

Sleep deprivation and false confessions

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Contributed by Elizabeth F. Loftus, December 30, 2015 (sent for review November 2, 2015; reviewed by Michael W. L. Chee and Saul Kassin)

False confession is a major contributor to the problem of wrongful convictions in the United States. Here, we provide direct evidence linking sleep deprivation and false confessions. In a procedure adapted from Kassin and Kiechel [(1996) *Psychol Sci* 7(3):125–128], participants completed computer tasks across multiple sessions and repeatedly received warnings that pressing the “Escape” key on their keyboard would cause the loss of study data. In their final session, participants either slept all night in laboratory bedrooms or remained awake all night. In the morning, all participants were asked to sign a statement, which summarized their activities in the laboratory and falsely alleged that they pressed the Escape key during an earlier session. After a single request, the odds of signing were 4.5 times higher for the sleep-deprived participants than for the rested participants. These findings have important implications and highlight the need for further research on factors affecting true and false confessions.

false confession | sleep deprivation | sleep

In the United States, an alarming number of people are convicted of crimes they did not commit (1). Although it has proven exceedingly difficult to measure the scope of this problem, a recent investigation suggested that at least 4% of people who have been sentenced to death in the United States were actually innocent (2). Studies of known wrongful convictions reveal that false confessions are a substantial contributor to this problem, implicated in 15–25% of cases (1, 3). A false confession occurs when an innocent person makes a false admission of guilt and subsequently produces a postadmission narrative, which includes details about how or why the crime was committed (4). Confessions are extremely powerful forms of evidence. An admission of guilt alone, even without a postadmission narrative, will have serious consequences for an innocent suspect who is the target of a criminal investigation, as will confessions that are later recanted (5). Surprisingly, even when jurors understand that a confession has been coerced, it nonetheless inflates their perception of the defendant’s guilt and influences their construal of other, unrelated evidence (5, 6).

False confessions can clearly have dire consequences and it might seem that they would only arise after some form of physical coercion. However, interrogators more often capitalize on psychologically coercive interrogation strategies, which are known to increase the risk of false confession in innocent suspects (3, 4, 7–10). As such, the use of these strategies contribute to an inordinately stressful and mentally taxing experience for an innocent suspect (11), who must rely on a number of complex cognitions and decision making skills to protect their interests and avoid self-incrimination during a potentially lengthy interrogation.

A robust literature reveals that sleep deprivation impairs many of the cognitive skills that may be crucial in resisting this type of coercive environment. In addition to disrupting mood and impairing a whole host of cognitive operations (12, 13), there is evidence suggesting that sleep deprivation reduces inhibitory control, leading people to make riskier decisions (14–16), and interferes with their ability to anticipate and measure the consequences of their actions (17). Finally, recent research has

linked sleep deprivation with false and distorted memories of past events (18), suggesting that sleep-deprived people may be especially vulnerable to suggestive influences.

These findings are cause for serious concern; studies have shown that as many as 17% of interrogations occur during typical sleep hours (between midnight and 8:00 AM) (19). Studies of known false confessions have found that a majority occurred following interrogations that lasted more than 12 h, with many lasting for longer than 24 consecutive hours (20). Moreover, as the Senate Select Committee on Intelligence recently revealed, the Central Intelligence Agency routinely used sleep deprivation for up to 1 wk to assist in their hardline interrogations of detainees, some of whom were later revealed to be wrongfully held (21). It is increasingly evident that the interrogation of unrested, possibly sleep-deprived, suspects is not out of the ordinary and may even be commonplace.

In the present research, we capitalized on available laboratory techniques for examining false confession processes (22) and compared the tendency of rested and sleep-deprived participants to falsely admit to wrongdoing that never occurred. Specifically, participants completed computer-based tasks, writing exercises, and questionnaires during three separate laboratory sessions (see Figs. S1–S3). Throughout their time in the laboratory, participants were repeatedly warned to never press the Escape key on their computer keyboards because doing so, they were told, would result in the loss of important study data. Importantly, the location of the Escape key on a standard PC keyboard made it highly unlikely that participants would have pressed this key accidentally during the course of the experiment.

Significance

False confessions occur surprisingly frequently in the context of interrogations and criminal investigations. Indeed, false confessions are thought to account for approximately 15–25% of wrongful convictions in the United States. Here we demonstrate that sleep deprivation increases the likelihood that a person will falsely confess to wrongdoing that never occurred. Furthermore, our data suggest that it may be possible to identify certain individuals who are especially likely to falsely confess while sleep deprived. The present research is a crucial step toward understanding the role of sleep deprivation in the problem of false confession and, in turn, raises complex questions about the use of sleep deprivation in the interrogation of innocent and guilty suspects.

Author contributions: S.J.F., S.R.B., E.F.L., and K.M.F. designed research; S.J.F. and K.M.F. performed research; S.J.F. and K.M.F. analyzed data; and S.J.F., S.R.B., E.F.L., and K.M.F. wrote the paper.

Reviewers: M.W.L.C., Duke NUS Graduate Medical School; and S.K., John Jay College of Criminal Justice.

The authors declare no conflict of interest.

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This article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1521518113/-DCSupplemental.

Table 1. Percentages (and raw numbers) of rested and sleep-deprived (TSD) participants who signed the statement containing a false admission of wrongdoing after the first request (left side) and both requests (right side)

False admission (first request)?	Rested	TSD	False admission (both requests)?	Rested	TSD
Yes	18% (8)	50% (22)	Yes	38.6% (17)	68.2% (30)
Refused	82% (36)	50% (22)	Refused	61.4% (27)	31.8% (14)
Total	100% (44)	100% (44)	Total	100% (44)	100% (44)

Following session 2, participants either slept for 8 h in laboratory bedrooms or remained awake throughout the night, carefully monitored by research staff (see Table S1). The morning following either their night of sleep or sleep deprivation, all participants were shown a personalized statement describing their time in the laboratory, purportedly written by a member of the research staff. Critically, the statement falsely alleged that the participant pressed the Escape key during their first visit to the laboratory, thereby compromising the study data. Participants were asked to read the statement and type their name beneath it to confirm its accuracy. If participants refused to sign their name to the statement, they were immediately shown the statement a second time and again encouraged to type their name (Fig. S3).

Our results indicate that after the initial request, 8 of the 44 rested participants (18%) signed the statement, as did 22 (50%) of the 44 sleep-deprived participants. As shown in Table 1, nine of the additional rested participants (for a total of 39%) signed after the second request, as did eight additional sleep-deprived participants (for a total of 68%). The odds of signing the statement were significantly greater for sleep-deprived participants than for the rested participants after the initial request, odds ratio (OR) (95% C.I.) = 4.5 (1.7, 11.8), and after both requests, OR = 3.4 (1.4, 8.2). It should be noted that despite the robust effect of sleep deprivation on false confession, participants' false admissions did not include a detailed postadmission narrative, which is commonly obtained in a criminal confession.

During the initial session (1 wk before the overnight session), we assessed participants' tendency to adopt an impulsive problem-solving strategy by using the Cognitive Reflection Task (CRT; ref. 23; see Fig. S2). As predicted, the effect of sleep deprivation on the likelihood of false confession was markedly increased among participants who showed higher impulsive responding, as shown in Fig. 1. In a logistic regression analysis, with false admission (yes or no) entered as the dependent variable, the main effect of CRT score approached significance, OR = 1.5 (1.0, 2.3), and there was a significant interaction between study condition (sleep-deprived or rested) and intuitive response rates, OR = 3.0 (1.1, 8.0), suggesting that individuals with an impulsive cognitive style were more vulnerable to the effects of sleep deprivation on false confessions.

Sleep-deprived participants reported increased sleepiness, and decreased positive and negative affect compared with rested participants (see Fig. S4 for further analyses). Of note, participants who signed the statement containing the false allegation showed no difference in positive affect, $t(86) = 1.47, P = 0.14$, or negative affect, $t(86) = 0.75, P = 0.45$, relative to participants who did not sign the statement. This finding suggests that changes in affect as a result of sleep-deprivation did not account for elevated rates of false confession. However, high ratings of sleepiness (i.e., 6 or a 7 on the 7-point scale) strongly predicted the likelihood of false confession, as shown in Fig. 2. An implication of this finding is that a suspect's self-reported sleepiness may be a powerful indicator of risk. Regardless of experimental condition, the odds of confessing were 4.5 times higher for participants who reported high levels of sleepiness, relative to participants who reported low-to-medium levels of sleepiness.

We considered the possibility that sleep-deprived participants were less able (or willing) to read and comprehend the statement containing the false allegation. As detailed in *Materials and Methods* below, we gave all participants a comprehension check in the morning. Two participants (one rested, one sleep-deprived) failed to demonstrate that they were reading and comprehending our materials, and excluding these subjects from our analyses had no effect on any results reported here. Relatedly, it is worth noting that in the context of a criminal investigation, an innocent suspect who signs a confession statement (even if they did not read or comprehend it) may face serious consequences as a result.

These findings are a crucial step in better understanding the role of sleep deprivation in false confessions as they unfold in the context of a police interrogation. We propose that sleep deprivation sets the stage for a false confession by impairing complex decision making abilities—specifically, the ability to anticipate risks and consequences, inhibit behavioral impulses, and resist suggestive influences.

Despite the strength of our findings, the present study has a few limitations. Although we found evidence suggesting that sleep deprivation may increase the risk of false confessions, our study sheds no light on the impact of sleep deprivation on true confessions. Sleep deprivation may increase confession rates of both innocent and guilty suspects. If sleep deprivation increases both true and false confessions, then law enforcement and military personnel may want to carefully weigh the costs and benefits of sleep deprivation in an interrogation, particularly when collecting intelligence that could prevent the loss of innocent lives. Future research would do well to examine the role of sleep deprivation on both true and false confessions.

Additionally, the consequences of signing the statement were ambiguous and unknown to the participants. We recognize that this scenario may differ in important ways from the situation a suspect may face in an interrogation room. Although obtaining more ecologically valid interrogation conditions are bound to present significant challenges for laboratory researchers because

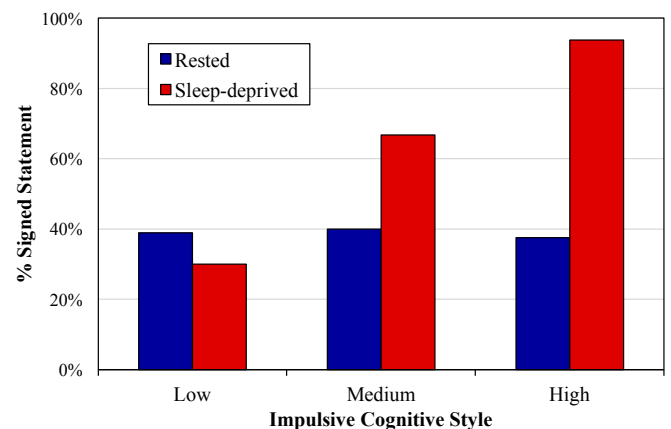


Fig. 1. Percentage of participants that signed the statement following both requests as a function of scores on the CRT.

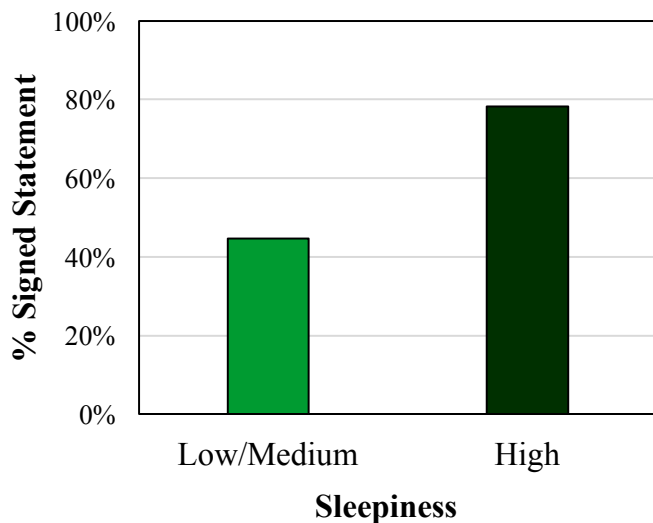


Fig. 2. Percentage of participants (collapsed across conditions) that signed the statement as a function of self-reported sleepiness by using the Stanford Sleepiness Scale. Participants who selected a 6 or 7 on the 7-point Stanford Sleepiness scale (25) were categorized as high in sleepiness, whereas participants who selected a rating of less than 6 were categorized as low/medium sleepiness. OR (95% C.I.) = 4.5 (1.5, 13.5).

of ethical constraints, further research might profitably investigate whether the severity of the purported wrongdoing and its perceived consequences moderate the effects of sleep deprivation. Finally, the extent to which cultural and/or demographic factors (e.g., age, education) moderate the effect of sleep deprivation on confessions remains an open question.

Nonetheless, to the extent that the same psychological processes are implicated both by laboratory studies and real-life interrogations, our findings have important implications for policies and procedures related to interrogations, particularly those involving innocent suspects. Depriving a suspect of sleep—whether intentionally as part of an interrogation strategy or incidentally as the result of a lengthy interrogation—may compromise the reliability of evidence obtained from an innocent suspect in an interrogation and put innocent suspects at increased risk. To this end, our findings provide an additional justification for the importance of videotaping all interrogations, thus providing judges, attorneys, experts, and jurors with additional opportunities to evaluate the probative value of any confession that is obtained.

Furthermore, we recommend that interrogators assess suspects' sleep habits for the days preceding the interrogation and measure suspects' sleepiness by using validated self-report scales (24, 25) before entering the interrogation room and over the course of the interrogation. It is worth noting that in our sample, participants who indicated a high degree of sleepiness on the single-item Stanford Sleepiness Scale were significantly more likely to sign off on the false allegation compared with participants who reported less severe sleepiness, irrespective of condition. This scale takes only seconds to administer, yet here it proved to be a reliable indicator of heightened risk for innocent suspects.

A false admission of wrongdoing can have disastrous consequences in a legal system already fraught with miscarriages of justice. We are hopeful that researchers will continue to uncover the sleep-related factors that influence processes related to false confession.

Materials and Methods

Participants were 88 undergraduates from Michigan State University who enrolled in the study in exchange for course credit. Their mean age was 19.3

(SD = 1.3; range = 18–23) and just under half were female (49%). Participants reported their race/ethnicity as Native American (2.3%), Asian (4.6%), Black (5.7%), Latino (1.1%), Middle Eastern (2.3%), and White (84.1%).

Several additional participants began the study but did not complete it and were excluded from all subsequent procedures and analyses. These participants either: napped on the day of the experiment ($n = 1$), consumed alcohol on the night of the experiment ($n = 1$), became ill during the deprivation night ($n = 1$), or chose to leave in the middle of the deprivation night because they had completed their credit requirement ($n = 1$). One additional participant chose to leave when the condition was revealed; this individual was assigned to the sleep condition but wanted to be in the deprivation condition to study for an examination the following day. All participants gave informed consent for experimental procedures before completing any experimental tasks. Furthermore, the experiment and informed consent procedures were approved by the Institutional Review Board at Michigan State University.

As shown in Fig. S1, the 88 participants who completed the study attended three laboratory sessions. In session 1, participants provided demographic information and received the first of several warnings not to press the Escape key during the study procedures. Specifically, they were shown a screen with the word "WARNING" at the top, followed by an instruction that read as follows: "Please remember: it's very important that while you work on the computer today that you do NOT press the 'escape key,' located at the top left corner of the keyboard, for any reason—this could cause the computer to lose valuable data. If you have any questions about today's study procedures or questionnaires, please be sure to raise your hand and a member of our research staff will quietly escort you out of the room so as not to disturb the other participants." Participants were asked to click a button to indicate that they understood the warning. To dissuade participants who may have been tempted to press the forbidden Escape key, a member of the research staff watched as participants completed the computer tasks.

Measures relevant to the present research questions were the Pittsburg Sleep Quality Index, a measure of general sleep quality (26) and the CRT (23) (Table S2 and Fig. S2). The CRT measures a person's "cognitive impulsiveness," or their tendency to hastily arrive at intuitive—yet incorrect—answers to a series of logic puzzles. For instance, one question reads, "A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost?" The correct answer to this question is \$0.05, but the more intuitive (yet incorrect) response is \$0.10. People who give intuitive answers to the puzzles are thought to prefer an impulsive thinking and problem-solving style. We measured cognitive impulsiveness by totaling the number of intuitive responses that each participant gave (out of three). We designated participants as "high" in cognitive impulsiveness if they gave intuitive responses to all of the puzzles on the CRT, "medium" if they gave intuitive responses to two puzzles, and "low" if they gave intuitive responses to either zero or one puzzle.

Session 2 took place on an evening ~7 d later. Participants returned to the laboratory at 10:00 PM and were first shown the Escape key warning, which was identical to the warning they received in session 1. Then, participants completed baseline measures of positive and negative affect [Positive and Negative Affect Schedule (PANAS); ref. 27] and sleepiness (Stanford Sleepiness Scale; ref. 25), and a series of filler computer tasks not relevant to the present study.

Half of the participants then slept for 8 h in laboratory bedrooms ($n = 44$, 21 female) and half remained awake throughout the night in the laboratory while being monitored by research staff ($n = 44$, 22 female) (Table S1). Participants were quasi-randomly assigned to condition. We used quasi-random assignment to ensure that the time interval between sessions 1 and 2 was equal across conditions. Specifically, participants' first session was roughly 1 wk before their overnight [mean (M) = 7.26 d, SD = 1.0]. Importantly, the interval between session 1 and session 2 was similar for the sleep ($M = 7.2$, SD = 1.1, range = 6–10) and the deprivation ($M = 7.3$, SD = 0.9) groups ($t(86) = 0.58$, $P = 0.55$). When they arrived to the first session, before completing any computer tasks, participants selected their overnight session. This procedure was designed so that if a participant could not attend any of the available evenings, we could reschedule their first session to maintain an average of 7 d between session 1 and the overnight. Although the experimenter knew which nights would be deprivation nights and which would be sleep nights, the participants remained blind to condition until after the computer tasks on the evening of their overnight session. Put simply, the participants were blind to condition until the last possible moment (e.g., ~11:00 PM, which is when we had to start setting sleep participants up for polysomnography).

Session 3 took place the next morning, after the night of sleep or sleep deprivation. Each participant began the morning procedure by reading, once again, the Escape key warning, completing measures of affect and sleepiness,

and filler tasks and questionnaires. Next, participants completed a comprehension check. In this task, we asked them to indicate whether they completed certain activities in the laboratory. Hidden among a list of events that actually occurred (e.g., "You filled out computer questionnaires") were foil events that could not possibly have occurred (e.g., "You drank a beer in the lab"). Only two participants (one rested, one sleep-deprived) failed to successfully complete the task, and when these participants were excluded from our analyses, all results and patterns of significance remained identical.

The critical outcome of interest was the participants' response to the false allegation. Before leaving the laboratory, each participant was shown a personalized statement, purportedly written by a member of the research staff. The statement described the participant's activities in the laboratory over the course of the week, and falsely alleged that the participant pressed

the Escape key during their first visit to the laboratory (the prior week when no participants had been sleep deprived), thereby compromising the study data. Participants were asked to read the statement, check a box confirming its accuracy, and type their name beneath the statement. If participants refused to confirm the accuracy of the statement, they were shown the statement a second time and again encouraged to sign it (Fig. S3). Participants who refused to sign the statement were asked which parts of the statement they believed were inaccurate and given an opportunity to freely respond. After signing their name (or refusing both requests, whichever came first), they were fully debriefed.

ACKNOWLEDGMENTS. We thank Nicholas Nicoletti and Joseph O'Connor for their invaluable assistance in coordinating and running this study and two reviewers for insightful comments on an earlier draft of this manuscript.

- Gross SR, Shaffer M (2012) Exonerations in the United States 1989 through 2012 (Natl. Registry Exonerations Report). Available at www.law.umich.edu/special/exoneration/Documents/exonerations_us_1989_2012_full_report.pdf. Accessed October 30, 2015.
- Gross SR, O'Brien B, Hu C, Kennedy EH (2014) Rate of false conviction of criminal defendants who are sentenced to death. *Proc Natl Acad Sci USA* 111(20):7230–7235.
- Garrett BL (2011) *Convicting the Innocent: Where Criminal Prosecutions Go Wrong* (Harvard Univ Press, Cambridge, MA).
- Leo RA (2009) False confessions: Causes, consequences, and implications. *J Am Acad Psychiatry Law* 37(3):332–343.
- Kassin SM, Sukel H (1997) Coerced confessions and the jury: An experimental test of the "Harmless Error" rule. *Law Hum Behav* 21(1):27–46.
- Hasel LE, Kassin SM (2009) On the presumption of evidentiary independence: Can confessions corrupt eyewitness identifications? *Psychol Sci* 20(1):122–126.
- Kassin SM (2008) Confession evidence: Commonsense myths and misconceptions. *Crim Justice Behav* 35(10):1309–1322.
- Kassin SM, Gudjonsson GH (2004) The psychology of confession evidence: A review of the literature and issues. *Psychol Sci Public Interest* 5(2):33–67.
- Kassin SM, McNall K (1991) Police interrogations and confessions: Communicating promises and threats by pragmatic implications. *Law Hum Behav* 15(3):233–251.
- Narchet FM, Meissner CA, Russano MB (2011) Modeling the influence of investigator bias on the elicitation of true and false confessions. *Law Hum Behav* 35(6):452–465.
- Kassin SM, et al. (2010) Police-induced confessions: Risk factors and recommendations. *Law Hum Behav* 34(1):3–38.
- Ratcliff R, Van Dongen HPA (2009) Sleep deprivation affects multiple distinct cognitive processes. *Psychon Bull Rev* 16(4):742–751.
- Pilcher JJ, Huffcutt AI (1996) Effects of sleep deprivation on performance: A meta-analysis. *Sleep* 19(4):318–326.
- Killgore WD, Balkin TJ, Wesensten NJ (2006) Impaired decision making following 49 h of sleep deprivation. *J Sleep Res* 15(1):7–13.
- Chuah YML, Venkatraman V, Dinges DF, Chee MWL (2006) The neural basis of interindividual variability in inhibitory efficiency after sleep deprivation. *J Neurosci* 26(27):7156–7162.
- Drummond SP, Paulus MP, Tapert SF (2006) Effects of two nights sleep deprivation and two nights recovery sleep on response inhibition. *J Sleep Res* 15(3):261–265.
- Harrison Y, Horne JA (2000) The impact of sleep deprivation on decision making: A review. *J Exp Psychol Appl* 6(3):236–249.
- Frenda SJ, Patihis L, Loftus EF, Lewis HC, Fenn KM (2014) Sleep deprivation and false memories. *Psychol Sci* 25(9):1674–1681.
- Kassin SM, et al. (2007) Police interviewing and interrogation: A self-report survey of police practices and beliefs. *Law Hum Behav* 31(4):381–400.
- Drizin S, Leo R (2004) The problem of false confessions in the post-DNA world. *North Carol Law Rev* 82:891–1007.
- U.S. Senate Select Committee on Intelligence (2014) *Committee Study of the Central Intelligence Agency's Detention and Interrogation Program*. Available at: www.intelligence.senate.gov/press/committee-releases-study-cias-detention-and-interrogation-program. Accessed October 30, 2015.
- Kassin SM, Kiechel K (1996) The social psychology of false confessions: Compliance, internalization, and confabulation. *Psychol Sci* 7(3):125–128.
- Frederick S (2005) Cognitive reflection and decision making. *J Econ Perspect* 19(4):25–42.
- Johns MW (1991) A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep* 14(6):540–545.
- Hoddes E, Zarcone V, Smythe H, Phillips R, Dement WC (1973) Quantification of sleepiness: A new approach. *Psychophysiology* 10(4):431–436.
- Buyssse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ (1989) The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Res* 28(2):193–213.
- Watson D, Clark LA, Tellegen A (1988) Development and validation of brief measures of positive and negative affect: The PANAS scales. *J Pers Soc Psychol* 54(6):1063–1070.