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More Tasks, More Ideas: The Positive Spillover Effects of Multitasking on Subsequent Creativity

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We propose that multitasking behavior influences creativity on subsequent tasks and that it does so through a serially mediated process in which multitasking increases activation, which increases cognitive flexibility, resulting in a positive effect on downstream creativity. We build support for our hypotheses through 4 studies designed to establish both internal and external validity: an archival study using coded data from the TV show, *Chopped*, and a laboratory experiment test the direct link between multitasking and subsequent creativity; while a quasi-experimental field study with restaurant servers and a second laboratory experiment examine the full serial mediation model. Results from the archival study and the first lab experiment support the proposed theory of a positive relationship between multitasking and subsequent creativity. Results from the quasi-experimental field study and second lab experiment suggest that multitasking increases creativity through activation and cognitive flexibility acting in tandem. Together, this work yields important theoretical and practical implications about managing creativity in a fast-paced contemporary workplace.

Keywords: creativity, multitasking, energy spillover, cognitive flexibility, activation

To one who lives with "time famine" (Perlow, 1999)—a chronic shortage of sufficient hours in the day—multitasking seems to hold out a brilliant solution. By performing two or more tasks concurrently, an individual can maximize the finite hours that make up a life. In many workplaces, multitasking is considered an essential job demand (Fleishman, Costanza, & Marshall-Mies, 1999), with 41% of employees stating that they engage in multitasking "all the time" at work (Barba, 2014). Yet, researchers across varied literatures have drawn a singular conclusion: Multitasking has a negative effect on performance. Indeed, supporting this finding, research on employee performance finds that people perform worse when they are faced with interruptions (Leroy, 2009) and distractions (Czerwinski, Horvitz, & Wilhite, 2004) and that they do so because thinking about incomplete prior tasks continues to draw on their cognitive resources (Zeigarnik, 1927). These findings underlie multitasking's many deleterious effects: reduced accuracy, efficiency, and quality of work performance (e.g., Laxmisan et al., 2007; Rubinstein, Meyer, & Evans, 2001), increased stress and work-family conflict (e.g., Glavin & Schieman, 2012; Voydanoff, 2005), as well as burnout and exhaustion (e.g., Howard, 2013; Steege, Drake, Olivas, & Mazza, 2015).

Despite significant evidence of multitasking's harms, extant research may not be able to capture the full effect of multitasking behavior because it has focused mainly on the effect of multitasking on the *very* tasks being multitasked—with a specific focus on how multitasking hurts analytical task performance. In contrast, we posit that the cognitive and affective changes elicited by multitasking behavior may lead to potential positive *downstream* effects for another crucial indicator of organizational performance: creativity. At first glance, multitasking behavior appears to be at odds with the factors that enable people to harness their creativity, an outcome improved by low time pressure (Amabile, 1996), enhanced time for incubation (Dodds, Ward, & Smith, 2003), short breaks (Segal, 2004), a flow state (Csikszentmihályi, 1991), and a relaxed focus (Isaksen, 1983). Yet, drawing from disparate research on creative performance, the process of accessing and recombining distinct and disparate knowledge (Guilford, 1956; Mednick, 1962), we propose that this positive multitasking-creativity link unfolds through a serially mediated process in which multitasking increases creativity first through an immediate, affective mechanism, activation, which then positively influences a secondary cognitive mechanism, cognitive flexibility, to result in creative outcomes on a subsequent task. We argue that from an affective standpoint, because multitasking is a resource-heavy effortful experience (Wetherell & Carter, 2014; Yeykelis, Cummings, & Reeves, 2014), it elicits energy (Mehler, Reimer, Coughlin, & Dusek, 2009), providing activating resources that then stimulate cognitive flexibility. Cognitive flexibility, the ability with which individuals can attend to divergent perspectives (Rothman & Melwani, 2017), is the cognitive precursor that enables

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creativity to proliferate on a set of future tasks (e.g., De Dreu, Baas, & Nijstad, 2008; see Figure 1).

By integrating perspectives from the creativity and energy domains with prior research on multitasking, we aim to uncover a benefit for this common, yet much-maligned, human behavior. In doing so, we make three main contributions to the existing literature on multitasking. First, we demonstrate that while multitasking behavior may result in low performance on analytical tasks, it may potentially improve performance on creative tasks as well as describe how this increase in creative performance arises only for subsequent tasks, but not current tasks. Second, we build on the excitation transfer literature by proposing that activation alone (over and above positive or negative valence) can induce cognitive flexibility; this is in contrast to prior research on cognitive flexibility has focused on emotions with a positive valence (Baas, De Dreu, & Nijstad, 2008; De Dreu et al., 2008; To, Fisher, Ashkanasy, & Rowe, 2012) or a negative valence (Mayer & Mussweiler, 2011). Last, we outline when and how multitasking behavior leads to creativity through a time-lagged model linking multitasking to both affective and cognitive mechanisms in a serial relationship that ultimately leads to downstream creative outcomes.

Multitasking at Work: A Theoretical Overview

Multitasking has been defined and studied across many different fields, including cognitive psychology, human factors, information science, and communication studies. Here, we focus the definition of multitasking specifically for the workplace context, and define multitasking as *the degree to which two (or more) tasks compete for one's attention within a given timeframe* (e.g., Carlson & Sohn, 2000; Monsell, 2003; Salvucci, Kushleyeva, & Lee, 2004). This definition highlights two key factors. First, we restrict the definition of multitasking to include only work-related tasks, defined as "distinct activit[ies] carried out for a distinct purpose" (Cascio, 1978, p. 133). In contrast with simpler undirected activities such as walking while talking (Neider et al., 2011), listening to music while working (Lesiuk, 2005), or doodling while on the phone (Andrade, 2010), which may have lower motivational consequences, this definition applies to real-life examples of multitasking at work: air traffic controllers at the airport (Lee & Anderson, 2001), doctors and nurses in emergency rooms (Chisholm, Collison, Nelson, & Cordell, 2000), military personnel (Chen & Terrence, 2009; Hambrick et al., 2011), and project managers in high-velocity industries (Patanakul & Milosevic, 2008).

Second, this definition captures multitasking as seen through the theory of threaded cognition (Salvucci & Taatgen, 2008, 2011a), which posits that multiple threads of cognitive processing run concurrently in the mind when performing multiple tasks, and these threads of cognition may interfere with each other, especially if they tap into the same type of cognitive, perceptual, or motor resources. In turn, because multiple tasks are being engaged concurrently, an individual's attention and working memory is divided (Klingberg, 2000). Thus, we argue that multitasking is not a binary experience, but rather a continuum based on the degree to which tasks compete for attention in people's minds, resulting in low to high levels of multitasking. In essence, a low level of multitasking may be captured by task switching behavior (Lu, Akinola, & Mason, 2017), in which people set aside one task before starting another and each task receives full attention during its allocated time (e.g., Salvucci & Taatgen, 2011b; Smith & Jonides, 1999). However, in other situations, people may struggle to process concurrent tasks, such as when they are responding to e-mails during a conference call (Marulanda-Carter & Jackson, 2012) while also listening for their cue to respond to a question, thus, constituting a higher level of multitasking. Therefore, the degree of multitasking may be increased by adding more tasks, increasing the degree of difficulty of the tasks, increasing the degree of alignment across the tasks, and increasing focus on multiple tasks, all of which reflect a greater demand on people's working memory (Bühner, König, Pick, & Krumm, 2006), and levels of multitasking may fluctuate throughout the course of the day as these demands change.

The Positive Spillover of Multitasking on Subsequent Creativity

The extant theoretical explanation for why multitasking has a primarily detrimental effect on performance is grounded in the notion that the different tasks involved in multitasking cognitively hinder each other. For example, theories of resource allocation (e.g., Kahneman, 1973) argue that because a person's attentional resources are distributed across the different tasks during multitasking, fewer resources can be allocated to each individual task, thus reducing performance. Similarly, bottleneck theories (e.g., Logan, 2004) and theories of task control (e.g., Cooper, 2010) argue that people's mental operations are not easily divided; as a result, trying to do two or more things at once results in a bottleneck that blocks the successful completion of task outcomes. Because high multitasking involves the concurrent processing of task-related information and goals, it is unlikely to enhance performance on the very tasks that are being worked on simultaneously because individuals' attention is divided and working memory is pushed to its limit as prior research has demonstrated. Because performances hinge on access to the same internal cognitive resources, working memory and attention (e.g., Kasof, 1997; Takeuchi et al., 2011), we concur with prior research that individuals engaging in high multitasking will not experience increased performance on those very tasks, but argue that multitasking may lead to higher performance on certain types of subsequent tasks.

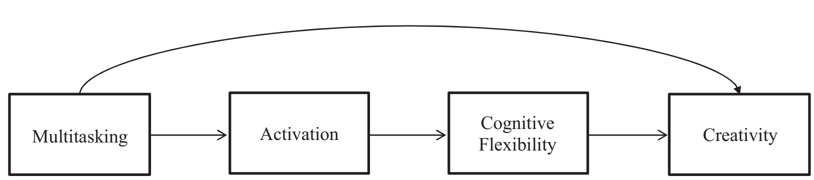

Figure 1. Full model.

While acknowledging these negative outcomes of multitasking, we believe it may also carry a potential positive benefit for another crucial indicator of organizational performance: creativity. Disparate research on creativity finds that it is enhanced by triggering two independent thoughts, cognitions or emotions in the mind (Mednick, 1962). Indeed, emotional ambivalence, or the simultaneous experience of two conflicting emotions (Fong, 2006), bicultural identity, which involves an activation of two cultural identities (Tadmor, Galinsky, & Maddux, 2012), paradoxical framing, mental templates for embracing seemingly contradictory statements or dimensions of a task (Miron-Spektor, Gino, & Argote, 2011), and dishonesty, which involves activating both a lie and a truth in the mind at the same time (Gino & Wiltermuth, 2014), are all phenomena that increase subsequent creativity. Like multitasking, each of these antecedents to creativity involves the activation of two opposing or independent cognitions, attitudes, or emotions. Together, this implies that the positive downstream effects of multitasking only extend to its effects on subsequent creative performance, not to overarching task outcomes. Thus, we propose:

> *Hypothesis 1:* Multitasking increases (a) subsequent creative task performance, but not (b) current creative task performance nor (c) subsequent analytical task performance.

Building a Model of the Link Between Multitasking and Creativity

Higher levels of multitasking, involving concurrent processing of task-related information and goals, may operate to enhance creative, though not analytical, performance on subsequent tasks through an affective and cognitive process that unfolds over time. This process first involves an affective response: Performing multiple tasks, an effortful experience, stimulates higher activation to enable individuals to meet these higher demands. In turn, as the initial demands of high multitasking are met, the activation generated to perform it dissipates slowly (Zillmann, 1971; Zillmann, Katcher, & Milavsky, 1972) leaving excess activated resources that then enhance cognitive flexibility, which ultimately drives subsequent creativity.

Multitasking, an effortful, cognitively taxing activity, requires those engaging in it to generate resources to be able to meet its cognitive demands. Activation, the subjective affective experience that is defined as the degree to which one feels mobilized or energized (Barrett & Russell, 1999), ranges on a continuum "from sleep (at the low end) through drowsiness, relaxation, alertness, hyperactivation, and, finally, frenetic excitement (at the opposite end)" (Barrett & Russell, 1999, p. 10). This particular dimension of the subjective affective experience is generated when there is a greater demand for resources, sustained attention or increased effort (Brehm, 1999; Bradley, 2009). Indeed, research finds that individuals need to generate energy to be able to cope with the increased demands of multitasking (Elkin & Leippe, 1986; Reimer, Mehler, Coughlin, Godfrey, & Tan, 2009); increasing multitasking demands increase physiological arousal (Mehler et al., 2009), and long-term multitasking leads to burnout and exhaustion, a signal of enduring energy use (e.g., Howard, 2013; Steege et al., 2015). This link is further supported by neurocognitive research, which finds that high levels of multitasking and the resulting increased demand for attention to multiple cognitive tasks produces dopamine and norepinephrine (Arnsten, 1998; Finlay, Zigmond, & Abercrombie, 1995; Koob, 1999), hormones that initiate the flight-or-fight response and, accordingly, allow individuals (Chatterton, Vogelsong, Lu, Ellman, & Hudgens, 1996) to perform simultaneous tasks.

What happens to this activated energy after the demands of high multitasking are met? Research on excitation transfer by Zillmann and colleagues (Zillmann, 1971; Zillmann et al., 1972) demonstrates that activation generated at one time point can spill over onto unrelated and subsequent activities because it dissipates slowly, resulting in greater amounts of leftover energy resources. Thus, we suggest that the excess activated energy generated from multitasking will trigger a chain reaction that leads to enhanced cognitive flexibility.

The activation-flexibility link is supported primarily by neuroscience research. In research utilizing functional MRI techniques, highly activated parts of the prefrontal cortex (Koechlin, Basso, Pietrini, Panzer, & Grafman, 1999), which are inactive during other similarly taxing activities (e.g., Burgess, 2000; Sigman & Dehaene, 2008; Szameitat, Schubert, Müller, & Von Cramon, 2002), are linked with abstract thinking (Christoff, Keramatian, Gordon, Smith, & Mädler, 2009) and the ability to engage in integration and recombination of ideas and cognitions (Koechlin & Hyafil, 2007). Further supporting this link, activation has also been linked to the release of the neurotransmitters, dopamine and noradrenalin (Flaherty, 2005; Usher, Cohen, Servan-Schrieber, Rajkowski, & Ashton-Jones, 1999), which have been shown to enhance working memory capacity (Floresco & Phillips, 2001; Usher et al., 1999). Working memory capacity, a cognitive system that describes an individual's ability to hold transient pieces of information in his or her mind is described as a precursor to enhanced cognitive flexibility (Baddeley, 2000; Dietrich, 2004). Thus, based on this prior theoretical and empirical research, we propose that multitasking stimulates physiological, cognitive, and emotional mechanisms associated with activation, and this activation, in turn compels individuals to integrate information, balance the consideration of multiple alternatives and engage in broader, more inclusive cognitive categorization (De Dreu et al., 2008), all aspects of increased cognitive flexibility, or one's ability to attend to divergent perspectives.

Specifically, we argue that it is the combination of the dual task requirement of high multitasking combined with increased activation that then leads to *downstream* creative task performance. High multitasking, with its increased cognitive demands and concurrent utilization of current working memory capacity and attentional resources will likely not influence current analytical nor creative task performance. Even though activation is likely to increase task effort (Seo, Barrett, & Bartunek, 2004), it will not influence future analytical performance as it does creativity, because the activation that accompanies high multitasking behavior is then utilized to create combinatorial resources for cognitive flexibility.

According to this serial mediation process, higher multitasking may not demonstrate greater creativity until after the affective resources have resulted in cognitive changes that result in higher creativity on downstream tasks. We argue that this process unfolds over time based on the connectionist models of cognition, which suggest that the activation from multitasking in cognitive neural networks takes time to spread throughout the brain since multitasking increases the number of "nodes" that are activated exponentially resulting in a delayed impact of activation on cognitive flexibility (McClelland & Rumelhart, 1986).

Cognitive flexibility, the ability to attend to divergent perspectives (Rothman & Melwani, 2017) and make novel associations between concepts (Guilford, 1967), is described as the cognitive core of creativity (Beghetto & Kaufman, 2007; Hennessey & Amabile, 2010) and is a cognitive process that is closely linked to higher creative performance (e.g., Baas et al., 2008; De Dreu et al., 2008; Mayer & Mussweiler, 2011). Integrating all these arguments, we argue that multitasking increases subsequent creativity through a serially mediated process in which multitasking first leads to higher activation, which provides physiological and motivational resources to generate higher cognitive flexibility, a cognitive process which, in turn, increases downstream creativity.

> *Hypothesis 2:* Multitasking increases subsequent creative task performance through a serial mediation process first through activation and then through cognitive flexibility.

Overview of Research

We tested these hypotheses in four studies. In Studies 1 and 2, we test the first hypothesis, establishing the main effect of multitasking on subsequent creative performance. In Study 1, we establish this causal relationship by manipulating multitasking (vs. sequential tasking) in a laboratory setting. Furthermore, as we describe earlier, because we expect that multitasking will only influence subsequent creativity not subsequent task performance, we tested for these diverging effects in this study. In Study 2, we used archival data from 132 chefs across 44 episodes of the TV show, *Chopped*, by looking at how multitasking in an earlier round led to enhanced downstream creativity in a later round. In addition to establishing external validity, this study demonstrates that greater multitasking has positive effects on downstream creativity but does not influence creativity on the very tasks that are being multitasked, and that this result remains consistent even in conditions where the subsequent task also requires high multitasking. In Studies 3 and 4, we test the second hypothesis—the full serial mediation model: Study 3 used an experimental methodology to explore the mediating roles of activation and cognitive flexibility in the multitasking-creativity relationship, while Study 4 corroborated this model through a quasi-experimental field study of restaurant servers.

Adding to our varied methodologies across these four studies, we also used four different measures of creativity. In Study 1, creativity was assessed by one of the most widely used measures of creativity, an idea generation task in which participants were asked to come up with alternate uses for a brick; we then coded for originality of these ideas (e.g., Sligte, De Dreu, & Nijstad, 2011). In Study 2, we used expert raters' assessments of creativity of dishes prepared in the TV show, *Chopped*. This study allowed us to demonstrate that multitasking continued to influence job-relevant creative performance. In Study 3, we asked participants to generate ideas for a new toy and coded these for creativity using the broad definition of novelty and usefulness (Amabile, 1983), and in Study 4, we measured creativity by looking at participants' responses to a structured imagination task (Ward, 1994). In Studies 3 and 4, we also took a closer look at the role of the serial activation and flexibility mechanisms that lead to creativity. While activation was measured using self-reported ratings in these studies, we measured cognitive flexibility by measuring category inclusiveness (Isen & Daubman, 1984) and broader, diverse associations (Guilford, 1967), respectively, in Studies 3 and 4.

Study 1

Method

Participants and experimental design. Two-hundred and 40 participants from a large southeastern university in the United States participated in the experiment in exchange for course credit. The participants (43% female; M_{age} = 20.66, SD = 2.04) were randomly assigned to one of three conditions (multitasking vs. two separate sequential task conditions). This study received ethical approval from the Institutional Review Board (IRB) at the University of North Carolina at Chapel Hill ("Multitasking Lab Study"; Protocol #15–0630).

Procedure. On arrival to the laboratory, participants, seated in individual cubicles equipped with personal computers, learned that they would play the role of a student representative of their university and were provided with information about the student representative's schedule and role. Each participant was then required to complete two tasks: They were to listen to a conference call on new ways to fund student organizations and respond with their own ideas at the end of the call, as well as reply to three e-mail messages concerning their work schedule. The conference call introduction and e-mails are described in detail in the Appendix. The timing of these tasks, either simultaneous (in the multitasking condition) or sequential (in the two sequential task conditions) comprised the manipulation. We chose this specific manipulation to mimic a real-life organizational situation, as research indicates that while at work, people tend to multitask while on conference calls and over 60% choose to do so by writing and responding to e-mails (Gavett, 2014).

In the multitasking condition, the participants worked for 4 min, simultaneously on both tasks. In the first sequential task condition (sequential task–long), the participants did the two tasks consecutively (conference call followed by e-mail task), working for 8 min total. This condition enabled us to confirm that our effects were not driven by the type of tasks the participants were engaging in. In the second sequential task condition (sequential task–short), the participants did shortened versions of the two tasks for a total of 4 min. This control condition enabled us to address the issue of time, by ensuring that participants worked for the same amount of time as in the multitasking condition. To keep the timing consistent across conditions, the survey automatically advanced when the requisite time had passed.

Upon completing the tasks, participants were asked to complete two additional tasks (which were counterbalanced). The task used for assessing subsequent creative performance was an idea generation task, generating creative uses for a brick (e.g., Goncalo, Flynn, & Kim, 2010). Counterbalanced with this task was an analytical task included to assess whether multitasking behavior affected all task performance or was specific to creative performance.

Measures. Unless otherwise indicated, all items used a 7-point Likert scale anchored from 1 = *strongly disagree* to 7 = *strongly agree*.

Manipulation check: Experienced multitasking. After completing the tasks, participants reported the extent to which they felt like they were multitasking in all conditions using a three-item scale, with the items: "I felt like I was multitasking"; "I felt like I was performing two tasks at the same time"; and "I felt like I was working on two tasks simultaneously" ($\alpha = .94$).

Dependent variable: Creativity. Participants were presented with a photo of a brick and asked to generate as many uses as they could (Goncalo et al., 2010). Each idea was coded for originality by two raters who were blind to the conditions. As their interrater reliability (κ) was .97, we averaged their scores to get an overall measure of originality.

Dependent variable: Analytical task. Participants were presented with 12 logical reasoning problems and asked to complete as many as they could in 3 min. The logical reasoning problems were based on GRE-style analytical reasoning problems and consisted of patterns of letters and numbers with one blank space. Each problem had four multiple choice options and the participant could choose one answer for each problem. For example, one problem was "SCD, TEF, UGH, ___, WKL" and the multiple-choice options were "CMN, UJI, VIJ, IJT." The correct answer in this problem is "VIJ."

Results and Discussion

Our analyses showed that the extent to which participants felt like they were multitasking in the multitasking condition (M = 5.30, SD = 1.71; $F(1, 158) = 49.73$, $p < .001$, d = 1.11) was significantly more than participants in the sequential task–long condition (M = 3.44, SD = 1.64).[1] We then used one-way analyses of variance (ANOVA) to test Hypothesis 1a, which proposes that multitasking increases creative performance. The results indicated that the participants in the multitasking condition generated significantly more original ideas (originality; M = 3.48, SD = .87; $F(2, 237) = 4.49$, p = .01) than participants in the sequential task–short condition (M = 3.08, SD = .86; $t(237) = 2.99$, p = .003, d = .46), but only marginally more significant than participants in the sequential task–long condition (M = 3.24, SD = .78; $t(237) = 1.82$, p = .07, d = .29). In contrast, as predicted in Hypothesis 1c, the results indicated that the effect of multitasking behavior on the analytical task performance was not significantly different across the multitasking (M = 6.28, SD = 2.57; $F(2, 237) = 1.52$, p = .46) versus sequential task–long condition (M = 6.76, SD = 2.42, $t(237) = -1.26$, p = .21 d = .19) and the sequential task–short condition (M = 6.54, SD = 2.37, $t(237) = -.68$, p = .50, d = .11).

While this study shows the positive relationship between multitasking and downstream creativity in an experimental setting, we wanted to build on this study by establishing external validity and did this by looking at whether the same pattern holds in a more realistic setting. Furthermore, we wanted to answer the question of whether multitasking would influence creativity on the very task being multitasked (Hypothesis 1b) and also confirm that our effects would hold even while the subsequent task required high levels of multitasking. In Study 2, we explored the effect of multitasking on subsequent creativity in a TV cooking show.

Study 2

Method

Participants and procedure. One-hundred and 76 chefs participated as contestants on 44 episodes over the first four seasons of the TV show *Chopped* (Lea, 2009–2010). In this U.S.-produced-and-broadcast reality TV show, each episode involves four professional chefs who are selected to compete to cook an appetizer, entrée, and dessert. One chef is eliminated in each round resulting in a single winner in each episode. At the end of every episode, the winner receives a $10,000 cash prize. As we were interested in the effects of multitasking on downstream creativity, we looked at multitasking in the appetizer round (Round 1) on the creativity of dishes in the entrée round (Round 2), as well as multitasking in the entrée round (Round 2) on creativity of dishes in the dessert round (Round 3). While 176 contestants (four per episode) started the competition, 132 (28.8% female) chefs advanced to the second (entrée) round and 88 (26.1% female) advanced to the final dessert round.

The premise of the show is as follows: At the start of each round, chefs receive a mystery basket containing up to five ingredients. The competing chefs are required to incorporate all these ingredients into their dishes, which are then judged on creativity, presentation, and taste, even though the judges do not share their numerical ratings with the competitors or the audience. This set of "mystery" ingredients is not typically prepared together and usually needs to be recombined or repurposed (e.g., watermelon, canned sardines, cheese, and zucchini; or, black cod, puffed rice cereal, pineapple, and chorizo). The chefs also have access to a variety of additional ingredients that they can incorporate into their food. Each round has a strict time limit: 20 min for the appetizer round and 30 min each for the entrée and dessert rounds.[2] Because of this strict time limit and because in each round the chefs all start with the same set of ingredients, this TV show enabled us to compare the degree to which each chef multitasked during each round as well as assess real, job-relevant creative outcomes.[3]

To build our dataset, the lead author watched all 44 episodes and (a) recorded the description for the appetizer, entrée, and dessert given by each chef contestant; (b) documented any text written on the screen for viewers; and (c) took a screenshot of each dish in these rounds. Next, we recruited six professional chefs who served as coders for our data. Two chefs coded all the dishes from both the appetizer and entrée rounds for multitasking by looking at the number of actions required to produce each dish. To ensure that there was no common source bias across the multitasking and creativity coding, two different chefs coded the creativity of the

[1] We collected this data in two waves with a similar set of participants who were part of the same course but taking a lab study for course credit at different points over the course of the semester. Due to an error in the second round of data collection, we did not obtain self-report measures of multitasking for the sequential task–short condition.

[2] In the first 7 episodes of *Chopped,* Season 1, chefs were given 30 min for the appetizer round. Accordingly, we statistically controlled for episode in our analyses.

[3] Though not depicted on the show, interviews with three recent chef contestants revealed that approximately 60–90 min passed between rounds after they were judged and before they began the next round. Furthermore, between the first and second rounds, the contestants ate lunch with the cast and crew.

appetizer and entrée dishes. Two separate pastry chefs coded the dessert rounds for creativity.

Measures.

Independent variable: Number of actions to create appetizer and entrée (Rounds 1 and 2). Because the amount of time per round was fixed (20 min for the appetizer round and 30 min for the entrée round), we coded the dishes for *number of actions* required to create the dish to reflect the level of multitasking that went into each dish's preparation. To develop this particular measure, we interviewed three professional chefs (mean age = 34.33 years, mean culinary experience = 12.00 years) about how to code multitasking behavior, especially without detailed footage of multitasking (as the show is heavily edited). Each chef independently proffered the solution that any expert chef would be able to work backward from pictures and descriptions of a completed dish to ascertain the number of actions that would lead to the completion of the dish. As an "action" in cooking takes a specific amount of time, a dish that required more actions in a specific period of time would involve more multitasking than a dish that required fewer actions, in the same set period of time. Before starting the coding, we confirmed this assertion with five other professional chefs (mean age = 32.6 years, mean experience = 14.6 years) and they agreed that if the time to complete the dish is fixed, then dishes requiring more actions would require more multitasking than dishes with fewer actions.

Based on these interviews, an "action" was defined as any activity such as dicing, sautéing, frying, and so forth (for detailed examples of the coding see Table 1). We then recruited two professional chefs (one male, age 33, 14 years of experience and one female, age 36, 12 years of experience) to code multitasking. Their ratings were significantly correlated (appetizer: $r = .54$, $p < .01$; entrée: $r = .57$, $p < .01$) with significant agreement for the appetizers (ICC(2) = .70, $p < .01$) and the entrées (ICC(2) = .72, $p < .01$). Thus, we averaged their scores to create an overall

Table 1
Examples of Coding From Study 2

Episode (Round)	Ingredients	Description of dish	Number of actions	Creativity score (1–7)	Taste score (1–5)
Season 1, Episode 1 (Appetizer)	Beef tenderloin, cucumber, Asian pears, bitter chocolate	Description: Beef carpaccio flashed with chocolate and brown butter sauce, served with a pickled cucumber and Asian pear salad.	Pickling cucumber, creating chocolate sauce, slicing and flashing beef tenderloin. *Coded number of actions: 3*	6	3.5
Season 1, Episode 6 (Entrée)	Watercress, tamarind paste, creamed corn, Arctic char	Description: Pan-seared arctic char with tamarind smashed potatoes and a creamy creamed corn sauce with a little watercress salad on top. Added cream, salt, and pepper.	Pulling pinbones out of char, searing the char, adding cream to creamed corn and cooking it down, cooking potatoes and mashing, adding tamarind to mashed potatoes. *Coded number of actions: 6*	3.5	3
Season 3, Episode 1 (Appetizer)	Whole peaches, peas in pods, whole eel	Description: Pan-roasted eel with bacon braised peas in spiced wine sauce. Chipotle peppers with bacon in the peas and then a little chipotle on top.	Roasting the eel, frying the bacon, braising the peas, blending the peaches, chopping the chipotle peppers, and creating a spiced wine sauce. *Coded number of actions: 6*	6.5	4
Season 2, Episode 6 (Appetizer)	Ground turkey, piquillo peppers (canned), fresh gooseberries	Description: Turkey meatballs with piquillo pepper gravy and the gooseberry is a standalone edible garnish.	Forming the meatballs and sautéing them, sautéing the piquillo peppers, blending the sautéed peppers, peeling open gooseberries. *Coded number of actions: 3.5*	1.5	3
Season 4, Episode 3 (Entrée)	Fresh horseradish root, goat chops, quick oatmeal, snap peas	Description: Horseradish oatmeal with roasted goat and a snap pea gel.	Trimming fat off goat and sear, making oatmeal, shredding horseradish and blending with vinegar to draw off harsh flavor and, blending snap peas, creating gel with agar agar and snap pea puree. *Coded number of actions: 5*	4.5	2

measure of multitasking for the appetizer ($M = 5.17$, $SD = 1.06$) and the entrée ($M = 5.73$, $SD = .97$).

Dependent variable: Creativity of entrée and dessert (Rounds 2 and 3). To measure creativity, we utilized the consensual assessment technique (Amabile, 1983) in which experts work independently of one another and are given no guidance for how to rate creativity, other than their own opinion of what they would judge as creative. We recruited four professional chefs (different from the chefs we recruited to code multitasking): two who served as independent judges of creativity of dishes made for the appetizer and entrée rounds (both male, mean age = 36.5, mean experience = 10.75 years) and two other chefs who had expertise in pastry making and served as raters for the creativity of the dessert round (both female, mean age = 34, mean experience = 5 years). To rate the creativity of a dish, each of the chefs was provided with a short textual description and picture of each dish as well as a list of mystery ingredients that were incorporated in the dish. They were asked to rate creativity on a 7-point Likert scale (from 1 = *strongly disagree* to 7 = *strongly agree*). The chefs highlighted that highly creative dishes involved an unusual combination of flavors or techniques while low creativity dishes used the ingredients in more typical or classic ways. The chefs' ratings were significantly correlated with each other (appetizer: $r = .44$, $p < .001$; entrée: $r = .43$, $p < .001$; dessert: $r = .39$, $p < .001$) and reached significant agreement (appetizer: ICC(2) = .61, $p < .001$; entrée: ICC(2) = .60, $p < .001$; dessert: ICC(2) = .56, $p < .001$). We averaged their ratings to create an overall measure of creativity for appetizers ($M = 3.77$, $SD = 1.22$), entrées ($M = 4.41$, $SD = 1.20$), and desserts ($M = 4.83$, $SD = .97$).

Control variables. As chefs in a single episode shared the mystery ingredients, we included *episode* as a second-level variable in our multilevel model. Second, we also controlled for creativity of dishes from the earlier rounds to ensure that individuals who received higher creativity ratings in the entrée or dessert rounds were not generally more creative overall. Third, we controlled for multitasking in the entrée round to ensure that dishes requiring more actions were not rated as more creative on that aspect alone. Last, we also controlled for taste, because we wanted to ensure that the unusual combination of flavors was not at the expense of taste.

Results

Table 2 shows the descriptive statistics and correlations among all major individual level variables. We proposed that multitasking at an earlier round would positively relate to creativity judgments of the dishes in the later rounds and tested our main hypothesis using multilevel analyses (Hofmann, 1997; Hofmann, Griffin, & Gavin, 2000; Raudenbush & Bryk, 2002). Because one-way analyses of variance indicated that controlling for the effects of the episode was necessary, $F(43, 88) = 1.54$, $p = .01$, we generated a multilevel model (Singer, 1998) in which we treat episode as a random factor (Nezlek & Zyzniewski, 1998).

Our analyses in Table 3, Model 2 showed support for Hypothesis 1a by showing that multitasking at Time 1, during the first appetizer round, positively and significantly related to downstream creativity in the entrée dishes, $\gamma = .26$ ($SE = .10$), $t(87) = 2.48$, $p = .02$; this relationship held even when controlling for creativity of the appetizer and multitasking during the entrée round, $\gamma = .26$ ($SE = .11$), $t(86) = 2.34$, $p = .02$. Furthermore, looking at how multitasking in the entrée round predicted creativity in the dessert round, we found, as seen in Model 5, a positive relationship that trended toward significance, $\gamma = .19$ ($SE = .10$), $t(43) = 1.91$, $p = .06$; this relationship was strengthened and became significant when controlling for multitasking and creativity of the earlier rounds, Model 6: $\gamma = .22$ ($SE = .11$), $t(40) = 2.04$, $p = .05$. Importantly, we corroborated that multitasking only positively influenced downstream creativity. Specifically, as per Hypothesis 1b, multitasking during the appetizer round did not influence creativity of the appetizer, $\gamma = .12$ ($SE = .10$), $t(87) = 1.18$, $p = .24$; similarly, multitasking during the entrée round did not affect creativity ratings of the entrée, $\gamma = .09$ ($SE = .11$), $t(87) = .75$, $p = .46$. Together, this supports our hypothesis regarding the positive relationship between multitasking and downstream creativity.

The results of our analyses from two separate studies now show that multitasking at Time 1 leads to creativity at Time 2. However, while showing a direct link, these two studies did not shed light on the underlying processes responsible in the multitasking-creativity link. While it is difficult to extrapolate completely from a reality TV show that has edited segments, the fact that our analyses and findings relied on external and expert coders enhances our confidence in our findings. In addition, the show's timeline helps set up the model tested in Studies 3 and 4. Specifically, because there is some nontask time between the three rounds, we believe this further signals the value of our serial mediation prediction: chefs who experienced higher activation from higher multitasking during their initial rounds were able to then generate and sustain higher cognitive flexibility in the transitions between rounds; this cognitive flexibility, in turn enhanced their creative performance in future rounds. Thus, in the following two studies we explore the cognitive and affective serial mechanisms underlying this link.

Table 2
Study 2 Means, Standard Deviations, and Correlations

Variable	*N*	*M*	*SD*	1	2	3	4	5
1. Multitasking (Appetizer: Time 1)	132	5.16	1.03	1				
2. Multitasking (Entrée: Time 2)	132	5.73	0.97	.34**	1			
3. Creativity (Appetizer: Time 1)	132	3.77	1.22	.10	.20*	1		
4. Creativity (Entrée: Time 2)	132	4.41	1.20	.22*	.05	.03	1	
5. Creativity (Dessert: Time 3)	88	4.83	.95	−.05	.19	.16	.11	1

* $p < .05$. ** $p < .01$.

Table 3
Study 2 Multilevel Regression Table

Variable	Creativity: Appetizer		Creativity: Entree		Creativity: Dessert	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	3.14** (.54)	3.08** (.55)	3.92** (.66)	2.76* (.99)	3.72** (.60)	3.05** (1.01)
Multitasking: Appetizer	.12 (.10)	.26* (.10)		.26* (11)		−.11 (.11)
Taste: Appetizer				.07 (.14)		
Creativity: Appetizer				.01 (.08)		
Multitasking: Entrée			.09 (.11)	−.00 (.12)	.19~ (.10)	.22* (.11)
Taste: Entrée						.17 (.16)
Creativity: Entrée						.09 (.09)
Pseudo-R^2	.01	.04	.02	.05	.01	.12

~ $p < .10$. * $p < .05$. ** $p < .01$.

Study 3

Method

Participants and experimental design. One-hundred and 71 business school students (52% male, mean age = 20.33 years, *SD* = 1.23) from a large southeastern university in the United States participated in the experiment in exchange for course credit. Like in Study 1, the participants were randomly assigned to one of three conditions: multitasking ($n = 57$), short-sequential tasking ($n = 59$), or long-sequential tasking ($n = 55$). This study received ethical approval from the Institutional Review Board (IRB) at the University of North Carolina at Chapel Hill ("Multitasking and Divergent Thinking"; Protocol #18–0247).

Procedure. The procedure was similar to Study 1, in that participants worked on two tasks: listening to a conference call and answering e-mails. In this study, however, we set up the task as a minibusiness simulation: Participants were told that they were part of the sales and marketing team for SheepyMe, a toy manufacturer that had designed a series of award-winning toys for the 3- to 5-year-old market. The company was described as being at a crossroads in terms of what type of toys to develop next and to resolve this issue, participants were invited to a conference call with the CEO and the marketing and sales vice presidents. In the conference call that lasted approximately 5.5 min (for the multitasking and long-sequential tasking condition; or an abbreviated 3 min for the short-sequential tasking condition), the two vice presidents argued about whether to develop a new line of fidget spinners or continue to build on their original, more expensive toy base. At the end of the call, participants were asked to provide suggestions about which strategy they thought would be best for the company to follow. In the second, e-mail task, participants were asked to respond to five e-mails based on a complex work calendar. The conference call introduction and e-mails are described in detail in the Appendix. The timing of these tasks, either simultaneous (in the multitasking condition) or sequential comprised the manipulation. In the case of the multitasking condition, the participants worked for a total of 5.5 min (while listening to the conference call); in the sequential condition, participants did the two tasks in consecutive order (conference call followed by e-mail task), working for a total of 11 min. In the short sequential-tasking condition, we set up the design so that participants would work for the same length as the multitasking condition: Thus, they were given 2.5 min to complete the e-mail task, working for a total of 5.5 min. Then, after completing the two tasks, participants completed a set of survey questions and were asked to provide a single creative idea for the company to expand its offerings to the 11- to 15-year-old age group. These ideas were coded for creativity.

Measures. Unless otherwise indicated, all items used a 7-point Likert scale anchored from 1 = *not at all* to 7 = *very much so*.

Manipulation check: Experienced multitasking. The same three-item survey as that used in Study 1 was used to assess perceptions of multitasking ($\alpha = .89$).

Mediator: Level of activation. Participants self-reported their current level of activation using three items from Feldman Barrett and Russell's (1998) activation scale: "I feel activated"; "I feel stimulated"; and "I feel stirred up" on a 0–100 scale twice, once at the onset of the study and once after completing the tasks ($\alpha = .82$ at Time 1, and $\alpha = .84$ at Time 2).

Mediator: Cognitive flexibility. Next, participants performed a categorization task developed by Rosch (1975) and used in Isen and Daubman (1984). In this task, participants were asked to rate items on a 10-point scale, indicating the extent to which they felt they belonged or did not belong to a specific category. Participants were presented with two separate categories, "vehicles" and "furniture"; within each of these categories, they were provided with nine items (three excellent exemplars, three moderately good exemplars and three weak exemplars). For the two categories, the weak exemplars were sled, wagon, and wheelchair and vase, stove, and telephone, respectively. Based on prior research that suggests that participants' ratings of the weak exemplars capture the degree to which they are making flexible cognitive connections, we averaged participants' ratings of the weak exemplars.

Dependent variable: Creativity. Participants were asked to come up with *one* idea to extend SheepyMe's toy line for the 11- to 15-year-old age range. We chose to have them generate only a single idea to explore whether the effect on creative performance applies only to idea generation (as in Study 1) or whether it also applies to idea generation and selection (Perry-Smith & Mannucci, 2017). Three coders, blind to the conditions, coded these ideas for creativity on the aforementioned 7-point scale, by telling them that their overall assessment of creativity should utilize its definition of involving both novelty and usefulness. As all three coders' ratings showed evidence of reliability (ICC(2) = .74), their scores were averaged and this measure was used as the dependent variable in our analyses. We also asked two coders to rate the creativity of responses at the end of the phone to corroborate that multitasking only had downstream effects. Using the same definition, these coders rated the extent to which the suggestions at the end of the phone call were creative (ICC(2) = .78).

Control variables. As activation is often imbued with a positive flavor, and because activated emotions have been linked to creativity (De Dreu et al., 2008), we included the items "enthusiastic," "excited," and "joyous" ($\alpha = .94$) to capture positive activated emotions. We also controlled for negative activated emotions ("frustrated," "irritated," and "anxious"; $\alpha = .97$).

Results

Table 4 provides the means and standard deviations for the variables. Our analyses showed that the extent to which participants felt like they were multitasking in the multitasking condition ($M = 5.55$, $SD = 1.25$) was significantly more than participants in the long-sequential task ($M = 3.19$, $SD = 1.41$); $t(167) = 8.99$, $p < .001$, and short-sequential task ($M = 3.86$, $SD = 1.54$); $t(167) = 6.31$, $p < .001$, conditions.

We used one-way analyses of variance (ANOVA) to test Hypothesis 1a, which proposes that multitasking increases downstream creative performance. As predicted, the results indicated that the participants in the multitasking condition were more creative ($M = 4.46$, $SD = 1.45$) than participants in the long- ($M = 3.34$, $SD = 1.26$); $t(168) = 4.00$, $p < .001$, and short-sequential task conditions ($M = 3.04$, $SD = 1.77$); $t(168) = 5.01$, $p < .001$. To confirm that this was a downstream effect only (that is, test Hypothesis 1b), coders' ratings of participants' suggestions at the end of the call for creativity showed that participants were not likely to be less creative on the multitasking tasks ($M = 2.86$, $SD = 1.15$) than participants in the long-sequential task ($M = 3.30$, $SD = 1.32$); $t(168) = 1.90$, $p = .06$, or short-sequential task condition ($M = 2.85$, $SD = 1.25$); $t(168) = .06$, $p = .95$.

We then tested the serial mediation hypotheses by looking at whether activation and cognitive flexibility (in order) mediated the link between multitasking and creativity and did so using Model 6 of the Process macro (Hayes, 2017) with 95% bias-corrected and accelerated confidence intervals and 10,000 bootstrap resamples. In this path model, activation and cognitive flexibility were entered as the mediators (M1 and M2), in that order, and creativity was entered as the dependent variable (Y). We also controlled for activated positive and negative emotions in these analyses. For the independent variable, we created two dummy-coded variables using indicator coding: The first (X1) had long-sequential tasking coded as a 1, and the multitasking and short-sequential tasking coded as a 0. In the second variable (X2), short-sequential tasking was coded as 1, while the multitasking and long-sequential tasking conditions were coded as 0. Because multitasking, the variable under study was dummy coded as 0 in both variables, results with negative coefficients for multitasking signify a positive result, that is, show that the effects of multitasking are higher than the comparative control condition.

We found support for our serial mediation hypothesis (please see Table 5). Significant indirect effects were observed from both dummy variables to creativity via, in turn, activation and cognitive flexibility: indirect effect (for X1, the comparison between multitasking and long-sequential tasking, $b = -0.06$, $SE = .03$, 95% CI [−0.14, −0.01]; for X2, the comparison between multitasking and short-sequential tasking, $b = -0.08$, $SE = .04$, 95% CI [−0.18, −0.01]). Critically, when we reversed the mediators so that cognitive flexibility came before activation, the indirect effects were not significant (for X1, the comparison between multitasking and long-sequential tasking, $b = -0.02$, $SE = .02$, 95% CI [−0.07, 0.001]; for X2, the comparison between multitasking and short-sequential tasking, $b = .001$, $SE = .01$, 95% CI [−0.02, 0.02]). This finding suggests that individuals who engage in multitasking experience more activation, which in turn spills over to enhance cognitive flexibility, and downstream creativity.

While this study enabled us to test our serial mediation hypotheses, we wanted to test the external validity of our model. Hence, we conducted a field study using a sample of restaurant servers, a group for which multitasking is an important aspect of the job description. Indeed, restaurant servers provide an optimal sample with which to test our model, as they are often required to multitask, describing their daily experience as "in the weeds: all your tables need something and you have to determine how to get everything done" (Gatta, 2009, p. 114). Additionally, unlike our prior studies in which participants engaged in short one-shot multitasking episodes, this study allowed us to test the effect of multitasking over longer periods of time. This is critical as among working employees, multitasking is often an everyday, repeated behavioral act (König, Oberacher, & Kleinmann, 2010) and a relatively enduring skill utilized in the job itself (e.g., Chisholm et al., 2000; Czerwinski et al., 2004). As restaurant servers work shifts that

Table 4
Study 3 Means and Standard Deviations

Variable	Multitasking		Sequential tasking: Long		Sequential tasking: Short	
	M	*SD*	*M*	*SD*	*M*	*SD*
1. Self-reported multitasking	5.55_A	1.25	3.19_B	1.41	3.86_C	1.54
2. Positive activated emotions	3.75_A	1.23	4.22_A	1.41	4.04_A	1.40
3. Negative activated emotions	3.22_A	1.44	2.35_B	1.10	2.89_A	1.41
3. Activation: Posttasks	54.65_A	20.30	41.11_B	16.75	35.52_B	18.93
4. Cognitive flexibility	3.90_A	1.73	3.12_B	1.76	4.01_A	1.62
5. Creativity: First task	2.86_A	1.15	3.31_A	1.34	2.85_A	1.25
6. Creativity: Subsequent task	4.46_A	1.45	3.34_B	1.26	3.04_B	1.77

Note. $n = 171$. Rows that do not share a subscript (A, B, C) are significantly different at $p < .05$.

Table 5
Study 3 Regression Table

Variable	Mechanism 1: Activation Model 1 B (SE)	Model 2 B (SE)	Mechanism 2: Cognitive flexibility Model 3 B (SE)	Model 4 B (SE)	Creativity outcome: Structured imagination task Model 5 B (SE)	Model 6 B (SE)
Intercept	54.65** (2.48)	61.80** (6.06)	2.94** (.44)	1.49** (.68)	3.05** (.43)	2.56** (.59)
Positive activated emotions		−.16 (1.08)		.20* (.10)		.27** (.08)
Negative activated emotions		−2.06 (1.11)		.19* (.10)		−.12 (.09)
X1	−13.54** (3.47)	−15.41** (3.65)	−.55 (.33)	−.45 (.34)	−.81** (.28)	−1.07** (.29)
X2	−19.13** (3.53)	−19.68** (3.57)	.48 (.32)	.48 (.34)	−1.24** (.30)	−1.37** (.29)
Activation			.02* (.01)	.02** (.01)	.01 (.01)	.01 (.01)
Cognitive flexibility					.20** (.07)	.19** (.07)
R^2	.16	.17	.09	.13	.22	.28

Note. X1= dummy coded variable with sequential task–long coded as 1 and multitasking and sequential task–short coded as 0; X2 = dummy coded variable with sequential task–short coded as 1 and multitasking and sequential task–long coded as 0. $n = 171$.
* $p < .05$. ** $p < .01$.

are often 10 to 12 hr long (Gatta, 2009) and multitask constantly, this study enabled us to address this limitation.

Study 4

Method

Participants and procedure. We surveyed 109 restaurant servers from 20 local restaurants; however, because four of these servers did not complete the survey, our final sample comprised of 105 restaurant servers with complete data. The sample of restaurant servers was 51.4% male with a mean age of 27.9 years (*SD* = 8.21 years) with an average of 6.11 years of experience working in restaurants (*SD* = 6.66 years). Participants received $5 as compensation. This study received ethical approval from the Institutional Review Board (IRB) at the University of North Carolina at Chapel Hill ("Multitasking and Creativity-Server Study"; Protocol #15–1979). This study was included in a prior version of this article published in the conference proceedings at the Academy of Management Meeting in Anaheim, California (Kapadia, 2016).

While each restaurant (and thus each server) was surveyed only once, to get varied levels of multitasking, we made sure to survey wait staff in restaurants on slower days, such as Tuesday and Wednesday nights, as well as busier days, such as Friday and Saturday nights. This survey included self-reports of multitasking and activation, a measure of cognitive flexibility (alternate uses for a brick; Goncalo et al., 2010), and a structured imagination task that comprised the creativity measure (Ward, 1994). We chose the structured imagination task as a practical and validated measure of creativity because it is a short task requiring no prior knowledge. This was especially important given the sample and context, as participants in the survey had varying educational backgrounds, roles, and work experience. Furthermore, we chose this particular task as another measure of creativity that varied from the tasks we used in prior studies to establish additional generalizability.

Measures. Unless otherwise indicated, all items used a 7-point Likert scale anchored from 1 = *strongly disagree* to 7 = *strongly agree*.

Multitasking during shift. Multitasking was assessed using the same multitasking scale used in Studies 1 and 3. This three-item scale asked participants to rate the extent to which they felt they were multitasking during their shift, $M = 6.21$, $SD = 1.13$ ($\alpha = .92$).

Mediator: Level of activation. Participants self-reported their level of activation at the end of their shift (but before completing the creativity tasks) using items "I feel stirred up"; "I feel amped up"; and "I feel stimulated"; $M = 3.96$, $SD = 1.43$ ($\alpha = .73$).

Mediator: Cognitive flexibility. Participants were given the Alternate Uses task, in which they were presented with a photo of a brick and asked to generate as many creative uses for the brick as they could. Two separate coders coded the ideas from Study 1 to develop a complete list of categories that they belonged to. All ideas were content coded by a rater who assigned one or more categories to each idea. Twenty categories emerged from this process. Two separate coders then categorized each idea based on these 20 categories (ratings of the two coders reached significant agreement: ICC(2) = .96, $p < .001$ and were thus averaged). Cognitive flexibility was assessed as the number of distinct categories ($M = 5.25$, $SD = 2.04$) each participant referenced (e.g., De Dreu et al., 2008; Nijstad, Stroebe, & Lodewijkx, 2002).

Dependent variable: Creative performance. We measured creativity using Ward's (1994) measure of structured imagination, in which participants were asked to draw an alien. Ward's (1994) alien task gauges the extent to which people can think outside of the constraints of their own experiences and knowledge to generate ideas that are divergent from their existing knowledge. In this test, participants were asked to draw a space creature based on the following instructions: "Imagine going to another galaxy in the universe and visiting a planet very different from Earth. You have one minute to draw a picture of a creature that is local to this other planet" (Ward, 1994). Following Ward's (1994) original coding scheme (more recently used by Goncalo et al., 2010), each alien was coded for creativity by assessing the atypicality of the space creatures' sensory organs. Two trained coders counted the atypicality of the creatures based on (a) lacking a major sensory organ (i.e., eyes, ears, nose); (b) an atypical number of sensory organs (e.g., one eye); (c) having an unusual configuration of senses (e.g., nose above eyes); (d) having organs with an unusual ability (e.g., eyes that shoot laser beams); or (e) having organs that serve an atypical function. The total number of atypical features was tallied for each participant. The ratings of the two coders reached significant agreement (ICC(2) $= .93$, $p < .001$) and were averaged together to create an overall measure of creative performance ($M = 6.62$, $SD = 2.24$).

Control variables. We controlled for individual and contextual factors that could be expected to influence activation, cognitive flexibility, and creativity. As affect has been shown to influence creative performance (Davis, 2009), and because we wanted to show that our findings were specific to the effects of activation and not hedonic tone, we also controlled for positive and negative affective tone using four items assessing valence. Items for negative emotions included "I felt negative" and "I felt unpleasant" ($M = 2.13$, $SD = 1.27$; $\alpha = .86$). Items for positive emotions included "I felt positive" and "I felt pleasant" ($M = 5.30$, $SD = 1.30$; $\alpha = .91$). Furthermore, we also controlled for the level of busyness in the restaurant to be able to demonstrate that multitasking, and not busyness was driving the creativity effect. We measured this variable by asking restaurant managers to evaluate each server's level of busyness during their shifts ($M = 3.77$, $SD = 1.76$). We also controlled for the length of the shift to show that the length of multitasking did not influence outcomes ($M = 294.77$, $SD = 146.90$).

Results

The descriptive statistics and correlations among the study variables are shown in Table 6. The regression analyses are shown in Table 7.

As the study design involved restaurant servers nested within 20 different restaurants, we checked to see whether creativity was influenced by restaurant-level factors. However, one-way analyses of variance indicated that controlling for the effects of the restaurant was not necessary (activation: $F(19, 83) = 1.42$, $p = .14$; cognitive flexibility: $F(19, 84) = 1.06$, $p = .40$; and, alien task creativity: $F(19, 85) = 1.55$, $p = .10$). Thus, we ran analyses at the individual level; but corroborated that our results do not change even with multilevel analyses controlling for restaurant-level variance.

We started with testing for Hypothesis 1a, which proposes that multitasking increases subsequent creative performance. Unlike our prior three studies, however, we did not find evidence of this main effect ($B = .03$, $SE = .21$, $p = .89$). We then tested Hypothesis 2 that proposes that activation and cognitive flexibility, in turn, serially mediate the relationship between multitasking and creative performance, using Hayes's (2013) PROCESS procedure (Model 6, 5,000 bootstrap samples), which utilizes the bootstrapping feature to calculate the indirect mediation effect. The results indicated that the indirect effect of multitasking on creativity through activation and cognitive flexibility, $b = .08$ ($SE = .04$), 95% CI [.01, .17] was significant. Confirming that this was the best model, the result of the model with cognitive flexibility predicting activation and then creativity, $b = .004$ ($SE = .01$), 95% CI [−.02, .03] was not significant. Together, these results support our overall serial process model.

General Discussion

Building a serial mediation model, we proposed and found that high levels of multitasking behavior had a positive downstream impact on subsequent creative performance and this association was mediated by increased levels of activation and cognitive flexibility in temporal sequence. The first study, an experimental laboratory study, and the second study, an archival study using data from the TV show, *Chopped*, provide support for the direct high multitasking-subsequent creativity link. In the former study, we also show that this relationship holds for creative performance but not analytical performance and in the latter study, we demonstrate that this relationship applies only to subsequent creative performance and not current creative performance. The third study, another experimental laboratory study, and the fourth study, a field study of restaurant servers, provide empirical support for the complete model, finding that high levels of multitasking engender activation, which stimulates cognitive flexibility in turn, ultimately driving improved creative performance on downstream tasks.

Contributions to Theory, Research, and Practice

A critical contribution of our work is the introduction of a theoretical model that demonstrates how and under what circumstances multitasking can have a positive influence on downstream creative performance. In doing so, this research makes contributions to the existing literature on multitasking and creativity. In reference to multitasking, our model differs from prior multitasking theories in considering the lingering effects behaviors can have on subsequent tasks and, to our knowledge, is the first article to propose and find support for a beneficial outcome of multitasking

Table 6
Study 4 Correlation Matrix

Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1. Multitasking	6.21	1.13	1							
2. Server busyness	3.77	1.76	$.31^{**}$	1						
3. Shift length (minutes)	4.91	2.45	.13	$.23^{*}$	1					
4. Positive emotions	5.30	1.30	−.06	$-.20^{*}$	−.15	1				
5. Negative emotions	2.13	1.27	.05	.14	.10	$-.78^{**}$	1			
6. Activation	3.96	1.43	$.28^{**}$	.19	.10	.01	.04	1		
7. Cognitive flexibility	5.25	2.04	.09	.17	−.07	.05	−.10	$.33^{**}$	1	
8. Creativity: Structured imagination	6.62	2.24	.01	.04	−.01	−.10	.03	$.27^{**}$	$.43^{**}$	1

Note. $n = 105$.
$^{*} p < .01$. $^{**} p < .05$.

Table 7
Study 4 Regression Table

Variable	Affective mechanism: Activation		Cognitive mechanism: Cognitive flexibility		Creativity outcome: Structured imagination task	
	Model 1 B (SE)	Model 2 B (SE)	Model 3 B (SE)	Model 4 B (SE)	Model 5 B (SE)	Model 6 B (SE)
Intercept	1.75** (.76)	.44 (1.52)	3.50** (1.10)	5.24* (2.11)	4.24** (1.18)	7.12** (2.24)
Multitasking	.36**(.12)	.32* (.13)	−.01 (.18)	−.06 (.19)	−.16 (.18)	−.11 (.19)
Server busyness		.09 (.09)		.21 (.13)		−.13 (.13)
Server shift length		.001 (.001)		−.002 (.001)		.00 (.001)
Positive emotions		.16 (.18)		−.18 (.25)		−.43 (.26)
Negative emotions		.12 (.18)		−.34 (.25)		−.22 (.26)
Activation			.47** (.14)	.47** (.14)	.24 (.15)	.25 (.16)
Cognitive flexibility					.45**(.10)	.46** (.11)
Total R^2	.08	.10	.11	.16	.23	.25

Note. $n = 105$.
* $p < .05$. ** $p < .01$.

behavior. A secondary contribution within this literature is that we were able to capture multitasking behavior using natural work scenarios and real work settings to demonstrate the impact of this behavior as it occurs in the workplace. Much of the prior research done in psychology has investigated multitasking in structured ways that do not map onto how people actually multitask at work (Salvucci & Taatgen, 2011b); yet, their findings are presumed to generalize to the organizational setting. By focusing on this behavior *at work*, we consider the longer-lasting impact of this behavior on other meaningful organizational outcomes. We were also able to confirm that multitasking had a positive effect on creative performance whether it was involuntary (as in Studies 1 and 3), voluntary (as in Study 2), or a combination of voluntary and involuntary behavior (as in Study 4, where servers both chose to multitask but were also subject to interruptions from customer requests). Furthermore, by assessing creativity using multiple creative measures across our studies, we demonstrated that the effect of multitasking on subsequent creativity holds in cases in which future creative tasks are related to the multitasking content and cases in which they are unrelated. In two of our four studies, we used established measures of creativity that did not correspond to the tasks being multitasked, but the results suggest that the effects of increased activation on higher cognitive flexibility on creativity are agnostic of the content involved in multitasking.

By integrating multiple creativity studies and theories, we contribute to creativity research by demonstrating that juggling multiple tasks concurrently increases subsequent creativity, which is similar to recent research showing support for increased creativity after holding dual contrasting thoughts in the mind (i.e., paradoxical framing; Miron-Spektor et al., 2011). By adding to this literature, we demonstrate that this effect could go beyond holding directly opposing thoughts to simply juggling two or more thoughts in the mind at once. By attending to multiple tasks or cognitions, individuals' attention may stimulate different perspectives. The activation generated from the effort involved in doing so may lead to a cognitive process that broadens categories and enables more atypical associations between different sets of information, resulting in enhanced cognitive flexibility and, in turn, creativity.

We also provide further support for the link between multitasking and activation (Yeykelis et al., 2014) and demonstrate a little-tested link between activation and creativity (Baas, De Dreu, & Nijstad, 2011). Research on activation regarding creativity (Baas et al., 2008; De Dreu et al., 2008; To et al., 2012) demonstrates that both positive and negative activating emotions can have positive effects on creativity. Our research adds to this literature by demonstrating that behaviors stimulating activation (absent of, or over and above valence) can also influence creative performance. Prior research on the spillover effects of energy and excitement suggest that the activation response incompletely dissipates after the first activity and this energy then "spills over" onto subsequent thoughts and emotions (Zillmann, 1971). Our study shows this spillover effect has a positive effect on cognitive flexibility through the residual activation generated from the initiation of high levels of multitasking. To this end, we contribute to a prior literature that addresses the spillover effects of emotions and behavior on subsequent outcomes (e.g., Zillmann, 1971; Zillmann et al., 1972).

Accordingly, our research offers important practical implications for how employees utilize their time at work. Rather than only thinking about the known negative consequences of multitasking for concurrent performance, our research suggests that under certain circumstances or in certain industries, it could be helpful for employees to multitask on occasion. While we found that high multitasking can sometimes hurt performance on current tasks, the downstream benefits of multitasking may outweigh the drawbacks for those who have discretion over their schedules, perform multitasking only for less important tasks, have high multitasking skills, or for whom the relative importance of creativity is higher than task performance. For example, those working in creative industries such as technology or advertising may derive benefits from multitasking based on how they structure their tasks over the course of their day.

Limitations and Future Directions

One of the strengths of our research is that we obtain fairly consistent results across four different studies that use experimental and field contexts and use both coded and self-reported measures. These differing research designs and methodologies serve the purpose of constructive replication (e.g., Gordon, Slade, & Schmitt, 1986) and enhance the ecological validity of the work. In addition, our samples include both students and working professionals thus enhancing our ability to generalize results across different situations and populations. Despite these strengths, our work, like all studies, is subject to limitations.

First, in our studies with the exception of Study 2 (*Chopped*), the subsequent creative task that followed multitasking behavior was not performed concurrently with other tasks, so people had the ability to focus solely on the creative task. Although our model suggests that high multitasking should lead to subsequent creative performance regardless of whether the subsequent task also involves high multitasking, we did not directly test this in our experiments and this may limit the generalizability of our findings to all work environments. Future work could explore how these relationships are affected by varying the level of cognitive demands or level of multitasking in the subsequent task.

Another major limitation of our study involves the self-report assessment of activation. Although we attempted to control for positive activated and negative activated hedonic tone in our experimental and quasi-experimental studies, the self-reported measures of activation may not capture the full range of experienced energy and may also carry positive connotations, as individuals perceive their higher levels of activation as energizing. Thus, we hope future studies may be able to explore this relationship using measures of "pure" activation such as physiological measures of heart rate and skin conductance. Not only will these measures reflect activation absent any valence, but they may also be more sensitive to activation well before it is consciously experienced by participants (Akinola, 2010), and could be instrumental in understanding how activation shifts in relation to the level of multitasking being performed over time. Furthermore, it could help illuminate the relationship between physiological activation and its resulting subjective affective experience.

Our studies also focused primarily on the idea generation phase of the creative process, although Study 3 did involve selecting and submitting only one creative idea. Future studies could further explore how multitasking behavior impacts idea selection or implementation. Because multitasking behavior operates through activation and cognitive flexibility, in turn, future research might find that the outcome for creative decision-making remains in line with our current model. Alternatively, multitasking behavior, by increasing cognitive busyness and creating high cognitive load (Gilbert, Pelham, & Krull, 1988), which has been shown to amplify individual biases in perception, may negatively affect idea selection by predisposing people to less creative ideas that may align more easily with their stereotypes (Mueller, Melwani, Loewenstein, & Deal, 2018). Similarly, multitasking behavior during implementation may generate more creative iterations of the idea or divert attention and energy from potential creative improvements.

Future research in multitasking could also explore other factors that may influence how multitasking affects subsequent creativity. Future research is important for determining whether the type of subsequent task, or the level of multitasking while engaging in it, affects creative performance. Additionally, future research could explore the effect of lower levels of multitasking such as concurrently performing a work task with a nonwork task, for example checking Facebook while in a meeting, or taking a personal call while working on a presentation, to see if the same relationships hold. Future research could also consider multitasking activities that have a depleting effect on energy to see if multitasking alleviates the energy depletion or whether it compounds it. Polychronicity, defined as an individual's preference for multitasking (Kaufman, Lane, & Lindquist, 1991), may also affect the relationship between multitasking and subsequent creativity. Counterintuitively, people with a lower preference for multitasking may experience higher levels of activation due to the temporal dissonance between their time use preferences and their multitasking experience and this may exacerbate the positive effect of multitasking on subsequent creativity through activation. It would also be interesting to understand multitasking behavior in teams and the organizational outcomes of these interactions. Research on team polychronicity, a team's preference for multitasking behavior, suggests that shared temporal cognition and temporal transactive memory systems moderate the relationship between team polychronicity diversity and team performance (Mohammed & Nadkarni, 2014). Perhaps by studying multitasking behavior in teams, future research can contribute to how teams develop these temporal cognitions and how they communicate and coordinate work tasks to improve performance.

Conclusion

Our research identifies a positive downstream consequence of high multitasking behavior on subsequent creative performance. Those who perform high levels of multitasking may gain benefits first through the generation of high activation, which leads, in turn, to high cognitive flexibility, resulting in higher creativity on the subsequent task. Our findings may serve as a starting point for future studies on the downstream consequences of multitasking behavior.

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(*Appendix follows*)

Appendix

Study Materials

Study 1 Inbox Task

Conference Call Information

Imagine that you have been appointed the student member of a small committee designed to brainstorm creative ways for funding student organizations on campus. The committee consists of: (a) the head of the Student Union, Bob Jones; (b) the undergraduate class president, Mary Smith; and (c) you, the student representative. Please listen to the conference call.

E-Mail Task Information

In addition to being the student representative at this committee, you are also involved with several organizations on and off-campus. You're the photographer for the student newspaper, a volunteer at the local elementary school helping tutor students who speak English as a second language, and you also work at Bed Bath & Beyond as an assistant manager. Next week, you're working 15 hr at your job, volunteering on Monday and Wednesday from 3:30–5:30 p.m., and taking photos at the women's soccer game on Tuesday at 5 p.m. Your job schedule for next week is: 8 a.m.–2 p.m. Tuesday, 8 a.m.–12 p.m. Thursday, and 10 a.m.–3 p.m. Friday.

E-Mail #1

hey . . . so it turns out that I have a paper due next Wednesday that I forgot about. would you mind switching your volunteer hours with me so that I can work on Monday and you can take the Tuesday 3:30–5:30 p.m. shift? let me know when you get a chance, cause if you cannot I have to find someone else to take it.

-ed

E-Mail #2

Listen, I know that I already scheduled you to take photos at the soccer game, but are you available on Tuesday at 6:30 p.m. to go to an opening at the art museum? We're doing an article on the new Andy Warhol exhibit they're featuring.

Let me know ASAP,

Taylor

Photo Editor, Student Newspaper

E-Mail #3

Hi,

I'm a prospective student from Midland High School. I'm interested in majoring in journalism like you, so Professor Mackworth mentioned that I should contact you to learn more about what it's like from a student's perspective.

What do you think of the journalism program? Do you find it difficult to balance your coursework with the demands of the newspaper? Would you recommend it?

Thanks for any advice that you can offer!

Christine LaPierre

Study 3 Inbox Task

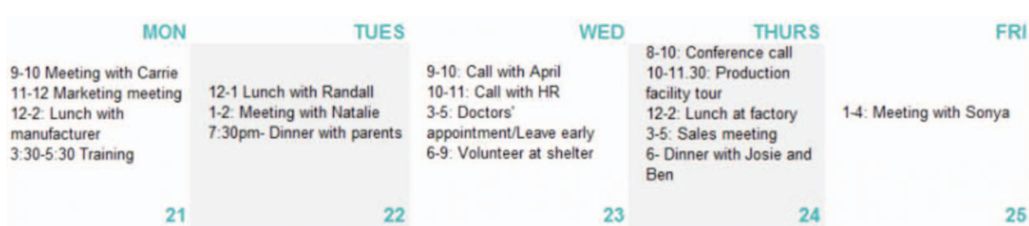
Conference Call Information

You are part of the sales and marketing team for SheepyMe, a toy manufacturer known for designing a series of award-winning toys for the 3- to 5-year-old market. The company is at a crossroads in terms of what type of toys to develop next and to resolve this issue, you are taking part in a conference call with the CEO and the marketing and sales vice presidents.

Conference call can be heard here: https://tinyurl.com/vfooodb

E-Mail Task Information

Answer the following e-mails based on your schedule



See the online article for the color version of this figure.

(*Appendix continues*)

E-Mail #1

hey . . . so it turns out that I have a deadline next Monday night that I forgot about. would you mind switching your training hours with me so that I can work on Monday and you can take the Tuesday 3:30–5:30 p.m. session? let me know when you get a chance, cause if you cannot I have to find someone else to take it.

thanks!

ed

E-Mail #2

Hi, I know that I already scheduled you to take photos at the gala, but are you available on Tuesday at 6:30 p.m. to go to an opening at the art museum? We're doing an article on the new Andy Warhol exhibit they're featuring. Let me know ASAP,

Taylor

E-Mail #3

Hi!

Hope the internship has started well. I've been interning with Sonya for a few weeks as well and she suggested that we get to know each other. Would you have time for lunch this week? My calendar is wide open.

Gabe

E-Mail #4

Hi,

I am a current junior at UNC and am really interested in entering an organizations like SheepyMe. Jeff Manly, an alumnus suggested I reach out to you to learn more about possible internship opportunities. I would also love to learn more about your role and the organization as a whole. How would you describe the culture? Would you have time for a phone conversation anytime on Thursday?

Thanks for any advice that you can offer!

Christine LaPierre

E-Mail #5

Dinner Wednesday or Friday? It's been ages!

-Carter

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