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Taking Engagement to Task: The Nature and Functioning of Task Engagement Across Transitions

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Engagement is widely viewed as a motivational state that captures the degree to which individuals apply their physical, cognitive, and emotional energies to their jobs, and ultimately improves job performance. However, this job-level view overlooks the possibility that engagement may vary across the different tasks within a job and that engagement in one task may influence engagement and performance in a subsequent task. In this article, we develop and test hypotheses based on a task-level view of engagement and the general notion that there is "residual engagement" from a task that carries forward to a subsequent task. We propose that although task engagement (engagement in a specific task that comprises a broader role) positively spills over to influence task engagement and performance in a subsequent task, in part because of the transmission of positive affect, task engagement simultaneously engenders attention residue, which in turn impedes subsequent task engagement and performance. These predictions were supported in a study of 477 task transitions made by 20 crew members aboard The National Aeronautics and Space Administration's Human Exploration Research Analog (Study 1) and in a laboratory study of 346 participants who transitioned between a firefighting task and an assembly task (Study 2). Our investigation explains how engagement flows across tasks, illuminates a negative implication of engagement that has been masked by the predominant job-level perspective, and identifies completeness as a task attribute that reduces this negative consequence of engagement.

Keywords: task engagement, task transitions, attention residue

> I think that's when mistakes happen–[it's] because you're not fully engaged, and . . . you move from one thing to the next, to the next. It's hard to keep your head in one game after the other after the other.
>
> —International Space Station Astronaut

The extent to which members of organizations engage with their work is a critical determinant of their effectiveness (e.g., Morgan, 2017; Zenger & Folkman, 2017). Defined as the investment of one's physical, cognitive, and emotional energies into the various activities that constitute one's work role (Kahn, 1990), *engagement* is beneficial to both individuals and organizations. For individuals, engagement is a positive motivational force that transmits the effects of a variety of individual and contextual factors to important job-relevant behaviors (Rich, LePine, & Crawford, 2010; Salanova & Schaufeli, 2008; Schaufeli & Bakker, 2004). Indeed, individuals who invest more of their personal energies at work are more satisfied with their jobs and are viewed as performing their jobs more effectively (Christian, Garza, & Slaughter, 2011). For organizations, employee engagement is positively associated with indicators of organization effectiveness such as customer loyalty, sales, and profitability (Harter, Schmidt, Killham, & Agrawal, 2009). Given these findings, scholars have proposed that an engaged workforce is a source of competitive advantage that allows organizations to gain an upper hand over their rivals (Gruman & Saks, 2011; Macey, Schneider, Barbera, & Young, 2009).

Engagement researchers tend to presume that individuals' engagement is relatively consistent across the tasks that comprise their jobs. As such, theories of engagement emphasize the investment of energies in individuals' overall jobs, and the most frequently used measures of engagement (e.g., Rich et al., 2010;

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Schaufeli, Salanova, González-Romá, & Bakker, 2002) capture how individuals attach themselves to their *overall* jobs or how they tend to immerse themselves in *all* the activities that define their work roles (Byrne, Peters, & Weston, 2016). Indeed, Rich and colleagues' (2010) elaboration of Kahn's (1990) engagement concept used the term *job engagement* to describe the construct in order to make the job-level focus explicit. Although this job-level perspective of engagement has clearly taken root in the literature and yielded valuable insights, it is limited in its ability to fully capture the nature and implications of engagement in organizations today.

Many jobs are multifaceted in that they comprise a number of very different tasks (Cohen, 2013; Grant & Parker, 2009; Hasan, Ferguson, & Koning, 2015). As illustrated by our opening quote, the need to switch rapidly between work tasks may be relevant to engagement, and yet it is unclear how engagement functions in contexts with these temporal rhythms or time sensitivity. Although Kahn (1990) mentioned that engagement might vary throughout the course of the workday—a claim that has been supported indirectly by evidence that engagement fluctuates on a daily basis (Fletcher, Bailey, & Gilman, 2018; Xanthopoulou, Bakker, Demerouti, & Schaufeli, 2009)—prior theorizing has not considered how engagement in the specific tasks that comprise one's job could ebb or flow as individuals transition from one task to the next. Moreover, little is known about the extent to which the spillover of engagement across task transitions affects performance in subsequent tasks. Thus, a task-focused perspective on engagement may result in a more complete and relevant theoretical explanation of the phenomenon and lead to practical insights related to issues such as task sequencing that could benefit employees who work in multifaceted jobs.

The objective of this article is to expand our understanding of engagement by advancing a task-level view of the concept and its functioning. Specifically, we develop and test a model that explains how engagement in one task carries over to influence engagement in a subsequent task and how this dynamic transfer of engagement influences performance at the task level. Expanding on Kahn's (1990) work, we propose that engagement in a task has both positive and negative consequences for engagement in a subsequent task. We propose a positive emotional pathway in which engagement in a task produces positive affect, which spills over to influence engagement in a subsequent task. We further propose a negative cognitive pathway in which engagement in a task causes individuals to experience *attention residue*—ruminative thinking about a prior task while engaged in a subsequent task (Leroy, 2009; Leroy & Glomb, 2018; Leroy & Schmidt, 2016)—which hinders engagement and performance in the subsequent task. We augment our theorizing with qualitative data provided by astronauts involved in missions aboard the International Space Station (ISS) and crew members confined in an analog environment on the ground who reported on their experiences transitioning between tasks.

We formally test our hypotheses in two studies. In Study 1, a field study with a sample of 477 task transitions experienced by 20 crew members in The National Aeronautics and Space Administration's (NASA's) Human Exploration Research Analog (HERA), we examine whether engagement in a prior task has a positive indirect effect on performance in a subsequent task through engagement in the subsequent task and whether this indirect relationship may be partially offset by a negative indirect effect through attention residue. We then test whether activated positive affect accounts for the positive spillover of engagement and whether task completion is a boundary condition that mitigates the effects of attention residue in a laboratory study of 346 participants transitioning between a group task and an individual task (Study 2).

The studies reported herein make several theoretical contributions. First, we advance engagement theory by responding to calls to explore the nature and functioning of engagement at the task level (e.g., Bakker, 2014; Sonnentag, 2011). Broadly, we advance the idea that engagement varies at the task level and that "task engagement" flows across transitions to new tasks. More specifically, we develop and test hypotheses regarding how engagement experienced in a task may be related to performance in a subsequent task because it influences engagement in the subsequent task. In this respect, we show how individuals' energies may flow from one task to another and also how this flow can be disrupted. Second, and relatedly, we illuminate both positive and negative consequences of task engagement. Although job-level engagement has been shown to improve job performance (Christian et al., 2011), we theorize and find that task-level engagement carries cognitive costs that can impair subsequent task performance. Thus, we respond to calls to explore how disconnected cognitive energies may influence employee motivation and functioning (e.g., Randall, Oswald, & Beier, 2014). Third, our research provides an integrative account of the mechanisms responsible for the conveyance of personal energies during transitions to new tasks. On the one hand, we identify positive affect as a mechanism that is partially responsible for the beneficial spillover of task engagement. On the other hand, we confirm that attention residue is responsible for the negative impact of prior task engagement on subsequent task performance.

From a practical standpoint, our findings illustrate the potential benefits of understanding how task engagement influences subsequent task performance. Many individuals begin their workday with relatively unengaging tasks (e.g., checking e-mail) that can have negative implications for their well-being (e.g., Kushlev & Dunn, 2015). Our results highlight the importance of individuals' engaging in their work early in the day to reap the positive benefits from "residual engagement" on subsequent engagement and performance. Of course, residual engagement also involves attention residue, which limits these benefits and, consistent with Leroy's (2009) work, can be managed by facilitating completion in a prior task in order to reduce the effect of task engagement on attention residue in contexts in which time urgency exists. Our discussion centers on the application of these ideas to practices such as task scheduling, which could be enhanced to accentuate the positive spillover of engagement and avoid the dampening effect of attention residue on engagement and performance in subsequent tasks.

Theory and Hypotheses

Kahn (1990) characterized engagement as a holistic concept describing how individuals invest their personal energies in their work. Specifically, Kahn theorized that engagement occurs as individuals harness their physical, cognitive, and emotional energies to their work role performances. Individuals invest their physical energy when they apply bodily effort and intensity to their work. They invest their cognitive energy when they mentally focus their attention on their work role requirements. Finally, individuals invest their emotional energy when they care and are enthusiastic about their work. Meta-analyses have shown that individuals' engagement in their jobs is positively associated with outcomes such as task and citizenship performance (Christian et al., 2011).

Task-Level Engagement

Empirical work has begun to examine how engagement might vary within one's job. For example, Xanthopoulou et al. (2009) found that fast food workers' daily engagement varied as a function of their perceived job and personal resources. As another example, Fletcher et al. (2018) found that daily engagement varied as a function of the meaningfulness of daily job tasks and whether resources were sufficient. Although these studies did not examine engagement at the task level or across task transitions, they do provide evidence that engagement is not always stable for a given job, as has been assumed by most prior research. In this article, we further advance the idea that engagement varies within one's job by offering a task-level view of engagement, which we believe is essential to understanding employee functioning and effectiveness in multifaceted jobs (e.g., Cohen, 2013; Sonnentag, 2012). To this end, we define *task engagement* as the degree to which individuals invest their physical, cognitive, and emotional energies into a specific task that composes part of their work role.

The notion of a within-job perspective of engagement and its value was alluded to by Kahn (1990), who wrote that "like using the zoom lens of a camera: a distant stationary image is brought close and revealed as a series of innumerable leaps of engagement and falls of engagement" (p. 719). Although he stopped short of advancing a task-level engagement concept, Kahn acknowledged that "people are constantly bringing in and leaving out various depths of their selves during the course of their work days" (pp. 692–693). Kahn and others (e.g., Fletcher et al., 2018) have also argued that engagement may fluctuate as a function of factors that vary at the task level. For example, Kreiner, Hollensbe, and Sheep (2006) noted that professional clergy might be engaged in meaningful tasks connected to caring for their flock but less so for more mundane, functional tasks such as balancing the church budget.

Our task-level view of engagement proposes that individuals may apply different levels of their full selves to different tasks throughout the workday and that this is reflected by the allocation of their physical, cognitive, and emotional energies that vary across the tasks that are performed. Given that scholars have already acknowledged that the process of attaching and detaching one's self from specific tasks may be influenced, in part, by differences in the characteristics of the particular tasks for which one is responsible (Saks & Gruman, 2014), and because our research centers on the question of how this task-level view informs our understanding of effectiveness in jobs in which these tasks are connected to each other, we focus our inquiry on how the attachment and detachment of one's self to a prior task influences the attachment of one's self through a transition to a subsequent task.

We developed our theoretical model a priori based on the literatures on engagement (Kahn, 1990; Rich et al., 2010; Shin & Grant, 2018), role transitions (Culbertson, Mills, & Fullagar, 2012; Rodríguez-Muñoz, Sanz-Vergel, Demerouti, & Bakker, 2014; Rothbard, 2001), and attention residue (Leroy, 2009; Leroy & Glomb, 2018; Leroy & Schmidt, 2016). However, to bring our theorizing to life and better situate it within our research context, we supplement the following section with illustrative quotes from a sample of 30 NASA crew members. The crew members consisted of astronauts conducting missions aboard the ISS and astronaut-like crew members, who are often aspiring astronauts, in a confined ground-based analog environment (HERA) designed to simulate conditions in space. These environments exert significant time pressure on crew members, as their workday consisted primarily of highly divergent tasks and structured transitions between those tasks. We collected the quotes by applying the critical incident technique (Flanagan, 1954) in 25 surveys administered during ISS missions, in which we asked crew members to recall a recent transition between two tasks and then describe the nature of the tasks, assess how they transitioned, and report any challenges they experienced transitioning. Additionally, within 10 days of the completion of the ISS and HERA missions, we conducted eight 30-min semistructured interviews. Given the limited number of data points, we did not achieve theoretical saturation (O'Reilly, Paper, & Marx, 2012). However, we believe the quotes add dynamism and precision to our theorizing by illustrating the flow of engagement across task transitions in our research context and by highlighting the importance of the mechanisms and boundary condition in our conceptual model (i.e., positive affect, attention residue, and Task 1 completion).

Spillover of Task Engagement

In many jobs, individuals are responsible for a series of different tasks or performance episodes (Cohen, 2013; Ilgen & Hollenbeck, 1991). Our task-centric view of engagement recognizes that engagement may vary across different tasks and that one's level of engagement in a task is likely to predict task performance (e.g., Christian et al., 2011). However, we also propose that when individuals stop working on a task, the energies applied to that particular task may remain activated through the transition to a new task to influence performance in the subsequent task (e.g., D'Mello & Graesser, 2011). In short, individuals' task engagement, or their allocation of personal energies in a task, may endure and impact their performance on a subsequent task. This concept, which we refer to as *residual engagement*, is supported by research that has established that motivationally relevant experiences in a task can spill over and influence performance in a subsequent task (e.g., Schmidt & DeShon, 2009, 2010). Moreover, researchers have provided glimpses into how and why these effects might occur. For example, individuals' physical activity at work has bearing on subsequent productivity (Coulson, McKenna, & Field, 2008), individuals continue to think about a task even after transitioning to something else (Levinson, Smallwood, & Davidson, 2012), and the duration of an emotional experience may last well beyond a trigger event (Rothbard, 2001; Verduyn, Van Mechelen, & Tuerlinckx, 2011). Next, we develop hypotheses regarding mechanisms that could explain how, why, and under what conditions engagement in a prior task might influence performance in a subsequent task.

Positive Affect

Researchers have theorized that engagement engenders and activates *positive affect* (Bakker & Bal, 2010; Kahn, 1990; Rothbard, 2001), defined as the degree to which one experiences a positive mood and feelings (Watson & Clark, 1997; Watson, Clark, & Tellegen, 1988). When individuals allocate and apply their physical, cognitive, and emotional energies to a task, they come to appraise that task as being more personally important, which, in turn, activates positive emotional energy and fosters an inherently satisfying emotional state. For instance, Kahn (1990) described an engaged architect who subsequently expressed the "joy of creating designs both aesthetical and functional" (p. 701). Consistent with Kahn's description, numerous researchers have demonstrated that engagement activates positive feelings that make individuals feel happy, alert, and inspired (e.g., Culbertson et al., 2012; Rothbard, 2001; Salanova, Llorens, & Schaufeli, 2011). This line of thinking is also consistent with scholarly work theorizing that positive affect is an outcome of motivation (e.g., George & Brief, 1996; Naylor, Pritchard, & Ilgen, 1980).

When a discrete event elicits an emotion, that emotion is relatively persistent and individuals continue to experience the emotion as it lingers (Verduyn et al., 2011). In this vein, positive affect does not immediately dissipate once activated but can influence individuals' subsequent activities (e.g., Bledow, Schmitt, Frese, & Kühnel, 2011). Specifically, researchers have theorized that the presence of positive affect may facilitate an individual's entry into a subsequent task (Richardson & Taylor, 2012). Indeed, as Erez and Isen (2002) have demonstrated, affect engendered in one context carries over to other contexts, such that individuals approach subsequent work with more motivation. Similarly, others have concluded that being engaged in a task may create an afterglow that influences subsequent tasks (Isen & Reeve, 2005; Shin & Grant, 2018). Taken together, we argue that task engagement engenders the flow of continued positive thoughts and feelings (Isen, Shalker, Clark, & Karp, 1978), which, in turn, produces an expanded reservoir of available energies (Elsbach & Hargadon, 2006; Fredrickson, 2001, 2004; Salanova, Bakker, & Llorens, 2006). Individuals can then draw upon and apply these enhanced personal energies to subsequent tasks in order to successfully accomplish the requirements of those tasks. Thus, a high level of engagement in one task can lead to positive "gain cycles and spirals" (Salanova et al., 2011), such that the positive and invigorating effects of engagement influence subsequent task performance because they create positive emotions and feelings that carry over to influence subsequent task engagement (e.g., Erez & Isen, 2002; Fisher, 2003).

The positive emotional spillover we have discussed is illustrated in insights we obtained from NASA crew members. For example, one HERA crew member described how positive affect experienced when engaged in a task lingered throughout subsequent task work:

> There was one instance that I can remember that was MMSEV [multi-mission space exploration vehicle] transitioning to something else. I remember thinking—because I was like, "Oh my God, I actually do feel affected" because I was so happy from the previous activity. And that was really kind of like my attitude carried over and that was about it. If I'm emotionally invested for whatever reason in something, that would have a lasting effect afterwards.

Another HERA crew member noted, "If anything spilled over for me it would be Robot and in terms of how I felt about Robot, I've said this a couple times: it was about 90 percent exhilaration and happiness and about 10 percent pure hate."

In summary, we hypothesize that task engagement may enhance performance in a subsequent task because it engenders positive affect, which, in turn, promotes engagement in the subsequent task (e.g., Beal, Weiss, Barros, & MacDermid, 2005; Rich et al., 2010).

> *Hypothesis 1:* Task 1 engagement is positively associated with Task 2 performance.

> *Hypothesis 2:* Task 1 engagement has a positive indirect effect on Task 2 performance through Task 2 engagement.

> *Hypothesis 3:* Task 1 engagement has a positive indirect effect on Task 2 performance through positive affect and Task 2 engagement.

Attention Residue

Although the relationships we hypothesized in the previous section have not been directly articulated previously, they reflect the predominant view that engagement is inherently good and can result in a positive upward spiral (Salanova et al., 2011). That is, engagement engenders positive feelings, which beget greater engagement. In this section, we identify a second mechanism through which task engagement may impact subsequent task engagement and performance. Importantly, this second mechanism serves to offset or mitigate the first and thus explains why the upward spiral of engagement is not limitless, or even assured. In essence, we argue that although task engagement, in general, may positively spill over from one task to another because it engenders positive affect, there may be negative cognitive consequences of task engagement that partially negate its benefits (George, 2011; Sonnentag, 2011).

As Kahn (1990) suggested, highly engaged employees may, at times, experience reduced availability of energies and engagement in subsequent work. Individuals who experience high task engagement are intensely involved and absorbed in their task activities, and when confronted with an altogether new task may have difficulty letting go because it requires the decoupling of the self with personally meaningful efforts that are intrinsically satisfying. Engagement in a task reflects thinking deeply about the task, and when asked to transition to a new task, it may be difficult to switch this thinking off and redirect it to the new task. The implications of this process are that engagement in a task may inhibit the transfer of cognitive energies to a new task, thereby limiting the level of engagement in the new task. This argument is aligned with research suggesting that it is difficult for people to switch cognitive gears at work (e.g., Ancona & Chong, 1996; Freeman & Muraven, 2010; Louis & Sutton, 1991). This line of reasoning is also consistent with experiences relayed by participants in our interviews. For example, one ISS astronaut noted after one particular task transition, "I kept thinking that I should have known better how to hook up the CMRS [Crew Medical Restraint System] and realized that I hadn't done it in a very long time." Similarly, a HERA crew member noted how they ruminated on engaging tasks after transitioning:

> Unpacking what went right and wrong on a mission and how we could do better in the next MMSEV, for example, or same thing with Robot, just could I have done that faster, could we have had a better strategy? So that's kind of still on my mind as I transition.

The idea that individuals may not completely refocus their cognitive energies after a transition to a new task has been explored by Leroy and colleagues in their research on *attention residue*, which refers to persisting thoughts about a previous task after starting a new one (Leroy, 2009; Leroy & Glomb, 2018; Leroy & Schmidt, 2016). Consistent with Leroy and colleagues' findings, as well as our prior arguments, we argue that task engagement engenders attention residue, which, in turn, inhibits engagement and performance in the subsequent task (e.g., Leroy, 2009; Leroy & Schmidt, 2016). This reasoning aligns with a long-standing notion that applying cognitive energy to a specific task soaks up cognitive resources and thereby limits the amount of cognitive energy individuals can allocate to other tasks to benefit task performances (Harrison & Wagner, 2016; James, 1890; Kanfer & Ackerman, 1989). Indeed, research on attention residue and task transitions has shown that transitioning from an engaging task can create interference that leads to reduced performance in terms of slower reaction times and elevated error rates (e.g., Cellier & Eyrolle, 1992; Freeman & Muraven, 2010; Kiesel et al., 2010; Kühnel, Sonnentag, & Westman, 2009; Leroy, 2009; Leroy & Schmidt, 2016). In summary, we argue that task engagement may serve to hinder performance in a subsequent task because it engenders attention residue that dampens engagement in subsequent tasks.

> *Hypothesis 4:* Task 1 engagement is positively associated with attention residue.

> *Hypothesis 5:* Task 1 engagement has a negative indirect effect on Task 2 performance through attention residue and Task 2 engagement.

Task Completion

Thus far, we have argued that there are two offsetting paths through which task engagement influences subsequent task engagement and performance. On the one hand, engagement instills positive affect, which, in turn, fosters engagement and performance in the subsequent task. On the other hand, engagement engenders attention residue, which, in turn, inhibits engagement and performance in the subsequent task. With this framework in mind, one key to understanding how to manage engagement and performance in multifaceted jobs lies in identifying factors that could serve to mitigate the negative pathway attributed to attention residue. Here, we argue that task completion, or the degree to which one perceives that a task has reached closure (Leroy, 2009; Webster & Kruglanski, 1994), is likely to limit the attention residue individuals experience when they transition out of an engaging task.

We propose that Task 1 engagement may produce the most attention residue when individuals perceive that they have left a prior task incomplete. Individuals who are engaged in a task couple their full selves to the task and are motivated to invest their energies to fully satisfy necessary task requirements (Diefendorff & Chandler, 2011; Kahn, 1990; Lewin, 1935). A requirement to transition from an incomplete engaging task may result in a sharp tension and an accompanying thought process, which may amplify the effects of engagement in a task on attention residue and subsequent task engagement and performance (Leroy, 2009; Zeigarnik, 1967). An individual in this dissatisfying situation may be left with a range of thoughts regarding implications of not finishing the engaging task and how best to catch up at some point in the future. As the level of attention residue from the first task increases, it is likely to inhibit the development of engagement in the subsequent task. The significance and implications of transitioning from an engaging but incomplete task were noted by several of the crew members in our sample. For example, one ISS astronaut noted after a task transition,

> I kept thinking about the first task because it had not been completed yet. But this second event is always time critical so you have to break off in the middle of the procedure to make the second event. This makes returning to the first event very hard. Especially because now you are behind the timeline.

Similarly, a HERA crew member indicated,

> I would say if there was something at the end of the task, let's say it was kind of unclear whether or not the task's completed in its entirety, or if for some reason we had unclear instructions or something to that effect where it left it kind of open ended, then sometimes I might think back about, "Oh you know, we need to check on that."

As is evident in these quotes, an engaging but incomplete task causes individuals to expend cognitive energy thinking about how they might pick up the incomplete task at a later time, making it difficult for them to engage with a subsequent task. These effects may be exacerbated by the time pressure individuals experience.

In contrast, we propose that Task 1 engagement is less likely to result in attention residue when individuals perceive they have completed the prior task. As individuals fulfill the requirements of an engaging task, they may perceive a sense of closure with the task and, consequently, are less likely to ruminate about the task or plan new or different strategies for task completion. Instead, their personal resources are likely to be more available to invest in other tasks that comprise their broader work roles. This argument is consistent with Leroy's (2009) work, which has shown that task completion reduces attention residue in contexts when individuals experience time pressure. In summary, we hypothesize the following:

> *Hypothesis 6:* Task 1 completion moderates the positive relationship between Task 1 engagement and attention residue such that the relationship is stronger when Task 1 is incomplete and weaker when Task 1 is complete.

> *Hypothesis 7:* Task 1 completion moderates the negative indirect relationship between Task 1 engagement and Task 2 performance through attention residue and Task 2 engagement such that the indirect effect is stronger when Task 1 is incomplete and weaker when Task 1 is complete.

Overview of Studies

We tested our conceptual model across two studies. With Study 1, our goal was to establish whether the positive spillover of task engagement on subsequent task engagement and performance is offset by attention residue. In this study, we collected 477 task-transition-task episodes across five missions in a confined NASA isolation field environment and formally tested Hypotheses 1, 2, 4, and 5. With Study 2, we tested our entire conceptual model (Hypotheses 1–7) and accounted for some of the methodological limitations of the data gathered in Study 1. The second study involved 346 participants who participated in a laboratory study involving a firefighting simulation and a transition to an assembly task. Study 1 received institutional review board approval under Protocol #2668 ("Residual Engagement—Human Exploration Research Analog [HERA]") from Arizona State University and Protocol #1772 ("Understanding and Preventing Crew Member Task Entrainment") from NASA. Study 2 received institutional review board approval under Protocol #2374 ("Residual Engagement Lab Experiment") from Arizona State University.

Study 1

Method

Sample and procedure. We assessed the offsetting effect of attention residue on task engagement spillover by collecting data from NASA's HERA isolation facility, where crews of four lived together and performed tasks in a confined space-like environment without leaving for 30 to 45 days. Participants included 20 crew members from five missions. This NASA context provided an appropriate environment to test our hypotheses because crew members' work schedule and time is highly programmed and regimented. Specifically, the crew members' workday consists of the performance of a wide array of tasks and transitions between the tasks. Prior to each mission, NASA compiles a daily "playbook" or schedule for each crew member. The playbook is available to view throughout the habitat and creates time pressure for crew members by serving as a constant reminder to complete tasks in the allotted time period before beginning another task.

The focus of this study was task-transition-task episodes in which crew members worked on one task and then transitioned directly to a different task. We worked closely with NASA subject matter experts to identify episodes that could potentially vary in terms of the level of crew member engagement. For example, crew members performed simulated moon walks, rover landing tasks, emergency simulations, public outreach events, asteroid sampling analysis, seed growth projects, brine shrimp analysis, and general maintenance tasks to maintain the habitat. In order to make a conservative test of our hypotheses, we coordinated with NASA subject matter experts to balance task-transition-task episodes, such that crew members switched between engaging tasks, mundane tasks, or a combination of the two. In short, the types and combinations of tasks produced an ideal setting to examine the dynamic nature of task engagement that may exist in many types of jobs and ensured adequate variance on our independent variable—Task 1 engagement. Moreover, some of the tasks were performed by crew members working alone (e.g., seed growth, system maintenance), whereas other tasks were performed with others (e.g., simulated moon walks, rover landing tasks). Crew members completed an average of 25 tasks per day, with the average task duration lasting approximately 30 min.

During the five missions (four of which consisted of 22 training days and 8 "rest" days, and one of which consisted of 32 training days and 13 "rest" days), we captured 477 task-transition-task episodes that crew members naturally performed during their workday. We also worked with NASA subject matter experts to select the episodes in which (a) crew members transitioned immediately from one task to another (without a break period in between), and (b) the first and second tasks were different enough to constitute a transition between different tasks (rather than two periods of performing the same task). Upon completion of a daily Task 1-transition-Task 2 episode, we administered a brief survey in which crew members rated their engagement in the first and second tasks, their attention residue in the initial task during the second task, and task performance. Crew members never reported on more than one task-transition-task episode per workday to protect against contamination with other transition episodes on the same day. Although we acknowledge limitations of the retrospective design (discussed later), we had to balance these concerns with constraints of the NASA mission and the necessity to study naturally occurring transitions. Administering surveys in the middle of a task-transition-task episode would have potentially disrupted the very flows of engagement we were attempting to study.

Task engagement. We measured crew members' engagement in both Task 1 and Task 2. To fit our surveys in the time window allowed by NASA, we used 9 items (3 items each for physical, cognitive, and emotional engagement) that Crawford, LePine, and Buckman (2013) adapted from the Rich et al. (2010) job engagement scale. We further adapted the items by changing the referent experience from "job" to "task." Sample items include "I exerted my full effort in the first task," "I felt energetic working on the first task," and "I concentrated completely on the first task." Crew members rated their level of agreement on a 5-point Likert scale (1 = "*strongly disagree*" to 5 = "*strongly agree*"). Coefficient alpha was .96 for engagement in Task 1, and .96 for engagement in Task 2.

Attention residue. Leroy and Glomb (2018) recently validated a nine-item measure of attention residue. However, the limited time window allowed by NASA necessitated a shortened measure. Consequently, we developed and administered a three-item measure of attention residue. Prefaced by the phrase "while performing the second task," our scale consists of the following items: "My mind kept on drifting back to the first task," "I kept on thinking about the first task," and "I thought about how to do the first task better." Participants rated their level of agreement on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The coefficient alpha for this scale was .95. To examine the validity of our attention residue scale, we recruited 114 full-time Amazon Mechanical Turk workers (33% were female, 65% were Caucasian, average age was 36.0 years [SD = 11.8], and average years of work experience was 13.7 [SD = 9.5]) and asked them to respond to our three-item measure and Leroy and Glomb's nine-item measure. In a principal components factor analysis with varimax rotation conducted in SPSS Version 25, we found that two factors emerged with eigenvalues greater than 1.0 and explained 75.6% of the variance. The first factor included all three of our items and six of Leroy and Glomb's items. The second factor consisted solely of the three reverse-coded items in Leroy and Glomb's scale. Each item factor loading was statistically significant, with values greater than .67 and no cross-loadings above .25. The correlation between Leroy and Glomb's scale and our measure was .79; however, the correlation increased to .89 when removing the three reverse-coded items. These findings provide us reasonable assurance that the two scales tap the same underlying construct.

Task 2 performance. We assessed participants' performance in the second task using a three-item scale developed by Aubé and Rousseau (2005). Sample items for this scale include "Attained the assigned performance goals on the second task" and "Produced quality work on the second task." Although we acknowledge the limitations of self-report performance ratings, in this context, participants understood that the attainment of goals and the quality of outputs could be verified by the parties involved in the mission. All items were on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Reliability of this scale was .82.

Controls. We controlled for crew members' perceptions of performance on the first task using the same measure as Task 2 performance. Controlling for Task 1 performance is important because the extent to which individuals believe that they performed well (or poorly) on a task could relate to their task engagement and attention residue after transitioning to a different task. In addition, social bonds may develop among members of a group involved in a group task (e.g., Hollenbeck, Ellis, Humphrey, Garza, & Ilgen, 2011; Kelly & McGrath, 1985); thus, individuals who transition from a group-based task to an individual-based task may differ in their psychological experience, such as the proclivity to experience attention residue and engagement. To account for this possibility, we included three dummy variables to control for the different types of transitions. We chose individual task to individual task for the comparison group, and thus the three transition dummy variables represented (a) individual task to crew task, (b) crew task to individual task, and (c) crew task to crew task. Finally, we included two temporal controls: the duration of the first task and the time of day a task-transition-task episode was completed (dummy coded as morning or afternoon). We reasoned that the time spent on a task could potentially introduce mind wandering (Randall et al., 2014), and crew members could be more fatigued with tasks performed later in the day (Hülsheger, 2016).

Results

Confirmatory factor analysis. Descriptive statistics, correlations, and reliabilities for our Study 1 variables are presented in Table 1. In order to verify the factor structure of our measurement model and further establish discriminant validity of our attention residue scale, we conducted a confirmatory factor analysis (CFA) using Mplus Version 7.4 (Muthén & Muthén, 2015). We specified a CFA model with three latent factors (task engagement, attention residue, and Task 2 performance), using individual items as indicators. Task engagement was modeled as a higher order factor consisting of three lower order dimensions: physical, cognitive, and emotional engagement (Rich et al., 2010). In addition, as our model includes the same latent factor (engagement) measured across two tasks, we modeled Task 1 engagement and excluded Task 2 engagement in our CFA model. Results with Task 2 engagement included and Task 1 engagement excluded did not significantly alter the results of the CFA. Overall, our hypothesized three-factor model exhibited good fit to the data, $\chi^2(84) = 185.98$, $p < .001$, comparative fit index (CFI) = .99, root mean square error of approximation (RMSEA) = .05, standardized root mean square residual (SRMR) = .02. In addition, all factor loadings were statistically significant, the average variance explained was greater than .50 for each factor (Fornell & Larcker, 1981), and the three-factor model fit the data better than alternative models that included one or two latent factors.

Hypotheses testing. Although the primary focus of our theoretical model is on the flow of task engagement across task transitions, the hierarchical structure of our data (477 task-transition-task episodes nested within 20 individuals) necessitated that we control for the nesting of task transition episodes within crew members. Following guidelines provided by Raudenbush and Bryk (2002), we first assessed whether sufficient Level 2 variance (between individuals) was present in our data. Specifically, we tested three null models for each of our dependent or endogenous variables of interest (attention residue, Task 2 engagement, and Task 2 performance). Results indicated that significant variance at Level 2 (individual level of analysis) existed for attention residue ($\tau^2 = .30$, $p = .003$, intraclass correlation coefficient (ICC)[1] = .31), Task 2 engagement ($\tau^2 = .17$, $p < .001$, ICC[1] = .22), and Task 2 performance ($\tau^2 = .06$, $p = .003$, ICC[1] = .13). We should note that although the 20 crew members that comprise our sample were nested in five crews, we did not account for crew-level nesting effects for two reasons. First, our three endogenous variables of interest had trivial levels of variance at the crew level: Task 2 engagement ($\tau^2 = .03$, ICC[1] = .04), attention residue

Table 1
Study 1: Descriptive Statistics, Correlations, and Reliabilities

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Task 1 engagement	4.19	.81	(.96)								
2. Attention residue	1.75	.98	.23*	(.95)							
3. Task 2 engagement	4.19	.88	.16*	−.18*	(.96)						
4. Task 2 performance	4.44	.68	.07	−.13*	.36*	(.82)					
5. Task 1 performance	4.43	.69	.33*	−.08	.16*	.32*	(.83)				
6. Individual to team transition	—	—	.07	.12*	−.20*	−.15*	−.07	—			
7. Team to individual transition	—	—	−.10*	−.14*	.14*	.08	.02	−.26*	—		
8. Team to team transition	—	—	−.09	−.07	−.04	−.04	.00	−.21*	−.25*	—	
9. Task 1 duration	61.07	38.26	.41*	.29*	−.22*	−.12*	.09*	.28*	−.28*	−.27*	—
10. Time of day	.54	.50	.06	.01	−.04	−.05	−.03	.06	−.20*	−.10*	.25*

Note. $N = 477$. Transition type dummy coded (i.e., individual to team transition, team to individual transition, and team to team transition); time of day dummy coded (1 = afternoon, 0 = morning).
* $p < .05$.

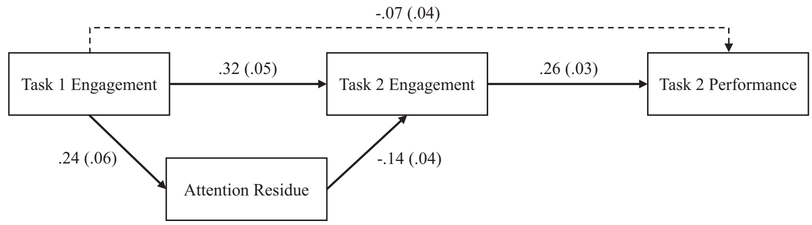

Figure 1. Structural equation model (Study 1); $N = 477$. Unstandardized path coefficients are presented; standard errors are in parentheses. All paths with a solid line are significant at $p < .05$.

($\tau^2 = .07$, ICC[1] = .08), and task performance ($\tau^2 = .02$, ICC[1] = .05). Second, the small number of crews did not afford us with sufficient statistical power to specify a three-level structural model. Accordingly, we specified a model in Mplus that accounted for nesting effects at the individual level of analysis (Level 2). Our hypothesized path model, which is depicted in Figure 1, suggested good fit to the data, $\chi^2(6) = 5.48$, $p = .48$, CFI = 1.00, RMSEA = .00, SRMR = .02 (for within level of analysis), and SRMR = .00 (for between level of analysis).

Results from our analysis do not support Hypothesis 1. That is, we did not find a positive relationship between Task 1 engagement and Task 2 performance ($b = -.07$, $SE = .04$, $p = .08$). In contrast, Hypothesis 4, which predicts that Task 1 engagement is positively related to attention residue, is supported ($b = .24$, $SE = .06$, $p < .001$).

Hypothesis 2 predicts a positive indirect relationship between Task 1 engagement and Task 2 performance through Task 2 engagement, and Hypothesis 5 predicts a negative indirect relationship between Task 1 engagement and Task 2 performance through attention residue and Task 2 engagement. Because indirect effects represent the product of multiple path coefficients, and therefore are not normally distributed, we estimated the sampling distribution of the first (Task 1 engagement → Task 2 engagement) and second (Task 2 engagement → Task 2 performance) stage coefficients using a Monte Carlo simulation in R with 20,000 iterations (Bauer, Preacher, & Gil, 2006; MacKinnon, Fairchild, & Fritz, 2007; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Preacher, Zyphur, & Zhang, 2010) to test Hypothesis 2. We used this same Monte Carlo approach to estimate the sampling distribution of the first (Task 1 engagement → attention residue), second (attention residue → Task 2 engagement), and third (Task 2 engagement → Task 2 performance) stage coefficients to test Hypothesis 5. This approach provides bias-corrected confidence intervals for assessing the statistical significance of the indirect effects depicted in Figure 1.

As shown in Table 2, Task 1 engagement has a positive indirect effect on Task 2 performance through Task 2 engagement (indirect effect = .08, 95% CI [.052, .119]), supporting Hypothesis 2. In other words, engagement in a task fosters engagement in a subsequent task, which, in turn, is positively associated with performance in the subsequent task. In support of Hypothesis 5, Task 1 engagement has a negative indirect effect on Task 2 performance through attention residue and Task 2 engagement (indirect effect = −.01, 95% CI [−.016, −.003]). Stated more plainly, engagement in a task engenders attention residue, which negatively impacts subsequent task performance through subsequent task engagement.

Discussion

We did not find support for our hypothesis that Task 1 engagement and Task 2 performance are positively related. However, the lack of a positive direct effect in our model, and the weak and nonsignificant zero-order relationship depicted in Table 1 are understandable in light of our hypothesis regarding the mitigating effects of attention residue. That is, the lack of an apparent relationship between Task 1 engagement and Task 2 performance may be explained by an indirect effect of attention residue that partially offsets the positive spillover of Task 1 engagement to Task 2 performance through Task 2 engagement. In other words, it is not that task engagement is irrelevant to performance in a subsequent task; rather, task engagement has mixed implications with respect to its impact on performance in subsequent tasks.

Of course, Study 1 is subject to limitations. First, constraints imposed by the research setting limited our ability to temporally separate the measurement of our study variables and, therefore, our ability to draw causal inferences. Second, task performance was self-reported, which increases the risk of bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). However, we were able to access a limited number of objective ratings of crew member performance (the number of objectives met during multimission space exploration flights). The correlation between self and objective performance ratings in 54 of the tasks was .49 ($p < .001$), which is consistent with findings of prior research regarding the relationship between subjective and objective metrics of performance (Bommer, Johnson, Rich, Podsakoff, & MacKenzie, 1995). Given that we controlled for self-rated prior performance, we are optimistic regarding the validity of the self-ratings in our study. Nevertheless, a study with an alternative source of performance ratings would be valuable. Perhaps more importantly, although we

Table 2
Study 1: Indirect Effects From Task 1 Engagement to Task 2 Performance

	Task 2 performance		
Mechanism	Indirect effect	*SE*	95% CI
Task 2 engagement	.08*	.02	[.052, .119]
Attention residue and Task 2 engagement	−.01*	.00	[−.016, −.003]

Note. $N = 477$. Unstandardized indirect effects, *SE*s, and Monte Carlo bootstrapped (20,000) CIs are reported. *SE* = standard error; CI = confidence interval.
* $p < .05$.

found support for the idea that engagement in the first task fosters engagement in the second task, we did not fully explore why engagement in the two tasks were related, nor did we explore factors that might influence the strength of the explanatory pathways. In particular, a second study examining our hypotheses concerning the mediating role of positive affect and the moderating role of task completion could provide further insight into how and under what conditions task engagement might influence engagement and performance in a subsequent task, and how performance in multifaceted work could also be enhanced.

Study 2

Study 2 was designed to build upon Study 1 in several ways. First, whereas Study 1 tested only a subset of our hypotheses, Study 2 tests our entire conceptual model. Second, although Study 1 occurred in a context in which task transitions are frequent and critical to mission success, aspects of the design increased the likelihood of measurement bias and presented threats to internal validity. Thus, in Study 2, we used a laboratory study to increase the degree of control over the tasks and reduce potential concerns regarding common method variance and retrospective accounts of beliefs and feelings regarding prior tasks.

Method

Participants. We conducted a laboratory study in which 364 undergraduate students at a large U.S. university participated in exchange for course credit. We excluded 18 participants who either expressed suspicions regarding the nature of our study or responded carelessly to the survey as identified by an even–odd consistency measure (Meade & Craig, 2012). Our final sample was composed of 346 participants. Participants' average age was 22.81 years (SD = 3.41) and 61.8% were male; 46.5% of participants were Caucasian, 29.2% were Asian, and 13.6% were Hispanic; 54.0% of participants reported that they were currently employed, with an average work experience of 4.06 years (SD = 3.53).

Procedure. Each session consisted of a group of four participants. Each group was randomly assigned to either the Task 1 incomplete condition or the Task 1 complete condition. Upon arriving at our lab, participants completed a survey of individual differences. Based on results of Study 1, which indicated that the type of transition (e.g., crew to individual, individual to crew, individual to individual, crew to crew) explained little variance in our outcomes, we controlled for type of transition by design. That is, we structured the study such that all participants first performed a group task that was followed by an individual task. In introducing the study, the experimenter told participants that they would take part in a series of tasks—a group firefighting task and an independent assembly task of a firefighting truck—that were part of their larger firefighting job. We allotted 20 min to each task so that participants would sense a degree of urgency, consistent with our previous study.

Upon completion of the initial survey, the experimenter introduced C3Fire (Johansson, Trnka, Granlund, & Götmar, 2010), a firefighting simulation, and informed the participants they would work on this computer simulation as a group for 20 min. We chose a firefighting task because it is meaningful and consequential to participants, and thus likely to engender task engagement that could spill over into a second task. Although there were elements of the task that necessitated some degree of interdependence and communication among participants, we programed the simulation in a way that emphasized distinct individual roles and the performance of those individual roles. Thus, the task was designed to promote sufficient individual-level variance to maintain the individual as the primary unit of theory and analysis. The experimenter conducted a brief training session (approximately 10 min) during which he explained the objective of the firefighting simulation and participants' individual roles.

Participants in the C3Fire simulation extinguish as many forest wildfires as possible while also containing the fire and protecting landmarks such as houses, schools, and hospitals. Participants were randomly assigned to one of the following four roles within the simulation: fire chief, fire fighter, fire scout, and water carrier. The fire chief was responsible for coordinating crew actions and movements, and was the only member that could see the location of other crew members and the location of all active fires. The firefighter's task was to put out and contain the fires. Although the firefighter could quickly extinguish fires, movement across terrain to other fires was slow. The fire scout, however, could move quickly across the terrain. Consequently, the fire scout's duties were to respond to, contain, and extinguish distant fires. To facilitate quick movement, the scout's complement of equipment was small and, thus, limited in firefighting capabilities. Finally, the water carrier was tasked with transporting water to other crew members so they could perform their task responsibilities. Members had distinct duties and communicated with each other during the simulation, but we programmed the task so that members spent the majority of their time performing their individual roles, which were quite similar in the level of complexity and required effort.

We manipulated Task 1 completion after participants had reached 20 min of activity on the firefighting simulation. At that time, the experimenter told participants in the Task 1 complete condition that the firefighting task simulation was complete. In the Task 1 incomplete condition, the experimenter told participants that they had not completed the firefighting task simulation and that they would need to continue to fight remaining fires later in the session. Although participants did not receive individual performance feedback, participants in both conditions were shown the wildfire map of their simulation results so that they could assess their group's performance in the task. Participants then answered a brief survey asking about their level of engagement and positive affect during the simulation.

Following this survey, participants were told the following:

> Many jobs contain maintenance tasks, wherein equipment and materials must be maintained in order to retain their useful life. During the course of your firefighting work, you have driven over rough, burned out terrain, and the top portion of your fire truck has been damaged. Consequently, if you want to fight future fires, you must now maintain and repair your truck.

Participants were told that to simulate this aspect of the firefighting job, they would need to assemble a LEGO fire truck. Participants were each given a complete set of LEGOs and were told they could take 20 min to complete the task of building the truck according to the instructions, which we supplied ("truck maintenance task"). We chose a LEGO task because it is similar to some of the assembly tasks performed by the crew members in Study 1 and provides a clear metric of performance. When participants completed the LEGO truck, they informed the experimenter, who recorded how long it took the participant to finish the task (some participants finished the task early). After the 20 min were complete, participants who had not yet finished the truck maintenance task were asked to stop working.

Participants were then given a survey in which they rated their attention residue from Task 1 (firefighting simulation) during Task 2 (truck maintenance task) and also their engagement in Task 2. During this time, the experimenter assessed the number of LEGO pieces each participant had accurately and inaccurately assembled. Finally, participants provided demographic information, indicated whether they had suspicions about the study's goals, and provided general open-ended comments about their reactions to the study. Upon completion of the final survey, participants were debriefed and dismissed. In all, each study lasted approximately 90 min.

Task engagement. We used the long form of Rich et al.'s (2010) Engagement scale, which included the nine items from Study 1, to assess participants' engagement in the firefighting and truck maintenance tasks (e.g., Crane, Crawford, Buckman, & LePine, 2017). Sample items include "I worked with high intensity on the [firefighting simulation/truck maintenance task]," "My heart was in the [firefighting simulation/truck maintenance task]," and "I paid a lot of attention to the [firefighting simulation/truck maintenance task]." Participants rated their level of agreement on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The coefficient alpha for this measure was .94 for engagement in Task 1 and .95 for engagement in Task 2.[1]

Attention residue. We assessed participants' attention residue with the three-item measure described in Study 1 and adapted it to pertain to the lab tasks. Participants rated their level of agreement on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The coefficient alpha was .79.

Positive affect. We measured participants' positive affect during the firefighting simulation using 10 items from the Positive and Negative Affect Schedule (PANAS-X; Watson & Clark, 1994). Participants were instructed to indicate the extent to which they felt "interested," "excited," "strong," "enthusiastic," "proud," "alert," "inspired," "determined," "attentive," and "active" during the firefighting simulation on a 5-point Likert scale (1 = *very slightly or not at all* to 5 = *extremely*). The coefficient alpha for this scale was .89.

Task 2 performance. We operationalized participants' performance in the truck maintenance task by first calculating the number of LEGO blocks they accurately assembled per minute. For instance, if a participant correctly put together a total of 60 blocks in 10 min, he or she received a score of 6. The truck maintenance task had a total of 77 LEGO pieces, and participants' average score was 4.68 (SD = 1.65). In order to assist in the interpretability of indirect effects in our model, we standardized participants' scores by conducting a z-score linear transformation. The mean score was 0 after transformation, with a standard deviation of 1.00.

Control variables. Although we randomly assigned participants to conditions, we measured rather than manipulated many of the variables in our model. Therefore, we included several statistical control variables to rule out alternative explanations and more accurately capture the relationships between our focal variables (Bernerth & Aguinis, 2016). This approach is commonly adopted in studies with similar research designs (e.g., Chen & Mathieu, 2008; Wagner, Barnes, Lim, & Ferris, 2012). First, individuals with high levels of general mental ability (GMA) may have more cognitive energies at their disposal to invest in their tasks and may be better able to focus on current tasks (e.g., Kanfer & Ackerman, 1989; Randall et al., 2014). As such, we controlled for participants' GMA by administering a 6-min general aptitude test that we developed for settings in which time constraints and participant fatigue is a concern.[2] We also controlled for participants' trait positive affect (Watson & Clark, 1994), as prior research indicates that the extent to which individuals experience positive affect in certain situations (i.e., state affect) is largely influenced by individuals' general mood (i.e., trait affect; Nemanick & Munz, 1997; Watson, 1988). Furthermore, individuals' dispositional willingness to try something different (McCrae & Costa, 1997) may influence how effectively they transition between tasks and perform those tasks (Dane, 2018), so we used 10 items from the International Personality Item Pool to control for participants' openness to experience (Goldberg et al., 2006). Additionally, because individuals performed the first task in teams with specific roles in which social bonds could develop (Hollenbeck et al., 2011), we controlled for team membership as well as team role. Consistent with Study 1, we reasoned that participants' performance on the first task could influence the degree to which they ruminated or experienced positive emotions with the first task that carried over to the second task. Consequently, we controlled for participants' objective performance and perceptions of their performance on the firefighting task. Finally, we controlled for participants' demographics (i.e., age and gender), as certain characteristics may potentially impact their familiarity with, and

[1] Given the importance of distinguishing *task* engagement from *job* engagement for our theoretical arguments, we took an additional step to ensure that participants were rating their levels of engagement in each *task*. Specifically, we examined participants' open-ended comments regarding the experiment and counted the number of times participants mentioned the terms *task* and *job*. The word *job* came up in seven participant responses (out of 346), and the term was used generically to refer to performance or how team members filled different roles in the firefighting task (e.g., "Overall our team did a really good job" and "Everyone should do their own job well in a group"). In contrast, the word *task* came up in 45 participant responses and was used most often in reference to the two experimental activities and switching between them (e.g., "Completing a task and then working on a different task" or "Switching from multiple tasks"). Combined with our experimental protocol that explicitly described the firefighting simulation and LEGO truck assembly as different tasks that comprise the firefighter job, we are confident that our items accurately captured participants' engagement at the task level.

[2] Our test is similar to the Wonderlic cognitive assessment (https://www.wonderlic.com/) with respect to the types of items. We administered the test we developed, along with the Wonderlic, to 73 undergraduate students (81% were male, 60% were Caucasian, and their average age was 22.6 [SD = 2.72]). We alternated between administering our GMA test first and the Wonderlic first, and found that scores on our GMA test are correlated with scores on the Wonderlic at .74, which gives us assurance that our test is tapping participants' GMA the same way the Wonderlic is. The magnitude of the correlation is about what we expect given research on alternative test forms reliability (e.g., Coyle, 2006). It is important to note that this correlation is commensurate or stronger than the correlation between scores on the Wonderlic and scores on other standardized tests that have been used as an indicator of GMA (e.g., Coyle, 2006; Coyle & Pillow, 2008; Frederick, 2005).

performance on, our experimental tasks (e.g., Blakemore & Centers, 2005).

Results

Manipulation check. Descriptive statistics, correlations, and reliabilities for Study 2 are presented in Table 3. As part of the survey participants completed when they rated their engagement and positive affect in the firefighting simulation, we also asked participants to rate the extent to which they had fully completed the firefighting simulation on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The mean of this manipulation check item was significantly higher for the Task 1 complete condition ($M = 4.05$, $SD = 1.05$) than for the Task 1 incomplete condition ($M = 3.17$, $SD = 1.26$), $t(344) = 7.03$, $p < .001$, suggesting that our manipulation worked as intended.

Hypotheses testing. As our sample for Study 2 had a nested structure (individual participants nested in teams), we first assessed whether significant between-team variance was present in our data. Consistent with Study 1, we conducted our Study 2 analysis in Mplus Version 7.4 (Muthén & Muthén, 2015). Moreover, following the same procedure as in Study 1, we tested null models for the endogenous variables in our path model (Raudenbush & Bryk, 2002). However, results indicated that significant between-team (Level 2) variance did not exist for our endogenous variables of interest: Task 2 engagement ($\tau^2 = .01$, $p = .78$, ICC[1] = .02), attention residue ($\tau^2 = .00$, $p = .93$, ICC[1] = .03), positive affect ($\tau^2 = .06$, $p = .12$, ICC[1] = .11), and Task 2 performance ($\tau^2 = .04$, $p = .40$, ICC[1] = .05). As such, we specified our path model at the individual level of analysis.

Our hypothesized model, which is depicted in Figure 2, provided a good fit to the data, $\chi^2(9) = 10.79$, $p = .29$, CFI = 1.00, RMSEA = .03, SRMR = .02. In addition, our model replicated the results of Study 1 (Hypotheses 1, 2, 4, and 5). Hypothesis 1, which predicted a positive relationship between Task 1 engagement and Task 2 performance, was not supported ($b = -.04$, $SE = .09$, $p = .71$). However, consistent with our predictions for Hypothesis 4, Task 1 engagement had a positive relationship with attention residue during the second task ($b = .17$, $SE = .08$, $p = .03$). To test the indirect effects of Task 1 engagement on Task 2 performance (i.e., Hypotheses 2, 3, and 5), we utilized the same approach as in Study 1. Specifically, we estimated the sampling distributions of the first-, second-, and third-stage coefficients using a Monte Carlo simulation with 20,000 iterations, then calculated the boundaries of a bias-corrected 95% confidence interval (Preacher et al., 2010). As reported in Table 4, Task 1 engagement had a positive indirect effect on Task 2 performance via Task 2 engagement (indirect effect = .17, 95% CI [.071, .288]), providing support for Hypothesis 2. In support of Hypothesis 3, Task 1 engagement had a positive indirect effect on Task 2 performance through positive affect and Task 2 engagement (indirect effect = .06, 95% CI [.006, .127]). Finally, Task 1 engagement had a negative indirect effect on Task 2 performance via attention residue and Task 2 engagement (indirect effect = −.02, 95% CI [−.051, −.001]), providing support for Hypothesis 5.

Hypothesis 6 predicted that task completion moderates the positive relationship between Task 1 engagement and attention residue such that this relationship is stronger when Task 1 is incomplete and weaker when Task 1 is complete. As shown in Figure 2, the interaction of Task 1 engagement and Task 1 completion was significantly associated with attention residue ($b = -.31$, $SE = .15$, $p = .04$). To assess the nature of the interaction, we conducted a simple slopes analysis (Aiken & West, 1991) and plotted the interaction at "incomplete" and "complete" conditions of the moderator, as shown in Figure 3. Providing further support for Hypothesis 6, the positive relationship between Task 1 engagement and attention residue was stronger in the Task 1 incomplete condition (*simple slope* = .32, $SE = .12$, $p = .01$) than in the Task 1 complete condition (*simple slope* = .02, $SE = .10$, $p = .86$).

Hypothesis 7 predicts that Task 1 completion moderates the negative indirect effect from Task 1 engagement to Task 2 performance through attention residue and Task 2 engagement such that the negative indirect effect is stronger when Task 1 is incomplete and weaker when Task 1 is complete. To test for conditional indirect effects (i.e., moderated mediation), we utilized the same

Table 3
Study 2: Descriptive Statistics, Correlations, and Reliabilities

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Task 1 engagement	3.77	.58	(.94)													
2. Attention residue	2.23	.87	−.00	(.79)												
3. Task 2 engagement	3.85	.65	.39*	−.28*	(.95)											
4. Positive affect (state)	3.22	.87	.64*	.02	.35*	(.89)										
5. Task 2 performance	.00	1.00	.15*	−.16*	.34*	.13*	—									
6. Task 1 completion	.52	.50	.07	−.16*	−.00	.04	.08	—								
7. Age	22.81	3.42	.16*	−.00	.10	.15*	−.06	−.02	—							
8. Gender	1.39	.49	−.02	−.11*	.16*	−.04	−.15*	.05	−.10	—						
9. General mental ability	9.51	3.69	.12*	−.27*	.10	.01	.25*	−.01	−.14*	−.04	—					
10. Positive affect (trait)	3.39	.77	.27*	−.10	.29*	.42*	.03	.06	.00	−.00	.13*	(.88)				
11. Openness to experience	4.91	.82	.17*	−.15*	.31*	.18*	.11*	.08	.01	.23*	.04	.28*	(.76)			
12. Team membership	—	—	.14*	−.10	.14*	.08	.07	−.02	.07	−.14*	.01	.13*	.09	—		
13. Team role	.24	.42	.11*	−.01	.00	−.01	.01	.01	−.09	−.02	.03	.11*	−.02	−.03	—	
14. Task 1 performance (objective)	455.50	214.39	.13*	−.15*	−.04	.20*	.15*	.04	−.05	.02	.07	.00	−.01	−.17*	−.01	—
15. Task 1 performance (subjective)	3.10	1.29	.15*	−.10	−.06	.24*	.09	.05	−.02	.01	−.01	.02	.01	−.03	−.02	.77*

Note. $N = 332$. Task 1 completion coded 0 = incomplete condition, 1 = complete condition. Gender coded 1 = male, 2 = female. Team role coded 1 = fire chief, 0 = other role.
* $p < .05$.

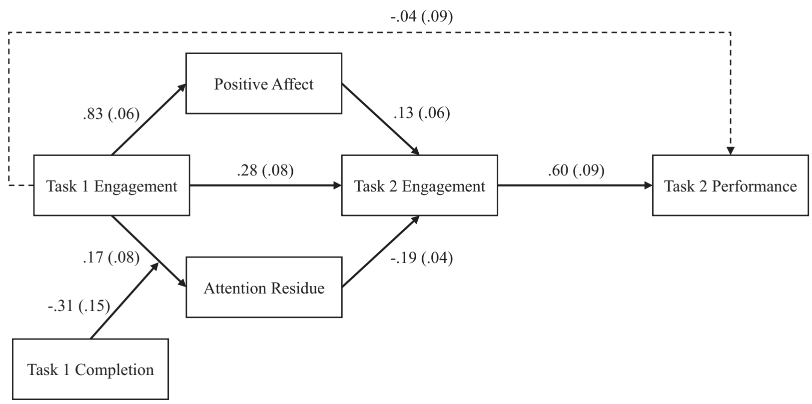

Figure 2. Structural equation model (Study 2); $N = 332$. Unstandardized path coefficients are presented; standard errors are in parentheses. All paths with a solid line are significant at $p < .05$.

approach as our analysis of indirect effects described in Study 1 but with the simple slopes at the complete and incomplete conditions replacing the coefficient for the first path of the indirect effect (Task 1 engagement → attention residue; Preacher, Rucker, & Hayes, 2007). Results show that the indirect effect is negative when Task 1 is incomplete (indirect effect = −.04, 95% CI [−.074, −.009]), but nonsignificant when Task 1 is complete (indirect effect = −.00, 95% CI [−.026, .020]). As an indication of moderated mediation and supporting Hypothesis 7, the conditional indirect effects are significantly different (Δ indirect effect = .04, 95% CI [.007, .086]).

Discussion

Study 2 results provide a more complete depiction of the dynamic effects of engagement in one task on engagement and performance in a subsequent task. Again, we did not find support for the direct relationship between Task 1 engagement and Task 2 performance. However, consistent with Study 1, our results suggest that this is a function of two offsetting pathways. That is, there is a positive spillover pathway, attributable to positive affect, which is partially offset by a negative pathway through attention residue. We also found that the detrimental effects of attention residue on subsequent engagement and performance are mitigated when a prior engaging task is viewed as being more complete. Thus, our findings illuminate the potential of managing attention residue so that the enhancing effects of task engagement on subsequent task engagement and performance can flow unobstructed throughout a workday.

Table 4
Study 2: Indirect Effects of Task 1 Engagement on Task 2 Performance

Mechanism	Task 2 performance: Indirect effect	*SE*	95% CI
Task 2 engagement	.17*	.05	[.071, .288]
Attention residue and Task 2 engagement	−.02*	.01	[−.051, −.001]
Task 1 incomplete condition	−.04*	.02	[−.074, −.009]
Task 1 complete condition	−.00	.01	[−.026, .020]
Difference between incomplete and complete	.04*	.02	[.007, .086]
Positive affect and Task 2 engagement	.06*	.03	[.006, .127]

Note. $N = 332$. Unstandardized indirect effects, *SE*s, and Monte Carlo bootstrapped (20,000) CIs are reported. *SE* = standard error; CI = confidence interval.
* $p < .05$.

General Discussion

Across two studies, we develop and test a task-level view of engagement that explains how, and under what conditions, engagement in one task may spill over and be related to engagement and, by extension, performance in a subsequent task. In both studies, we found that task engagement positively cascades to a subsequent task when individuals transition from one task to another. However, we also found that task engagement can lead to attention residue that reduces the positive effect of task engagement on subsequent task engagement and performance. In Study 2, we specifically examine and find support for positive affect as the mechanism partially responsible for the positive spillover of engagement. Furthermore, task completion mitigates the effects of Task 1 engagement on attention residue.

Theoretical Implications

The research reported in this article has several important implications. First, our view of engagement at the task level provides a more nuanced and dynamic explanation of how engagement operates. By focusing our theoretical attention at the task level, we were able to examine how engagement in a specific task influences the extent to which individuals invest their energies in a subsequent task. Our results underscore the critical role that task transitions play in understanding task engagement and task performance, primarily because of the residual engagement or spillover effect of engagement that we observed across transitions. This spillover of engagement further illuminates "the momentary ebbs and flows" of engagement over the course of daily performance episodes (Kahn, 1990, p. 693). In this respect, we not only respond to calls to explore engagement in specific tasks (Bakker, 2014;

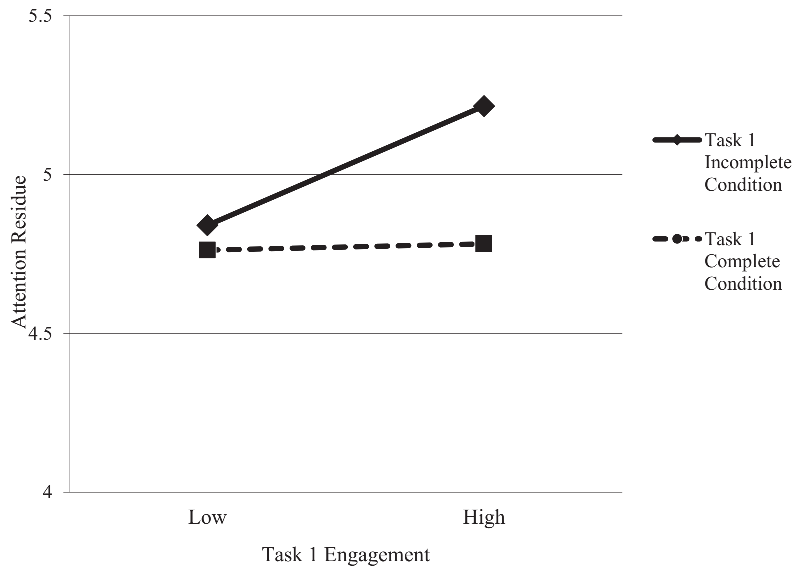

Figure 3. Task 1 engagement and Task 1 completion predicting attention residue (Study 2).

Sonnentag, 2011) but also consider the dynamic nature of engagement across task transitions in a way that is more reflective of today's multifaceted work environment.

Second, in contrast to the predominant view that engagement at the job level is largely beneficial in terms of general work performance (e.g., Christian et al., 2011), we find that viewing engagement at the task level uncovers both positive and negative performance implications. Importantly, we find that the emotional and cognitive components of engagement may have differential effects at the task level. Although the emotional component of engagement positively spills over to facilitate subsequent task engagement and performance, the cognitive component hinders subsequent task performance by producing attention residue. Our findings—that aspects of engagement may have some drawbacks when viewing how engagement unfolds from one task to the next—respond to scholars who have speculated that engagement may have previously unexplored costs (George, 2011; Sonnentag, 2011). Moreover, attention residue provides an explanation for why there may be limits to engaged employees' energies (e.g., Kim, Park, & Headrick, 2018) and what could otherwise be an upward spiral of engagement from one task to another. Indeed, to the extent that engagement in a task is viewed as something that is unequivocally positive with regard to the next task, the upward bounds could have no limits. Thus, the inclusion of attention residue to our understanding of the functioning of task engagement has ecological value and addresses an obvious logical gap with current theory. At the very least, our work presents a more balanced view of engagement that illuminates the performance implications of its bright and dark sides.

Third and relatedly, we provide a more fine-grained perspective of the psychological mechanisms that facilitate or hinder the transfer of individuals' personal energies and produce these positive and negative effects across task transitions. By unpacking the dynamic nature of task engagement, we "specify more precisely the processes underlying micro role transitions" (Ashforth, Kreiner, & Fugate, 2000, p. 486) that occur between the tasks that comprise a work role. On the one hand, our results show that when individuals invest their energies in a task, their efforts generate positive affect which in turn facilitates increased engagement and performance in subsequent tasks. On the other hand, investing in one's work can also produce attention residue. In contrast to positive affect, attention residue restricts subsequent task engagement and performance as individuals' focus remains tethered to a previous task. Thus, task engagement appears to have mixed implications for individuals as positive affect and attention residue differentially impact subsequent task engagement and subsequent task performance. By increasing our understanding of how positive affect and attention residue operate in tandem, we provide a view of the task transition phenomenon that is more cohesive. In sum, we provide greater theoretical insight regarding engagement in boundary-crossing activities at the task level as well as the internal mechanisms that span multiple boundaries.

Finally, our research extends Leroy's (2009) research on the workplace implications of attention residue. We replicate Leroy's findings that experiencing attention residue from a prior task can impede performance on a subsequent task. However, we extend prior work by identifying task engagement as an attribute of task work that can intensify the experience of attention residue. These findings are significant given that "very little is known about predictors of performance variability within persons who are still participating in the workplace" (Sonnentag & Frese, 2012, p. 569), particularly with respect to how engagement dynamically impacts performance. Our finding that the association between Task 1 engagement and attention residue is weaker when individuals perceive that the prior task is completed is also consistent with Leroy's finding that task completion reduces attention residue under conditions of high time pressure. However, the present research is the first to establish that the effects of completion are strong enough to offset the negative cognitive effects of high levels of Task 1 engagement. These findings suggest that the beneficial effects of task completion in mitigating attention residue may be even stronger than has been suggested by previous research.

Limitations and Future Research

Although our studies have several theoretical implications, there are also limitations. First, we considered task engagement and its effects over the course of only one task transition episode, and we were unable to capture the far-reaching impact of positive affect and attention residue over multiple transitions. To provide a richer understanding of task engagement, future research could examine these effects over many performance episodes and transitions. This examination could lend additional insight into how individuals invest energies in specific tasks and even how they manage a state of flow over many episodes (e.g., Csikszentmihalyi, 1997). Relatedly, in Study 2, we manipulated a boundary condition rather than the independent variable, which may reduce our ability to make casual claims. Although we considered manipulating Task 1 engagement, we realized that doing so would actually manipulate antecedents of engagement such as task meaningfulness or one's willingness to invest in the task (Kahn, 1990). Given our Study 1 findings, we took as given that Task 1 engagement would be related to Task 2 engagement and instead sought to parse out the mechanisms and boundary conditions that influenced this relationship. Thus, we control for alternative explanations and replicate our findings across two studies which gives us confidence in our theoretical model. Still, we see value in potential studies that track the ebbs and flows of task engagement over many transitions.

Second, our examination of positive affect may neglect other emotions, such as negative affect, that individuals experience across a task transition. Although our focus on positive affect is consistent with Kahn's (1990) theorizing and empirical measures (Rich et al., 2010), considering the role of negative affect calls to mind research on affect and multiple goal pursuit (e.g., Carver, 2003; Carver & Scheier, 1990). This research has proposed and found that experiencing negative affect while working on a task can cause individuals to invest more heavily in that task, because it provides a signal that additional resources are needed to complete the task effectively. This research also articulates how positive affect experienced in a task may cause individuals to invest fewer resources because it signals successful task accomplishment. Carver and colleagues' (Carver, 2003; Carver & Scheier, 1990) perspective contrasts with our engagement-based arguments and findings that positive affect helps sustain engagement from task to task. Although our intention was not to compare the multiple goal pursuit perspective with Kahn's (1990) work, an integration of these perspectives could be a worthwhile endeavor to develop a more nuanced theory of performance in multiple tasks. Such a theory could potentially propose circumstances that influence whether positive affect and negative affect lead to engagement or disengagement by virtue of spillover and goal-related discrepancy cognitions.

Third, there may be value in examining other moderators that could influence the relationship between task engagement and attention residue. Task similarity, or the degree to which a task requires comparable sets of personal energies, is one potential boundary condition. Our study participants may have stayed absorbed in a previous task after switching because tasks were perceived to be similar and require related energies (e.g., Ashforth et al., 2000). However, if two tasks are highly similar, attention residue might facilitate, rather than hinder, a task transition because individuals are in sync with the mode of the first task and would need few cognitive resources to adjust. An interdependence perspective may be a valuable lens to view task similarity (e.g., Bush, LePine, & Newton, 2018) to directly determine when switching between individual and team tasks is most beneficial or detrimental.

Considering effective task transitions also evokes task planning (Earley, Wojnaroski, & Prest, 1987) and prospective task engagement wherein individuals look forward to an upcoming task. Although task anticipation may aid in preparing for and performing a future task, it may also occupy individuals' attention and take their focus away from preceding tasks (Leroy & Glomb, 2018) in a way that impairs previous task performance. In other words, we believe that an examination of how individuals anticipate upcoming tasks to the potential detriment of present tasks could be particularly important to explore. In probing these potential relationships, scholars should be aware that our measure of attention residue is narrower in scope than Leroy and Glomb's (2018) measure, particularly if their task context involves a wider array of cognitive residue than our study contexts. In summary, testing some of the boundary conditions that alter the nature of the relationships implied in our work could be fruitful avenues of inquiry.

Finally, because we focused exclusively on engagement at the task level, we are unable to explore the implications of task engagement for individuals' overall job engagement. Although our approach is consistent with the conventional view that tasks are nested within jobs (Cohen, 2013; Ilgen & Hollenbeck, 1991; Pearlman, 1980), our research also raises the question of how engagement at the two levels is connected. This relationship might take several possible forms. For example, job engagement may reflect the average of individuals' engagement across all of their tasks. Alternatively, job engagement may be more a function of individuals' core tasks, the tasks that require the most time, or the tasks that are the most memorable. It may also be that job engagement is a function of the engagement experienced in the task immediately preceding the measurement of job engagement. This latter possibility is consistent with the notion of residual engagement and has implications regarding when job engagement should be measured. Subsequent research that explores these and related possibilities by bridging the task-level and job-level aspects of engagement would further advance engagement theory.

Practical Implications

Our work has several implications for practice. Organizational leaders desire an engaged workforce (e.g., Morgan, 2017; Saks & Gruman, 2014), and our empirical findings offer some ideas as to how organizations may address employee task engagement. Individuals in organizations would do well to take part in intentional task planning that accentuates the positive effects of task engagement through positive affect and mitigates the negative effects of task engagement through attention residue. For example, many employees begin their workday by focusing their energies on tasks that are often less than engaging (e.g., checking e-mail), and beginning with a less engaging task may not lead employees to start their day "off on the right foot." Instead, our findings suggest that when individuals invest their energies in an engaging task, they not only experience positive feelings but are also more engaged in a subsequent task and perform that subsequent task more effectively. Thus, organizations may find value in encouraging employees to deliberately plan and prioritize their workdays so that they begin with an engaging task and thereby reap the positive—and potentially multiplicative—benefits of task engagement in their subsequent task activities (Salanova et al., 2011). Of course, our findings point to an important caveat in scheduling engaging tasks early in the day. Specifically, it may be important to select tasks for which some degree of completeness can be reached prior to a task transition. Not being able to finish an engaging task elevates attention residue that dampens the positive effects from the engaging task. In some jobs—such as those involving project work—engaging tasks are often ongoing, which makes "completing" the task difficult. In these cases, it may be possible to segment the work into smaller defined chunks (i.e., sets of related activities with a defined objective) and setting aside time to achieve them so that a sense of closure can be reached and the positive effects of task engagement can be most pronounced.

Individuals who desire to perform effectively may need to balance how they allocate their energies across the many tasks that are required in their job. It may be helpful for individuals to identify an optimal number of tasks that they can transition between before the availability of their cognitive energies is spent (e.g., Kahn, 1990). Organizational leaders could be aware of the demands they put on their employees and could help structure or support task activities in a way that maximizes the positive transfer of engagement across tasks. For example, organizations may find value in a mental thought exercise that enables employees to close the door mentally on a prior engaging task even if it is incomplete. As another example, instead of interrupting employees and immediately demanding their attention, managers could allow employees to wrap up a current task so that employees can be fully attentive to a manager's request. Finally, managers may desire to temper their performance expectations on highly engaging tasks that occur back to back or may find it valuable to help employees in these instances so that subsequent engagement and performance do not suffer.

Conclusion

We offer a task-level view of engagement to understand how the motivation pinned to the various tasks that comprise a multifaceted job are connected to each other and to performance. More plainly, we explain how task engagement influences performance in a subsequent task through engagement in the subsequent task. We show that task engagement is associated with positive affect and, in turn, engagement and performance in a subsequent task. We also show that task engagement is associated with attention residue, which, in turn, impedes subsequent task engagement and performance. Finally, we show that the negative effect of attention residue is ameliorated when a task is viewed as complete. In articulating the positive and negative pathways through which task engagement operates, we present a balanced view of engagement.

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