Can misinformation about sleep shape aggressive and prosocial behaviour?

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Abstract

Purpose: Previous research has linked poor sleep quality to aggressive behaviour, with cognition clearly implicated. A separate strand of research has shown that presenting participants with misinformation about the quality of their sleep may affect task performance. Consequently, we investigated the question of whether misleading participants about their sleep could also affect aggressive responses.

Methodology: Through a bogus sleep quality diagnosis procedure, participants were led to believe that they had either slept well or slept poorly during the previous night. Aggression was measured using the Tangrams Help/Hurt Task (THHT) and potential differences between groups according to misinformation was assessed.

Findings: Overall, participants who were told they had slept poorly showed more aggressive responses than those who were told they had slept well. Further analyses indicated that on this task, the effect of sleep misinformation was based on reducing prosocial behaviour rather than increasing hurtful behaviour. Thus, manipulating sleep beliefs may offer a simple route to shaping aggressive and prosocial responses.

Originality: This research elucidates our understanding of the relationship between sleep and aggressive/prosocial behaviour by demonstrating, for the first time, the moderating role of cognition and belief. Beliefs about sleep may directly influence aggressive behaviour, suggesting that even simple changes in these beliefs may help shape how people act. However, it remains unclear whether individuals must be consciously aware of the link between sleep and aggression for this effect to emerge.

Keywords: sleep; aggression; misinformation; Tangrams Help/Hurt Task; THHT; prosocial

Introduction

Sleep is a fundamental biological necessity for health. Insufficient or disrupted sleep is not simply an annoyance but should be viewed as a public health issue with widespread health consequences (Hale *et al.*, 2020). There are also mental health consequences of chronic sleep disturbance, with evidence demonstrating a relationship between poor sleep and numerous mental health conditions (Freeman *et al.*, 2020). Importantly, the relationship has been shown to be bi-directional. That is, insomnia is not only a symptom of, for example, depression but also a risk factor for the development of these symptoms (Baglioni *et al.*, 2011). Increasingly, sleep disturbance is being recognised as a transdiagnostic process, being involved in multiple mental health conditions, increasing symptom severity and attenuating treatment outcomes (Hertenstein *et al.*, 2019). Achieving good sleep, therefore, is central to safeguarding physical and psychological health.

The pattern of effects is more striking when we consider the effects of even short-term sleep disruption. A single night of sleep restriction is enough to dampen cognitive processes, resulting in lapses in attention and poorer decision-making (Lim and Dinges, 2010). The stability of emotional responses is similarly precarious. Experimental studies show that a single night of fragmented sleep may impair emotional regulation, leading to irritability and raised reactivity to stress (Goldstein and Walker, 2014). Neuroimaging evidence highlights a potential neural mechanism to explain these effects. Sleep disruption leads to intensified amygdala activity combined with dampened inhibitory responses from prefrontal areas, leaving the tired brain more likely to produce exaggerated or blunted affective responses (Yoo *et al.*, 2007). The emotional effects may also lead to behavioural consequences. Evidence suggests that minor sleep loss reduces empathy and compassionate responding (Guadagni *et al.*, 2014), lowers the likelihood of helping others (Simon *et al.*, 2022) and increases the risk for hostile attribution biases to occur (Freitag *et al.*, 2017).

Short-term sleep disruption compromises the brain's capacity to process information effectively and balance emotional responses. Social cognitive models of aggression, such as the *Integrated Social Information Processing Model* (Huesmann, 2016) are perhaps particularly useful here in explaining how negative impacts on processing can distort how events are both perceived (e.g., hostile attribution biases) and acted on via the selection of scripts that are informed/primed by an attributional bias and/or any resulting emotional response (e.g., hostility leading to a hostile script becoming more easily accessed). Cognitive mechanisms are considered particularly important in this instance, with models such as the *Cognitive Sleep Model for Aggression and Self Harm* (CoSMASH) (Greenwood *et al.*, 2022) arguing how unhelpful cognitive processes concerning sleep serve to increase negative affect and, for some, a sleep attribution bias that may lead to the suppression of a prosocial attribution bias. This in turn is thought to raise the potential for outward aggression. Furthermore, more recent research has argued that among those with low self-control – a core individual factor that is known to mediate aggression and other variables – sleep quality and aggression are reciprocally linked (Liu *et al.*, 2025).

Indeed, at least anecdotally, poor sleep has been linked with short temper and irritability, and both observational and experimental research supports a link between poor sleep and increased aggression (Van Veen *et al.*, 2022). Sleep problems are associated with difficulties in response inhibition (Drummond *et al.*, 2006), a greater likelihood of interpreting neutral stimuli negatively (Daniela *et al.*, 2010) and greater propensity for irritation and hostility (Granö *et al.*, 2008). Thus, a role for self-control, attributional biases and affect dysregulation is indicated (Krizan and Herlache, 2016). Indeed, sleep problems have been implicated in increased aggression across the spectrum, in the general population (Street *et al.*, 2016), in prison samples (Barker *et al.*, 2016), and in forensic mental health (Kamphuis *et al.*, 2014).

Nevertheless, subjective perceptions of sleep – that is, how well one believes oneself to have slept – may also be influential (Barker *et al.*, 2016; Freitag *et al.*, 2017) and yet has not been well-considered to date. There is convincing evidence that the relationship between subjective and objective measures of sleep is weak (Matthews *et al.*, 2018) with multiple theoretical accounts for why this may be (Harvey and Tang, 2012). In some cases, subjective measures of sleep quality have been shown to be a strong predictor of outcomes. For instance, subjective sleep ratings have been shown to predict wellbeing better than actigraphy-based measures (Lenneis *et al.*, 2024). Together, these findings highlight a proposal that perceptions about sleep may shape functioning more than the physiological reality of sleep.

A small number of experimental studies have examined the impact of sleep perceptions on functioning. By altering clock speeds, Rahman et al. (2020) convinced participants that they had slept either more or less than they had. In a vigilance task, they found that reaction times were slower when participants believed they had slept poorly and faster when they believed they had slept well, irrespective of how long they had slept. Similarly, using a bogus sleep diagnosis procedure, Draganich and Erdal (2014) gave false feedback to participants about their sleep quality, finding that those who were told they had slept well performed better on cognitive tasks than those told they had slept poorly. Extending this approach to clinical populations, Gavriloff et al. (2018) reported that patients with insomnia who were given negative feedback about their sleep reported greater daytime impairment and sleepiness than those given positive feedback. Across these studies, false feedback about sleep reliably biased subjective ratings and task performance.

Combining these unrelated findings leads logically to an interesting and untested hypothesis. If the subjective perception of sleep may influence aggression, and false feedback on sleep has an impact on task performance, this raises the question of whether providing

participants with false information on sleep may also affect aggression. Such a relationship, while speculative, would make theoretical sense. Beliefs about impaired sleep may induce expectations of reduced self-control and increased irritability (Bozzay and Verona, 2023) creating a nocebo-like effect (Webster *et al.*, 2016). These expectations may then negatively bias social appraisals toward hostility and reduce emotional resources for empathy (Greenwood *et al.*, 2022), increasing aggression while decreasing prosocial behaviour (Freitag *et al.*, 2017).

Evidence suggests that subjective perceptions of sleep may impact aggression, and that false information can shift perceptions of one's own sleep quality. What is not currently known is whether providing false information about sleep quality, either that someone slept well or poorly, may impact aggressive or prosocial behaviour. Thus, this study investigated whether leading participants to believe that they had slept poorly during the previous night would result in higher levels of aggression than leading participants to believe they had slept well.

Method

Design

The study used a single factor (sleep misinformation) between-groups design with participants being told that they had either 'slept well' or 'slept poorly'. The dependent variable was the overall score from the Tangrams Help/Hurt Task (Saleem *et al.*, 2015) used as an index of aggressive responses, and self-reported measures altruism and sleep were also gathered as potential covariates in addition to demographic data. The study was conducted in accordance with the Declaration of Helsinki and ethical approval was granted by the Science Research Ethics Committee at the University of [redacted] (ref: SCIENCE 01039).

Participants

A total of 71 volunteer participants from a university in the UK completed the study. Eight participants (11%) at the debrief stage indicated suspicion that the sleep diagnosis procedure was not authentic or raised suspicions concerning the test more broadly and were excluded from the main analyses. The final sample consisted of 63 participants (43F, 20M). The mean age was 20.1 years (SD 3.8). A previous study of the effect of sleep misinformation on cognitive tasks (Draganich and Erdal, 2014) suggested that sleep misinformation exerted a large effect. Using this potential effect size, a power analysis (Faul *et al.*, 2007) suggested that 64 participants would be required for a study to have 80% power to detect a large effect ($f=0.4$, $\alpha=.05$) in an analysis of covariance involving two groups and one covariate.

Materials

The index of aggressive behaviour used here was the Tangrams Help/Hurt Task (THHT) (Saleem *et al.*, 2015), which has been used widely to assess helping (prosocial behaviour) and hurting (aggressive behaviour) (Kjærvik *et al.*, 2022). The original version of the task presented the participant with seven geometric puzzle pieces that could be selected and positioned to create larger figures. Participants were given 30 target figures clearly labelled in three categories of difficulty (10 easy, 10 medium, 10 hard) and asked to choose 11 figures for someone else to complete. Thus, the participant was in the position of acting in a helpful or harmful way towards another by choosing easy or hard target figures for them. The measure of helping/hurting is defined as the number of hard figures chosen (minus 1) subtracted from the number of easy figures chosen (minus 1), hereafter referred to as the tangrams 'difference' score where positive values indicate more helping than hurting (Saleem *et al.*, 2015). The task has been successfully administered in numerous studies (Kjærvik *et al.*, 2022) and meta-analysis suggests that the THHT correlates with prosociality and negatively with trait aggression (Saleem *et al.*, 2017). Importantly, experimental evidence

indicates that situational primes influence task scores (Saleem *et al.*, 2015, 2017). In our minor modification of the task, we followed Saleem's (2015) recommendations for improving the effectiveness of the THHT by including an opportunity for the participant to try to complete some of the target figures themselves and included in the cover story the idea that the fellow participant would win a prize if they completed all 11 target figures within 10 minutes.

Trait altruism was measured using the short form of the Self-Report Altruism scale (9-SRA) (Manzur and Olavarrieta, 2021). The scale has values that range 9-45 with higher scores indicating higher trait altruism and has acceptable reliability (Cronbach's $\alpha = 0.77$) and validity.

Self-reported sleep was measured using a single item as part of the basic demographics questionnaire used in the study. Participants rated the item, 'Last night, I slept…', on a 7-point scale from 'very poorly' to 'very well'.

Procedure

Participants responded to an advertisement asking for volunteers to take part in a study ostensibly concerning the influence of sleep quality on task performance and attended the research laboratory at an appointed time for the study session. They were given details of the cover story for the study, specifically that they would be asked to complete a set of short questionnaires, complete three puzzle tasks under timed conditions and finally undergo a sleep quality diagnosis procedure that would objectively measure the quality of their sleep during the previous night. It was explained that the diagnosis procedure was necessary because people's subjective perceptions of how well they have slept are quite often inaccurate. They then completed a short demographic questionnaire that also included a self-report sleep measure and the altruism scale. Following this, they were presented with the tangrams task and shown the set of 30 target figures that they could be asked to create with

the tangrams pieces. It was explained that they would be timed in their attempt to complete one target figure from each of the three categories of difficulty (easy, medium and hard) with a maximum time of two minutes for each puzzle figure. Target figures were presented in increasing order of difficulty and participants were timed in their attempt to solve each of the three puzzles. Participants were led to believe that their completion times would be the measure of task performance for the study. In reality, their attempts were not recorded as part of the data. Participants were asked to complete the three puzzles merely so that they could appreciate the difficulty of each level of puzzle, in line with recommendations from Saleem *et al*. (2015).

Following this, participants were asked to undergo a (bogus) sleep quality diagnosis procedure whereby a galvanic skin response monitor and digital finger pulse oximeter were attached to different fingers of the non-dominant hand. Participants were asked to relax and breathe normally while a sleep-related lexical decision task was presented on a 17-inch laptop. The experimenter explained that in this task, words would appear one at a time in the centre of the screen and the participant, using their dominant hand and responding as quickly as possible, should press one key if the word was a real word and another key if it was a nonsense word. Items remained on the screen until a keypress response. There were 60 items, organised into three blocks of 20 trials preceded by a 10-item practise block with a short break between blocks. During the task it would be apparent to the participant that some of the words were related to sleep (e.g., rest, tired, awake). Following the completion of the task, all monitors were removed from the participant, and the experimenter appeared to spend a few seconds conducting an analysis on the laptop, with the screen not visible to the participant. The experimenter then revealed that the procedure had diagnosed that last night the participant had either slept very well (“sleep quality in the top 25%”), or very poorly (“sleep

quality in the bottom 25%"). This had, in reality, been determined by prior random assignment.

At this point, which for the participant was ostensibly the end of the study, the experimenter casually asked the participant for a small favour. The experimenter explained that he was later going to collect data for a separate study involving the same tangrams task. In that study, someone would be asked to complete 11 tangram puzzles under time pressure and, if they were successful within 10 minutes, they would win a £10 prize. The experimenter was meant to have someone independent of the study to choose the target puzzle figures to be used and asked the participant if they would take a few seconds to choose 11 puzzles. The participant was presented again with the 30 target shapes, in three categories of 10 that were labelled easy, medium and hard, and asked to mark their choices. Following this, the participant was debriefed and asked about their views on the study, their experience of taking part and what they thought the aim of the study was. Through a funnel debriefing and discussion process (Boynton *et al.*, 2013), the experimenter assessed the participant's level of suspicion about the aim of the study and the authenticity of the sleep diagnosis procedure. Finally, the experimenter revealed the deception involved in the study and reconfirmed the participant's consent to taking part.

Results

Following the analytical approach set out by Saleem *et al*. (2015, 2017), we conducted preliminary correlation analyses to assess which variables should be entered into the main analysis. The alpha level was set at 0.05 and all analyses were conducted using SPSS v.31.

Table 1. Correlations and mean scores (standard deviation) for all measures

	gender	age	sleep rating	altruism	helping	hurting	mean (SD)
age	-.029						20.11 (3.33)
sleep rating	.107	.004					3.59 (1.20)
altruism	.179	-.107	.272*				24.38 (6.27)
helping	.103	-.011	-.035	.443***			3.89 (2.26)
hurting	-.063	-.100	.091	-.332**	-.809***		1.70 (1.64)
diff. score	.091	.037	-.062	.416***	.996***	-.934***	2.19 (3.71)

*p<.05, **p<.01, ***p<.001

Preliminary analyses

Overall, participants chose tangrams mostly from the easy category, M = 4.89, followed by the medium, M = 3.41, and hard categories, M = 2.70. For altruism scores, the 'slept well' (M = 24.97, SD = 6.80) and 'slept poorly' (M = 23.81, SD = 5.76) groups did not differ, $t(61) = -0.73$, $p = .47$. Similarly, there were no differences in the self-reported sleep rating between the 'slept well' (M = 3.45, SD = 1.15) and 'slept poorly' (M = 3.72, SD = 1.25) groups, $t(61) = -0.88$, $p = .38$. Mean scores, standard deviations, and correlations for all variables are provided in Table 1.

Figure 1. *Mean tangram difference score in 'slept well' and 'slept poorly' conditions. Note*. Bars indicate 95% confidence interval.

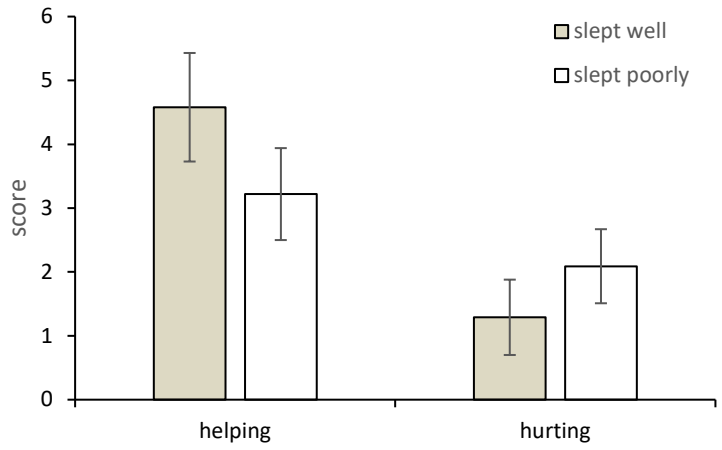

Figure 2. *Mean helpful and hurtful behaviour in the 'slept well' and 'slept poorly' conditions.*
*Note: Bars indicate 95% confident interval. *p < .05.*

As expected, the helping, hurting and overall difference scores were highly correlated because these factors are dependent on each other to varying degrees. Age and gender were unrelated to tangram scores and thus were omitted in further analyses. Interestingly, the single item self-reported sleep rating correlated positively with altruism scores, but as it did not relate to tangram scores, it was also omitted from further analyses. Altruism correlated with tangram helping, hurting and overall difference scores, all *p*s<.01, and was entered into the main analysis.

Main analysis

Tangrams difference scores were entered into a one-way (sleep misinformation: slept poorly/slept well) analysis of covariance (ANCOVA) with altruism as a covariate. This revealed a significant effect of sleep misinformation, $F(1,60) = 5.17$, $p = .027$, $d = 0.53$, $\eta_p^2 = .079$, with a medium effect (see Figure 1). Participants who were informed they had slept well, $M = 3.29$, $SD = 3.72$, were more helpful/less hurtful than those who were told they had

slept poorly, $M = 1.12$, $SD = 3.44$. Altruism was also positively associated with difference scores, $F(1,60) = 11.99$, $p < .001$, $b = 0.23$.

Separate helping and hurting scores

A further analysis assessed helping and hurting scores separately (see Figure 2). For helping scores, participants in the 'slept well' condition ($M = 4.58$, $SD = 2.32$) were more helpful than those in the 'slept poorly' condition ($M = 3.22$, $SD = 2.01$), $F(1,60) = 5.69$, $p = .020$, $d = 0.55$, $\eta_p^2 = .087$, with a medium effect. However, a different pattern emerged for the hurting scores where the 'slept well' (M = 1.29, SD = 1.62) and 'slept poorly' (M = 2.09, SD = 1.59) conditions did not differ significantly, $F(1,60) = 3.34$, $p = .073$, $d = 0.44$, $\eta_p^2 = .053$. Altruism was positively associated with helping scores, $F(1,60) = 14.16$, $p < .001$, $b = 0.15$, and negatively associated with hurting scores, $F(1,60) = 6.84$, $p = .011$, $b = -0.08$.

Discussion

This study investigated whether false feedback about sleep quality can shape aggression and prosocial behaviour, using choices in the THHT that are obstructive or helpful to others as a proxy for those constructs. In line with our predictions, participants who were told they had slept poorly were more aggressive/less prosocial than those who were told they had slept well. But closer analysis indicated that this effect was driven primarily by a reduction in prosocial behaviour rather than a meaningful increase in aggression. In other words, beliefs about sleep appeared to shift the balance between helping and harming. This pattern is supported by the CoSMASH model (Greenwood *et al.*, 2022) which emphasises the role of prosocial cognition and behavioural scripts, proposing how beliefs about poor sleep could potentially suppress a prosocial attribution bias. Building on findings by Draganich and Erdal (2014), who showed that sleep misinformation can impair cognitive performance, the

present results extend this effect into the domain of deliberate social behaviour. This supports the idea that social scripts (goal-directed actions) may be shaped by cognition, even when those cognitions are inaccurate (Huesmann, 2016).

These findings also potentially contribute to a growing body of research highlighting the importance of subjective sleep evaluations in predicting daytime functioning. Previous work has shown that perceived sleep quality, rather than objective sleep duration, predicts aggression and irritability (Freitag *et al.*, 2017) and influences interpersonal behaviour (Zong *et al.*, 2024). Given the weak correspondence between subjective and objective sleep measures (Harvey and Tang, 2012), individuals' appraisals of their sleep may act as psychological cues that influence mood and self-regulation. This interpretation, although speculative, is consistent with social cognition models of aggression, which emphasise how beliefs and appraisals shape emotional labelling and behavioural responses (Huesmann, 2016). The present study suggests that even brief, experimentally induced beliefs about poor sleep can alter social decision-making, reinforcing prior findings (Draganich and Erdal, 2014) and arguably supporting theoretical accounts linking sleep-related beliefs to behaviour (Greenwood *et al.*, 2022).

In terms of a potential neurobiological mechanism, Studler et al. (2024) found that increased slow-wave activity in the right temporo-parietal junction during sleep predicted stronger prosocial preferences, pointing to a neural link between restorative sleep and cooperation. Similarly, Sharon et al. (2024) reported that insufficient sleep impairs social cognition and reduces prosocial tendencies by altering emotional perception and decreasing sensitivity to others' needs. Complementing this, Palmer et al. (2023) demonstrated that even a single night of restricted sleep lowers motivation for social engagement and reduces feelings of gratitude. In this context, negative sleep feedback may temporarily disrupt

individuals' perceived readiness for social interaction, thereby diminishing their motivation to help others.

Importantly, the absence of a significant increase in hurtful behaviour suggests that beliefs about poor sleep may influence prosociality more readily than overt aggression. This pattern fits theoretical models proposing that sleep affects aggression through emotion regulation and cognitive control processes (Krizan and Herlache, 2016), while also potentially suppressing prosocial attribution biases (Greenwood *et al.*, 2022). Sleep disruption, whether real or perceived, has been shown to heighten amygdala reactivity and reduce prefrontal inhibitory control, biasing individuals toward negative interpretations (Satterfield *et al.*, 2019). Although reduced self-control is widely linked to increased aggression (Liu *et al.*, 2025), in non-provocative settings such as the THHT, these shifts may manifest more subtly as reduced empathy or helping behaviour rather than explicit aggression. This is certainly one potential interpretation speculatively suggested.

This distinction may also be explained by the nature of the experimental task. Many aggression paradigms rely on provocation or threat to elicit reactive aggression. In contrast, the THHT involves a neutral decision-making context in which participants allocate puzzles to another person without conflict or provocation. In such situations, the threshold for overtly aggressive behaviour may be relatively high, while prosocial actions may be more sensitive to internal states. If beliefs about poor sleep temporarily reduce social cognitive resources (e.g., empathy, regulatory capacity), the most observable outcome may be a reduction in helping rather than an increase in harming. This is certainly an area that future research could also explore.

Believing one has slept poorly may induce a subjective sense of fatigue, reduced self-regulation and this diminished capacity is likely to impair effortful, voluntary behaviours such as helping others. Supporting research shows that sleep disruption reduces empathy and

compassionate responding (Simon *et al.*, 2022). By contrast, the pathway from sleep loss to overt aggression often requires both impaired inhibitory control and an external trigger, such as provocation (Kamphuis *et al.*, 2014). Without such a trigger, the behavioural outcome may be characterised more by diminished prosocial engagement than by overt hostility.

The precise mechanism through which beliefs about sleep influence behaviour remains unclear. However, common expectations about sleep may play an important role. Many people believe that poor sleep leads to irritability, cognitive impairment, and poor judgement. These expectations could directly shape behaviour following negative sleep feedback. Alternatively, the effects may be mediated by reduced motivation or perceived capacity to engage socially. It remains to be seen if individuals who are less aware of the link between sleep and behaviour are less influenced by such misinformation and future research should explore the role of these expectancies in moderating the observed effects.

Several limitations should be noted. The sample consisted primarily of young, educated individuals, which may limit the generalisability of the findings (Henrich *et al.*, 2010) and it is possible that the level of education in this sample increased the likelihood that they were aware of the link between sleep and behaviour, potentially inflating the effect size. Future work should thus recruit a sample more representative of the general population. Also, while the groups did not differ in actual sleep, sleep was only measured with a coarse self-report rating and it is possible that the 'slept well' group had in reality slept better than the 'slept poorly' group. Thus future studies could also incorporate objective measures of sleep, such as actigraphy or EEG, to better distinguish between perceptual and neurobiological influences. Additionally, while we propose that misinformation about sleep may potentially affect perceived capacity, mood and/or social withdrawal (thus reducing prosociality), the present study did not measure these constructs. Future work could include measures of mood and self-control to provide further insight into how sleep perceptions influence behaviour

(Liu *et al.*, 2025). Finally, we did not find an effect of sleep misinformation on hurtful behaviour and, while this may be reassuring from a societal standpoint, it is possible that this may be an artefact of the THHT and specifically, the lack of provocation involved in the paradigm. Future research that uses an aggression paradigm involving provocation may reveal effects on hurtful behaviour that were not observed in the current non-provocative task.

The broad implication of the current work is that perceptions of sleep may be as influential to behaviour as actual sleep quality. That is, social behaviour may be influenced not only by biological sleep processes but also by what people subjectively believe about their sleep. This would suggest that sleep interventions should target sleep-related cognitions and beliefs, as well as sleep duration and efficiency. Furthermore, recent years have seen a growth in the popularity of wearable devices that claim to track sleep quality but the accuracy of such devices can vary widely between devices (e.g., Schyvens *et al.*, 2025) and between individuals (Herberger *et al.*, 2025). A wearable device that gives inaccurate reports of sleep quality (e.g., underestimating deep sleep) may exert undesirable consequences on the prosocial behaviour of the wearer, and there should be greater better awareness of these links. Finally, as alluded to previously, future research should focus on the mechanistic issues surrounding this effect, elaborating on the factors that may mediate the link between sleep perception and prosocial behaviour, potentially including specific measures of perceived self-control, emotion regulation and hostile attributions.

Conclusion

The current findings demonstrate that what individuals believe about their sleep can shape how they behave toward others, highlighting again a role for cognition as an important mechanism in understanding the link between perception and behaviour. False feedback that one slept poorly reduced helping behaviour without significantly increasing aggression,

suggesting that subjective sleep beliefs may influence the ‘warmth’ rather than the ‘hostility’ dimension of social interaction. This underscores the broader psychological insight that perceptions of one’s internal states, rather than mere physiological reality, guide social cognition.

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