The Impact of Partial Sleep Deprivation on Moral Reasoning in Military Officers

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Study Objectives: The present study explores the impact of long-term partial sleep deprivation on the activation of moral justice schemas, which are suggested to play a prominent role in moral reasoning and the formation of moral judgments and behavior.
Design: Participants judged 5 dilemmas in rested and partially sleep deprived condition, in a counterbalanced design.
Setting: In classroom and field exercises at the Norwegian Naval Academy and the Norwegian Army Academy.
Participants: Seventy-one Norwegian naval and army officer cadets.
Measurements and Results: The results showed that the officers' ability to conduct mature and principally oriented moral reasoning was severely impaired during partial sleep deprivation compared to the rested state. At the same time, the officers became substantially more rules-oriented in the sleep deprived condition, while self-oriented moral reasoning did not change. Interaction effects showed that those officers who displayed high levels of mature moral reasoning (n = 24) in the rested condition, lost much of this capacity during sleep deprivation in favor of a strong increase in rules-oriented moral reasoning as well as self-orientation. Conversely, officers at low levels of mature moral reasoning in rested condition (n = 23) were unaffected by sleep deprivation.
Conclusions: The present data show that long-term partial sleep deprivation has an impact on the activation of moral justice schemas, and consequently on the ability to make moral justice judgments.
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STUDIES SHOW THAT, IN GENERAL, SLEEP DEPRIVATION IMPAIRS PERFORMANCE OF A WIDE RANGE OF COGNITIVE TASKS AND SENSORY FUNCTIONS, SUCH as mental arithmetic, logical reasoning, memory, vigilance, and meta-cognition.[1,2] The detrimental effects of sleep deprivation on cognition, motor performance, and mood have also been documented by meta-analyses and other reviews.[3] In contrast, some studies show that the ability to apply standard operational procedures, drills, and regulations may counteract some detrimental effects of sleep deprivation.[4] Research has shown that tasks that are dependent on the prefrontal cortex are particularly sensitive to loss of sleep,[5] indicating a neuroanatomical localization of the observed cognitive impairments.

Military operations often entail sleep deprivation. Such operations also involve a multitude of moral judgments, ranging from managerial decisions to extremely difficult choices, such as whether to attack insurgents in a setting surrounded by civilians. Great importance is therefore assigned to morals in military operational and leadership doctrines[6] as well as in contemporary leadership theory.[7] In the wake of moral scandals such as Enron and the Abu Grahib prison abuse scandal in Iraq, leadership research has shown increasing interest in contextual antecedents of leaders' moral behavior. Based on observations, it has been reported that sleep deprivation appears to foster laissez-faire leadership.[8] Killgore and coworkers[9] conducted the only known experimental study until now on the effects of sleep deprivation on moral judgments. They found that sleep deprivation caused longer response latencies for moral personal dilemmas, but not for moral impersonal or non-moral dilemmas. Sleep deprivation also led to an overall increase in permissiveness in terms of judging difficult courses of action to be appropriate. It was also found that subjects with a high score on emotional intelligence were less susceptible to the effects of sleep deprivation. However, the authors stated that their study did not investigate whether sleep deprivation caused any qualitative changes in moral reasoning.

The evaluation of qualitative aspects of moral reasoning is normally based on theories of cognitive moral development (CMD), of which Kohlberg's[10] stage theory is probably the most well known. According to Rest, Narvaez, Bebeau, and Thoma,[11] the most mature moral level is defined as the post-conventional schema (PCS). This schema includes Kohlberg's stages 5 and 6 and is characterized by autonomous reasoning on the grounds of universal moral principles such as justice and equality. According to Narvaez and Bock,[12] such moral reasoning requires higher-order cognitive processing, where the individual deduces moral principles from observing, assessing, and inferring potential moral consequences from the situation. This schema implies a decentration from self-oriented personal perspectives[13] in favor of a principled community focused moral orientation. The maintaining norms schema (MNS) equals Kohlberg's stage 4, which represents a moderate level of CMD.[11] Here, moral reasoning is structured by external factors such as rules and regulations, motivated by an aim to maintain stability and the established social order. The moral content of judgments based on the MNS rests heavily on the moral substance of the applied set of rules. Finally, the personal interest schema (PIS), which encompasses Kohlberg's stages 2 and 3, represents the least mature level of CMD.[11] Here, moral reasoning is instrumentally oriented towards pursuing self-serving ends, based on an egocentric and opportunistic outlook on the external world (i.e., "what's fair is what serves my personal interests best"). In

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general, this perspective represents severely limited and simplistic moral cognitive processing, displayed in a poor ability to view matters from other peoples' perspectives.

The objective of the present study was to investigate whether and how long-term partial sleep deprivation influences military officers' ability to make moral justice judgments. We addressed the following questions: (1) does sleep deprivation influence activation of moral schemas? and (2) will officers who are the most competent at making mature moral judgments in rested condition be more affected by sleep deprivation than officers with less mature moral judgments in rested condition?

METHODS

Sample

The participants in the present study were first-year officer cadets at the Royal Norwegian Naval Academy (n = 42) and the Norwegian Army Academy (n = 50). All participants had a minimum of one year of military service before entering the academies (M = 2.8 years of service), and they were all screened to ensure good physical and mental health and cognitive aptitude prior to admission. The mean age for the total sample (N = 92) was 24.2 years (SD = 4.18; range 22–32 years), and 7 (8%) were women. A total of 71 cadets (77%) participated in all parts of the study. At our first data collection, 6 cadets (7%) were absent due to external service demands. At the time of the second data collection, 8 cadets (9%) were absent due to various medical conditions disqualifying them from participation in the field exercise that framed our experiment. In all, 7 cadets (8%) chose not to participate.

Measures

The Stanford Sleepiness Scale (SSS)

SSS is a one-item scale, where participants are instructed to rate the current degree of sleepiness on a 7-point scale ranging from 1 ("feeling active, vital, alert or wide awake") to 7 ("no longer fighting sleep, sleep onset soon, having dreamlike thoughts"). High scores indicate greater sleepiness.[14] The scale is widely used as a state measure of subjective sleepiness, and it has consistently been shown to be sensitive to acute sleep deprivation.[15]

The defining issues test – 2 (DIT-2)

DIT-2,[16,17] an improved version of the DIT, is designed to activate and measure the domination of moral schemas. The participants are presented with 5 moral dilemmas and asked to rate the importance of each of the 12 items according to its value in making a decision about the dilemma presented. The scale is a 5-point Likert scale ranging from "no importance" to "great importance." The items are typical representations of Kohlberg's stages 2 to 6 of cognitive moral development. The participants are then asked to rank order the 4 items that they consider the most important in making their decision by distributing 4 points to the most important, 3 points to the second most important, 2 points to the third, and 1 point to the fourth. By this procedure of rating and ranking as highly important the arguments that best fit their preferred schemas for making moral judgments, the participants demonstrate the level at which they most likely make moral decisions. The presumption of the DIT-2 is that the fundamental structure of moral judgments assessed by the test can be encompassed in 3 developmental schemas, represented by 3 indexes presented as percentage scores. The post-conventional score (P-score), which is the most frequently utilized assessment of moral judgment development on the DIT-2, is expressed as the percentage of principled reasoning utilized by the participant in judging the dilemmas.[16] The maintaining norms score (MN-score) is a representation of an individual's preference for rule-based moral thinking in their judgments (e.g., Kohlberg's stage 4). Finally, the personal-interest score (PI-score) is a representation of an individual's preference for self-serving moral thinking (e.g., Kohlberg's stages 2 and 3). The internal consistency in the present sample was acceptable (Cronbach $\alpha \geq 0.71$), and the translation into Norwegian was done by bilingual translators using a translation-back translation procedure.[18] Rest[19] provided recommended cut-off points (thirds) with which to divide a distribution of respondents into principled reasoning groups for comparison purposes, assigning P-scores from 0-27 to the lowest third, from 28–41 to the middle third, and 42 to 95 to the highest third. The test-rest reliabilities of the DIT-2 ranges from 0.70 to 0.80.[20]

Procedure

The present study was approved by the Navy Staff of Education, RNoNA. Subjects were informed that participation was voluntary and that they could withdraw from the experiment at any time. Subjects signed a declaration of consent and completed the questionnaires individually. They were informed that the results were for research purposes and that individual results would not be made available to the academies.

Subjects then took part in an experiment with a repeated measures design, with a total of 2 conditions (rested and sleep deprived). In order to control for circadian variation, the DIT-2 and SSS data in the sleep deprived condition were collected between 04:30 and 05:30 for both groups, during 2 combat simulation training exercises. At this point, all the cadets had slept an average of 2.5 hours per day for 5 days. This amount of sleep was reported by supervisors/officers who acted as observers during the combat simulation training. The testing (DIT-2 and the SSS) in the rested condition took place between 07:30 and 08:30. Prior to this, the cadets were not under any sleep restriction regime imposed by their military units, but had regular daytime service for about 8 hours per day.

To control for potential order effect, a counterbalanced design was used,[21] whereby half the sample completed the DIT-2 and the SSS (i.e., justice schema activation) in the rested condition one week prior to the sleep deprived condition, and the other half completed the DIT-2 and the SSS one week after the end of the exercise. In the rested condition, data were collected during ordinary daytime service, which lasted for about 8 hours. Data were manually transferred to SPSS 15.0 for statistical analysis, and all questionnaires were coded to achieve anonymity.

Statistics

In order to identify changes in moral schema activation from rested to sleep deprived condition (research question 1), a series of paired t-tests were conducted. All significance tests were 2-tailed, and the α level was set to 0.05. To control for type I errors, a Bonferroni correction was applied (which reduced the significance level to 0.017). Effect sizes (Cohen's d) expressing the difference

Table 1—Change in activation of moral justice schema from the rested to the partial sleep deprived condition

	Rested (n = 71)		Sleep-deprived (n = 71)				
	Mean	(SD)	Mean	(SD)	t	P	d
Post-conventional schema							
Stage 6	7.07	5.58	5.55	5.55	−1.82	ns	−0.27
Stage 5	28.28	11.69	18.51	8.35	−6.62	< 0.001	−0.96
P-score	35.35	14.12	24.37	9.55	−6.70	< 0.001	−0.91
Maintaining norms schema							
Stage 4	31.49	12.88	35.10	11.22	2.18	0.032	0.30
Personal interests schema							
Stage 3	21.66	10.86	20.79	9.99	−0.69	ns	−0.08
Stage 2	6.51	6.14	8.68	6.69	2.31	0.024	0.34
PI-schema	28.20	12.50	29.46	12.06	0.82	ns	0.11

Table 2—Activation of the post-conventional justice schema in rested and sleep deprived condition between groups of high- vs. low P-score in rested condition

	High P-score group (n = 24)		Low P-score group (n = 23)	
	Mean	(SD)	Mean	(SD)
Time1: Rested	51.42	10.17	20.91	4.56
Time2: Sleep-deprived	28.75	8.86	19.47	8.25

Table 3—Activation of the maintaining norms justice schema in rested and sleep deprived condition between groups of high vs. low P-score in rested condition

	High P-score group (n = 24)		Low P-score group (n = 23)	
	Mean	(SD)	Mean	(SD)
Time1: Rested	23.33	11.92	36.70	11.96
Time2: Sleep-deprived	34.16	10.98	36.78	10.03

Table 4—Activation of the personal interests' justice schema in rested and sleep deprived condition between groups of high vs. low P-score in rested condition

	High P-score group (n = 24)		Low P-score group (n = 23)	
	Mean	(SD)	Mean	(SD)
Time1: Rest	22.75	9.81	36.43	12.15
Time2: Sleep-deprived	28.17	14.12	31.39	9.80

between the 2 states in terms of pooled standard deviations were calculated. As an aid to interpreting effect sizes based on effect size statistics, Cohen[22] provided the following benchmarks for the behavioral sciences: a value of 0.2 represents a small effect, 0.5 a medium effect, and 0.8 a large effect. Moreover, in order to investigate group interaction effects between "high P-score" vs. "low P-score" groups (research question 2) related to change in PCS, MNS, and PIS activation from rested to sleep deprived condition, a "mixed between-within subjects ANOVA"[23] was conducted. Here, a partial eta squared effect size was calculated. As an interpretation aid, Cohen[24] suggested a value of 0.01 as a low effect size, a value of 0.06 as moderate, and a value of 0.14 as large.

RESULTS

Degree of Sleepiness

Mean scores from the Stanford Sleepiness Scale (SSS) were calculated to confirm that the subjects were in significantly different states of sleepiness in the partially sleep deprived condition compared to the rested condition. The results indicated a low degree of sleepiness in rested condition (M = 1.49, SD = 0.65) in contrast to a significantly higher degree of sleepiness in the sleep deprived condition (M = 4.56, SD = 1.35). The mean increase in SSS score was 3.07, with a 95% confidence interval ranging from 2.72 to 3.42. The change was statistically significant (t = 17.75, df = 70, P < 0.01), and the effect size (d = 2.9) was large.

Change in Schema Activation from Rested to Sleep Deprived Condition

The results are showed in Table 1. A significant decrease was found in activation of the PCS from the rested to the sleep deprived condition. In contrast, the results show that activation of the MNS (Kohlberg's stage 4) increased from the rested to the sleep deprived condition. Finally, we found that activation of the PIS (Kohlberg's stages 2 and 3) did not change from the rested to the sleep deprived condition for the total sample.

Change in Schema Activation Between High Vs. Low P-Score Groups

A mixed between-within subjects analysis of variance was conducted to assess the impact of participants P-score level in rested condition (high vs. low P-score) on participants' justice schema activation across the 2 conditions (rested and sleep deprived). There was a significant and strong interaction effect between group (high vs. low P-score) and condition (Wilks lambda = 0.53, $F_{1,45}$ = 40.72, P < 0.0005, eta squared = 0.48), showing that the decrease in P-score from the rested to the sleep deprived condition was much higher for the high P-score group than for the low P-score group (see Table 2). Analyzing MNS activation as the dependent variable, a significant and large interaction effect was found between group (high vs. low P-score) and condition (Wilks lambda = 0.86, $F_{1,45}$ = 7.40, P = 0.009, partial eta squared = 0.14). The (increase) in MNS-activation from rested to sleep deprived condition was much higher for the high P-score group than for the low P-score group (see Table 3). Finally, with *PIS activation* as the dependent variable, a significant and large interaction effect was found between group and condition, (Wilks lambda = 0.86, $F_{1,45}$ = 7.40, P = 0.009, partial eta squared = 0.14), revealing an increase in PIS activation from the rested to the sleep deprived condition for the "high P-score" and a decrease in PIS activation from the rested to the sleep deprived condition for the "low P-score" group (see Table 4).

DISCUSSION

The present study provides new empirical evidence for the potential detrimental effects of long-term partial sleep deprivation on principled moral judgment. When assessed in a true-to-

life field experiment, Norwegian officer cadets showed strong impairment of their ability to activate autonomous and principle-oriented moral reasoning in the sleep deprived compared to the rested condition, as the reduction in P-score from the rested to the sleep deprivation equaled almost one standard deviation. These findings complement previous studies which suggested that partial sleep deprivation in particular affects cognitive processes that involve complex integrating tasks where flexibility, innovation, or plan revision is required.[1] Only one previous study on sleep deprivation and moral reasoning has been conducted. The results from this showed that reaction time to moral personal dilemmas (but not for moral impersonal or non-moral dilemmas) increased following sleep deprivation.[9] The current study complements that study by investigating how the quality of moral reasoning becomes affected by sleep deprivation.

In the social cognition context, this indicates that sleep deprivation may cause a reduction in the adoption of a social perspective and in the ability to incorporate different stakeholders' rights and needs into moral judgments.[13,17] These findings could have important consequences in organizations that rely heavily on chronically sleep deprived people performing critical services while faced with moral dilemmas.

Given that most contemporary military operations involve long periods of partial sleep deprivation[25] and fighting in highly complex environments,[26] one possible consequence of moral decay may be disproportionate use of power.[27] It is worth noting that Kohlberg and Candee[28] claim that principled moral judgment stimulates a sense of moral duty in the individual (i.e., "deontic judgments") that serves as the basis for moral reasoning. Previous research shows that the ability to engage in principled moral judgment has further predicted subsequent moral behavior.[17,29] Notably, sleep loss may not only affect officers' moral behavior, but also their followers' trust and motivation. Emerging research from Brown and Treviño[7] suggests that a leader's ability to handle high moral intensity situations is of great importance in relation to retaining his or her followers' respect and continued commitment.

A notable result from the present study was that the officer cadets became more rule-oriented and self-oriented in their moral justice reasoning during sleep deprivation, at the expense of principle-oriented justice reasoning. In relation to our second research question, this indicates that those officers who are best qualified to make complex justice judgments seem to lose much of this capacity during partial sleep loss. One positive implication of these results may be that sleep deprived officers do not regress into pure self-centeredness when faced with moral challenges that may involve the life and welfare of others. By applying laws and rules, the moral standards and concerns incorporated in the rules may provide a basis for sound moral judgments. In many organizations like the armed forces, the adverse effects of sleep deprivation are an important reason for having so-called rules of engagement (ROE) or standard operational procedures (SOP) that serve as simplified rules for making decisions in complex operational situations.

On the other hand, impairment of principled moral judgment could entail a higher vulnerability to "group thinking" and pressure to conform, as well as fueling unethical norms that could develop in highly cohesive organizations over time.[30] In military history, many cases have been reported in which soldiers have shown poor moral choices.[6] However, a shift from principled moral reasoning to a more rule-based decision-making process could also be seen as an adaptive process, in that the brain adapts to sleep deprivation by bringing additional neural resources online. Finally, an interesting and somewhat surprising finding was that the officers who displayed the most principled moral thinking (high P-score) also increased their self-oriented moral thinking (PIS-activation) from the rested to the sleep deprived condition. This finding could indicate that the effects of partial sleep deprivation may also be modulated by individual differences in personality and cognitive functioning.[31-34]

We did not collect data suggestive of any specific neurological loci responsible for the impairment in moral reasoning found in the present study. Still, previous studies have shown that moral dilemmas evoking strong emotions particularly seem to activate the medial prefrontal cortex.[35] This region has been shown to be particularly sensitive to the effects of sleep loss,[36] and is consistent with studies showing that, for example, affect regulation[37] and humor appreciation[38] become impaired by sleep deprivation.

Some limitations, which should be addressed in futures studies, could be noted. The fact that subjects with low levels of mature moral reasoning in rested condition did not change their scores in the sleep deprived condition might indicate that the measure of moral reasoning did not have adequate sensitivity to detect changes across different levels of sleepiness. We did not have any data on the sleep of the participants prior to participation in the current study. However, the SSS score in the rested condition showed the participants had low levels of sleepiness, indicating that the amount of sleep obtained before participation in this condition had been sufficient. Although the context of the data collection (combat simulation exercise and ordinary daytime service) can be considered naturalistic, it should still be kept in mind that the ethical dilemmas inherent in the DIT-2 were not specifically relevant for the actual military setting. Nor did the participants suffer any real consequences for their responses to the dilemmas.

An extension of the present study could therefore include several other antecedents of moral behavior in order to better represent the processes that produce actual moral behavior.[17] In the present study, testing in the sleep deprived condition was carried out from 04:30 to 05:30, and from 08:00 to 09:30 in the rested condition. Thus, performance in the sleep deprived condition could very well have been negatively influenced by a circadian factor as well, as it took place near the circadian trough.[39] Therefore, future research should control more accurately for the effects of circadian rhythms than the present study did.[40] That being said, the beneficial aspects of experimental control must be compared to the advantages of increased ecological validity by conducting a true-to-life experiment in a naturalistic setting, as was done in this case. It is, for instance, well known that military operations simultaneously may demand performance during sleep deprivation as well as near the circadian trough.[8]

The present study presents new empirical evidence to support qualitative changes in moral reasoning as a result of partial sleep deprivation, from principle-oriented moral judgments to more rules-based and egocentrically oriented perspectives. This pattern was most pronounced in those subjects who were

most inclined to apply principled moral reasoning in the rested condition. Given modern society's increased reliance on highly skilled professionals, such as the armed forces, to perform and excel in complex and demanding environments, sleep management and morally anchored rules-based decision-making procedures are important leadership responsibilities.

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DISCLOSURE STATEMENT

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