instructions, which manipulated their perception of time pressure. Even though all participants had 5 min to work on Task A, they were told either that "when this test was originally administered at other universities, participants" (a) "reported that 5 min was not a lot of time to complete the task and that they had to work fast. So try to work as fast as you can" [high time pressure condition] or (b) "reported that 5 min was enough time to complete the task and that they had worked at their own pace. So work at your own pace" [low time pressure condition]. To reinforce the high time pressure manipulation, as done in prior research manipulating time pressure (e.g. Carnevale and Lawler, 1986, p. 645), time was made salient in all high time pressure conditions by using a tape recorder that counted down the minutes in the background. The announcement was made every minute and said: "4 min left, 3 min left", etc up to "time is up". No tape recorder was used in the low time pressure conditions. Note that the time pressure manipulation was specific and limited to Task A only. For the rest of the experiment, including working on Task B, the perception of time pressure was not manipulated and participants were placed in the same experimental conditions.

*Measures*

*Manipulation checks*

Three manipulation check questions were asked right after Task A and before Task B. To test the effectiveness of the completion manipulations, participants were asked (a) whether or not they completed Task A and (b) to what extent they were satisfied with their performance on Task A (7-point Likert scale). Responses to these two manipulation check questions indicated that the completion manipulation was effective. First, participants' answers to whether or not they completed Task A were consistent with the experimental conditions and their actual performance. Second, participants in the unfinished-task condition reported that they were less satisfied with their performance on Task A ($M = 3.39$; $SD = 1.50$) than were participants in the finished-task condition ($M = 5.19$; $SD = 1.37$), $t(82) = 5.74$, $p = 0.000$, $d = 1.27$ (see Table 1).

To test the effectiveness of the time pressure manipulation, participants were asked to what extent they experienced time pressure when they worked on Task A (7-point Likert scale). Participants assigned to the high time pressure conditions reported working under more time pressure on Task A ($M = 4.78$; $SD = 1.23$) than did participants assigned to the low time pressure conditions ($M = 4.05$; $SD = 1.46$), $t(82) = 2.44$, $p = 0.02$, Cohen's $d = 0.55$ (see Table 3).

**Table 1**
Means and standard deviations for variables – Study 1.

| | Finished Task A | | Unfinished Task A | |
|---|---|---|---|---|
| | High time pressure | Low time pressure | High time pressure | Low time pressure |
| *Satisfaction with Task A performance*[A] | | | | |
| Mean | 4.82[a] | 5.57[a] | 3.47[b] | 3.45[b] |
| *SD* | (1.53) | (1.07) | (1.50) | (1.43) |
| *Experienced time pressure on Task A*[A] | | | | |
| Mean | 4.30[b] | 3.38[a] | 5.20[c] | 4.45[b] |
| *SD* | (1.37) | (1.43) | (0.98) | (1.09) |

[a–c] Cell means not sharing the same superscript differ at $p < 0.05$.
[A] Variables that were measured based on a 7-point Likert scale.

*Measures*

Attention residue was measured by using a lexical decision task. The same lexical decision task was also used to measure other variables included in the study to rule out alternative explanations.

*Lexical decision task*

The lexical decision task was performed on a computer. As described above, participants had to recognize whether the letter stings presented on the computer screen were real word or non-word by pressing on the keyboard the letters "P" or "Q", respectively. They were told to respond as accurately and as fast as they could. Participants' reaction times and accuracy were recorded. The letter strings that were presented were from three categories: (a) non-words (for example: belrys); (b) real "target" words that were real words chosen to measure the dependent variables and thus were related in meaning to these variables (i.e. task activation of Task A was measured using some of the clues from Task A and goal activation of Task A was measured based on the activation level of verbs such as "finish", "solve", etc.) and (c) real "neutral" words that were unrelated to the target words but were each matched, based on frequency in the English dictionary and number of letters, to one of the target words (for example: "belong", neutral word matching with the target word "finish").[3] The neutral words served as base rate. For this lexical decision task, 15 pairs of target-neutral words and 30 non-word stimuli were generated and shown to participants.

*Attention residue* was measured using the lexical decision task described above. Attention residue was measured by computing the average activation level of the goal and content of Task A after participants had switched to Task B. Cognitive activity is, indeed, likely to occur when the content and/or goal of a task is active on people's minds. Goal related activation (referred to as goal activation) was based on the activation level of four verbs associated with the goal of Task A (i.e. solve, finish, think, and discover). Task content related activation (referred to as task activation) was based on the activation level of five clues taken directly from Task A. The number of clues was limited to five to prevent the lexical decision task from lasting too long. These five clues were identified during pre-testing and represented the clues that participants kept thinking about the most when they did not finish Task A. High levels of goal or task activation of Task A were revealed by faster recognition of the relevant stimuli (the four verbs and the five clues, respectively) as real words and thus by smaller reaction times (measured after people had switched to Task B). Only reaction times for accurate answers[4] to Task A goal and task related words

[3] The neutral words were used as a base line in reaction times for each subject. Word frequencies were found in Frequency Analysis of English Usage: Lexicon and Grammar (Francis and Kucera, 1982).
[4] Accuracy rate: 0.95.

were averaged to produce the measure of attention residue. Matching neutral words served as base rate in reaction times.

*Variables testing alternative explanations*

Consistent with prior research (e.g. Martin & Tesser, 1996) Task A was described as being diagnostic of one's intelligence to make sure participants were motivated to work on the task and cared about reaching completion. It is important, however, to show that such framing did not affect attention residue. Indeed, participants who did not finish Task A could be preoccupied with Task A not because they did not finish the task but rather because their opportunity to demonstrate their intelligence was thwarted or because their self-efficacy beliefs were impaired. Such hypotheses would be reflected in an elevated activation of the concepts of intelligence and self-efficacy for participants who did not finish Task A (i.e. unfinished-task condition). The lexical decision task was used to rule out these explanations. *Concern with intelligence* was measured based on the activation level of three words related to intelligence (smart, clever, and intelligence) and *self-efficacy* was measured based on the activation level of three related words (skilled, competent, and capable). Matching neutral words were also used as base rate.

*Results*

Participants' attention residue was subjected to a 2 (completion) × 2 (time pressure) × 2 (word type: target word versus neutral word) repeated measure analysis of variance (ANOVA). Since the neutral words were used as base rates, a significant effect of completion (or time pressure) was to be reflected in a significant interaction between word type and completion (or time pressure). As shown in Table 2 and consistent with research proposition 1, the analysis of attention residue revealed a significant Task A completion × word type interaction, $F(1, 79) = 7.88$, $p = .01$, $\eta^2 = 0.09$, such that participants assigned to the unfinished-task conditions responded faster to the goal of Task A ($M = 583.63$ ms), demonstrating that the goal was more active on their minds, than did participants assigned to the finished-task conditions ($M = 610.24$ ms). No significant Time pressure × Word type interaction emerged, but, consistent with research proposition 2, the completion × time pressure × word type interaction was significant, $F(1, 79) = 7.60$, $p = 0.01$, $\eta^2 = 0.09$. As predicted, the time pressure × word type interaction had a significant effect among participants assigned to the finished-task condition $F(1, 40) = 11.52$, $p = 0.002$, $\eta^2 = 0.22$, such that participants in the low time pressure condition responded faster to the clues from Task A ($M = 617.45$ ms), demonstrating that Task A was more active on their minds, than did participants in the high time pressure condition ($M = 632.15$ ms). The time pressure × word type interaction did not have such an effect among participants assigned to the unfinished-task condition ($p > 0.28$). See Table 4 for a summary of the correlations between the main variables.

**Table 2**
Means and standard error for reaction times (ms) – lexical decision task – Study 1.

| | Finished Task A | | Unfinished Task A | |
|---|---|---|---|---|
| | High time pressure | Low time pressure | High time pressure | Low time pressure |
| *Attention Residue*[A] | | | | |
| Mean | 636.3[a] | 584.17[b] | 583.91[b] | 583.35[b] |
| S.E. | (25.6) | (17.63) | (31.14) | (24.20) |
| *Base line (i.e. matching neutral words)* | | | | |
| Mean | 617.46 | 632.15 | 642.26 | 618.23 |
| S.E. | (28.77) | (17.12) | (28.06) | (20.70) |

[a–b] Cell means not sharing the same superscript differ at $p < 0.05$.
[A] Reaction times are measured in milliseconds (ms).

**Table 3**
Means and standard error for reaction times (ms) – lexical decision task – Study 1, alternative explanations.

| | Finished Task A | | Unfinished Task A | |
|---|---|---|---|---|
| | High time pressure | Low time pressure | High time pressure | Low time pressure |
| *Intelligence activation*[A] | | | | |
| Mean | 645.31[a] | 595.57[a] | 615.36[a] | 613.62[a] |
| S.E. | (28.40) | (18.36) | (22.42) | (24.93) |
| *Base line (i.e. matching neutral words)* | | | | |
| Mean | 794.18 | 707.18 | 777.36 | 799.97 |
| S.E. | (45.05) | (35.12) | (32.08) | (39.61) |
| *Self-efficacy activation*[A] | | | | |
| Mean | 656.59[a] | 622.06[a] | 675.35[a] | 630.07[a] |
| S.E. | (26.92) | (21.37) | (27.79) | (23.97) |
| *Base line (i.e. matching neutral words)* | | | | |
| Mean | 614.63 | 627.48 | 627.35 | 589.23 |
| S.E. | (23.30) | (39.29) | (27.66) | (29.59) |

[a] Cell means not sharing the same superscript differ at $p < 0.05$.
[A] Reaction times are measured in milliseconds (ms).

*Alternative hypotheses*

Repeated measures ANOVAs on the activation levels of the self-efficacy and intelligence revealed no differences across conditions, suggesting that the experimental conditions (task completion and time pressure) did not affect participants' ruminations about their intelligence or self-efficacy, even though Task A was presented as diagnostic of their intelligence. More specifically, as shown in Table 3, participants who did not complete Task A reported similar levels of activation for intelligence ($M = 614.54$ ms) and self-efficacy ($M = 653.29$ ms) than did participants who completed Task A ($M = 621.57$ ms and $M = 639.73$ ms, respectively). Further, when repeated measures ANOVAs were conducted on attention residue, on goal activation, and on task activation, controlling for the activation levels of intelligence and self-efficacy, the same pattern of results were found as in the ANOVAs reported earlier without these control variables. Further, the control variables were not significant. As a result, the effect of the experimental conditions on attention residue cannot be explained by the fact that not having finished Task A threatened participants' intelligence or self-efficacy belief. See Table 3 for relevant means.

*Study 1 discussion*

Study 1 supported the prediction that switching tasks before having completed the first task is associated with more attention residue. Consistent with Research Proposition 1, Task A stayed significantly more active (thus demonstrating more attention residue) in the minds of those who did not finish Task A than in the minds of those who finished Task A before switching tasks. These effects were revealed by faster reaction times to words associated with the goal and content of Task A. Yet, as predicted, having finished Task A did not necessarily reduce attention residue. Consistent with Research Proposition 2, participants who completed the first task under low as opposed to high time pressure reported more attention residue. In other words, time pressure moderates the effect of task completion on attention residue.

Study 1 reveals that people do not systematically transition their attention as they move from one task to another. In fact, ending one's cognitions about a task is difficult even when one must engage in another task. While completion theories have argued that cognitions persist when a goal is unmet and recede with goal attainment, the present research shows that completing a task does not necessarily lead people to end their cognitions about that task, as revealed by the presence of attention residue on the next

**Table 4**
Correlation between main variables – Study 1.

| | Attention residue | Task activation | Goal activation | Time pressure (0, 1) | Completion on Task A (0, 1) | Experienced time pressure on Task A | Satisfaction with Task A performance | Intelligence activation | Self-efficacy activation |
|---|---|---|---|---|---|---|---|---|---|
| Attention residue | – | | | | | | | | |
| Task activation | 0.86*** | – | | | | | | | |
| Goal activation | 0.82*** | 0.45*** | – | | | | | | |
| Time pressure (0,1) (experimental condition) | −0.13 | −0.18 | −0.05 | – | | | | | |
| Completion on Task A (0,1) (experimental condition) | −0.32*** | −0.30*** | −0.27** | 0.02 | – | | | | |
| Experienced time pressure on Task A | −0.02 | −0.01 | −0.05 | −0.19* | 0.47*** | – | | | |
| Satisfaction with Task A performance | 0.22† | 0.22† | 0.15 | 0.16 | −0.61*** | −0.48*** | – | | |
| Intelligence activation | 0.25** | 0.12 | 0.34*** | −0.02 | −0.01 | 0.17 | −0.01 | – | |
| Self-efficacy activation | −0.02 | −0.17 | 0.11 | 0.00 | 0.19 | 0.08 | −0.28** | 0.131 | – |

† $p < 0.01$.
* $p < 0.05$.
** $p \leqslant 0.01$.
*** $p \leqslant 0.001$.

task. Time pressure is needed on a completed task to reduce attention residue when people switch to a next task. These findings suggest that having experienced time pressure during task performance allows people to cognitively close on that task once it is completed. Further, the present research reveals that the persistence of cognitive processes when one stops working on a task is not only due to the persistence of goal activation, but also to the persistence of task activation. While completion reduces goal activation, the present findings reveal that it is the experience of time pressure on a completed task that affects task activation, and thus attention residue.

## Effects on task performance

The first study focuses on the effects of task completion and time pressure on attention residue. The second part of this paper explores the implications of the same factors, task completion and time pressure, on people's performance once they have switched to another task. More specifically, does the fact that task completion and time pressure on one task affect the way people allocate their attention when switching to another task has implications for their performance after the switch? Because attention and the ability to inhibit competing goals is at the core of better performance (e.g. Beal et al., 2005; Johnson et al., 2006; Shah & Kruglanski, 2002), the answer to this question is likely to be positive. The second part of this paper also explores in more detail the effect of time pressure when coupled with task completion. While Study 1 confirmed that completing a task under high as opposed to low time pressure reduces attention residue on the next task, the underlying mechanism was not tested. Study 2 provides such a test.

### *Effect on task performance*

Traditional research in psychology has shown that people have limited cognitive resources (Kahneman, 1973; Norman & Bobrow, 1975; Pashler, 1994). As a result, people who are distracted by unrelated thoughts have fewer cognitive resources available for their current activity (Dijker & Koomen, 1996; Gilbert & Hixon, 1991; Gilbert, Pelham, & Krull, 1988). People who experience attention residue after switching tasks are then likely not only to experience cognitive load as mentioned earlier (e.g. Kanfer & Ackerman, 1989), but also to have fewer cognitive resources available for their task performance.

Based on the results found in Study 1, not having finished one task before switching to another or having done so but under low time pressure is likely to increase people's cognitive load and reduce their cognitive availability once they switch to the next task. By contrast, having completed a task under high time pressure before switching to another will allow people to free their cognitive resources from the first task, and thus be cognitively more available and under lower cognitive load when working on the next task.

Performance suffers when people devote only part of their resources to their current task (e.g. Beal et al., 2005; Kahn, 1992) or work under cognitive load (Kanfer & Ackerman, 1989). This is all the more the case if the task at hand requires cognitive resources. By contrast, keeping one's attention focused on a current goal (as opposed to dividing one's attention among several goals) enhances task persistence and task performance (Beal et al., 2005; Kahn, 1990; Kahn, 1992; Shah & Kruglanski, 2002). Building upon the above theoretical arguments, I then state the following two research propositions, which are tested in Study 2.

RP 3: People who do not finish Task A before switching to Task B demonstrate lower performance on Task B than do people who finish Task A prior to switching to Task B.

RP 4: People who finish Task A under high time pressure before switching to Task B demonstrate higher performance on Task B than do people who finish Task A under low time pressure.

### *Time pressure and confidence*

As predicted, the first study showed that finishing a task under high as opposed to low time pressure reduces attention residue when working on a next task. Building on research on time pressure (Kruglanski, 2004) and choice (Iyengar, 2000), it was argued that this effect occurs because time pressure reduces the number of possible paths to completion people consider when performing a task and because such narrow focus increases confidence in one's performance once the task is actually finished). As a result, this leads me to state the following research proposition tested in Study 2.

RP 5: People who finish Task A under high time pressure are more confident in their Task A performance than are people who finish Task A under low time pressure.

Further, the theory developed for Study 1 argued that confidence in task performance once completion is reached allows people to end their cognitions about the completed task (e.g. Chaiken et al., 1989; Metcalfe, 1998). This, in turn, is likely to increase people's cognitive availability and reduce their cognitive load once they switch to a next task. Because cognitive availability and reduced cognitive load enhance task performance (e.g. Beal et al., 2005; Kahn, 1992; Kanfer & Ackerman, 1989), I then state the following research proposition tested in Study 2.

RP 6: Elevated confidence in Task A performance results in higher performance on Task B.

The research propositions 4, 5, and 6 taken together provide the foundation for proposing a mediated effect tested in Study 2. More specifically, because having finished a task (Task A) under high as opposed to low time pressure is likely to lead to (a) elevated confidence in Task A performance (RP5) and (b) higher performance on a Task B (RP4), and because elevated confidence in Task A performance is likely to contribute to higher performance on Task B (RP6), confidence is likely to have a mediating effect. Building upon this reasoning, I state the following research proposition.

RP 7: The influence of completing Task A under high versus low time pressure on Task B performance is mediated by confidence in Task A performance.

## Study 2

Research propositions 3–7 are tested using an experimental design similar to the one used in Study 1. As in Study 1, participants work on Task A and then switch to Task B, but this time, participants fully perform Task B. Performance on Task B is measured. The lexical decision task is removed from the design since it introduces a third task that could interfere or contaminate the experimental results on Task B. Study 2 focuses on the effects of task completion and time pressure experienced on Task A on (a) Task B performance and (b) confidence in Task A completion. The mediation effect of confidence in Task A completion between the experimental conditions and performance on Task B is also tested.

### *Participants and design*

Seventy-eight undergraduate students (30 men; 48 women) from an Eastern university were randomly assigned to a 2 (task completion: finished/unfinished) × 2 (time pressure: high/low) factorial between-participants design. Participants received $10 for their participation and the experiment was conducted in individual sessions of approximately 40 min.

### *Procedure and materials*

Upon arrival at the laboratory, participants completed a consent form and a questionnaire with a few demographic questions, before working on Task A. Task A was identical to the one used in Study 1 and, as in Study 1, the task completion and time pressure manipulations were introduced in the instructions for Task A. After Task A, participants were asked to answer three manipulation check questions and to report (a) their confidence in Task A completion and (b) the extent to which they found Task A difficult. That question was added to check that the experimental story did not affect Task A difficulty in ways that could explain performance differences on Task B. After these questions, people were asked to work on Task B.

As in Study 1, Task B was presented as a study of how people evaluate job candidates and participants were given 5 min to review four resumes. They were told that after the 5 min, they would be given a job description and would be asked to indicate which candidate they preferred for the position. The rest of the experiment differs from Study 1. After participants had 5 min to read the resumes, the experimenter took the resumes back and asked them to perform a surprise recall of the resumes. The surprise recall was presented as an important step that would help participants select the best candidate for the job position. To do this, participants were provided blank resumes and were encouraged to write down any ideas that they could remember about each resume. Borrowing from Kelly and Karau's (1999) instructions for a recall test, participants were asked to stop only when they could not remember anything else from the resumes. Participants were given as much time as they wanted on the recall test. Upon completion of the recall test, participants were given the job description and performed the evaluation of the candidates. Once Task B was finished, participants were asked to answer a final questionnaire, asking them to report the extent to which they experienced time pressure on Task B and goal commitment to Task B. Participants were then debriefed. As in Study 1, the debriefing indicated that none of the participants realized the true nature of the experiment or guessed that Task A was not feasible.

### *Manipulations*

The completion and time pressure manipulation instructions were identical to those used in Study 1. Responses to the manipulation check questions indicated that the completion manipulation was effective. First, participants' perceptions of whether or not they completed Task A were consistent with the experimental conditions, which also corresponded to their actual performance. Second, participants in the unfinished-task conditions reported that they were less satisfied with their performance on Task A ($M = 2.97$; $SD = 1.62$) than were participants in the finished-task conditions ($M = 5.16$; $SD = 1.60$), $t(76) = 5.97$, $p = 0.00$, $d = 1.37$. The time pressure manipulation was also effective, as participants assigned to the high time pressure conditions reported working under more time pressure on Task A ($M = 4.78$; $SD = 1.44$) than did participants assigned to the low time pressure conditions ($M = 4.02$; $SD = 1.60$), $t(76) = 2.12$, $p = 0.04$, $d = 0.5$ (see Table 5).

To make sure that the time pressure manipulation on Task A did not carry over to Task B, thus affecting the experience on Task B, participants were asked to report after working on Task B the extent to which they had experienced time pressure while working on Task B (7-point Likert scale). A $t$-test was conducted and revealed no significant difference across conditions. Participants assigned to the high time pressure conditions on Task A reported to experience similar levels of time pressure on Task B ($M = 3.55$; $SD = 1.44$) than did participants assigned to the low time pressure condition on Task A ($M = 3.34$; $SD = 1.66$), $t(74) = 0.59$, $p = 0.59$. In addition, the experience of time pressure on Task B was subjected to a 2 (completion on Task A) × 2 (time pressure on Task A) ANOVA which further revealed no significant difference among the four conditions (see Table 5). Note that controlling for time pressure on Task B when conducting the analysis presented in the result section did not change the results reported in the paper.

### *Performance on Task B*

Performance on Task B was based on the total number of accurate ideas that a subject recalled from the four resumes. Two different coders coded the accuracy of the information recalled. The two coders were blind to the experimental conditions and one of them was also blind to the research hypotheses. Reliability for those coders was satisfactory ($r = 0.95$). The coding from the coder who was

**Table 5**
Means and standard deviations for variables – Study 2.

| | Finished Task A | | Unfinished Task A | |
|---|---|---|---|---|
| | High time pressure | Low time pressure | High time pressure | Low time pressure |
| *Confidence in Task A completion*[A] | | | | |
| Mean | 6.10[a] | 4.80[b] | 2.42[c] | 2.05[c] |
| *SD* | (0.99) | (1.95) | (1.35) | (1.47) |
| *Performance on Task B*[A] | | | | |
| Mean | 64.57[a] | 46.97[b] | 45.10[b] | 44.32[b] |
| *SD* | (21.07) | (15.17) | (17.39) | (19.78) |
| *Perceived time pressure on Task A*[A] | | | | |
| Mean | 4.60[b] | 3.50[a] | 5.20[c] | 4.40[b] |
| *SD* | (1.40) | (1.73) | (1.18) | (1.60) |
| *Perceived time pressure on Task B*[A] | | | | |
| Mean | 3.89[a] | 3.25[a] | 3.25[a] | 3.44[a] |
| *SD* | (1.18) | (1.65) | (1.62) | (1.72) |
| *Satisfaction with Task A performance*[A] | | | | |
| Mean | 5.42[a] | 4.95[a] | 3.00[b] | 2.95[b] |
| *SD* | (1.42) | (1.73) | (1.30) | (1.93) |
| *Perceived difficulty of Task A*[A] | | | | |
| Mean | 3.74[a] | 3.35[a] | 5.15[b] | 5.15[b] |
| *SD* | (1.37) | (1.27) | (1.35) | (1.56) |
| *Perceived effort to perform Task A*[A] | | | | |
| Mean | 4.57[a] | 3.95[a] | 4.75[a] | 4.90[a] |
| *SD* | (1.26) | (1.13) | (1.40) | (1.44) |

[a–c]Cell means not sharing the same superscript differ at $p < 0.05$.
[A] Variables that were measured based on a 7-point Likert scale.

**Table 6**
Regression results testing the mediation by confidence in Task A completion of the relationship between time pressure and performance on Task B within the finished-task conditions – Study 2.

| | Task B performance | |
|---|---|---|
| | Column 1 (main effects) $\beta$ | Column 2 (mediation) $\beta$ |
| Independent variables | | |
| Time pressure | −0.44** | −0.29† |
| Confidence in Task A completion | | 0.42** |
| Overall *F* | 8.86** | 9.36*** |
| df | 1, 36 | 2, 35 |
| $R^2$ | 0.20 | 0.35 |
| Change in $R^2$ compared to column 1 | | 0.15 |
| *F* change | | 8.12** |

*Note:* Standardized regression coefficients are shown.
† $p < 0.10$.
* $p < 0.05$.
** $p \leqslant 0.01$.
*** $p \leqslant 0.001$.

blind to the research hypotheses was then chosen to be used in the analysis.

### *Confidence in Task A completion*

Right after Task A, participants were asked to report the extent to which they felt confident that they had met the goal of Task A (7-point Likert scale).

### *Results*

A two-way multivariate analysis of variance (MANOVA) was used to examine between-participants effects of completion and time pressure on Task A on the major dependent variables (i.e. Task B performance and confidence in Task A completion). Results indicated significant main effects for both completion $F(2, 73) = 55.43$, $p = 0.00$, $\eta^2 = 0.60$ and time pressure $F(2, 73) = 4.22$, $p = 0.02$, $\eta^2 = 0.10$ (Wilk's Lambda). *t*-test analyses and univariate ANOVAs were then conducted for each of the dependent variables. Tables 5 and 7 present the relevant mean, standard deviations, and correlations.

### *Task B performance*

Participants' performance on Task B was subjected to a 2 (completion on Task A) × 2 (time pressure on Task A) between-participants analysis of variance (ANOVA). Consistent with Research Proposition 3, a significant main effect of completion on Task A emerged, $F(1, 74) = 7.02$, $p = 0.01$, $\eta^2 = 0.09$, indicating that participants who finished Task A performed better on Task B ($M = 55.30$, $SD = 20.04$) than did participants who did not finish Task A before switching tasks ($M = 44.71$, $SD = 18.39$). In addition, a significant main effect of time pressure emerged, $F(1, 74) = 4.84$, $p = 0.03$, $\eta^2 = 0.06$, indicating that participants who worked on Task A under high time pressure performed better on Task B ($M = 54.32$, $SD = 21.36$) than did participants who worked on Task A under low time pressure ($M = 45.65$, $SD = 17.45$). Upon further investigation and as reported below, *t*-test analyses reveal that this effect was only driven by differences in mean levels within the finished-task conditions, and not within the unfinished-task conditions. That is, even though the statistical analysis reveals a main effect of time pressure, the data is in fact consistent with Research Proposition 4 and exhibits a significant interaction effect between completion and time pressure, $F(1, 74) = 4.06$, $p = 0.05$, $\eta^2 = 0.05$. As predicted, high time pressure had a significant main effect among participants who were assigned to the finished-task conditions, $t(36) = 2.98$, $p = 0.005$, $d = 0.99$, such that participants who finished Task A under high time pressure performed better on Task B ($M = 64.57$, $SD = 21.07$) than did participants who finished Task A under low time pressure ($M = 46.97$, $SD = 15.17$). No such effect

**Table 7**
Correlations between the main variables – Study 2.

| | Task B performance | Time pressure (0, 1) | Completion (0, 1) | Confidence in Task A performance | Perceived TP on Task A | Perceived TP on Task B | Satisfaction with Task A performance | Perceived difficulty of Task A |
|---|---|---|---|---|---|---|---|---|
| Task B performance | – | | | | | | | |
| Time pressure (0 = high,1 = low) | −0.21† | – | | | | | | |
| Completion (0 = completion,1 = incompletion) | −0.29** | −0.03 | – | | | | | |
| Confidence in Task A performance | 0.31*** | −0.11 | −0.78*** | – | | | | |
| Perceived time pressure on Task A | −0.10 | −0.25* | 0.38*** | −0.46*** | – | | | |
| Perceived time pressure on Task B | 0.03 | −0.13 | −0.16 | 0.15 | 0.26* | – | | |
| Satisfaction with Task A performance | 0.19 | −0.06 | −0.64*** | 0.79*** | −0.42*** | 0.08 | – | |
| Perceived difficulty of Task A | −0.16 | −0.14 | 0.50*** | −0.58*** | 0.57*** | 0.18 | −0.42*** | – |
| Goal commitment on Task B | 0.11 | 0.21† | −0.14 | 0.09 | 0.02 | 0.08 | 0.00 | −0.05 |

† $p < 0.01$.
* $p < 0.05$.
** $p \leqslant 0.01$.
*** $p \leqslant 0.001$.

of time pressure emerged among participants who were assigned to the unfinished-task conditions ($p > 0.90$).

*Confidence in Task A completion*

Consistent with Research Proposition 5, a regression analysis confirmed that confidence in Task A completion predicted higher performance ($\beta = 0.32$, $p = 0.004$; $R^2 = 0.11$). It was also checked that within the completion conditions, confidence in Task A completion significantly predicted performance on Task B ($\beta = 0.53$, $p = 0.001$).

Research Proposition 6 predicted that, within the completion conditions, participants who finished Task A under high time pressure as opposed to low time pressure would be more confident in having completed the goal of Task A. A *t*-test analysis comparing the finished-task/high time pressure condition and the finished-task/low time pressure condition revealed a significant main effect of time pressure, $t(37) = 2.63$, $p = 0.01$, $d = 0.86$. Participants assigned to the finished-task/high time pressure condition were more confident in having met the goal of Task A ($M = 6.10$, $SD = 0.99$) than were participants assigned to the finished-task/low time pressure condition ($M = 4.80$, $SD = 1.95$).

It was also confirmed that no such effect of time pressure emerged when participants were assigned to the unfinished-task conditions ($p > 0.50$). In addition, as might be anticipated, participants assigned to the unfinished-task conditions were overall less confident in having completed Task A ($M = 2.23$, $SD = 1.40$) than were participants assigned to the finished-task conditions ($M = 5.44$, $SD = 1.66$), $t(76) = 9.184$, $p = 0.00$, $d = 0.21$.

*Mediation analysis*

I have argued that time pressure within the finished-task conditions would enhance Task B performance by increasing people's confidence in having reached the goal of Task A. Mediation analysis was performed following the steps recommended by Baron and Kenny (1986). As in the analyses of variance, time pressure significantly predicted both performance on Task B ($\beta = -0.44$, $p = 0.005$) and confidence in Task A completion ($\beta = -0.40$, $p = 0.012$). In addition, confidence in Task A completion significantly predicted performance on Task B ($\beta = 0.53$, $p = 0.001$). A final regression analysis on Task B performance, including time pressure as independent variable and confidence in Task A performance as covariate, revealed a significant effect of confidence in Task A completion on Task B performance ($\beta = 0.42$, $p = 0.007$), while the effect of time pressure was reduced to marginally significant ($\beta = -0.29$, $p = 0.07$). A calculation of the Sobel test showed that this reduction in $\beta$-weight for the effect of time pressure is significant ($z = 1.93$, $p = 0.05$), confirming that the mediation is significant, thus supporting Research Proposition 7 (see Table 6).

*Alternative explanations*

It is possible that the time pressure manipulation, which manipulated whether participants *believed* that they had enough time to complete Task A, also affected the perceived difficulty of Task A. It is then important to make sure that the perceived difficulty of Task A did not explain the performance results on Task B. Indeed, being able to finish a task that is perceived to be difficult could boost people's self-efficacy belief, which in turn could explain why participants in the finished task, high time pressure condition performed better on Task B. Even though the pilot study and the first experiment did not reveal any effect of the time pressure manipulation on self-efficacy belief, it seemed important to rule out this alternative explanation one more time from a different angle. I then explored whether the differences in Task B performance across the experimental conditions could be due to a difference in how participants evaluated the difficulty of Task A across conditions. As such, right after Task A, participants were asked to report the extent to which they experienced Task A as difficult (7-point Likert scale).

Participants' experience with Task A (i.e. the possibility (or lack of thereof) to finish Task A) could also have influenced their commitment to performing well on Task B. Indeed, people can follow negative experiences (here, not having finished Task A) by either withdrawing (Baumeister, Bratslavsky, Muraven, & Tice, 1998, Seligman, 1975; Vroom, 1964) or trying to compensate for their poor performance (e.g. Brunstein and Gollwitzer, 1996). Because goal commitment is likely to affect people's performance (Erez & Zidon, 1984; e.g. Locke, Latham, & Erez, 1988 for review), it is important to make sure that the completion and time pressure manipulation did not affect participants' commitment to Task B, which is turn could explain differences in Task B performance. As a result, goal commitment on Task B was measured, after Task B, by asking participants to what extent they cared about (a) doing well on; and (b) demonstrating their competence on Task B. The two items were combined into one average score ($r = 0.86$, $p = 0.000$).

*Results*

It was tested that the time pressure manipulation did not artificially affect the perception of Task A difficulty, which in turn could influence performance on Task B, especially in the completion conditions. Task A difficulty was then subjected to a 2 (completion on Task A) $\times$ 2 (time pressure on Task A) ANOVA, which revealed no significant main effect of time pressure ($p > 0.54$). Task completion, however, revealed a significant main effect on Task A difficulty, $F(1, 75) = 26.29$, $p = 0.00$, $\eta^2 = 0.26$, while the interaction between task completion and time pressure was not significant. When controlling for Task A difficulty in an ANOVA of Task B performance, the same pattern of results was found as in the ANOVA conducted without the control variable, suggesting that Task A difficulty did not influence the performance results. Finally, performance on Task B and Task A difficulty were not significantly correlated.

The effect of the experimental conditions on goal commitment on Task B was also tested using a 2 (completion: finished/unfinished) $\times$ 2 (time pressure: high/low) ANOVA with goal commitment on Task B as the dependent variable. It revealed no significant main effects for completion or time pressure on Task A, and no significant interaction ($p > 0.15$), suggesting that having finished Task A or not and having experienced time pressure on Task A or not did not affect participants' commitment to performing well on Task B, and thus did explain the differences in performance on Task B.

*Study 2 discussion*

The act of transitioning between tasks has behavioral implications on subsequent task performance. Study 2 supports the idea that task performance suffers when a prior task is unfinished. Performance also suffers when people have completed the prior task under low time pressure. It is only when people have completed the prior task under high time pressure that their subsequent task performance is enhanced. Study 2 also provides evidence that time pressure, when combined with task completion, increases people's confidence in having met of the goal of Task A. Moreover, the results indicate that such heightened confidence is associated with higher subsequent task performance and mediates the effect of time pressure on participants' subsequent task performance.

While Study 1 focused on the cognitive implications of having to transition between tasks, Study 2 reveals that similar patterns

of results occur when focusing on the behavioral implications of task transitions. Overall, this study demonstrates that, while performance on a current task suffers when a prior task is unfinished, completion of a prior task, by itself, is not always enough to help people transition to the next task and enable high performance. As in Study 1, time pressure, when coupled with task completion, provides the necessary incentive to transition tasks more effectively. Even though time pressure on a task makes it more difficult to reach task completion, when the two co-exist they provide the most favorable context for transitions in terms of less attention residue once working on the next task (i.e. Study 1) and in terms of higher performance on that next task (i.e. Study 2). Further, Study 2 validates the psychological mechanism that was hypothesized in Study 1 regarding the effect of time pressure when coupled with task completion. As predicted, having experienced time pressure during task performance increases people's confidence in their performance once they reach task completion. Further, it is because of this elevated confidence that time pressure helps people transition their resources more effectively to the next task as revealed by higher performance after the switch.

## General discussion

Two studies were conducted to understand how switching tasks affects people's ability to be fully present in their work and perform at their full potential. The present findings reveal that the act of transitioning between tasks has implications on how people engage in a subsequent task; switching attention tends to be difficult for people and subsequent task performance easily suffers. More specifically, factors associated with the first task – not having finished the first task before switching to the next one or having finished it under low time pressure – contribute to the difficulty of task transitions. People need to have both finished their first task and have done so under high time pressure to be able to switch their attention to the next task, thus exhibiting less attention residue and reaching higher subsequent task performance.

Compared to people who finished the first task, people who did not finish the first task exhibited more attention residue and lower subsequent task performance. Because the prior task was unfinished, it continued to attract attention despite the necessity of focusing on a subsequent task. The solution to more effective task transitions is, however, not as simple as being able to finish the prior task. Even when task completion is obvious and reinforced by external feedback, as it was the case in the two experimental studies, people find it difficult to fully free their mind from the finished task, thus experiencing attention residue on a next task. Time pressure experienced during the performance on the first task does matter when predicting the effect of task completion on attention residue. Indeed, people who finished the first task under high as opposed to low time pressure were more likely to let go of the finished task, exhibiting lower attention residue and high performance on the next task.

Study 1 had hypothesized that the beneficial effect of time pressure (when coupled with task completion) occurred because time pressure increases people's confidence in having met the task goal once completion is attained. It was also predicted that this elevated confidence would help people end their cognitions about the completed task, which in turn would be beneficial for the next task (i.e. lower attention residue and higher task performance). Study 2 confirmed that the beneficial effect of time pressure (occurring when time pressure was coupled with task completion) was due to the increased confidence in having met the goal of Task A experienced after completion of Task A under high as opposed to low time pressure. Interestingly, such difference in confidence occurred even though participants knew and reported that they had completed the task (see manipulation check questions in Studies 1 and 2). These findings confirm that the cognitive and behavioral implications of task completion are not as straight forward as prior research could imply. They cannot be fully understood without considering how people experience and react to task completion and how these reactions are also a product of the contextual factors present during the task performance (e.g. time pressure).

### *Implications*

The present research has both theoretical and practical implications.

#### *Theoretical implications*

There has been much research – both at the task and at the organizational level – studying the factors that motivate people to engage in their work and perform well. The present research suggests that task performance is not solely a function of the motivation to work on a given task, but should also be considered in a broader temporal context. People need to end their cognitions about one task in order to fully focus on another. Similarly, the present research suggests that the way people regulate their attention at work is not based solely on the current activity they must engage in. The prior activity and the way it was experienced also strongly influence the regulation of attention.

The present paper shows the importance of studying how people regulate their attention when they transition between sequential tasks, and as such contributes to the goal shielding research. While one could expect that a change of tasks, including a change of goals, would help people regulate their attention, the present studies reveal that it is not necessarily the case. Indeed, contrary to what the goal shielding theory would predict, whereby the activation of one goal should inhibit the activation of another goal, transitioning from one task to another does not necessarily lead people to stop thinking about the prior task they just worked on. Shielding a focal goal from a prior goal pursuit is then quite difficult.

Furthermore, the present research contributes to the literature on goal/task completion (Martin & Tesser, 1996; Moskowitz, 2002; Rothermund, 2003). Whereas traditional research suggests that task completion reduces goal activation, it has not explicitly studied the effect of completion on people's ability to stop thinking about a task. Task completion is not enough to explain how people regulate their attention. The present research reveals the importance of differentiating task completion from cognitive closure, whereby people end their cognitions about a task. Indeed, task completion does not necessarily lead to cognitive closure, as revealed by the presence of attention residue after people completed a task under low time pressure. Yet, being able to end the cognitions associated with one task (i.e. reach cognitive closure) when switching to another is necessary to reduce attention residue and enhance performance after the switch.

The present research also contributes to the time pressure literature. Most of the existing research has documented the detrimental effects of time pressure on a current task performance (De Dreu, 2003; Karau & Kelly, 1992; Kelly & McGrath, 1985). However, the effect of time pressure has mainly been studied during the performance of a task and no research has explored the cognitive effect of having experienced time pressure on a task after that task is finished. The present research reveals that time pressure has an important post-completion effect. It triggers cognitive processes that elevate people's confidence in having met the goal of the task they just finished. It is this confidence, which allows people to fully stop thinking about the completed task (as revealed by lower

attention residue on the next task) and to increase their performance on the next task. In other words, while most research focus on then negative effects of time pressure, the present findings reveal that time pressure on a completed task can be beneficial; it facilitates the process of transitioning to another task and thus contributes to higher subsequent task performance.

*Managerial implications*

In order to stay competitive, organizations and employees often strive to manage more tasks or projects at the same time, while keeping up with their fast-paced environment; but at what costs? People often fail at fully switching their attention when they switch tasks and their task performance tends to suffer. In some industries, the effects may be dramatic as when a surgeon goes from one operating room to another throughout the course of a morning. These results suggest that, even when people are asked to work on only one of their tasks, their mind tends to multitask: that is, they tend to think about several tasks at the same time. Multi-tasking (i.e. doing several things *simultaneously*) has often been considered in terms of what people "do" and not necessarily in terms of what people "think about" or how they allocate their attention among their tasks. The present research suggests that even when people are behaviorally focused on one task and are not multi-tasking, their minds may not be completely focused on the task at hand. In other words, multi-tasking may not only be due to competing simultaneous demands, like receiving an email or a text message during a meeting, but may also be a function of how the mind operates in a context where people must manage multiple tasks, activities or responsibilities at the same time.

The solution to being cognitively more focused on a given task may then not fully come from turning off one's Blackberry or working offline. Making people manage only one task at a time is not likely to be a practical solution either. Time pressure, on the contrary, can be beneficial when people complete their task, but it also makes it less likely that people will be able to finish that task. By extension, deadlines may then not only be a good motivator but also have cognitive benefits for task transitions when they can be reached and are actually met. When people can choose which task to focus on, their performance can be enhanced if instead of persisting on working on a task while experiencing attention residue, they go back to the task source of attention residue and first complete that task within time limits.

The issue is also to understand what can aid people in switching tasks, that is, what can help them close their minds to one task when they must concentrate on another. Could people anchor on having reached a milestone or an intermediate goal to temporarily close their minds to a task and thus be able to transition their attention to the next task? This is another question that future research should address. Research on mindfulness may also bring interesting insights. Some studies suggest that people may be able to train their minds to be more fully focused on the present (e.g. Kabat-Zinn, 2005). Such an approach may also help people regulate their attention at work based on their current work activities as well as reduce the impact of prior work activities on their minds.

*Limitations*

As in most research, the present studies have some limitations, which set the direction for future research. Given that people have limited cognitive resources, task performance tends to suffer when people are distracted by unrelated stimuli (Schneider & Fisk, 1982). The effect of task transitions on subsequent task performance is then likely to be mediated by the way people regulate their attention between the prior and the subsequent task, that is, by attention residue. The present findings are consistent with a mediation effect, since both attention residue and performance on task B follow the same pattern of results across the experimental conditions. The experimental design, however, did not permit for actually testing for mediation. To test for mediation, the lexical decision task, measuring attention residue, should be administered before participants perform Task B. But the introduction of the lexical decision task changes the nature and flow of the transitions by adding a third task between Task A and Task B. Performance on Task B is then likely to be influenced by how participants experience not only Task A but also the lexical decision task, thus changing the nature of the study. Future research should explore whether attention residue mediates the effects of the experimental conditions on performance.

Furthermore, task completion in this paper was considered as a dichotomous variable (i.e. finished task/unfinished task). Future research should consider task completion as a continuous variable and explore whether performance on a second task depends upon the degree to which the first task is unfinished or how far one perceives him/herself to be from reaching the goal of the first task. Commitment to the first task or the importance or meaning of its goal may also influence the way people experience not having finished a task and thus may influence how they transition to the next task. The greater the importance or meaning attached to a task, or the more committed people are, the more not having finished a task is likely to be aversive (e.g. Martin & Tesser, 1996). Future research should then explore the extent to which these variables may moderate the effect of an unfinished task on people's attention residue and their performance on the next task.

In the present studies, the timing of the transition was kept constant across conditions. However, transitioning may be more difficult for people if they have to switch tasks at the peak of their concentration on the first task as opposed to when they are just beginning to work on the first task or have worked on it for a long time and have started losing their concentration. Along the same line, group research shows that people tend to change the way they approach their work at the mid-point of the time allotted to a task (Gersick, 1988). The timing of transition, whether in relation to one's concentration level, fatigue, or mid-point of the allotted time for performance, may influence how people experience and react to having to transition to a next task. Future research should explore how the timing of a transition (vis-à-vis the first task) affects attention residue and performance on the next task. Besides, the present paper focused on the case where people could not return to Task A at a later time if they did not finish Task A before switching to Task B. Expecting to return to an unfinished task at a later time may also affect how people transition their attention to and perform on a next task. Because it is difficult to transition one's attention fully and perform well on a task if the previous one is left unfinished, I expect that what matters for task transitions is not simply the ability to later return to Task A when unfinished but rather the expectation of being able to finish Task A upon one's return. Future research should then explore the conditions under which expecting to return to an unfinished task in the future facilitates or hinders the transition of attention to another task and the performance on that task. Overall, this paper sets the stage for further exploring the cognitive and behavioral implications of having to transition between sequential tasks.

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## Appendix A. Task A used in Study 1 and Study 2

| Clues | One word answer |
|---|---|
| 1. It follows "ginger" | 1 |
| 2. It precedes "berry" | 2 |
| 3. It precedes "sled" | 3 |
| 4. Fastener | 4 |
| 5. Palindrome | 5 |
| 6. NYC borough | 6 |
| 7. Music genre | 7 |
| 8. It precedes "up" | 8 |
| 9. Head of a bee hive | 9 |
| 10. Three Little Pig's building material | 10 |
| 11. Soda | 11 |
| 12. Abbreviation for "Robert" | 12 |
| 13. Shade of red | 13 |
| 14. Another word for "father" | 14 |
| 15. It precedes or follows "stick" | 15 |
| 16. Gem | 16 |
| 17. Chess piece | 17 |

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