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IRONIC EFFECTS OF SLEEP URGENCY

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Summary—Normal sleepers were instructed either to fall asleep as quickly as they could or to fall asleep whenever they desired, under a high mental load (listening to John Philip Sousa marches) or a low mental load (listening to sleep-conducive new age music). Under low load, participants trying to fall asleep quickly did so faster than those attempting only to fall asleep whenever they desired. Under high load, however, and consistent with the ironic process theory of mental control (Wegner, D. M., 1994, *Psychological Review*, *101*, 34–52), sleep onset latency was greater for participants attempting to fall asleep quickly than for those not attempting to do so. Copyright © 1996 Elsevier Science Ltd

INTRODUCTION

> Sleep [is like] a dove which has landed near one's hand and stays there as long as one does not pay any attention to it; if one attempts to grab it, it quickly flies away. (Frankl, 1965, p. 253)

Most of us have had the experience of lying in bed trying hard to sleep—and then listening intently to a dripping faucet or barking dog for what seems like hours. Although we can usually fall asleep when we so desire, the combination of an urgent desire to sleep and some annoying event or recurring bothersome thought can make us lie awake. It even seems that the harder we want to sleep under these conditions, the more difficult the state of slumber is to obtain. The theory of ironic processes of mental control (Wegner, 1994) predicts just such a phenomenon in normal sleepers, and the present research was designed to examine this possibility with a view toward understanding processes that may contribute to acute or chronic insomnia.

Early research on the effects of relaxation on the sleep onset latency of insomniacs versus normal sleepers led researchers to believe that physiological hyperactivity was the underlying mediating factor causing sleep onset insomnia (e.g. Monroe, 1967). However, subsequent comparisons of insomniacs and normal sleepers failed to support this hypothesis (e.g. Borkovec, 1979; Hauri, 1968), and competing theories emerged with an emphasis on cognitive mediators rather than physiological ones (Gross & Borkovec, 1982). Specifically, a cognitive hyperactivity hypothesis surfaced suggesting that intrusive mental activity rather than physiological hyperactivity is the cause of sleep onset insomnia. Research examining pre- and post-sleep cognitions of problem sleepers relative to good sleepers has led to the conclusion that a common mechanism of sleep onset disturbance is indeed uncontrollable cognitive hyperactivity and worry.

Borkovec (1982), for example, found that insomniacs are often chronic worriers. Insomniacs, he suggested, may spend their waking lives in a constant worry state possibly due to their inability to fall asleep. Chronic insomniacs were reported to have more excessive and more worrisome thoughts about sleeping than normal sleepers and these obsessions were reported to be more uncontrollable for insomniacs than normal sleepers. Research has further suggested that the uncontrollable obsessive thoughts of insomniacs are actually centered around the problems they are having with their sleep. Geer and Katkin (1966) noted that insomniacs report a "racing mind" phenomenon at bedtime, including thoughts, worries, general and specific concerns about sleep, and fears about their insomnia. Relative to normal sleepers, insomnia sufferers report a greater number of intrusive thoughts about sleep and report pre-sleep cognitions as more worried and negative (Borkovec, Lane & VanOot, 1981). Chronic insomnia might result, then, from chronic

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worry that arises from initial problems with sleep. As a result of initial sleep onset difficulty, a self-perpetuating cycle of chronic insomnia seems to develop: the greater the sleep urgency, the less one is able to sleep (cf. Lundh, Lundqvist, Broman & Hetta, 1991).

These observations suggest that processes of sleep onset control, both normal and pathological, may be understood from the perspective of the theory of ironic processes of mental control (Wegner, 1994). This theory specifies conditions under which the desire to control a mental state (such as sleep, mood, attention, etc.) can yield the ironic opposite of what is desired—and this certainly seems to be what happens to chronic insomniacs. Ironic process theory holds that the central variable dividing successful control from ironic or counterintentional effects is the availability of mental capacity. In this view, the normal operation of mental control is often successful when there is adequate mental capacity to achieve control. When capacity is reduced for some reason (e.g. cognitive load or distraction, stress, annoyance, time pressure, anxiety), however, the intended control does not merely decline to some uncontrolled baseline or zero-level. Rather, mental control exerted during mental load will often produce ironic effects, resulting in mental states that go beyond 'no change' to become the opposite of what is desired. In terms of sleep onset, the urgent desire to sleep combined with a mental load should lead to ironic wakefulness.

The potential for such an ironic effect exists because of the nature of the processes that allow us the normal and successful mental control we generally enjoy. The theory holds that mental control occurs through two processes that work together to promote desired mental states: an *intentional operating process* that searches for the mental contents that will yield the desired state, and an *ironic monitoring process* that searches for mental contents that signal failure to achieve the desired state. So, when a person is trying to fall asleep, the intentional operating process implements this desire by searching for mental contents consistent with sleep (e.g. signs of drowsiness, restful thoughts). This conscious and effortful process is accompanied, however, by the relatively less conscious and effortful monitoring process. The ironic monitoring process conducts an automatic and unconscious search for mental contents inconsistent with the desired state (i.e. signs of alertness or wakefulness), so that if they are found the operating process can be reinstated.

Normally, the cyclic interaction of these processes promotes successful mental control. Together, they form a control system that promotes the desired mental state (cf. Miller, Galanter & Pribram, 1960). The operating process is far more effective than the monitor (given its conscious resources), and it thus fills consciousness with restful contents that induce the sleep state. Because the monitor stays watchful of lapses in control, however, it keeps the mind sensitive to contents that indicate that intentional mental control is failing. This means, then, that when mental capacity is undermined for any reason and the operating process is limited, the sensitivity supplied by the monitor can be our undoing. Under mental load, intentions to sleep unleash a monitoring system that not only searches for wakefulness but then primes such thoughts and so tends itself to create wakefulness.

There is evidence supporting the ironic process theory in the control of mood (Wegner, Erber & Zanakos, 1993), thought suppression (Wegner & Erber, 1992), action initiation and inhibition (Ansfield & Wegner, 1996), and in the control of a number of other psychological processes (Wegner, 1994)—and, most pertinent to the present concerns, in the case of intentional relaxation as well. In an experiment by Wegner, Broome and Blumberg (1995), normal college students were given progressive muscle relaxation instructions or were invited merely to sit for an equivalent period in a comfortable chair. Participants were then asked to remember a 9-digit number or were given no such mental load as they continued either to relax or sit. Electrodermal measurements indicated the instructions had a significant influence in the intended direction for participants under a low load; skin conductance level (SCL) decreased with relaxation as compared with no-instruction participants. However, this effect reversed for participants given the higher mental load. For these individuals, intentional relaxation rendered their SCL higher than no instruction. Thus, it appears that trying to relax under a high load can ironically cause increased alertness.

Gross and Borkovec (1982) conducted an experiment that is especially relevant to the role of ironic processes in sleep onset with normal sleepers. They instructed good sleepers to go to sleep as quickly as possible in a daytime nap session under one of three instructional sets. For one group, quick sleep was the only instruction (sleep-only). Participants in the other groups asked to sleep quickly were told in addition either that they would present a speech at the end of the session (speech-only), or that they would present a speech on a specific topic (speech-plus-topic). Ironic process theory would predict that sleep urgency combined with a compelling cognitive load (in this case, a speech topic to think about) should yield noteworthy sleep onset problems, and this is what was found. The theory would also hold that such problems would not ensue from a cognitive load if there were no sleep urgency, however, and this prediction was not tested in this study.

The theory is also consistent with a large literature on the beneficial impact of sleep non-urgency on the sleep onset of insomnia sufferers. Research on the effects of the paradoxical directive to try to stay awake for as long as possible consistently reports significant reductions in sleep onset latency for insomniacs (Ascher & Efran, 1978; Ascher & Turner, 1979, 1980; Espie & Lindsay, 1985; Espie, Lindsay, Brooks, Hood & Turvey, 1989; Ladouceur & Gros-Louis, 1986; Relinger & Bornstein, 1979; Relinger, Bornstein & Mungas, 1978; Steinmark & Borkovec, 1974; Turner & Ascher, 1979). If it is true that people troubled with insomnia commonly worry about it so much that they find ruminations about their lack of sleep themselves to constitute a mental load, it makes sense that any instruction that helps them to reduce their control attempts would have the effect of promoting earlier sleep onset.

Of course, there already exist several theories of how paradoxical instructions to stay awake might help to restore sleep onset control. Accounts beginning with the initial ideas of Frankl (e.g. Frankl, 1965) on 'paradoxical intention' have focused on a number of possible ways in which prescribing the symptom might be effective in the control of insomnia (cf. Katz, 1984). People might sleep as a result of instructions not to sleep because they are reacting to a perceived loss of freedom by trying to reinstate it (Brehm, 1966). Alternatively, it might be that paradoxical directives work because following such instructions allows people to gain voluntary control over sleep in one direction which then can be exercised in the opposing direction (Bateson, Jackson, Haley & Weakland, 1956). Ascher (1980, 1981) offers a third theory that focuses on a self-perpetuating cycle of anxiety production that results from the individual's constant attempts to control a disorder. According to this model, the paradoxical instruction might undermine the anxiety-production cycle and so allow control to occur without this impediment.

The ironic process theory moves beyond all these accounts by suggesting that problems in sleep onset control will only arise under very specific conditions of sleep urgency—that is, urgency combined with mental load. In the present study, we explored the effects of different sleep onset instructions on sleep onset latency of normal sleepers under either a high or low mental load. The ironic process hypothesis was that under a low mental load, participants attempting to fall asleep quickly would be able to do this faster than participants who were not attempting to fall asleep quickly; without load, in other words, there would be no ironic or paradoxical effect of sleep urgency. Under load, however, it was expected that participants attempting to fall asleep quickly would ironically take longer to sleep than would participants falling asleep without urgency.

METHOD

Overview and design

Participants took home a Sony walkman and listened to an audio cassette at bedtime instructing them either to fall asleep "as fast as you can" or to fall asleep "whenever you want". While they fell asleep, half heard restful, sleep-conducive music (a low mental load), while the others heard John Philip Sousa band marches (a high mental load). Immediately upon awakening the next morning, participants reported their sleep onset latency and completed a post-experimental questionnaire. The design was a 2 (sleep instructions: fall asleep quickly vs fall asleep whenever) × 2 (cognitive load: low vs high) between-*S*s design. Sex of participants was also included in all analyses, but neither effects of nor interactions with sex were expected.

Participants

Participants were 55 male and 55 female undergraduates who voluntarily participated as a partial requirement for an introductory psychology course. All participants were asked not to drink alcohol during the experimental period due to the effects of alcohol on sleep. Participants were excluded from the analyses if they reported drinking alcohol during the experimental period

($n = 11$), if they had taken medication that might disturb their sleep ($n = 9$), or if they did not fall asleep before the end of the 90-min manipulation tape ($n = 7$). These excluded cases were approximately equally represented in all conditions of the design. Analyses conducted including all *S*s yielded statistical conclusions that did not depart from those reported below.

Procedure and materials

On the day of the experimental trial, participants came into the laboratory to obtain instructions and pick up the materials required. Participants came in groups of 6 or fewer and were told that the study was an attempt to explore how instructions before sleep affect a person's sleeping patterns and dreams. They were informed that they would be asked to listen to an audio cassette as they fell asleep that night at home and answer some questions in a sleep diary immediately upon awakening the next morning. They were additionally informed that they would need to come back to the lab the next day to return the materials and the sleep diary, answer a final questionnaire, and obtain a debriefing form and their research credit slips. Each participant was then given a battery-operated Sony walkman with headphones, an audio stimulus cassette to be played while falling asleep that night (distributed with respect to the randomly pre-assigned condition), and a sleep diary to be filled out immediately upon awakening the next morning.

Participants were assured that measures had been taken to protect their privacy and to guarantee confidentiality concerning participation. They then read and signed a consent form and noted the number of hours they had slept the previous night. Participants were informed that it was crucial for the validity of the study that once they chose to go to bed there be no distractions and that late-studying roommates should be asked to find alternative places to study. They were asked to make sure they had a visible clock by their bed so that they could note the time they went to bed and estimate the time they had taken to fall asleep. They were directed to lie down in bed at "the normal time you would usually go to bed" and begin listening to the tape at a "comfortable listening level". Participants were notified that it was vital for the experiment that the cassettes be played at a normal listening level, in their entirety. If they had not fallen asleep by the time both sides of the tape had played (90 min), they were to feel free to take the headphones off.

Participants were informed that immediately upon awakening the next morning, they were to complete the sleep diary found in the envelope they had received, replace it in the envelope and seal it, and bring it back to the laboratory at a specified time that same day. After all questions had been answered, participants departed from the laboratory.

Each audio stimulus tape began with instructions directing participants either to fall asleep as quickly as possible or to fall asleep whenever they wanted. Participants asked to fall asleep quickly heard the following: "Good evening. You should be lying in bed with the lights out and your eyes closed. As you listen to the music that follows, you should try to fall asleep as quickly as possible. Your task is to put yourself to sleep in record time. Please concentrate on going to sleep quickly. Glance at the clock right now to remind yourself when you are beginning. Now, go to sleep".

Participants instructed to fall asleep whenever they so desired heard these instructions: "Good evening. You should be lying in bed with the lights out and your eyes closed. As you listen to the music that follows, you should fall asleep whenever you feel like it. Your task is to fall asleep whenever you would like. Glance at the clock right now to remind yourself when you are beginning. Now, go to sleep whenever you would like".

Immediately following these instructions, the load manipulation appeared in the form of either sleep-conducive music (low load) or sleep-inhibiting music (high load). We chose to use music as our cognitive load manipulation because of the general report of the distracting nature of stimulative music compared with sedative music. Research has consistently reported that stimulative music such as marching band music and rock and roll music increases worry, interferes with concentration, and is a greater distraction than sedative music such as 'easy listening' music (e.g. Brown, Chen & Dworkin, 1989; Fogelson, 1973; Mowsesian & Heyer, 1973; Smith & Morris, 1976, 1977). Each tape contained 90 min of music following the sleep onset instructions. Participants assigned to the low load heard sleep-conducive, new age music from Steve Gordon's "Still Waters" containing restful outdoor sounds such as birds, crickets, and a stream bubbling in the background. Participants assigned to the high load condition heard sleep-inhibiting selections from recordings of John Philip Sousa's marching band music, starting with a stirring rendition of "The Thunderers".

Immediately upon awakening the next morning, participants opened an envelope containing a sleep diary with 8 questions regarding their sleep the night before. Participants were first asked to fill in the following open-ended items: "What time did you go to bed"; "What time did you get up"; "Number of minutes before falling asleep the previous night"; "Number of times awoken during the night"; and "Number of times awoken during the night and had difficulty falling back to sleep". Next, participants completed the following two rating questions: "How difficult was it to fall asleep last night?" on a 7-point scale labeled 1—*very easy* to 7—*very difficult* and "How rested did you feel upon awakening this morning?" on a 7-point scale labeled 1—*very rested* to 7—*not rested*. Finally, participants were asked "Did you have any dreams last night? If so, briefly describe what you remember". Self-report of sleep onset latency in sleep diaries has consistently been found to be a reliable and valid measure of sleep onset latency and has become a widely accepted measure for estimating sleep parameters (e.g. Bootzin & Engle-Friedman, 1981; Borkovec & Fowles, 1973; Nicassio & Bootzin, 1974).

Later that day, participants came back to the lab to return their materials and complete a post-experimental questionnaire. The questionnaire consisted of 11 questions on participants' general sleeping and dreaming patterns on what they would consider a 'normal weekday night', questions designed to explore the participant's activities during the experimental period (i.e. throughout the entire day of the experimental trial) such as the use of alcohol or other drugs that would affect their sleep, questions exploring their past experiences with insomnia, and questions about their perceptions of the study. When all the materials were returned and the post-experimental questionnaire was completed, participants were debriefed and thanked for their participation.

RESULTS

General sleep patterns

A series of 2 (sleep instructions: fall asleep quickly vs fall asleep whenever) × 2 (cognitive load: low vs high) × 2 (sex) between-*S*s analyses of variance (ANOVAs) on self-reported general sleep patterns was conducted to assess whether there were any pre-existing differences across experimental groups. No significant differences were found for any of the variables (all Ps > 0.10). For the entire sample of participants, reported time slept on a normal weekday night was 6.40 hr, and reported time slept on experimental trial night was 6.95 hr. Reported latency to sleep onset on a normal weekday night was 29.35 min. Whereas 24.1% of our participants reported having experiences with insomnia in their lives, 4.8% reported having had problems with insomnia within the week prior to the experimental trial. Reported recall of at least one dream on a normal weekday night was 41.0% and dream recall on the experimental trial night was 48.2%. Reported number of times having been disturbed during the experimental trial night was 1.30, and reported number of times awoken during a normal weekday night was 0.90 times/night.

Sleep onset measures

A 2 × 2 × 2 ANOVA was conducted on reported time prior to sleep onset on the experimental trial night. There were no significant main effects, but the expected ironic effects of sleep onset control efforts under mental load were observed in a significant interaction of instruction and load: $F(1, 75) = 13.26$, $MSE = 270.13$, $P < 0.001$ (see Fig. 1). Under a low cognitive load, participants who attempted to fall asleep quickly were able to do so significantly more quickly ($M = 15.55$ min) than those *not* told to fall asleep quickly ($M = 29.28$ min): $F(1, 75) = 7.70$, $P < 0.01$. Those attempting to fall asleep quickly under a high load, however, showed longer sleep onset times ($M = 34.40$ min) than did those under high load not attempting to fall asleep quickly ($M = 21.80$ min): $F(1, 75) = 5.70$, $P < 0.02$. Participants under a low load told to fall asleep quickly ($M = 15.55$ min) were able to do so significantly more quickly than those under a high load told to fall asleep quickly ($M = 34.40$ min): $F(1, 75) = 13.69$, $P < 0.001$. There was not a significant difference between participants not told to fall asleep quickly when under a low load ($M = 29.28$ min) vs a high load ($M = 21.80$ min): $F(1, 75) = 2.20$, $P < 0.15$.

A related analysis was performed to determine whether sleep onset for the experimental trial night deviated from the reported normal sleep onset dependent upon the type of sleep onset instruction and level of cognitive load. A difference score was computed (experimental onset time minus reported general sleep onset time on a normal weekday night) and a significant interaction of instruction and load was found: $F(1, 75) = 13.89$, $MSE = 202.19$, $P < 0.001$. Specifically, participants trying to fall asleep as quickly as they could under a low load fell asleep 3.23 min faster on average than they reported doing on a normal weekday night, whereas participants under a high load fell asleep 14.08 min slower than on a normal night: $F(1, 75) = 16.21$, $P < 0.001$. Participants under a low load fell asleep more quickly than normal during the experiment when they were trying to fall asleep quickly ($M = 3.23$ min) than did those under low load not trying to fall asleep quickly ($M = -11.55$ min): $F(1, 75) = 11.96$, $P = 0.001$. Although all high load participants fell asleep more slowly than normal those not trying to fall asleep tended not to be quite as slow ($M = -5.54$ min) as those who were trying to fall asleep ($M = -14.08$ min): $F(1, 75) = 3.52$, $P < 0.07$. There was no significant difference in this deviation score between participants not trying to sleep in the low and high load conditions.

Reported difficulty falling asleep also followed the predicted pattern. As would be expected, participants under a high load reported greater difficulty falling asleep ($M = 4.60$) than participants under a low load ($M = 3.12$): $F(1, 75) = 18.37$, $MSE = 2.44$, $P < 0.001$. A significant instruction by load interaction was also revealed on reported sleep onset difficulty: $F(1, 75) = 4.00$, $P < 0.05$. Participants told to fall asleep quickly under high load reported significantly greater difficulty ($M = 5.07$) than those told to fall asleep quickly under low load ($M = 2.91$): $F(1, 75) = 18.86$, $P < 0.001$. Participants under a high load tended to differ in reported sleep onset difficulty dependent upon whether they were told to fall asleep quickly ($M = 5.07$) or were not told to fall asleep quickly ($M = 4.12$): $F(1, 75) = 3.18$, $P < 0.08$. However, participants not told to fall asleep quickly did not differ in reported sleep onset difficulty dependent upon whether they were under a high load ($M = 4.12$) or a low load ($M = 3.34$): $F(1, 75) = 2.49$, $P < 0.12$. And, those under a low load did not differ in reported sleep onset difficulty dependent upon whether they were or were not told to fall asleep quickly, $P > 0.10$.

Other sleep behaviours

There were some manipulation effects on other aspects of participants' rest as well. Those participants under a high load reported greater incidence of waking up and having difficulty

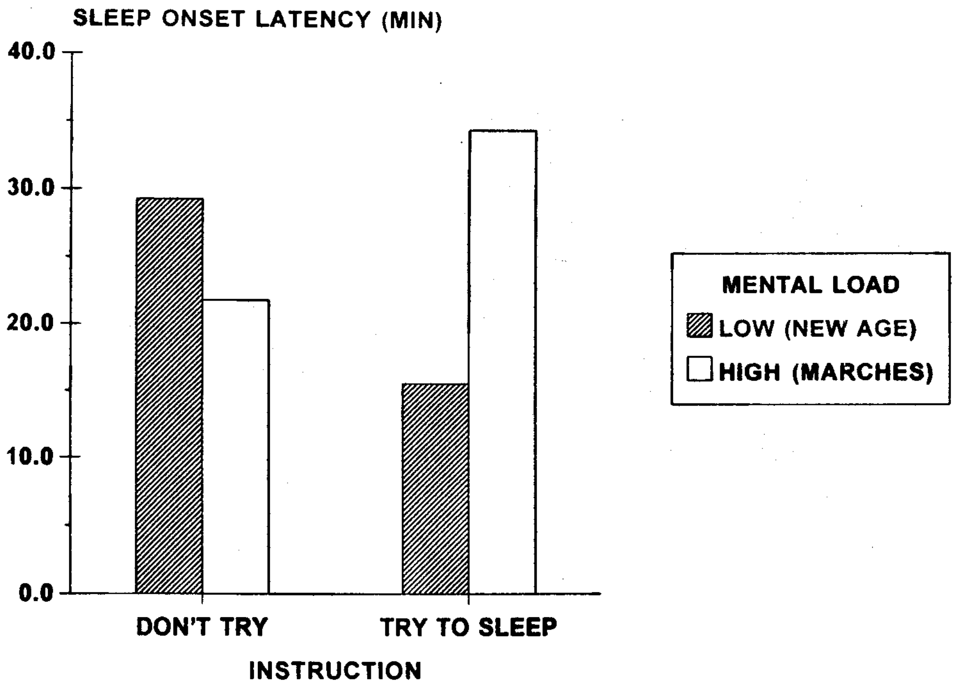

Fig. 1. Mean sleep onset latency as a function of mental load and sleep instruction.

failing back asleep throughout the trial night ($M = 0.51$ occurrences) than those under a low load ($M = 0.11$): $F(1, 75) = 4.77$, $MSE = 0.69$, $P < 0.04$. Participants under a high load also reported feeling less rested ($M = 4.26$) than those under a low load ($M = 3.30$): $F(1, 75) = 6.22$, $MSE = 3.04$, $P < 0.02$. Two additional measures of reported sleep difficulty (number of times awoken during the trial night and number of times awoken during a normal weekday night minus the trial night) did not show any significant effects.

DISCUSSION

The results of this experiment shed some light on the mental processes that are involved when people try to fall asleep and may have implications for both normal sleepers and chronic insomniacs. We have identified conditions in which people's purposeful attempts at falling asleep result in falling asleep more quickly than not trying at all. In our study, participants attempting to fall asleep quickly under a low mental load did indeed fall asleep more quickly than those not purposefully attempting to do so. We have also identified conditions in which people's purposeful attempts at falling asleep can ironically lead to paradoxical wakefulness. In our study, participants trying to fall asleep quickly under a high mental load actually took longer to fall asleep than those not purposefully attempting to do so. Consistent with the predictions obtained from the ironic process theory of mental control (Wegner, 1994), paradoxical wakefulness was found for those trying to fall asleep quickly under a high mental load.

Along with sleep onset latency effects, other findings also furnished support for the ironic process model of sleep control. When comparing sleep onset latency for the experimental trial night compared to a normal (i.e. nonexperimental) night, we found that participants trying to fall asleep quickly under a low load fell asleep faster on average than they reported doing on a normal weekday night whereas participants trying to fall asleep quickly under a high load took longer to fall asleep than a normal weekday night. Additionally, participants under a high load reported greater difficulty falling asleep than participants under a low load. It is not surprising that those under a high load (marching band music) reported greater difficulty falling asleep than those under a low load (restful music). However, this effect interacted with the instruction type such that those trying to fall asleep quickly under a high load reported greater difficulty falling asleep than those who were not trying. Taken together, these results lend clear support for an ironic process model of sleep onset control.

A few potential problems of interpretation should be addressed here. Our primary dependent measure was self-reported sleep onset latency—a measure reliably and consistently used in the sleep literature. The interpretation of such a measure is somewhat problematic in studying insomnia *per se* because insomniacs tend to overestimate sleep onset latency (Borkovec, 1982); however, our *S*s were normal sleepers and so would not be expected to show systematic biases in their estimates. A second concern with this measure centers on the finding that people tend to overestimate the passage of time when under a high cognitive load (Cantor & Thomas, 1977). This suggests that our results might be an artifact of a time judgment deficiency for those under a high load. However, the differences in the load conditions interacted with instruction (fall asleep quickly vs. fall asleep whenever). If the reported effect was merely a result of time estimation under load, we likely would not have found the interaction that indicates that trying to fall asleep quickly under a high load causes ironic wakefulness compared to not purposefully trying to fall asleep.

The self-report sleep onset measure also brings with it concerns about possible influences of experimental demand on the results. Our findings might reflect not actual sleep onset, perhaps, but rather how long participants thought it would take them to fall asleep depending upon their instruction by load condition. In the absence of more precise measures of sleep onset, we cannot rule this possibility out entirely. However, we can point again to the interactive nature of our main findings, and note that participants would need to have had a fairly sophisticated theory of sleep onset to have influenced their self-reports in the observed directions. Although they might have surmised that an instruction to fall asleep quickly could have the effect of speeding up their sleep onset, or perhaps that the instruction could have slowed their sleep onset, it seems highly unlikely that they would adopt one of these hypotheses under high load and the other under low load. Just to make sure, we did ask our participants in a post-experimental questionnaire to indicate what they thought we were testing. None came close to guessing the purpose or hypotheses of our experiment.

These findings have interesting implications for the study and treatment of chronic insomnia. This is because, in a sense, one condition of the experiment induced a bit of insomnia in otherwise good sleepers. Participants instructed to try hard to get to sleep during a distracting mental load found it particularly difficult to do so, and this observation suggests that chronic insomniacs may have somehow got themselves into similar straits. The idea that insomnia is accompanied by a chronic form of sleep urgency is, of course, part of the wider literature on this topic that spurred our investigation (e.g. Borkovec, 1982). And it is well-documented, too, that occurrences of insomnia are often associated with periods of acute stress or other instigators of mental load (e.g. Gillin & Byerley, 1990; Partinen, 1994). What our results add to these observations is a new appreciation of the interactive role of sleep urgency and mental load in precipitating acute insomnia.

These conditions could also contribute to chronic insomnia, perhaps in a cyclic and self-perpetuating process. A complete account of chronic insomnia that draws on the ironic process theory would begin with the realization that chronic sleep urgency probably begins with one or a few experiences of failing to sleep. These failures could occur when sleep is attempted under transitory mental loads; topics that prompt rumination could arise (e.g. work stress, relationship problems) or environmental annoyances might surface (e.g. noisy neighbors, a lumpy mattress, that faucet drip). The desire to sleep might be prompted first by these frustrations, and only later become a response to the perceived chronic failure to sleep. Eventually, though, the person's thoughts about not being able to sleep could themselves come to constitute a chronic and debilitating mental load which, in combination with the long-frustrated and continuing desire to sleep, could yield chronic insomnia. In what Wegner (1994) has called a 'self-loading system', the thwarted desire for mental control becomes the source of mental incapacitation that produces the opposite of the desired state of mind.

This account resembles prior theorizing about insomnia, and is largely consistent with the theories of cyclic escalation of anxiety about disorders proposed by Ascher (1980, 1981) and worry about sleep proposed by Borkovec (1982). What it adds is the realization that anxiety and worry are not the only mental loads capable of initiating a self-perpetuating tumble into chronic insomnia. Problems getting to sleep could begin quite simply with the combination of sleep urgency and any sort of mental load, even marching music. The ironic process account adds some implications for potential modes of treatment as well. The theory suggests, of course, that rescinding the desire to sleep can be a key step in the pursuit of relief from insomnia. The theory also suggests that the reduction of mental loads of all kinds could be helpful; this means not only the reduction of anxiety, but the reduction of other drains on mental capacity such as time constraints, environmental distraction, or ongoing cognitive tasks. These implications of the sources of sleeplessness in normal sleepers could be helpful in understanding and treating the problems of people who truly suffer from lack of sleep.

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