RESEARCH REPORT

Building a Self-Regulatory Model of Sleep Deprivation and Deception: The Role of Caffeine and Social Influence

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Employees are getting less sleep, which has been shown to deplete self-regulatory resources and increase unethical behavior (Barnes, Schaubroeck, Huth, & Ghumman, 2011; Christian & Ellis, 2011). In this study, we extend the original mediated model by examining the role of 2 moderators in the relationship between sleep deprivation, depletion, and deceptive behavior. First, we derive psychological arguments from the psychopharmacology literature to hypothesize that caffeine moderates the relationship between sleep deprivation and depletion by replenishing self-regulatory resources. Second, we draw from recent research in social psychology to hypothesize that social influence moderates the relationship between depletion and deceptive behavior, such that depleted individuals are less able to resist the negative influence of others. Results of a laboratory study provide support for our expanded model combining mediation and moderation, adding to our understanding of the role of sleep deprivation in the incidence of workplace deception.

Keywords: behavioral ethics, deception, self-regulation, caffeine, social influence

Recent highly publicized scandals and corporate malfeasance instigated by employees and executives across a wide variety of organizations has increasingly turned the attention of managers and scholars toward understanding the drivers of unethical behavior (see Treviño, Weaver, & Reynolds, 2006), or "behavior that is subject to (or judged according to) generally accepted norms of behavior" (Reynolds & Ceranic, 2007, p. 1610). In this study, we focus specifically on deception, which researchers typically view as unethical (e.g., Gu, Zhong, & Page-Gould, 2013; Shalvi, Dana, Handgraaf, & De Dreu, 2011; Zhong, 2011). One perspective adopted by researchers is based on theories of self-regulation and suggests that the depletion of self-regulatory resources increases

unethical behavior at work (Gino, Schweitzer, Mead, & Ariely, 2011; Mead, Baumeister, Gino, Schweitzer, & Ariely, 2009). Following this line of reasoning, some have begun to focus on the effects of sleep deprivation.

Sleep deprivation is becoming more relevant to both scholars and practitioners due to the fact that employees are working more hours every year, a trend that is expected to continue in the near future (National Institute for Occupational Safety and Health, 2004). In fact, the number of Americans who sleep fewer than 6 hr per night has increased from 13% to 20% from 1999–2009 (National Sleep Foundation, 2009). Sleep deprivation adversely affects the functioning of the prefrontal cortex, a part of the brain involved in self-regulation (Durmer & Dinges, 2005; Jennings, Monk, & Van der Molen, 2003). Drawing on this physiological evidence, recent organizational studies have found that sleep deprivation depletes regulatory resources, leading to increases in unethical behavior (Barnes et al., 2011; Christian & Ellis, 2011). In this study, we expand the original mediated model by drawing on research from psychopharmacology and social psychology to identify the role of two important moderators: caffeine and social influence.

In terms of the relationship between sleep deprivation and depletion, we theorize that caffeine will play a moderating role. In the United States, there has been rapid growth in the consumption of both energy drinks and coffee, with 90% of Americans now ingesting caffeine on a daily basis (Hruby, 2012). Caffeine significantly increases the alertness of individuals who are sleep de-

prived (e.g., Penetar et al., 1993), so it may replenish self-regulatory resources and mitigate the effects of sleep deprivation on unethical behavior at work.

In terms of the relationship between depletion and deceptive behavior, we theorize that social influence will play a moderating role. Many of the more notable scandals involving companies such as Enron, Adelphia Communications, and Worldcom were instigated by groups of individuals across a variety of levels within the organization (Fusaro & Miller, 2002; Kulik, O'Fallon, & Salimath, 2008; Scharff, 2005). In such situations, the influence of others plays a significant role in determining one's behavior (see Cialdini & Goldstein, 2004; Robinson & O'Leary-Kelly, 1998; Salancik & Pfeffer, 1978). Perhaps the most infamous example comes from a series of studies performed by Stanley Milgram, who found that "normal" individuals would administer a lethal shock to another human being so long as the directive came from a reputable authority figure (Milgram, 1974). We argue that individuals are more susceptible to the influence of others when depleted, which has implications for unethical behavior at work.

Our hypothesized model is pictured in Figure 1. This study contributes to the literature by introducing boundary conditions to suggest that there are situations in which sleep deprivation does not necessarily lead to unethical behavior. First, we add to literature focused on the relationship between sleep deprivation, depletion, and deception by suggesting that the strength of the mediated model can be buffered by caffeine and exacerbated by unethical social influence. Second, we contribute to self-regulatory theories of workplace behavior by demonstrating that caffeine increases the resources depleted by lack of sleep and that these resources help employees resist social influence. Third, we add to the behavioral ethics literature by combining ideas from psychopharmacology and social psychology to provide a more complete picture of when and why employees engage in workplace deception.

The remainder of the article unfolds as follows. First, we review recent research regarding the effects of sleep deprivation on unethical behavior, building our initial model using theories of self-regulation. Second, we introduce caffeine and argue that it buffers the effects of sleep deprivation on depletion. Third, we introduce social influence and argue that it exacerbates the effects of depletion on deceptive behavior. Finally, to test our hypotheses, we report the results of a laboratory study with 229 undergraduate business students.

Sleep Deprivation, Unethical Behavior, and the Role of Self-Regulation

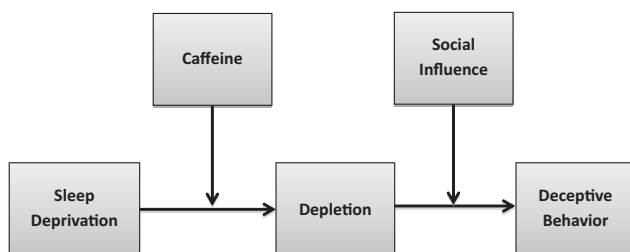Throughout the workday, employees must engage in self-regulation in order to overcome impulses and abstain from imme-diate gratification. Under the strength model of self-regulation, acts of self-control draw from a common, global resource (Baumeister, Bratslavsky, Muraven, & Tice, 1998). This resource allows executive control over thoughts, emotions, and behaviors. However, one's self-regulatory resources are limited and are susceptible to depletion over time. Depletion of self-regulatory resources involves a temporary reduction in one's capacity to engage in volitional action, which can occur when employees are sleep deprived (Barnes et al., 2011; Baumeister, Muraven, & Tice, 2000; Christian & Ellis, 2011).

Sleep is a homeostatic process involving a reorganization of neural activity that has a restorative effect on the brain (Hobson, 2005; Saper, Scammell, & Lu, 2005; Weinger & Ancoli-Israel, 2002). Total deprivation, defined as at least one night without sleep, represents an induced state of diminished cognitive capacity (Barnes & Hollenbeck, 2009) and is known to have deleterious effects on human functioning (Harrison & Horne, 2000; Pilcher & Huffcutt, 1996). Although sleep deprivation appears to have relatively little impact on some tasks, such as IQ tests, sleep-deprived individuals have been observed to behave in an uninhibited manner and show a lack of regard for social conventions (Ghumman & Barnes, 2013; Horne, 1993).

From a neuroscience perspective, sleep deprivation impairs brain functioning in the prefrontal cortex, which is associated with executive control over behavior (Durmer & Dinges, 2005; Jennings et al., 2003). The brain requires glucose to operate effectively, and sleep deprivation reduces the prefrontal cortex's rate of glucose metabolic activity (Dahl & Lewin, 2002; Gailliot et al., 2007), a physiological process that manifests psychologically as self-regulatory depletion (Barnes et al., 2011; Christian & Ellis, 2011). For example, across four studies conducted in both lab and field settings, Barnes et al. (2011) found that lack of sleep impaired self-regulation. Similarly, Christian and Ellis (2011) found in a lab study of undergraduate students that sleep deprivation led to a reduction in self-regulatory resources, using survey and behavioral measures of state self-control. This suggests that the effects of sleep deprivation are self-regulatory, rather than simply resulting from fatigue, an idea bolstered by meta-analytic findings that self-regulatory depletion and fatigue are distinct both theoretically and empirically (Hagger, Wood, Stiff, & Chatzisarantis, 2010).

Because self-regulation is required to overcome temptations and resist impulses to gratify needs and desires, depletion may enable nonoptimal motivational tendencies to exert a greater influence on behavior (e.g., Barnes et al., 2011; Christian & Ellis, 2011; Mead et al., 2009). For example, Gino et al. (2011) found that individuals depleted of self-regulatory resources were more likely to behave dishonestly by over-reporting their performance to claim unearned compensation.

In sum, evidence converging across psychology, neuroscience, and management suggests that sleep deprivation affects unethical behavior through self-regulatory depletion, a mediated model that has been supported in multiple studies (Barnes et al., 2011; Christian & Ellis, 2011). In the next section, we argue that two variables, caffeine and social influence, fit within the self-regulatory framework and represent potential moderators of the original mediated model.

Figure 1. Hypothesized model.

The Effects of Caffeine

Caffeine is the most widely used psychoactive drug in modern society, with approximately 90% of Americans consuming caffeine on a daily basis (Hruby, 2012; Penetar et al., 1993), often to help them to stay awake (Fredholm, Battig, Holmen, Nehlig, & Zvartau, 1999). In the psychopharmacology literature, studies have demonstrated that caffeine improves alertness in sleep-deprived individuals (Lumley, Roehrs, Asker, Zorick, & Roth, 1987; Penetar et al., 1993). Caffeine operates via the blockage of adenosine receptors in the brain (El Yacoubi et al., 2000; Fredholm, 1995) and the effects of caffeine in increasing alertness have been demonstrated across multiple studies (see Smith, 2002 for a review). However, in contrast to strong stimulants, such as amphetamine, that almost completely restore alertness to rested levels, caffeine has been found to partially restore alertness (Penetar et al., 1993).[1]

We believe that caffeine buffers the effects of sleep deprivation through specific physiological mechanisms associated with self-regulatory capacity. Caffeine operates by attenuating some of the physiological effects associated with sleep deprivation (Solinas et al., 2002). Sleep deprivation increases adenosine, an inhibitory neuromodulator that decreases cellular activity (El Yacoubi et al., 2000). However, caffeine operates by blocking adenosine receptors and increasing the nerve cell messenger glutamate, thereby producing an increase in central nervous system activity (Solinas et al., 2002). By blocking adenosine receptors, caffeine prevents adenosine's depressing effect on cellular activity, thereby attenuating the effects of sleep deprivation (Solinas et al., 2002). Thus, research suggests that caffeine mitigates the neurological effects of sleep deprivation on brain functioning.

In support of our arguments, studies have generally shown that caffeine increases the performance of sleep-deprived individuals on a variety of simple tasks including reaction time tasks, categorical search tasks, choice response time tasks, and repeated digits vigilance tasks (Smith, 2002). We extend previous research by examining the moderating effects of caffeine in a more complex ethical decision making context. We believe caffeine use will influence unethical behavior by significantly reducing the depletion experienced by sleep-deprived individuals, leading to the following hypotheses:

Hypothesis 1: The effects of sleep deprivation on depletion will be significantly weakened following the consumption of caffeine.

Hypothesis 2: The mediated relationship between sleep deprivation, depletion, and deceptive behavior will be significantly weaker for those who ingest caffeine than for those who do not ingest caffeine.

The Effects of Social Influence

According to Pratkanis (2007), social influence represents "a way for one or more members of the species to direct, coordinate, and influence other members of the species" (p. 17). Social influence is a key driver of deception and other types of unethical behaviors in organizations (e.g., Robinson & O'Leary-Kelly, 1998; Weaver, Treviño, & Agle, 2005) and has a long history within the social psychological literature, particularly when it comes to unethical and immoral action (e.g., Milgram, 1963, 1965, 1974).

According to social information processing theory, individuals use information from the surrounding social environment to develop expectations regarding the consequences of their behavior (Salancik & Pfeffer, 1978). People learn normative information from what others do and say (Hogg, 2010). Along those same lines, social learning theory suggests that, if individuals work with a supervisor who is acting unethically, they will likely model that behavior because the situation provides an opportunity to diffuse responsibility and disengage moral control (Bandura, 1990, 1991).

We are less interested in examining the direct effects of social influence on deception and more interested in determining whether an individual's momentary capacity to self-regulate is likely to impact the extent to which that individual is able to resist unethical social influence in order to behave in a socially normative manner. Recent research supports our arguments across a wide variety of contexts, indicating that resistance to social influence consumes self-regulatory resources and attempts at resistance are more likely to fail when resources and self-control are low (Burkley, 2008; Fennis, Janssen, & Vohs, 2009; Wheeler, Briñol, & Hermann, 2007). For example, false confessions have been obtained during intensive police interrogations in which the alleged perpetrator experienced high levels of sleep deprivation and stress over an extended period of time (Kassin, 2008). Sleep-deprived individuals have also been found to be more susceptible to leading questions when asked to describe a series of events (Blagrove, 1996).

Outside of law enforcement, Burkley (2008) found that participants who were depleted had more difficulty resisting social influence and were more likely to comply with the requests of others. Specifically, participants whose self-regulatory resources were depleted on an earlier task showed greater agreement with a persuasive message advocating that the academic summer be reduced to 1 month. As the message grew more persuasive, depleted participants experienced greater difficulty in resisting. Along those same lines, Jacobson, Mortensen, and Cialdini (2011) found that participants who were asked by the experimenter to take some extra surveys to distribute to their friends were more likely to do so when approached immediately after a demanding task.

In sum, a growing body of research has demonstrated that resisting social influence both requires and consumes self-regulatory resources (see Burkley, Anderson, & Curtis, 2011, for a review). Extending this line of research, we predict that social influence will moderate the relationship between depletion and deception such that depleted individuals will be particularly susceptible to a suggestion to deceive someone else, leading to the following hypotheses:

Hypothesis 3: The effects of depletion on deceptive behavior will be significantly stronger when social influence is present.

Hypothesis 4: The mediated relationship between sleep deprivation, depletion, and deceptive behavior will be significantly strengthened when social influence is present.

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[1] These effects moderately increase with dosage levels ranging from 150 mg (approximately one cup of coffee) to 600 mg of caffeine (Penetar et al., 1993).

Method

Participants and Design

This study was conducted in a laboratory setting using 229 undergraduate students from a large public university in the United States. Southwest. We utilized a 2 (sleep deprivation, no sleep deprivation) × 2 (social influence, no social influence) × 2 (caffeine, no caffeine) factorial design and randomly assigned individuals to conditions. The median age of participants was 21 years, and 50% were female. The recruitment, screening, payment, and procedures were all adapted from Christian and Ellis (2011). Specifically, participants were recruited through an online sign-up system and screened via an online pre-survey.[2] Participants received course credit and earned monetary compensation for performance on the experimental tasks. Additionally, participants in the sleep-deprivation condition were paid $60 for their willingness to stay up all night.

Measures

Depletion. Consistent with previous research (e.g., Bertrams, Englert, & Dickhauser, 2010), depletion was measured using five items from the State Ego Depletion Scale (Ciarocco, Twenge, Muraven, & Tice, 2010). A sample item is "My mental energy is running low." Participants responded to these items on a 7-point scale ranging from *strongly disagree* to *strongly agree*. Coefficient alpha was .87.

Deceptive messaging. We used a task adapted from Gneezy (2005), which involves the allocation of $7 between two parties. Participants were instructed that they would be assigned to either a Sender Role or a Decider Role. They were told that individuals in the Sender Role would be provided information about the monetary payouts associated with two options, whereas individuals in the Decider Role would not be informed about the payouts and would only select an option after receiving information from the Sender. In accordance with previous research, participants were all assigned to the Sender Role and played against a computer in order to allow control over the outcomes, although participants believed they were playing against another randomly selected participant.

Participants were informed that there were two potential options. Option A pays the Sender $2 and the Decider $5, whereas Option B pays the Sender $5 and the Decider $2. After receiving this information, participants were instructed to choose a message to send to the decider. Participants could send a truthful message (Message 1) to the decider "Option A will earn you more money than Option B" or a lie (Message 2), "Option B will earn you more money than Option A." Previous research has demonstrated that most participants (over 80%) believe that their partner will believe the message that they send (Cohen, Gunia, Kim, & Murnighan, 2009; Gneezy, 2005). Following Gneezy (2005), deceptive behavior was dichotomously operationalized based on whether participants chose to send either the truthful or the deceptive message. The computer automatically recorded which message was sent.

Manipulations

Sleep deprivation. Following Christian and Ellis (2011), several days prior to the study, participants in the sleep-deprivation condition received an e-mail instructing them to prepare for the study by getting normal sleep (at least 7 hr) for at least two nights before the study, to wake up no later than 9:00 am the day before the study to ensure at least 24 hr of sleep deprivation.[3] Participants in the sleep-deprivation condition entered the lab at 11:00 pm and stayed awake during the entire night. Participants were confined to a lounge and workroom area and were permitted to play board games, watch TV, surf the Internet, read, work on homework, or eat the snacks provided. Two research assistants monitored the participants during the night to ensure that all participants stayed awake.

Caffeine. Participants were given two pieces of wintergreen-flavored chewing gum placed on a napkin at their desks. They were instructed to chew the gum for the first 5 min of the experiment while the experimenter was giving the directions for the study. Participants completed filler scales for approximately 30 min in order to ensure ample time for caffeine absorption. Caffeinated gum is frequently used by researchers as a vehicle for caffeine delivery (e.g., Kamimori, Johnson, Thorne, & Belenky, 2005; Syed, Kamimori, Kelly, & Eddington, 2005) because of the fast absorption rate, in which 85% of the caffeine contained in the gum is delivered after 5 min (Syed et al., 2005). In the caffeine condition, each piece of chewing gum contained 100 mg of caffeine. Thus, participants in the caffeine condition consumed 200 mg of caffeine prior to the start of the experiment. This is approximately the same amount of caffeine contained in a 12-once coffee or 16-ounce energy drink and is consistent with average estimates of daily caffeine consumption in the United States (Frary, Johnson, & Wang, 2005). Participants were not instructed about the function of the gum to avoid a potential priming effect.

Social influence. Social influence was manipulated immediately prior to completing the Gneezy (2005) task. In the social influence conditions, after participants read the instructions and the information regarding the payouts, the experimenter encouraged participants to send the deceptive message rather than the truthful message by saying "My personal advice is to send Message 2 [the deceptive message]." In the control condition, no encouragement was given.

Procedures

Consistent with Christian and Ellis (2011) and Harrison and Horne (1999), we conducted the study over 2 days with sleep deprivation manipulated on the night of Day 1 and participants in both groups completing the experimental tasks at 9:00 am on Day 2. At 8:30 am on Day 2, all participants were served breakfast.[4] At 9:00 am, all participants were brought to the laboratory and assigned to computer terminals located in separate carrels. At this time, the caffeine manipulation was introduced. Following the

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[2] Participants with sleep disorders, heart problems, epilepsy, or clinically diagnosed psychological problems were not allowed to participate. Neither were participants who would not consume caffeinated products.

[3] Participants were also instructed no not take naps on the day before the study, to not bring food or beverages to the study, to not drink alcohol the day before the study, and to arrange for someone to pick them up at the end of the study. Participants in the non-sleep-deprivation condition received a similar e-mail instructing them to get normal sleep prior to the study, to not drink alcohol the day before the study, to not bring food or beverages to the lab, and to avoid consuming caffeinated products on the day of the study.

[4] Participants were provided typical breakfast foods, such as cereal, milk, bagels, and fresh fruit.

caffeine manipulation, participants completed approximately 30 min of filler scales related to personality in order to provide ample time for caffeine absorption. After completing the filler scales, participants completed the depletion measure. Participants then received information from the experimenter regarding the Gneezy (2005) task, at which point the social influence manipulation was introduced. Following the manipulation, participants were provided with ample time to consider the two options and to reach a decision. After completing the Gneezy (2005) task, participants were debriefed. To avoid rewarding deception, all participants later received the maximum amount of $5 for this task.

Results

Table 1 provides means, standard deviations, and correlations. As expected, sleep deprivation had a significant positive correlation with depletion ($r = .49$), and depletion had a significant positive correlation with deceptive behavior ($r = .17$), although sleep deprivation was not significantly correlated with deceptive behavior ($r = .09$). Caffeine had a significant negative correlation with depletion ($r = -.13$), and social influence also had a significant positive correlation with deceptive behavior ($r = .24$). On average, participants sent the deceptive message 52% of the time.

According to researchers, a statistically significant direct relationship between the independent and dependent variables (i.e., sleep deprivation and deceptive behavior) is not necessary for an indirect relationship to exist (Kenny, Kashy, & Bolger, 1998; MacKinnon, Krull, & Lockwood, 2000). Therefore, before testing the moderating effects of caffeine and social influence, we tested the indirect effect of sleep deprivation on deceptive behavior via depletion using Preacher and Hayes's (2008) approach. This procedure is an extension of the Sobel test (Sobel, 1982) and is recommended over that of Baron and Kenny (1986) because it does not assume a normal sampling distribution of indirect effects. As Preacher and Hayes recommend, we estimated the indirect effects using unstandardized coefficients and utilized bootstrapping procedures with 1,000 resamples to place 95% confidence intervals around the estimates of the indirect effects. Bootstrapping provides evidence of mediation if the bias-corrected 95% confidence interval (CI) excludes zero for indirect effects. We found a significant indirect effect of sleep deprivation on deceptive behavior through depletion (coefficient = .37; 95% CI = .07, .77).

Figure 2. The effects of the interaction between sleep deprivation and caffeine on depletion.

Hypotheses Tests

Hypothesis 1 predicted that caffeine would moderate the effects of sleep deprivation on depletion. The results of a two-way analysis of variance indicated a significant interactive effect between sleep deprivation and caffeine on depletion, $F_{(1, 215)} = 3.91$, $p < .05$. As shown in Figure 2, participants who were sleep deprived were significantly less depleted after ingesting caffeine ($M = 4.36$) than participants who were sleep deprived and did not ingest caffeine, $M = 5.09$, $t_{(105)} = 3.22$, $p < .01$. In contrast, when participants were not sleep deprived, there was not a significant difference in mean depletion levels between those who ingested caffeine ($M = 3.33$) and those who did not ingest caffeine, $M = 3.44$, $t_{(110)} = 0.51$, $p > .05$. Thus, Hypothesis 1 was supported.

Hypothesis 2 predicted that caffeine would moderate the mediated relationship between sleep deprivation, depletion, and deceptive behavior. Moderated mediation occurs when the strength of the mediated effect depends on the level of a third variable (Preacher, Rucker, & Hayes, 2007). To test stage one moderated mediation, we used Model 7 in SPSS PROCESS (Hayes, 2013). Specifically, we estimated the conditional indirect effect of sleep deprivation on deceptive behavior through depletion both with and without caffeine using unstandardized coefficients and bootstrapping with 1,000 resamples to place 95% confidence intervals around estimates of the indirect effects. Evidence of moderated mediation exists if the estimates of the indirect effects transmitted through the mediator variable are significantly different across levels of the moderator variable as indicated by a significant interaction (Preacher et al., 2007). Just as moderation can either indicate conditions in which a nonsignificant direct effect becomes significant or conditions in which a significant direct effect is significantly further strengthened, moderated mediation can occur either when there is a significant interaction effect in which mediation exists at some levels of the moderator but not at others, or when mediation effects are present at multiple levels of the moderator, but these effects are significantly stronger or weaker across

Table 1
Means, Standard Deviations, and Correlations Among Variables

Variable	M	SD	1	2	3	4	5
1. Sleep deprivation[a]	0.49	0.50	—				
2. Social influence[a]	0.51	0.50	.01	—			
3. Caffeine[a]	0.52	0.50	.08	.02	—		
4. Depletion	4.14	1.15	.49**	−.03	−.13*	—	
5. Deceptive behavior[a,b]	0.52	0.50	.09	.24*	−.04	.17*	—

Note. $n = 229$.
[a] The correlations between Variables 1 through 3 and Variable 5 are tetrachoric. [b] Deceptive behavior coded as 0 = sent truthful message, 1 = sent deceptive message.
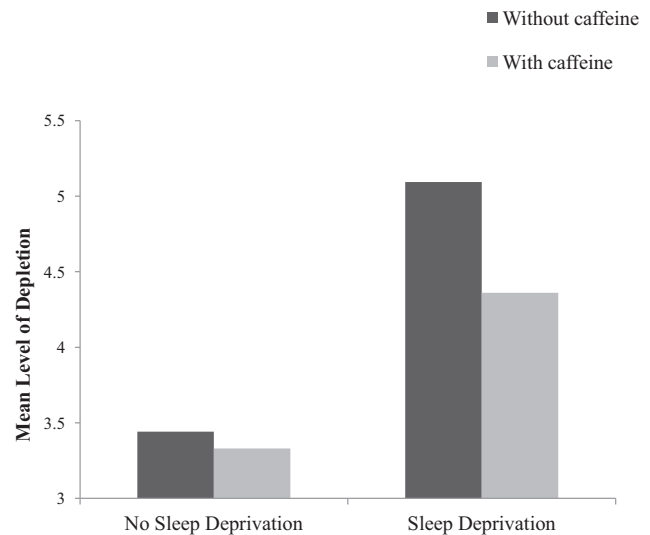* $p < .05$. ** $p < .01$.

Table 2

Coefficient Estimates for the Moderated Mediation Model for Deceptive Behavior

| Variable | First stage (dependent variable = depletion) | | | | | | Second stage (dependent variable = deceptive behavior) | | | | | |
| | Step 1 | | | Step 2 | | | Step 1 | | | Step 2 | | |
	B	SE	t	B	SE	t	B	SE	Wald	B	SE	Wald
Constant	3.59	0.13	26.85**	3.44	0.15	22.71**						
Sleep deprivation	1.34	0.16	8.46**	1.65	0.22	7.46**						
Caffeine	−0.41	0.16	−2.61*	−0.10	0.22	−0.45						
Sleep Deprivation × Caffeine				−0.63	0.31	−2.02*						
Constant							−1.46	0.50	8.60**	−0.50	0.67	0.56
Sleep deprivation							−0.15	0.32	0.22	−0.20	0.32	0.37
Depletion							0.30	0.12	6.21*	0.08	0.16	0.23
Social influence							0.67	0.28	5.63*	−1.09	0.92	1.41
Depletion × Social Influence										0.44	0.22	3.98*
R^2/total Nagelkerke R^2		.26			.28			.07			.10	
ΔR^2/Δ Nagelkerke R^2					.01						.03	
$\Delta F/\Delta\chi^2$					4.09*						4.06*	

Note. $N = 229$. Unstandardized regression coefficients are reported. In the first stage of the moderated mediation model, R^2, ΔR^2, and ΔF are reported; in the second stage, total Nagelkerke R^2, Δ Nagelkerke R^2, and $\Delta\chi^2$ are reported.
* $p < .05$. ** $p < .01$.

levels (Edwards & Lambert, 2007; Preacher et al., 2007). As shown in Tables 2 and 3, the indirect effect of sleep deprivation on deceptive behavior through depletion was significantly attenuated when participants ingested caffeine (coefficient = .29; 95% CI = .02, .91) compared to when participants did not ingest caffeine (coefficient = .47; 95% CI = .06, .69) as indicated by the significant interaction between sleep deprivation and caffeine ($B = −.63$, $t = −2.02$, $p < .05$). Thus, Hypothesis 2 was supported.

Hypothesis 3 predicted that social influence would moderate the effects of depletion on deceptive behavior. The results of a logistic regression indicated a significant interactive effect between depletion and social influence on deceptive behavior, $z_{(217)} = 1.96$, $p < .05$. As shown in Figure 3, the slope of the effect of depletion on deceptive behavior was significant when social influence was present (simple slope = 0.47, $z = 3.11$, $p < .01$) and nonsignificant when social influence was not present (simple slope = 0.05, $z = 0.31$, $p > .05$), $t_{(215)} = 1.93$, $p = .05$. Thus, Hypothesis 3 was supported.

Hypothesis 4 predicted that social influence would moderate the mediated relationship between sleep deprivation, depletion, and deceptive behavior. To test stage two moderated mediation as outlined in our theoretical diagram we used Model 14 in SPSS PROCESS (Hayes, 2013). Specifically, we estimated the conditional indirect effect of sleep deprivation on deceptive behavior through depletion both with and without social influence using unstandardized coefficients and bootstrapping with 1,000 resamples to place 95% confidence intervals around estimates of the indirect effects. The indirect effect of sleep deprivation on deceptive behavior through depletion was significantly increased when social influence was present (coefficient = .68; 95% CI = .20, 1.24) compared to when social influence was not present (coefficient = .10; 95% CI = −.42, .60), as indicated by the significant interaction between depletion and social influence ($B = .44$, $z = 1.99$, $p < .05$). Thus, Hypothesis 4 was supported.

Finally, to test the full model with depletion mediating the effects of sleep deprivation on deceptive behavior, caffeine mod-

erating the effects of sleep deprivation on depletion, and social influence moderating the effects of depletion on deceptive behavior, we used Model 21 in SPSS PROCESS (Hayes, 2013).[5] Specifically, we estimated the conditional indirect effect of sleep deprivation on deceptive behavior through depletion both with and without caffeine and with and without social influence using unstandardized coefficients and bootstrapping with 1,000 resamples to place 95% confidence intervals around estimates of the indirect effects. As shown in Table 3, we found significant interactions between sleep deprivation and caffeine in predicting depletion ($B = −.63$, $t = −2.02$, $p < .05$) and between depletion and social influence in predicting deceptive behavior ($B = .44$, $z = 1.99$, $p < .05$), providing evidence of moderated mediation at two different points along the causal chain. Thus, results supported our hypothesized model.

Discussion

While researchers have long documented the health risks associated with lack of sleep (Colten & Altevogt, 2006), studies have recently begun to look at the effects of sleep deprivation on unethical behavior at work (Barnes et al., 2011; Christian & Ellis, 2011). Taking a self-regulatory perspective, researchers have suggested that sleep deprivation depletes employees, which detracts from their ability to resist ethically questionable actions at work. We believe the self-regulatory model contains significant explanatory value but requires further expansion and the identification of relevant moderating variables. In this research, we integrated the psychopharmacology and social psychology literatures with self-regulatory resource theories to examine the effects of caffeine and social influence.

In terms of our specific results, caffeine moderated the relationship between sleep deprivation and depletion by attenuating the depleting effects of sleep deprivation. Caffeine counteracts the

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[5] PROCESS automatically switches to a logistic model of estimation when it detects a dichotomous outcome.

Table 3
Bootstrap Results for the Conditional Indirect Effects

Condition	Indirect effect	SE	Boot LL 95% CI	Boot UL 95% CI
No caffeine, no social influence	.13	.31	−0.49	0.76
Caffeine, no social influence	.08	.20	−0.27	0.50
No caffeine, social influence	.85	.34	0.29	1.59
Caffeine, social influence	.53	.24	0.16	1.09

Note. CI = confidence interval; LL = lower limit; UL = upper limit. Unstandardized regression coefficients are reported. Bootstrap sample size 1,000.

negative effects of sleep deprivation by blocking adenosine receptors and increasing the nerve cell messenger glutamate. However, while our results support supplying employees with caffeinated products, any benefits must be carefully balanced with the well-documented negative effects of these drugs. Excessive caffeine consumption may operate as a diuretic, increase anxiety, elevate heart rate, and lead to withdrawal symptoms including headaches and fatigue (Green, Kirby, & Suls, 1996; Juliano & Griffiths, 2004). Caffeine is not a panacea for self-regulatory problems or a complete substitute for rest, and sleep-deprived employees should not expect to fully restore their self-regulatory capabilities. Future research could consider how dosage levels, the number of dosages (e.g., one large dose vs. several smaller doses), and the buildup of tolerance influence the effectiveness of caffeine in attenuating the depleting effects of sleep deprivation. Future research could also investigate the effects of other stimulants or depressants, such as alcohol, on the responses of sleep-deprived employees.

Social influence, on the other hand, moderated the relationship between depletion and deceptive behavior by increasing the propensity of depleted individuals to send a deceptive message. According to Treviño and Brown (2004, p. 72), when employees make ethics-related decisions, "[t]hey tend to 'look up and look around,' and they do what others around them do or expect them to do." This is consistent with social psychological work regarding social learning theory (Bandura, 1977) and social influence (see Hogg, 2010), as well as the work of Robinson and O'Leary-Kelly

Figure 3. The effects of the interaction between depletion and social influence on deceptive behavior.

(1998), who found that employees are more likely to act in an antisocial manner when they see members of their workgroup exhibiting antisocial behavior. Our results add to this literature by showing how this process becomes more difficult to resist when employees are depleted.

Our results also highlight several avenues for future research, including investigating different forms of social influence. For example, our study suggests that participants receiving a suggestion to do something prosocial, altruistic, or involving self-sacrifice might be more likely to comply when sleep-deprived. This idea is in line with research showing that making people more aware of social norms increases ethical decisions (e.g., Gino, Ayal, & Ariely, 2009; Mazar, Amir, & Ariely, 2008) and that ethical leadership promotes ethical behavior (Brown, Treviño, & Harrison, 2005; Mayer, Aquino, Greenbaum, & Kuenzi, 2012). If sleep-deprived individuals are more "open to suggestion," perhaps this effect can be harnessed in a positive manner.

In addition, future research could manipulate the source of the influence. For example, research has examined how people respond to the unethical influence of peers (e.g., Gino et al., 2009; Robinson & O'Leary-Kelly, 1998), and it would be interesting to compare whether peers are more or less influential than authority figures in stimulating unethical behavior. However, based on the results of Gino et al. (2009), the critical factor may be in-group/out-group status. If authority figure is considered an in-group member, which was likely not the case in our study, he or she may be significantly more influential.

Conceptually, our model fits with the notion that there are two separate processing systems in the brain: System 1 and System 2 (Stanovich & West, 2000). System 1 is fast, intuitive, and effortless, whereas System 2 is deliberative, logical, and allows executive control in decision making (Kahneman, 2003). As self-regulatory resources are depleted, System 2 processing likely becomes impaired leading to greater reliance on less-effortful System 1 processing (Pocheptsova, Amir, Dhar, & Baumeister, 2009), which is more automatic and may increase susceptibility to influence from others more than careful System 2 deliberation. Additionally, interventions that restore depleted resources also improve System 2 processing (Masicampo & Baumeister, 2008), which suggests that caffeine may bolster executive control via increased System 2 processing. Future research could draw on this information processing framework to further expand the model connecting sleep deprivation, depletion, and deception.

In terms of limitations, we were unable to assess the physiological basis for our arguments regarding self-regulatory depletion. However, research has shown that the subjective experience of
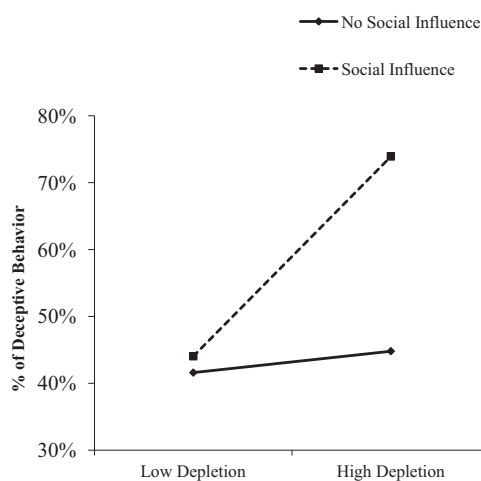
depletion is due to the well-documented effects of sleep deprivation on prefrontal cortical function (e.g., Durmer & Dinges, 2005; Jennings et al., 2003) and is a valid indicator of decrements in brain function (e.g., Jennings et al., 2003). Future research could focus more effort on uncovering the biological effects of sleep deprivation, possibly using brain imaging technology. These studies could also attempt to unpack differences between physiological and subjective aspects of depletion (e.g., Job, Dweck, & Walton, 2010).

Although we followed the procedures of Christian and Ellis (2011), we note that one difference between the sleep-deprivation and no-sleep-deprivation conditions is that participants in the sleep-deprivation condition were paid an additional $60 for the extra time that they spent in the lab. On the one hand, paying participants in the sleep-deprivation condition could reduce the likelihood that they would engage in deceptive behavior because they received more compensation than they typically receive for participation in experiments. On the other hand, there is a chance that they viewed the payment of $60 as distributively unfair following a long night in the lab. If so, they may have been more motivated to rectify the inequity by acting in a deceptive manner (see Siegel Christian, Christian, Garza, & Ellis, 2012). Nevertheless, it would be difficult to argue that payment in the sleep-deprivation condition influenced the hypothesized interactive effects.

Finally, we should note that, because this study was done in a laboratory context, the external validity of our results needs to be verified by future research. Although the nature of the tasks was not the same as it would be in an actual organization, we believe there were certain features of the tasks and the participants that achieved a certain level of "mundane realism" (Berkowitz & Donnerstein, 1982), particularly as participants were recruited from a business school that strongly encourages ethical behavior and prosocial behavior between students. The effects we found might be even stronger in an organizational context where employees not only have to stay awake all night but must also fulfill challenging job responsibilities during this period. In addition, while field research would certainly address generalizability concerns, our results would likely be stronger when the parties involved have a longer history working with each other and have developed high levels of trust (see Pearsall & Ellis, 2011).

Conclusion

We believe that our research represents significant progress in the continued development of the self-regulatory model linking sleep deprivation and unethical behavior at work. Bringing in literature from psychopharmacology and social psychology, we found that the original mediated model introduced by Barnes et al. (2011) and Christian and Ellis (2011) can be strengthened or weakened with the introduction of caffeine and/or social influence at two different points along the causal sequence. Specifically, mediation is strongest when employees do not ingest caffeine and when someone in a position of authority is exerting influence over their behavior. We hope that our findings will stimulate further expansion of the self-regulatory model of unethical behavior at work.

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