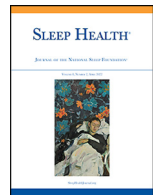


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Sleep quality and duration are associated with greater trait emotional intelligence



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ABSTRACT

Objectives: Prior work suggests that short sleep and total sleep deprivation are associated with reduced trait Emotional Intelligence (trait EI) but not reduced ability Emotional Intelligence (ability EI). To expand this knowledge base, we investigated the role of habitual sleep quality on trait and ability EI above and beyond the known effects of recent sleep duration.

Methods: A large sample, comprising 477 healthy adults completed the Pittsburgh Sleep Quality Index (PSQI), Trait Emotional Intelligence Questionnaire (TEIQue; trait EI), and Mayer-Salovey-Caruso Emotional Intelligence Scale (MSCEIT; ability EI).

Results: Bivariate correlation and multiple linear regression showed that recent sleep duration and PSQI sleep quality each independently predicted higher trait EI scores, including Emotionality, Self-Control, Sociability, and Well-being, but were unrelated to ability EI scores.

Conclusions: In this large community sample, recent sleep duration and habitual sleep quality both independently associated with self-perceived dispositional aspects of EI (ie, trait EI). In contrast, recent sleep duration and PSQI score were unrelated to more crystallized aspects of EI performance, which encompass the general fund of emotional information and the ability to understand and reason about emotional concepts (ie, ability EI). In sum, self-reported longer sleep duration and better sleep quality were associated with subjective perceptions of better emotional functioning, but was unrelated to performance-based metrics of emotional reasoning.

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Introduction

Sleep and emotion are inexorably linked.¹ Without sufficient sleep, people become moody,² easily frustrated,³ and prone to respond with anger.⁴ Sleep deprivation impairs a host of emotional capacities, which can result in difficulty recognizing emotional facial expressions,⁵ blunting of emotional expression through facial⁶ and vocal cues,⁷ deficits in the ability to use emotions to guide decision-making,⁸ and reduced capacity to suppress unwanted negative thoughts.⁹ These capabilities represent facets of the construct of Emotional Intelligence (EI), postulated as the ability to both accurately recognize and understand emotional information, reason effectively about that information, and use such knowledge to adaptively guide thought and behavior in oneself and others.¹⁰

Current approaches to EI include 2 different theoretical constructs, described as *trait EI* and *ability EI*. The construct of *trait EI*

reflects a set of relatively stable and measurable affective and interpersonal traits embodied within the framework of subjectively-rated personality.¹¹ Trait EI, sometimes referred to as *trait emotional self-efficacy*, is measured by subjective rating scales that focus on the individual's perceptions of their emotional capabilities.¹² Trait EI can be conceptualized as part of the fundamental lower levels of traditional personality hierarchies and tends to correlate with most major dimensions of personality¹² and measures of affective state or well-being.¹³ However, other conceptualizations of EI view it as a set of emotional abilities or skills, which can be measured using maximum performance-based tests in a manner analogous to other standard forms of intelligence.^{14,15} This model, known as *ability EI*, focuses on a person's demonstrated capacity to understand emotional information and solve emotional problems. Most commonly, ability EI tests include items requiring some form of perceptual decision, reasoning, or discrimination about emotional content that is compared to consensus responses from a normative sample.¹⁴⁻¹⁶ In contrast to trait EI, which correlates highly with domains of personality, mood, and well-being, ability EI appears to correlate significantly with standard measures of cognitive intelligence.¹⁷ The EI scores derived from each

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model are often negligibly correlated and appear to measure essentially orthogonal constructs.^{17,18} The well-established finding that these 2 constructs are each related to different aspects of emotional functioning and essentially unrelated to one another suggests that they may be differentially susceptible to the degrading effects of sleep loss.

We previously demonstrated that two nights of total sleep deprivation significantly reduced scores on a measure of trait EI.¹⁹ We have also shown that recent sleep duration was associated with changes in trait EI but not ability EI,²⁰ suggesting that poor sleep quality or insufficient sleep may differentially affect an individual's perception of their emotional status and subjective wellbeing more than it affects performance-based aspects of EI that involve emotional reasoning and problem solving. Here, we followed up on our prior work by collecting data from a large community sample of individuals who completed assessments of sleep quality, recent sleep duration, and measures of both ability and trait EI. We hypothesized that both poor sleep quality (as assessed by PSQI) and reduced sleep duration would be associated with lower scores on trait EI but not ability EI.

Methods

Participants

A large sample comprising 447 (125 male; 322 female) healthy, English-speaking, young adults (ages 18–40 years; *M* = 23.7, *SD* = 5.6; *M* = 14.8 years of education, *SD* = 2.3) were recruited from the greater Tucson/Phoenix metropolitan area via posted flyers as well as advertisements in newspapers, social media, targeted web advertisements (Google; Facebook), and university listservs. Enrolled participants classified themselves as 60.9% White, 3.4% Black or African American, 0.7% Native American or Alaska Native, 6.5% Asian, 21.0% Latino or Hispanic, 5.8% Mixed race/ethnicity, 0.4% Other, and 0.9% preferred not to answer. Written informed consent was obtained prior to enrollment and participants were compensated for their time. The protocol for this study was approved by the University of Arizona Institutional Review Board and the US Army Human Research Protections Office.

Materials and procedure

Participants completed a series of questionnaires about demographics, health, and sleep habits. They also quantified the amount of sleep (to the closest half hour) they obtained the night before coming to the assessment session (ie, Sleep Last Night; SLN), and completed the Pittsburgh Sleep Quality Index (PSQI), a validated questionnaire that assesses overall sleep habits and difficulties²¹ (PSQI total). Participants also completed a measure of trait EI, the Trait Emotional Intelligence Questionnaire (TEIQue),¹¹ comprising 4 primary factors (ie, Emotionality, Self-Control, Sociability, and Well-being) and a global score. The internal consistency reliabilities for the TEIQue range from 0.73 (Emotionality) to 0.92 (global score).¹¹ As a measure of ability EI, we administered the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT 2.0),^{14,15} which provides a total EI score and four branch

scores (ie, Perceiving Emotions; Facilitating Thought; Understanding Emotions; Managing Emotions), standardized to sex-specific norms, with internal consistency reliability of 0.93 for the total EI score and alpha reliabilities between 0.61 and 0.88 for the subtests comprising the branch scores.¹⁵

Analysis

All independent and dependent variables were screened for outliers (ie, values exceeding 3.29 SD from the mean). While SLN had 8 outliers (ie, individuals who reported getting 3 or less hours of sleep the night before testing), these were not considered implausible for this population of young adults, so they were retained. There were no outliers for PSQI or any of the TEIQue scales. For the MSCEIT the scaled scores showed several outliers, which were eliminated on an analysis-wise basis for each regression model. The associations between sleep metrics (PSQI total and SLN) and the total and factor/branch scores of the TEIQue and MSCEIT were evaluated using Pearson's bivariate correlations, with Bonferroni correction for multiple comparisons (corrected $\alpha = 0.05/20 = 0.0025$; Table 1). To determine the unique contribution of sleep problems (ie, PSQI total) and recent sleep duration (ie, sleep last night; SLN) to describing the variance in EI, PSQI and SLN were entered simultaneously as independent variables into a series of regression analyses to predict each EI outcome measure, with Bonferroni corrections (corrected $\alpha = 0.05/10 = 0.005$) applied to each model. No additional covariates were included.

Results

Overall, average scores on the PSQI total were slightly above the normal range (*M* = 6.45; *SD* = 2.24; range = 3–14). Based on the common cut-off value for poor sleep (ie, a PSQI total score > 5²¹), 60% of our sample exceeded this criterion, suggesting some evidence of poor sleep in the majority of the sample. Furthermore, participants reported obtaining 6.49 hours (*SD* = 1.25; range = 1–10 hours) of sleep the night before the assessment (SLN), which is below the recommended levels of 7 to 9 hours of sleep for healthy individuals.²² As would be expected, there was a modest, but statistically significant, negative correlation between PSQI and SLN ($r = -0.26, p < .001$), indicating that individuals with better sleep quality (as assessed by the PSQI) also tended to report getting more sleep the night before the assessment session. Greater severity of sleep problems on the PSQI was significantly correlated with lower scores for all four factors and the global score of the TEIQue, even after correction for multiple comparisons (Table 1). In contrast, with the exception of the Managing Emotions branch, PSQI total scores had no significant associations with total EI or any other branch scores derived from the MSCEIT. Similarly, SLN was positively correlated with two of the TEIQue factors, Self-Control and Wellbeing, as well as the global EI score. However, SLN was not correlated with total EI or any EI branches measured by the MSCEIT.

Next, we entered both PSQI total and SLN simultaneously into individual regression analyses to determine the unique variance contribution provided by these variables for each of the scale scores of

Table 1
Emotional intelligence (EI) scale ranges and Pearson's bivariate correlations with sleep metrics

	TEI emotionality	TEI self-control	TEI sociability	TEI well-being	TEI global	MSCEIT perceiving	MSCEIT facilitating	MSCEIT understanding	MSCEIT managing	MSCEIT total
Range	3.2–6.2	2.2–6.8	2.4–6.8	2.2–7.0	2.8–6.5	73–166	62–150	70–166	59–166	58–166
PSQI Total	−0.158*	−0.313*	−0.154*	−0.306*	−0.309*	−0.092	−0.063	−0.138	−0.149*	−0.143
SLN	.138	.144*	.141	.207*	.206*	.000	−0.010	−0.024	.062	.028

PSQI = Pittsburgh Sleep Quality Index; SLN = Sleep Last Night; TEI = trait Emotional Intelligence; MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test.

* $p < .05$, Bonferroni corrected.

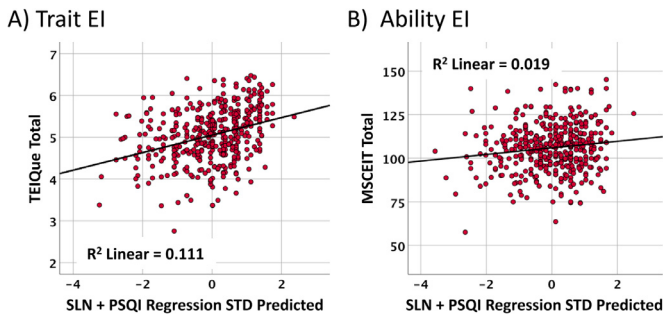


Fig. 1. Standardized (STD) predicted regression plots showing the combined variables of sleep last night (SLN) and total sleep quality from the Pittsburgh Sleep Quality Index (PSQI) as predictors of Trait and Ability Emotional Intelligence (EI). A) The combination of SLN and PSQI was significantly predictive of Trait EI on the Trait Emotional Intelligence Questionnaire (TEIQue; $R^2 = 0.111$, $p < .05$, Bonferroni corrected). B) The combination of SLN and PSQI was not significantly predictive of Ability EI on the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT; $R^2 = 0.019$, $p > .05$, Bonferroni corrected).

the TEIQue and MSCEIT. First, for the TEIQue, Global scores were significantly associated with a linear combination ($R^2 = 0.111$, $p < .05$, corrected) of lower PSQI total ($\beta = -0.275$, $p < .0001$) and greater SLN ($\beta = 0.130$, $p = .006$). This association is shown in Fig. 1A. To assess the possible contribution of collinearity to the TEIQue Global score, we examined the variance inflation factor, which was 1.07, indicating low collinearity between independent variables. Similarly, TEIQue Emotionality was predicted ($R^2 = 0.035$, $p < .05$, corrected) by lower PSQI total ($\beta = -0.131$, $p = .007$) and greater SLN ($\beta = 0.103$, $p = .034$). TEIQue Self-Control was predicted ($R^2 = 0.102$, $p < .05$, corrected) by lower PSQI total ($\beta = -0.296$, $p < .0001$), although SLN did not add significantly to the prediction ($\beta = 0.063$, $p = .177$). TEIQue Sociability was predicted ($R^2 = 0.034$, $p < .05$, corrected) by lower PSQI total ($\beta = -0.126$, $p = .010$) and higher SLN ($\beta = 0.107$, $p = .028$). Finally, TEIQue Wellbeing was predicted ($R^2 = 0.109$, $p < .05$, corrected) by lower PSQI total ($\beta = -0.272$, $p < .0001$) and higher SLN ($\beta = 0.129$, $p = .006$). In contrast, for the MSCEIT, combining PSQI total and SLN did not add any additional predictive power above and beyond that provided by the simple bivariate correlations, with none of the combined models meeting the corrected alpha criterion for significance. Fig. 1B shows the combined variables of PSQI and SLN on MSCEIT total ($R^2 = 0.019$, ns). The regression equation for the total MSCEIT EI was not meaningfully influenced by collinearity, as the variance inflation factor was 1.07, indicating negligible collinearity.

Discussion

Here, we showed that sleep quality (as assessed by PSQI) over the preceding month, along with the amount of sleep obtained the night before testing, were significantly and independently associated with higher trait EI, but generally unrelated to ability EI, as defined by the current metrics that were employed. The present findings demonstrate that individuals who routinely experience higher quality sleep and obtain more sleep the night before testing also tend to have greater trait EI, suggesting that they perceive themselves as more competent at: 1) social interactions, listening, and communication (Sociability Factor), 2) perceiving and expressing emotions effectively to maintain relationships (Emotionality Factor), 3) feeling positive, fulfilled, and happy (Wellbeing Factor), and 4) controlling impulses and coping with the stresses of life (Self-Control Factor). Again, it should be borne in mind that as a trait measure, these reflect self-perceptions rather than objectively measured abilities. Our prior studies showed that two nights of total sleep deprivation significantly reduced trait EI and emotional coping capacities,¹⁹ and that greater sleep time the night before testing was associated with greater trait EI.^{20,23} The present results expand those findings to a nonlaboratory

context and demonstrate that sleep quality (as assessed by the PSQI) over the preceding month is also independently associated to trait EI, above and beyond the association seen with recent sleep quantity.

The present findings are consistent with some evidence of the neurobiological effects of sleep and sleep loss on the brain. Neuroimaging work suggests that a full night of sleep helps sustain functional connectivity among some key emotional control systems within the brain, permitting greater regulation of the emotionally responsive limbic system (ie, amygdala) by the prefrontal cortex.^{20,24} Decreased sleep alters this cortical modulation of emotions, leading to declines in mood, wellbeing, and trait EI accordingly.²⁰ While trait EI has been shown to be affected by recent sleep duration,²⁰ ability EI seems unrelated.²⁰ Moreover, in our prior work, the strength of connectivity between the prefrontal cortex and amygdala was shown to correlate with higher trait EI, but was unrelated to ability EI.²⁰ In another study, we also found that individuals who habitually obtain more sleep than their subjective requirements tended to have larger gray matter volume within the medial prefrontal cortex (a region important for modulating emotion), which was correlated with higher trait EI. The finding that PSQI score and sleep duration duration have a differential associations with trait vs. ability EI is not entirely unexpected, as several studies have now shown that these two concepts of EI are generally uncorrelated¹⁷ and appear to involve different brain networks and structures.^{18,25–31} Together, the data are in accord with the notion that lack of sleep is related to brain systems associated with emotional self-perception (eg, motivation, mood, negativity bias, self-reflection, etc.), which are assessed by trait EI metrics. Of course, causality cannot be inferred here, and it is possible that possessing higher trait EI, and the enhanced wellbeing it facilitates, allows individuals to obtain higher quality sleep in greater quantities. While it is likely that the causal links between sleep and trait EI are bi-directional, our prior findings during experimental sleep deprivation argue for a decline in emotional abilities following the curtailment of sleep.¹⁹ This is a fruitful area for further research.

Finally, consistent with our prior work,²⁰ we found that sleep quality (as assessed by PSQI) and duration were generally not predictive of ability EI. In contrast to trait EI, which is heavily influenced by immediate wellbeing and emotional outlook,¹¹ the assessment of ability EI using the MSCEIT recruits more crystallized aspects of intelligence, such as the recognition or retrieval of learned emotion knowledge and the breadth of understanding about emotions and their operation in various settings.³² However, the MSCEIT's simple format does not allow for the measurement of more sophisticated aspects of emotional expression, regulation, or fluid problem-solving that also relate to the general construct of ability EI.

Several additional caveats need to be considered when interpreting the present findings. First, while the present associations are statistically significant, it is important to also recognize that the effect sizes of many of the regression coefficients were relatively modest. For instance, our data suggest that roughly a 2-hour difference in sleep the night preceding testing, or a difference of around 3 points on the PSQI, would each be associated with about a quarter of a standard deviation difference in trait EI. Thus, typical daily fluctuations in these sleep variables are unlikely to produce obvious shifts in EI in most situations. However, the role of emotional reasoning, reactivity, or wellbeing may differ across circumstances and may show complex interactions with situational stress, so it is conceivable that even a subtle shift in EI due to sleep-related issues could have clinically, interpersonally, or occupationally meaningful implications under some circumstances. Second, the present study was also limited by the correlational nature of the data, which does not allow for the inference of directionality or causality. Thus, we cannot say for certain here whether better sleep leads to improved EI, or whether individuals with greater EI tend to get better sleep (although our prior work suggests that reduced sleep can adversely affect trait EI¹⁹).

Third, the subjective nature of the present data has inherent limitations as well. For instance, the data on sleep were provided by self-report, which is often poorly correlated with objective measures of sleep.³³ Finally, the present study is limited by the nature of the specific metrics of EI that were used. In particular, while the MSCEIT is a commonly used metric for assessing ability EI, it suffers from a limited sampling domain of emotional items,¹² and we did not assess many other objective aspects of emotional abilities, such as real-time emotion regulation and fluid emotional problem-solving. Further research using objective measures of sleep and emotional behavior will be necessary to further validate these findings.

With full acknowledgement to the aforementioned limitations, we believe these findings have implications for the wider field of sleep health research. For example, previous research suggests that individuals who believe that sufficient sleep can reduce emotional “moodiness” may be more likely to engage in activities aimed at improving sleep health.³⁴ Future studies may show that sleep health interventions improve EI. Also, prior research suggests that EI is associated with engagement in healthy behaviors.³⁵ It is possible that EI represents a novel pathway linking poor sleep health and both mental health and cardiometabolic health risk factors, which have been shown to be related to sleep health.³⁶

Thus, we conclude that PSQI score and sleep duration are each independently associated with aspects of trait EI; encompassing self-perceptions of general wellbeing and self-confidence in the ability to cope with stress and regulate impulses. However, the effects of sleep may have little impact on an individual’s crystalized knowledge about emotions and their objective understanding and reasoning about the best way to manage them when measured by maximum performance tests. In short, when it comes to emotional functioning, sleep is related to how you feel more than what you know.

Declaration of conflict of interest

The authors have no conflicts of interest to disclose.

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