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Sleep Health xxx (2018) xxx-xxx



Contents lists available at ScienceDirect

Sleep Health

Journal of the National Sleep Foundation



journal homepage: sleephealthjournal.org

Chronic sleep restriction affects the association between implicit bias and explicit social decision making*

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ARTICLE INFO

Article history: Received 12 March 2018 Received in revised form 29 June 2018 Accepted 10 July 2018 Available online xxxx

Keywords: Sleep deprivation Judgment Facial perception

ABSTRACT

Objectives: Previous work suggests that sleep restriction (SR) reduces cognitive control and may increase negative implicit biases. Here we investigated whether SR might influence decision making on a social-evaluative task where individuals had to make judgments of threat based on facial photographs. Furthermore, we investigated the effect of changes in negative implicit biases as a result of sleep restriction on this decision-making task.

Design: Fourteen healthy adults underwent two 3-week counterbalanced in-laboratory stays (chronic SR and control sleep [CS] conditions). Participants completed the Arab Muslim Names implicit association test (a measure of implicit bias/attitudes toward Arab Muslims) and the Karolinska Airport Task (a measure of explicit decision making). The Karolinska Airport Task requires participants to judge the potential dangerousness of individuals based on facial photographs.

Results: After SR, participants were more likely to deem individuals with less positive and more negative facial features as dangerous than after CS. In addition, after SR, those participants showing higher negative implicit bias toward Arab Muslims tended to consider as more dangerous individuals with more quintessentially untrustworthy facial features (r = 0.76, P = .007), whereas this relationship was nonsignificant after CS (r = 0.33, P = .28).

Conclusions: These findings show not only that SR may increase implicit biases against a particular minority group but that SR also modifies how individuals make explicit decisions about another's trustworthiness based on facial features. These findings may have important implications for many occupations where workers who are routinely restricted of sleep are also responsible for making judgments about other people's trustworthiness (eg, police, security, military personnel).

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Introduction

Chronic sleep restriction (eg, restricting sleep on weekdays and catching up on the weekends) is prevalent in modern society. Although the National Sleep Foundation recommends 7-9 hours of sleep per night,⁹ around 44% of Americans get less than 7 hours of sleep on weekdays and try to catch up on sleep on weekend nights.⁵ In a recent study, we demonstrated that chronic sleep restriction influences negative implicit biases toward a particular minority group using the Arab Muslim version of the Implicit Association Test (IAT).¹ The IAT is a commonly used test that measures the strength of automatic associations between a concept (eg, a minority group) and an evaluation (eg, good and bad). Specifically, our prior results indicated that whereas individuals showed no evidence of a negative implicit bias toward Arab Muslims when fully rested (ie, given the opportunity to sleep for 8 hours per night for 3 weeks), evidence of negative implicit biases emerged within these same individuals when sleep was restricted to 4 hours per night on weekdays (and 8 hours on weekends) for 3 consecutive weeks.¹ Thus, our previous work suggested that chronic insufficient sleep can adversely affect social perceptions of minorities, whereas regular nightly sleep appeared to minimize or prevent such biases.

https://doi.org/10.1016/j.sleh.2018.07.003

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Please cite this article as: Alkozei A, et al, Chronic sleep restriction affects the association between implicit bias and explicit social decision making, Sleep Health (2018), https://doi.org/10.1016/j.sleh.2018.07.003

[☆] Author contributions: AA conducted the data analysis and wrote the manuscript. MH designed the study and collected the data. JS assisted in data analysis. RS, BCS, and AR contributed to writing of the manuscript. WDSK contributed to study design and writing of the manuscript.

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2

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A. Alkozei et al. / Sleep Health xxx (2018) xxx-xxx

Studies have shown that negative implicit biases toward minority groups, as measured using the IAT,⁸ might also influence explicit discriminatory behavior. For example, one study showed that individuals with higher implicit bias scores on the Arab Muslim Names IAT were less likely to invite someone with an Arab Muslim name vs a Swedish name to a job interview despite identical resumes of the candidates.¹⁵ However, it is currently unknown whether increases in implicit bias as a result of sleep restriction also influence explicit judgments and behaviors. Despite this current lack of knowledge, there is some evidence to suggest that total sleep deprivation impacts some aspects of social perception, such as the perception of facial expressions. This alteration in emotional facial perception may lead to differences in judgments about an individual's level of trustworthiness, but it is worth noting that the nature of the findings remains mixed. For example, whereas some research has shown that neutral facial expressions were most adversely affected by sleep loss,¹³ other studies find that the recognition of some specific emotions may be impaired, such as anger,^{11,20} happiness,¹¹ or sadness.³ Furthermore, another study has shown that the ability to identify the dominant emotion from facial expressions displaying complex emotional blends (eg, fear and surprise) was significantly reduced after sleep deprivation, indicative of a more global emotion recognition deficit.¹⁰ Finally, one study investigated specifically whether sleep deprivation increased threat sensitivity to facial cues and found that whereas participants were able to discriminate threatening from nonthreatening faces when fully rested, this ability was significantly reduced after 24 hours of sleep deprivation such that participants overestimated the level of threat from facial expressions.⁷

In a separate line of work, we also recently developed a socialevaluative decision-making task that requires individuals to rely on subtle facial cues to make decisions about an individual's potential trustworthiness.² In this task, known as the *Karolinska Airport Task* (KAT), study participants are required to imagine that they are an airport security officer and must view a series of facial photographs and make a decision about whom to detain as a possible terrorist threat. Using the KAT, we found that among healthy individuals, those with higher levels of emotional intelligence were more likely to base trustworthiness decisions on subtle social cues reflected in facial features. We concluded that highly emotionally intelligent individuals were better able to perceive or incorporate these subtle facial features into decision making than those with lower emotional intelligence. In other words, individuals with lower emotional intelligence tended to make random decisions about the trustworthiness of each depicted individual, whereas those with higher emotional intelligence tended to detain only the most threatening-appearing passengers (according to prior ratings of the photographs made by other independent raters). At present, it is not known how implicit biases toward a particular minority group may also be associated with such explicit judgments about individuals more generally and how this relationship may be affected by restricted sleep.

In the present study, we aimed to follow up on our previous analyses by assessing whether sleep restriction impacts social-evaluative decision making about the trustworthiness of individuals based on subtle facial features using the KAT and how this may be associated with individual differences in implicit bias. It is possible that changes in implicit bias caused by sleep restriction are also associated with changes in explicit decision making. Based on prior work showing that perceptions of facial features of threat become particularly salient during sleep loss, we reasoned that those who show greater implicit biases as a result of restricted sleep would also show greater tendencies to base decisions on threatening facial features in the KAT.

In summary, the following research questions were examined:

1. Does sleep restriction impact decisions about the trustworthiness of individuals based on subtle facial features?

- 2. Do changes in implicit bias as a result of restricted sleep correlate with changes in decision making about the trustworthiness of individuals?
- 3. Does sleep restriction amplify the strength of the relationship between implicit bias and explicit decision making about the trustworthiness of individuals?

Methods

Participants

Seventeen healthy young adults (8 women, 9 men; mean age = 24.53 years, SD = 4.20) completed a counterbalanced within-subjects crossover sleep restriction study. Subjects reported habitual sleep durations between 7 and 9 hours, with their regular habitual sleep period beginning within 1 hour of 11:00 pm. Some data from this sample have been reported elsewhere, including those for the IAT,¹ but the associations with the KAT are novel and have never been reported. The exact inclusion and exclusion criteria and participant characteristics can be found in Alkozei et al¹ and Simpson et al.¹⁶

Missing data

Out of 17 participants originally recruited for this study, data for 14 participants were available for the KAT (50% female; mean age = 24.9, SD = 2.76), and data for 12 of those 14 participants were available for the IAT (50% female; mean age = 24.8, SD = 4.80). Of the 14 participants, 7 participants identified as African American (47.1%), 5 as white (41.2%), 1 participant identified as Asian (5.9%), and 1 identified as Native American (5.9%). The 2 participants who did not have a full data set for the IAT identified as African American. In the analyses described below, we only included individuals who had a complete data set for each of the analyses.

Arab Muslim Names IAT

The Arab Muslim Names version of the IAT was used for this study and is described in detail in Alkozei et al.¹ In brief, the IAT is a computerized task to measure implicit biases, in this case, toward "Arab-Muslim" names in comparison to names of "Other People" (ie, common European American names). Scores on the IAT were analyzed in line with the Greenwald et al⁸ scoring algorithm to obtain a *d*score. The *d*-score has a possible range of -2 to +2. A *d*-score of zero indicates no IAT effect, positive scores indicate a slight (~0.15), moderate (~0.35), or large (~0.65) negative bias toward Arab Muslims, whereas negative scores of the same magnitude indicate a positive bias for Arab Muslims.

Karolinska Airport task

The KAT is described in detail in Alkozei et al.² In brief, it is a computerized task that mimics an airport security screening situation. Participants were instructed to assume the role of an airport security officer who was informed that there was one certain but unidentified terrorist in line to board an airplane that was evacuating people from an impending natural disaster. Participants were presented with a series of 66 facial photographs of white men and women taken from the set published by the Karolinska Institute in Sweden.¹² For each passenger, the participant was asked to decide whether to allow them to board the plane or whether they should be detained for further questioning. Participants had unlimited time to respond to each photograph. These photographs were previously rated on 14 character traits by independent judges from another institution. The rated dimensions included negative character traits: aggressive, dominant, mean, threatening, unhappy, and weird; and positive character traits: attractive, caring, confident, emotionally stable, intelligent, responsible, and trustworthy. Each face had an associated z-score based on the

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