

## Social Psychology

# Sleep Deprivation and Negotiation

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In a series of five studies, we examined the effects of sleep deprivation on negotiation outcomes. In three experiments (total  $N = 398$ ), sleep-deprived dyads versus dyads with regular sleep participated in (Studies 1 and 2) or observed (Study 3) an integrative negotiation. In all three studies, we found no evidence that sleep deprivation reduces the quality of agreements in terms of joint economic outcomes. A Bayesian meta-analysis across studies supported this finding. These findings contradict our theoretical prediction and also laypersons' expectations (Study 4). However, we found first evidence for compensatory effort in sleep-deprived individuals that could account for the absence of the expected effect. We conducted qualitative interviews with 22 German elected politicians (including heads of state and federal ministers; Study 5). Their responses shed light on the nature of compensatory strategies to cope with sleep deprivation in real-life negotiations.

Sleep deprivation (SD) affects human interactions (cf. Hafner et al., 2017) and possibly also negotiations. Negotiations are crucial in private, business, and political domains (De Dreu & Gelfand, 2008). They are at times prolonged late into the night until an agreement is reached or an impasse is inevitable. There is robust evidence that SD negatively affects cognitive performance, e.g., working memory and complex decision-making (cf. Alhola & Polo-Kantola, 2007; Harrison & Horne, 2000) and motivation (Engle-Friedman, 2014; Mathew et al., 2021) with more severe decrements resulting from prolonged wakefulness (Lim & Dinges, 2010; Philibert, 2005). The question whether SD also negatively impacts the quality of interactive decisions such as negotiation outcomes has been addressed in a recent theoretical model (Häusser et al., 2022). Since empirical evidence is yet lacking, we aim to test the model's key prediction that SD impairs joint economic outcomes of negotiations.

There is growing theoretical interest in potential impairments due to SD in social contexts (e.g., Faber et al., 2017; Gordon et al., 2021; Sattler et al., 2023), and first pertinent empirical investigations have been conducted (e.g., Anderson & Dickinson, 2010; Dickinson et al., 2022). With the first empirical examinations of how SD affects negotiations, our studies contribute to the literature in both fields, sleep, and negotiation research. Regarding sleep research, our re-

search provides insights into the—yet understudied—*social* effects of sleep, and broadly contributes to the discussion around how individual-level impairments play out in social contexts (Faber et al., 2017; Faber & Häusser, 2022; Sattler et al., 2023). Regarding negotiation research, by assessing a possible effect of SD as highly prevalent context factor of high-stakes negotiations (e.g., political summits, labour negotiations), further insights are gained into the determinants of successful negotiation.

### Integrative negotiations

Negotiations are social interactions, in which different parties seek to find an agreement concerning a conflict of interests (Pruitt, 1983; Pruitt & Carnevale, 1993). A broad distinction is typically made between distributive and integrative negotiations (Walton & McKersie, 1965). In distributive negotiations, one party's gain corresponds to an equivalent loss of the other party (i.e., zero-sum situations). In integrative negotiations, in contrast, the interests of both parties can be partly reconciled (i.e., variable-sum situations). Negotiators can systematically exchange concessions when they have different priorities related to negotiation issues (i.e., *log-rolling*, Froman & Cohen, 1970; L. L. Thompson & Hastie, 1990) or when they identify issues with compatible preferences (L. L. Thompson & Hrebec, 1996). By recognizing differing priorities or full com-

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patibility on negotiation issues and applying this insight appropriately, negotiators can increase the *joint economic outcomes (JO)* (i.e., the mutual “payoff” resulting from the agreement) beyond mere compromises (i.e., using the *integrative potential*, Walton & McKersie, 1965).

Most negotiations comprise at least some integrative potential (Raiffa, 1982; L. L. Thompson & Hastie, 1990). JO are therefore an important indicator of the agreement’s overall quality. To identify the integrative potential and to utilize strategies such as log-rolling, a correct understanding of the partner’s priorities and preferences is crucial. This can be obtained by directly exchanging interest-related information (Hüffmeier et al., 2019; L. L. Thompson, 1991). Alternatively, negotiators can make and respond to offers more unsystematically using a heuristic *trial-and-error* approach to infer their partner’s priorities and preferences (Pruitt & Lewis, 1975). For instance, a negotiator’s reluctance to concede on an issue may reveal its importance to them. Both the interest-related and the trial-and-error routes, underline the importance of information exchange and processing to enable strategic issue trade-offs (Froman & Cohen, 1970) and compatibility (L. L. Thompson & Hrebek, 1996), which are crucial to unlock the integrative potential and increase JO (L. L. Thompson, 1991; Zerres et al., 2013).

### How SD Should Affect Negotiations

SD refers to a state of insufficient sleep typically extending beyond 24 hours of wakefulness (cf. Ben-Simon et al., 2020; Reynolds & Banks, 2010). However, chronically restricted sleep over several days results in cumulative deficits akin to total SD (Van Dongen, Maislin, et al., 2003). SD impairs diverse domains of cognitive functioning (for a review, see Alhola & Polo-Kantola, 2007) and motivation (for a review, see Engle-Friedman, 2014), both critical for negotiation outcomes (De Dreu et al., 2000; Neale & Bazerman, 1992).

In the domain of cognitive functioning, there is consistent empirical evidence that SD impairs processes such as vigilance, attention, and working memory capacity (Harrison & Horne, 2000; Lim & Dinges, 2010; Wickens et al., 2015), information updating (Harrison & Horne, 1999, 2000), as well as the ability to adopt strategies when facing new contingencies (*cognitive flexibility*; cf. Frings, 2011; Horne, 1988; Luchins, 1942; Whitney et al., 2015). Negotiations require processing of extensive verbal and non-verbal information (Bazerman et al., 1999; De Dreu et al., 2006) and demand sufficient cognitive capacities for systematic exchange and processing of information to reach better negotiation outcomes (Fulmer & Barry, 2004; Sharma et al., 2013). Moreover, impaired information updating and reduced cognitive flexibility due to SD may contribute to the persistence of biases such as perceiving both parties’ interests as completely incompatible (*fixed-pie perception*, cf. De Dreu & Carnevale, 2003; L. L. Thompson & Hastie, 1990). Taken together, sleep-deprived negotiators should be less effective in exchanging and processing information, less likely to correctly infer the negotiation partners’ interests,

and ultimately less successful in unlocking the integrative potential.

As dual-process models (e.g., Petty & Wegener, 1999) highlight the necessity of skill (cognitive resources) and will (motivation) for systematic information processing, motivation should also matter in reaching successful agreements. SD generally reduces the willingness to process complex information (Engle-Friedman, 2014; Mathew et al., 2021), but particularly, SD could impair negotiators’ willingness to exert effort to obtain an accurate and comprehensive understanding of a situation (*epistemic motivation*; De Dreu et al., 2008; see also Webster et al., 1996). Earlier research consistently demonstrated that unlocking a negotiation’s full integrative potential requires high levels of epistemic motivation (Brett & Thompson, 2016; De Dreu et al., 2008) with high epistemic motivation being linked to higher JOs (Ten Velden et al., 2010) and low epistemic motivation to the use of sub-optimal heuristics (De Dreu et al., 1999). Consequently, SD’s negative impact on epistemic motivation could limit negotiators’ capacity to fully explore and utilize the integrative potential, resulting in suboptimal agreements.

Thus, we put forward the following hypothesis: *Sleep-deprived dyads, as compared to dyads with regular sleep, will achieve lower joint economic outcomes in integrative negotiations.*

### Present Research

To test our hypothesis, we conducted three experimental studies (the latter two were pre-registered). The first two laboratory experiments involved dyads in integrative negotiation under conditions of SD or regular sleep. Both studies revealed an absence of the expected medium-sized effects and suggested compensatory efforts. To test whether the results may be attributable to the activating laboratory setting, we conducted an online experiment (Study 3) where participants passively observed a video-taped negotiation, proposing an agreement, and again found no effect and further indications of compensatory effort. We then conducted an online survey (Study 4) to explore whether lay persons expect a negative impact of SD since this anticipation could trigger compensatory efforts and further explain the findings. In an additional qualitative study (Study 5), we conducted semi-structured interviews with politicians to gain insights into compensatory strategies.

In all studies, we report how we determined sample sizes, all data/ participant exclusions, manipulations, and exclusion of measurements. Data were analyzed using IBM SPSS for Windows. We provide the data, syntax, and codebook for the empirical studies on OSF ([https://osf.io/47agt/?view\\_only=caef24094e924bba9eb5abbc48e0df6a](https://osf.io/47agt/?view_only=caef24094e924bba9eb5abbc48e0df6a)), study material on request.

## Study 1

### Method Study 1

#### Participants and Design

Study 1 provides a first-time test of the effects of SD in negotiations by testing the impact of one night of total SD on JOs in an integrative negotiation. We included participants who were not working night shifts, not diagnosed with sleep disorders or depression, not using sleep-inducing medication, and not being pregnant (cf. Horne, 1988). We excluded eight dyads because of violations of the experimental protocol (e.g., caffeine intake, day-time napping), resulting in a final sample of  $N = 80$  participants (40 dyads,  $M_{\text{age}} = 22.15$  years,  $SD_{\text{age}} = 3.09$ ; 18-31 years; 75% women). We determined our sample size a priori to be able to detect a large effect ( $d = .8$ ) with  $\alpha = .05$  and a  $1 - \beta = .8$  (G\*Power, Faul et al., 2007). Participants were randomly assigned to one of two *sleep status* conditions. All undergraduate participants were recruited via email and randomly paired into same-sex dyads to control for gender effects (Mazei et al., 2015). The study adhered to the Declaration of Helsinki and was approved by the local ethics board (Department of Psychology and Sport Science, University of Giessen, 2016-0026). Participants gave informed consent, were debriefed, and received course credit for participation.

#### Procedure

Upon arrival for testing at 9 AM, participants completed questionnaires on compliance with instructions and their subjective tiredness. Afterward, they were randomly paired and worked on a negotiation task. The negotiators faced each other at tables with shoulder-high screens concealing negotiation material from one another. Participants had ten minutes to prepare and 20 min to negotiate an agreement for all issues.

**Sleep Deprivation.** We modified the sleep manipulation protocol from Barnes and colleagues (2015) to increase control. Participants in the control condition were instructed to get at least 6 hours of sleep at home, while those in the sleep-deprived condition spent the night awake. The latter received hourly emails from 11 PM to 8 AM with links to short questionnaires, which had to be completed within 15 min to remain eligible for the study. Participants were instructed not to consume caffeine and other stimulants. Self-reports confirmed total SD for the experimental group and an average of seven hours of sleep for the control group.

**Negotiation Task.** We adapted a car sale negotiation task from Thompson and Hastie (1990). Participants received role-specific payoff schedules which involved four issues with five options each (see [Table 1](#)). The task featured two distributive issues, for which one party's gain was equivalent to the other's loss (i.e., zero-sum issues), and two pair-wise integrative issues, where one party's gain was higher than the other's loss for one issue and vice versa for

the other. The JO of an agreement could range from 8000 (minimum) and 12,800 points (optimum).

#### Measures

**Manipulation Check.** We asked participants to indicate subjective tiredness on a 10-point scale, from '1 = not at all tired' to '10 = very tired' prior to negotiating.

**Joint Economic Outcomes (Dependent Variable).** Based on the individual pay-off schedules, the JO was calculated as the sum of both parties' individual outcomes for the final agreement.

**Exploratory Measures.** We also measured energetic arousal using the *Multidimensional Mood Questionnaire* (MDMQ; Wilhelm & Schoebi, 2007), which was measured with two items on a 7-point scale, from '0 = very tired' to '6 = very awake' and '0 = full of energy' to '6 = without energy' (reverse coded) before ( $r = .717, p < .001$ ) and after ( $r = .604, p < .001$ ) the negotiation.

#### Results

##### Manipulation check

SD participants ( $M = 7.41; SD = 1.89$ ) were significantly more tired than participants in the control group ( $M = 4.80; SD = 1.62$ ),  $t(77) = 6.60, p < .001, d = 1.49, 95\% \text{ CI } [.98, 1.98]$  prior to the negotiation, indicating a successful manipulation.

##### Joint Economic Outcome

To test our hypothesis, we analyzed differences in JO between SD versus control group using an independent  $t$ -test. Results showed that dyads in the control group ( $M = 11,480; SD = 883.5$ ) did not realize higher JO as compared to SD dyads ( $M = 11,780; SD = 756.4$ ),  $t(38) = -1.15, p = .256, d = -.37, 95\% \text{ CI } [-.99, .26]$ . Thus, our hypothesis was not supported. Additional  $t$ -tests revealed that the JO of the control condition,  $t(19) = -6.68, p < .001, d = -1.49, 95\% \text{ CI } [-2.13, -.84]$ , and the SD condition,  $t(19) = -6.03, p < .001, d = -1.35, 95\% \text{ CI } [-1.95, -.73]$  were significantly below the maximum JO (12,800 points), indicating that ceiling effects are unlikely.

**Exploratory Measures.** A repeated-measures ANOVA with condition as a between-subjects factor (control vs. SD) and energetic arousal as a within-subjects factor (before vs. after negotiation) found a significant interaction,  $F(1,76) = 6.39, p = .014, \eta_p^2 = .08$ . Dependent  $t$ -tests of the simple effects verified that energetic arousal increased during the negotiation for the SD group,  $t(37) = -4.14, p < .001, d = -.67, 95\% \text{ CI } [-1.02, -.32]$ , but not for the control group,  $t(39) = -1.70, p = .097, d = -.27, 95\% \text{ CI } [-.58, .05]$ .

#### Discussion Study 1

Study 1 provides a first-time test of the impact of SD on negotiation agreement quality and revealed no (strong) effect, thus not supporting our hypothesis. Given this was the first test, we conducted Study 2 with crucial modifications: We increased sample size, we used a more rigorous manip-

**Table 1. Summary Chart for the Negotiation Task of Study 1**

Issue	Option	Buyer payoff	Seller payoff	Joint outcome	Type of issue
Interest	2%	1600	0	1600	Log-Rolling
	4%	1200	1000	2200	
	6%	800	2000	2800	
	8%	400	3000	3400	
	<b>10%</b>	<b>0</b>	<b>4000</b>	<b>4000</b>	
Stereo system	Type A	0	2400	2400	Distributive
	Type B	600	1800	2400	
	<b>Type C</b>	<b>1200</b>	<b>1200</b>	<b>2400</b>	
	Type D	1800	600	2400	
	Type E	2400	0	2400	
Warranty	6 month	0	1600	1600	Log-Rolling
	12 month	1000	1200	2200	
	18 month	2000	800	2800	
	24 month	3000	400	3400	
	<b>30 month</b>	<b>4000</b>	<b>0</b>	<b>4000</b>	
Delivery	1 week	2400	0	2400	Distributive
	2 weeks	1800	600	2400	
	<b>3 weeks</b>	<b>1200</b>	<b>1200</b>	<b>2400</b>	
	4 weeks	600	1800	2400	
	5 weeks	0	2400	2400	

Note. This table shows the payoff schedule for each role and the joint economic outcome by issues and options. The joint economic outcome is determined by summing the number of points (individual outcomes) of both negotiators. The total joint economic outcome (dependent variable) is calculated as the sum of the joint outcomes of each option they agreed upon. Bold options indicate the optimal solution.

ulation of SD ensuring full control over compliance, and a more complex negotiation task.

In Study 1, we observed an increase in energetic arousal during negotiation for the SD group (but not the control group). Fatigued individuals are known to be able to identify poor performance and attention lapses (Baranski, 2007; Dorrian et al., 2000), prompting them to exert additional effort and adopt strategies to counteract impairments (Engle-Friedman, 2014; Pilcher & Walters, 1997; Rogers et al., 2003). Hence, in Study 2 we additionally explored indicators of compensatory effort—a concept supported by literature on overcoming psycho-physiological deficits in social contexts (Faber & Häusser, 2022). Despite evidence linking SD to individual cognitive and motivational impairments affecting performance, individual-level impairments may not directly translate to social contexts, because individuals may invest effort to compensate for impairments to meet social demands (e.g., fulfilling expectations or social norms; cf. Faber et al., 2017 for a discussion).

## Study 2

In Study 2, we increased power ( $N = 174$ ) to be able to detect at least medium-sized effects. Participants underwent SD in our laboratory, ensuring adherence to the experimental protocol. Additionally, we used a more complex negotiation task (Moran et al., 2008) and included a measure of compensatory effort to clarify potential null findings. The preregistration of Study 2 ([https://osf.io/x8mgi/?view\\_only=271656baf6f647c0a49d78e1fc4a9cbf](https://osf.io/x8mgi/?view_only=271656baf6f647c0a49d78e1fc4a9cbf))

includes the study design, planned sample size, inclusion criteria, and planned primary analyses. Additionally, we preregistered four mediation hypotheses. We do not report these analyses due to the absence of a significant total effect and our focus on the main effect in this manuscript. We collected further data for student projects which are beyond the scope of the present paper.

## Method Study 2

### Participants and Design

One-hundred-and-eighty-two participants who did meet our participation criteria took part in the study. The exclusion criteria were: Sleep or psychological disorders, sleep-inducing substance intake, being parent of small child(ren), pregnancy, nightshifts, age limits (below 18 or above 40), non-native German speaker, considering oneself as an extreme morning or evening type, heavy smoker, habitual caffeine consumption  $> 2$  cups/day, psychology students,  $>$  one-hour jet-lag in the last 7 days, and long travel times to the lab (cf. Horne, 1988; Swann et al., 2006). We had to exclude four dyads for not being fluent in German and violating instructions, which resulted in 174 participants in the final sample (87 dyads,  $M_{\text{age}} = 23.73$  years,  $SD_{\text{age}} = 3.27$ ; 18–39 years; 60.9 % women). Ninety-five percent were students. The sample size was calculated to sufficiently detect medium effects ( $d = .6$ ) for the difference in JO between

conditions with  $\alpha = .05$  and  $1-\beta = .8$  (G\*Power, Faul et al., 2007). As in Study 1, we used a one-factorial experimental design with the between-subjects factor *sleep status*. Participants were randomly assigned to conditions, dyads, and roles. To control for potential gender effects (Mazei et al., 2015) we used same-sex dyads and balanced gender across conditions. The study adhered to the Declaration of Helsinki and was approved by the local ethics board (Department of Psychology and Sport Science, University of Giessen, 2017-0027). Participants provided informed consent, were debriefed, and received €30 for participation and additional €50 in the experimental condition.

### Procedure

Four days before testing, participants were briefed on protocols and were provided with sleep diaries and activity monitors (ActiGraph). Testing began at 10 AM in rooms with completely shielded windows. Participants sat at separate tables with privacy screens and initially watched a 30-minute documentary about underwater sea life on 17-inch laptops to mitigate arousal accompanying commuting and test initiation. They were asked to indicate their tiredness. Dyads negotiated in separate rooms, sitting face-to-face with shoulder-high screens between them. They had 15 minutes to prepare and 30 min to negotiate. Finally, participants reported their subjective tiredness for a second time.

**Sleep Deprivation.** To achieve at least 26 hours of total SD, we followed an experimental procedure similar to Häusser et al. (2016, see also Harrison & Horne, 1999). Participants in the SD condition woke up at 8 AM the day before testing and arrived at the laboratory by 10 PM, where they stayed awake all night at private tables under the supervision of two research assistants without sleeping, interacting, or consuming caffeine or other stimulants. Activities like watching movies or reading were allowed. Two group walks were scheduled at 2 AM and 6 AM without interacting or talking. Non-caffeinated beverages and snacks were available ad-lib, and breakfast was provided at 8:30 AM the next day. Testing began at 10 AM. Control group participants were instructed to spend a night of normal sleep at home, wake up at 8 AM, and appear at the laboratory at 10 AM.

**Negotiation Task.** The integrative task simulating a negotiation on a residential community development project was adopted from Hüffmeier et al. (2019, Negotiation 3; see also Moran et al., 2008). It varied from the task in Study 1 in complexity and structure as negotiators had to engage in different value-creating strategies beyond log-rolling to unlock the integrative potential. Participants had to find an agreement for six issues: One distributive issue, two log-rolling issues, one issue with different expectations about a future event (contingent contract), one issue involving different time preferences, and one compatible issue (see Table 2), plus an optional seventh issue that allowed for creating more value. The JO ranged between € -450,000 (minimum) to € 150,000 (optimum).

### Measures

**Manipulation and Compliance Check.** Four days before the experimental session, participants were equipped with activity monitors (ActiGraph® wGT3X-BT) and sleep diaries to ensure adherence to the experimental protocol and to record sleep data. The activity patterns were translated into indicators of sleep duration (Sadeh et al., 1994; Tryon, 2004). Subjective tiredness was measured as in Study 1, and again post-negotiation to test trajectories of tiredness. Additionally, participants rated how much tiredness affected their ability to perform the task using a 7-point scale from 'not at all' to 'very much'.

**Joint Economic Outcomes (Dependent Variable).** JO was calculated as the sum of both parties' individual outcomes in Euro for the final agreement.

**Compensatory Effort.** We measured the individual effort to compensate for performance losses due to SD with two items on a 7-point scale from 'not at all' to 'very much': (1) "How hard did you try to fight tiredness and stay awake during the task?" (2) "How hard did you try to stay focused during the task?" ( $r = .584, p < .001$ ).

### Results

#### Induction of SD

Using activity monitor data, we computed that participants slept an average of 7 hours and 3 minutes ( $SD = 70.56$  min) nightly over three days before testing. The control group slept 6 hours and 46 min ( $SD = 85.88$  min) on average the night before testing. SD individuals reported higher subjective tiredness before negotiations ( $M = 7.28, SD = 2.15$ ) than control group participants ( $M = 4.00, SD = 1.79$ ),  $t(171) = 10.91, p < .001, d = 1.66, 95\% CI [-2.00, -1.31]$ . A mixed ANOVA with sleep status (SD vs. control condition) as between-subject factors and subjective tiredness (pre- vs. post-negotiation) as a within-factor only revealed a significant main effect for sleep status on tiredness: The control group reported lower tiredness ( $M = 3.77, SD = .21$ ) than SD participants ( $M = 6.98, SD = .20$ ),  $F(1,171) = 124.59, p < .001, \eta_p^2 = .42$ . Additionally, tiredness decreased from before ( $M = 5.64, SD = .15$ ) to after ( $M = 5.12, SD = .18$ ) the negotiation,  $F(1,171) = 11.13, p = .001, \eta_p^2 = .06$ , but the interaction was not significant,  $F(1,171) = .23, p = .631, \eta_p^2 = .001$ . The subjective impairment due to tiredness was also higher for SD individuals ( $M = 5.23, SD = 1.34$ ) than for individuals in the control group ( $M = 2.19, SD = 1.35$ ),  $t(172) = 14.93, p < .001, d = 2.26, 95\% CI [1.88, 2.64]$ . Thus, our experimental manipulation was successful.

#### Joint Economic Outcome

All dyads reached an overall agreement. For the partial impasses of two dyads (i.e., no agreement for one issue), the sample's lowest value was imputed. Dyads in the control condition ( $M = -31,325.58; SD = 78,373.87$ ) did not significantly outperform SD dyads ( $M = -38,863.64; SD = 112,770.94$ ),  $t(76,80) = .36, p = .718, d = .08, 95\% CI [-.34, .50]$ . Another  $t$ -test revealed that the JOs of the control

**Table 2. Summary Chart for the Negotiation Task of Study 2**

Issue	Option	Real estate developer	City council	Joint Outcome	Type of issue
a) Amount of city council financing	Non	0 €	0 €	0 €	Distributive
	<b>Small</b>	<b>250.000 €</b>	<b>-250.000 €</b>	<b>0 €</b>	
	Large	500.000 €	-500.000 €	0 €	
b) Developing of a park	<b>Real estate developer</b>	<b>-100.000 €</b>	<b>0 €</b>	<b>-100.000 €</b>	Log-Rolling
	Real estate developer and city council	-50.000 €	-100.000 €	-150.000 €	
	City council	0 €	-200.000 €	-200.000 €	
c) Sewage tank		Role-specific expectation			Contingent Contract
		Price decreases	Price increases		
	Buy now	-400.000 €	-400.000 €		
	<b>Wait</b>	<b>-350.000 €</b>	<b>-450.000 €</b>		
d) Developing of a parking lot	Real estate developer	-200.000 €	0 €	-200.000 €	Log-Rolling
	Real estate developer and city council	-100.000 €	-50.000 €	-150.000 €	
	<b>City council</b>	<b>0 €</b>	<b>-100.000 €</b>	<b>-100.000 €</b>	
e) Dividing incomes from a sports club	Income to divide each year: € 250.000				Time-related trade of
	Tax year 1	0%	40%		
	Tax year 2	40%	40%		
	Tax year 3	40%	40%		
f) Duration of contract	8 years	0 €	-50.000 €	-50.000 €	Compatible
	9 years	25.000 €	-25.000 €	0 €	
	<b>10 years</b>	<b>50.000 €</b>	<b>0 €</b>	<b>50.000 €</b>	
g) Property	<b>Included</b>			<b>100.000 €</b>	Additional issue
	not included			0 €	

Note. This table shows the payoff schedule for each role and the joint economic outcome by issues and options. The joint economic outcome is determined by summing the number of points (individual outcomes) of both negotiators. The total joint economic outcome (dependent variable) is calculated as the sum of the joint outcomes of each option they agreed upon. Bold options indicate the optimal solution (except for Issue e).

( $t(42) = -15.17, p < .001, d = -2.31, 95\% \text{ CI} [-2.89, -1.73]$ ) and the SD condition ( $t(43) = -11.11, p < .001, d = -1.68, 95\% \text{ CI} [-2.13, -1.21]$ ) were significantly below the maximal outcome (150,000), excluding a possible ceiling effect.

### Compensation

Additional analyses exploring compensatory effort showed that SD dyads finished negotiations faster ( $M = 20.61 \text{ min}; SD = 5.83$ ) than the control group ( $M = 24.02 \text{ min}; SD = 5.76$ ),  $t(85) = 2.74, p = .007, d = .59, 95\% \text{ CI} [.16, 1.02]$ , suggesting potentially more focused discussions and increased effort. An independent  $t$ -test further revealed that SD participants reported higher compensatory effort in terms of fighting tiredness and trying to maintain focus ( $M = 4.81, SD = 1.53$ ) as compared to the control group ( $M = 3.02, SD = 1.59$ ),  $t(172) = 7.55, p < .001, d = 1.15, 95\% \text{ CI} [.82, 1.47]$ .

### Discussion Study 2

Replicating the finding of Study 1, we find no support for our hypothesis that SD does impair JOs in integrative negotiations to any significant extent (in terms of at least medium-sized effects), despite our successful manipulation. The absence of a (medium) effect of SD could stem from successful efforts to compensate for tiredness, as suggested by self-report measures. An alternative explanation for our findings could be that SD participants were activated by engaging in the interactive face-to-face negotiation, indicated by higher subjective tiredness before than after the negotiation in Study 2 (in both conditions). Taking this into account, we conducted an online study where participants passively observed a video-taped negotiation alone at home, to exclude activation due to interaction. During this negotiation, the negotiators revealed all their priorities and preferences. After watching the video, participants had to suggest an agreement. If the null effects in Studies 1 and 2 stemmed from the activation due to the interactive setting, the hypothesized effect should emerge. In addition, we used a different SD approach to further gener-

alize our findings beyond total SD by manipulating chronic sleep restriction and so-called “sleep debt” (Van Dongen, Rogers, et al., 2003).

### Study 3

We reduced sleep to 50% of the participant’s average bedtime over two nights before the study (Swann et al., 2006). Participants watched a video of an integrative negotiation and proposed an agreement. The preregistration of Study 3 ([https://osf.io/u8paj/?view\\_only=480750a3a1034fe9a9b07ac0deb01f52](https://osf.io/u8paj/?view_only=480750a3a1034fe9a9b07ac0deb01f52)) includes the study design, planned sample size, inclusion criteria, and planned primary analyses. Additionally, we preregistered three mediation hypotheses. We do not report these analyses due to the absence of a significant total effect and our focus on the main effect in this manuscript. We collected further data for student projects which are beyond the scope of the paper.

### Method Study 3

#### Participants and Design

Three hundred eighty-eight pre-screened participants were eligible to participate in our preregistered study (exclusion criteria, see Study 2). After a 7-day sleep protocol with 246 participants, we excluded 22 persons whose average sleep was less than seven or more than nine hours (see Swann et al., 2006). From the qualified sample, we invited randomly selected participants for the main study. From 156 participants we excluded 12 for violating the scheduled bedtimes ( $n = 4$ ) for daytime napping ( $n = 8$ ). Even though the final sample of 144 undergraduate students ( $M_{\text{age}} = 22.85$  years,  $SD_{\text{age}} = 2.85$ ; 18–36 years; 83.3% women) is slightly below the preregistered target of 150, the sample was still sufficient to detect small to medium effects ( $d = .4$ ) for the critical test of the effect of SD on the quality of proposed agreements between the experimental conditions with  $\alpha = .05$  and  $1 - \beta = .8$  (G\*Power, Faul et al., 2007). We used a one-factorial experimental design with the between-subjects factor *sleep status*. The study adhered to the Declaration of Helsinki and received local ethics approval (Department of Psychology and Sport Science, University of Giessen, 2020-0046). Participants provided informed consent and received €20 plus an additional €20 for sleep-restricted participants (or course credit).

#### Procedure

Participants were recruited via email and within two weeks after finishing an online sleep diary for baseline assessment, randomly selected and assigned to either control or experimental condition (see below). On testing day, which started at 7 PM, participants were not allowed to consume any caffeine or other stimulants after 1 PM. After indicating their current tiredness, participants were instructed to review the negotiation material. Then, they watched a 15-min negotiation video, in which two negotiators discussed all negotiation issues. The video stopped

before an agreement was reached. Participants received a table displaying the negotiation issues and the related options and were asked to propose an agreement by choosing those options for each negotiation issue that they believed would yield the highest JO. Finally, they were asked to indicate their subjective tiredness for a second time and whether they made efforts to compensate for tiredness and to perform well.

**Sleep Deprivation.** To restrict sleep participants’ habitual sleep to 50% for two nights, we adopted Swann and colleagues’ (2006) procedure, who found impaired psychomotor performance after reducing participants’ sleep to 60%. For baseline assessment, participants recorded their bedtimes, sleep onset, wake-up times, and daytime napping (duration in min) for one week. Participants in the control condition were given their average bed- and wake-up time from the baseline assessment. They were instructed to follow these times for two nights and record them in a sleep diary. Sleep-restricted participants were required to reduce bedtimes to 50% for two nights before the testing, by going to bed later by 25% of the individual sleep duration and waking up earlier by 25% of the individual sleep duration, as calculated from the baseline assessment. Text message reminders 30 min before bed and at wake-up time had to be replied to.

**Negotiation Video.** The video showed a negotiation on the construction of a thermal cracking system (cf. Hüffmeier et al., 2019, Negotiation 1; see also L. Thompson et al., 1996) between two male negotiators. The negotiation consisted of two distributive issues, four log-rolling issues, and two compatible issues (see Table 3). The trained negotiators exchanged the preferred option for each issue as well as their priorities between issues, without settling on an agreement. Two videos were pretested with pilot participants ( $N = 60$ ,  $M = 24.50$  years,  $SD = 4.09$ , 70% women) and we selected the video, for which participants could better identify the correct interests.

#### Measures

**Manipulation and Compliance Check.** As in Study 2, we measured subjective tiredness before and after the task and asked the participants how much it affected their ability to perform the task.

**Joint Economic Outcome.** To propose an agreement, participants chose the one option for each negotiation issue that they deemed optimal for maximizing the JO. We calculated the absolute difference between the selected option and the optimal option for each issue. For example, choosing option 3 for issue 2 when option 5 was optimal resulted in a difference score of 2 for this issue. The possible range of deviations from optimal options for all integrative and compatible issues was 0–4. The score for distributive issues ranged from 0–2 because distributive issues are fixed-sum and deviations from the middle option reduce fairness, but not JO. The sum of all difference scores served as our dependent variable (see Kappes et al., 2020, for similar procedures), with a range of 0–28 with 0 representing the optimal solution.

Table 3. Summary Chart for the Negotiation Task of Study 3

Issue	#	Option	Seller (Pollmann GmbH)	Buyer (Petro Star Inc.)	Type of issue
Price	1	7.500.000 €	0	<b>2400</b>	distributive
	2	7.600.000 €	600	1800	
	3	<b>7.700.000 €</b>	1200	1200	
	4	7.800.000 €	1800	600	
	5	7.900.000 €	<b>2400</b>	0	
Payment conditions	1	0 / 0 / 100 (% at time of contract / on delivery / after acceptance)	0	<b>800</b>	integrative
	2	0 / 50 / 50	800	600	
	3	10 / 30 / 60	1600	400	
	4	10 / 40 / 50	2400	200	
	5	<b>30 / 30 / 40</b>	<b>3200</b>	0	
Date of delivery	1	<b>October 15</b>	0	<b>4000</b>	integrative
	2	October 29	400	3000	
	3	November 12	800	2000	
	4	November 26	1200	1000	
	5	December 10	<b>1600</b>	0	
Number of companies from Oman participating in the installation of pumps	1	0%	0	0	compatible
	2	25%	300	300	
	3	50%	600	600	
	4	75%	900	900	
	5	<b>100%</b>	<b>1200</b>	<b>1200</b>	
Transfer of risk and shipping costs	1	Pollmann takes over risk and costs up to the construction site (CIP Yibal)	-6000	<b>0</b>	distributive
	2	Transfer at the port of destination in Oman (CIF Mina al-Fahal)	-4500	-1500	
	3	<b>Transfer at the port of exchange in Alexandria (CFR Mina al-Fahal)</b>	-3000	-3000	
	4	Transfer when loading onto the ship in Genoa (FOB Genoa)	-1500	-4500	
	5	PetroStar takes over risk and costs ex Pollmann plant in Germany (EXW)	<b>0</b>	-6000	
Included inspections	1	4 inspections included	0	<b>1600</b>	integrative
	2	3 inspections included	1000	1200	
	3	2 inspections included	2000	800	
	4	1 inspections included	3000	400	
	5	<b>No inspections included</b>	<b>4000</b>	0	
Maintenance agreement	1	<b>24 month</b>	0	<b>3200</b>	integrative
	2	18 month	200	2400	
	3	12 month	400	1600	
	4	6 month	600	800	
	5	No maintenance included	<b>800</b>	0	
Supplier of connection pipes	1	Tuyanterie Francois Marchand SA (France)	-2400	-2400	compatible
	2	Smithson Pipe Systems Inc. (USA)	-1800	-1800	
	3	Tubos Rocco Roletti SA (Italy)	-1200	-1200	
	4	Rohrsysteme Vulkan GmbH (Germany)	-600	-600	
	5	<b>MacCogan Pipes PLC (UK)</b>	<b>0</b>	<b>0</b>	

Note. This table shows the payoff schedule for each role by issues and options. The joint outcome (DV) is determined by summing the differences between the proposed option (1-5) and the optimal option for all issues. Bold options indicate the optimal solution.

**Compensatory Effort.** Effort to stay focused and to fight tiredness was measured with the same items as in Study 2 ( $r = .301, p < .001$ ).

## Results

### Induction of SD

The experimental manipulation resulted in an average sleep duration of 4 hours and 1 minute ( $SD = 20.57$ ) for sleep-restricted participants and 8 hours and 1 minute ( $SD = 26.27$ ) for participants in the control condition in the two nights prior to testing. Subjective tiredness prior to the negotiation was higher for sleep-restricted participants ( $M = 6.73, SD = 20.06$ ) as compared to the control group ( $M = 4.05, SD = 2.10$ ),  $t(142) = 7.71, p < .001, d = 1.29, 95\% CI [.93, 1.65]$ . A mixed ANOVA with sleep status (sleep restriction vs. control group) as a between-subjects factor and subjective tiredness (pre-negotiation vs. post-negotiation) as a within-subjects factor revealed that participants in the control group reported lower tiredness ( $M = 4.02, SD = .23$ ) than sleep-restricted participants ( $M = 6.70, SD = .24$ ),  $F(1,142) = 65.49, p < .001, \eta_p^2 = .32$ . The main effect for measurement time [ $F(1,142) = .21, p = .648, \eta_p^2 = .001$ ] and the interaction [ $F(1,142) = .00, p = .985, \eta_p^2 = .000$ ] were not significant, indicating that, as intended, participants were not activated by their participation as in Study 2. Sleep-restricted individuals perceived a higher degree of impairment due to tiredness ( $M = 3.31, SD = 1.80$ ) than the control group ( $M = 2.09, SD = 1.38$ ),  $t(124.82) = 4.61, p < .001, d = .78, 95\% CI [.44, 1.12]$ . Overall, our manipulation was successful and the task did not activate participants as intended.

### Deviation from Optimal Solution

Participants in the control condition did not achieve a significantly lower (more optimal) difference score ( $M = 4.79, SD = 2.82$ ) as compared to the sleep-restricted participants ( $M = 4.54, SD = 2.81$ ),  $t(142) = -.54, p = .589, d = -.09, 95\% CI [-.42, .24]$ . The scores in both groups were significantly higher than the optimal score of zero, with  $t(76) = 14.91, p < .001, d = 1.70, 95\% CI [1.35, 2.05]$ , for control participants and  $t(66) = 13.20, p < .001, d = 1.61, 95\% CI [1.25, 1.97]$  for the sleep-restricted participants, indicating substantial deviations from the optimal solution and the absence of a floor effect.

### Compensation

An independent  $t$ -test revealed that sleep-restricted participants reported more compensatory effort ( $M = 4.95, SD = 1.18$ ) than control participants ( $M = 3.80, SD = 1.23$ ),  $t(142) = 5.73, p < .001, d = .96, 95\% CI [.61, 1.30]$ .

### Discussion Study 3

Study 3's methodical approach together with the observed null effect indicates that the findings from Studies 1 and 2 are probably not attributable to the activating nature of face-to-face negotiations. This could further imply that the null effects could rather be a result of compensatory ef-

fort. Supporting this—and similar to Study 2—sleep-restriction participants reported higher compensatory effort than participants in the control condition.

## Bayesian Analysis Across Studies

While with frequentist null-hypothesis significance testing it is not possible to establish direct support for a null hypothesis, Bayesian analyses allow quantifying “evidence of absence”, that is, the degree to which data is in favour of the null hypothesis (e.g., Dienes, 2011; Lee & Wagenmakers, 2013). For Study 1, the Bayes factor (JASP 0.13.1., JASP Team, 2020) suggests that these data are 6.16 ( $BF_{01}$ ) times more likely to be observed under the null hypothesis relative to our hypothesis. The Bayes factors of Study 2 and Study 3 are also in favour of the null hypothesis (Study 2:  $BF_{01} = 3.33$ , Study 3:  $BF_{01} = 8.05$ ). As a single-paper meta-analysis provides important benefits for effect summary (McShane & Böckenholt, 2017), we conducted a Bayesian model-averaging meta-analysis (cf. Berkhout et al., 2024) across all three studies (total  $N = 271$ ; JASP 0.13.1., JASP Team, 2020) which considers the evidence for different possible models (e.g., random- or fixed-effects model) simultaneously. The analysis again supported the null hypothesis,  $d = -.07, 95\% CI [-.34, .19], BF_{01} = 5.84$ .

Opposing our initial predictions that SD leads to sub-optimal negotiation agreements, we found cumulative evidence in favour of the null hypothesis. Even though we cannot rule out the possibility of small or very small effects, our findings contradict discussions and criticisms by the public and media around negotiations under SD (Weaver, 2015). To explore these lay conceptions further, we investigated laypeople's beliefs of SD's impact on negotiations (Study 4). Deeply entrenched lay beliefs may influence compensatory efforts by negotiators aiming to preserve agreement quality as a preventive measure.

## Study 4

### Method Study 4

#### Participants and Design

The preregistration of Study 4 includes the design, planned sample size, inclusion criteria, and planned analyses ([https://osf.io/9d68m/?view\\_only=4ed71a53cbb344759b628245354c2fa2](https://osf.io/9d68m/?view_only=4ed71a53cbb344759b628245354c2fa2)). The online study was conducted via Prolific with  $N = 152$  participants (no exclusions;  $M_{age} = 29.51, SD_{age} = 9.68$ ; 53.9% women, 2% diverse). The sample size was calculated to sufficiently detect small effects ( $d = .25$ ) for the critical test with  $\alpha = .05$  and  $1 - \beta = .9$  (G\*Power, 59). We did not obtain ethics approval, but the study adhered to the Declaration of Helsinki. Participants provided informed consent.

#### Procedure and Measures

Following a similar procedure to Häusser et al. (2019), participants read an accurate description of Study 2 (manipulations and procedures) and were given a shortened

version of the negotiation material, informing them about the underlying integrative potential, the optimal solution, and the possible range of the JO. Participants were informed about the average JO (€ -31,330) achieved by the dyads in the control condition and then estimated the JO of SD dyads within a range of € -450,000 to € 150,000. Finally, participants generally evaluated negotiation outcomes with SD compared to without SD on a 5-point scale, from 1 = 'much worse' to 5 = 'much better', and their own expected negotiation performance with SD compared to without SD on a 5-point scale from 'much worse' to 'much better'.

## Results

A one-sample *t*-test showed that the average estimated JO for the SD condition of € -120,463.27 ( $SD = 106,598.04$ ) was significantly lower than the reference value from the control group,  $t(151) = -10.32, p < .001, d = -.84, 95\% \text{ CI} [-1.02, -.65]$ . Moreover, participants expected the results of real negotiations under SD to be worse than without SD ( $M = 1.99, SD = 1.01$ ) which is significantly different from the centre of scale ("3"),  $t(151) = -12.37, p < .001, d = -1.00, 95\% \text{ CI} [-1.20, -.81]$ . They also expected themselves to perform worse in such a situation ( $M = 1.65, SD = .78$ ), which significantly differs from the centre of scale ("3"),  $t(151) = -21.24, p < .001, d = -1.72, 95\% \text{ CI} [-1.96, -1.46]$ .

## Discussion Study 4

With the survey from Study 4, we demonstrated that layperson's expectations fall in line with our predictions based on our theoretical arguments and earlier empirical research (expectation of a detrimental effect of SD). Hence, the null findings are surprising from a scientific as well as a lay beliefs viewpoint. Moreover, the expectation that SD should have a detrimental effect on performance could motivate negotiators to exert compensatory effort. However, laypersons likely neglected individual and social compensatory dynamics, which may have resulted in the overestimation of the negative effects of SD on JOs. To further investigate the role of compensatory strategies in negotiations under SD, we conducted qualitative interviews in our last study (Study 5) with professionals who are experienced with negotiating under SD to learn which specific measures they use to compensate for SD-induced impairments when negotiating.

## Study 5

### Method Study 5

#### Sample Characteristics

We conducted interviews with 22 politicians (five women,  $M_{\text{age}} = 55.6$  years,  $SD_{\text{age}} = 11.3$ , from 37 to 79 years) who fulfilled the sampling criteria of at least one major negotiation under SD throughout their careers. Interviews took on average 20.5 minutes (min: 10 min, max: 30 min). Respondents' professional experience in political positions (four members of the federal parliament, including ministers; 15 members of state parliaments, including heads of

state and state ministers; three communal politicians, including a mayor) ranged from 3 to 44 years ( $Mdn = 23$ ). Interviews were audio-recorded and conducted in German via telephone or in person.

#### Procedure

Two interviewers followed a manual with open-ended questions to conduct semi-structured interviews to allow exploration beyond predefined topics. The interview started with information about the interview goals, data protection, obtaining informed consent, and the provision of a definition of negotiation. Based on the *Critical Incident Technique* (Flanagan, 1954), we asked for descriptions of an experienced negotiation under SD, followed by the following open-ended questions: "How and to what extent did SD impair the negotiation process and the negotiators?", "How did you deal with this situation and circumstances?", and we asked for specific compensatory strategies on the individual and inter-individual level: (a) "How did you behave? What helped or did not help you personally?" (b) "How did the group behave? How did people deal with each other during the negotiation?" Two independent coders analyzed the anonymized and transcribed interviews systematically, following the procedural rules of the *Qualitative Content Analyses* (QCA) approach by Mayring (2014). Relevant text passages were paraphrased, reduced, and generalized to a higher level of abstraction until a comprehensive category system emerged. The first author then reviewed and merged the conceptually identical category systems of both coders into a categorical system of compensatory strategies for the individual and the inter-individual level.

## Results and Discussion

A set of three main categories of cognitive and behavioral strategies to compensate for impairments due to SD emerged from our data (see [Table 4](#), for all subcategories and exemplary quotes): (1.) preconditions for compensation, (2.) compensatory strategies at the individual level, and (3.) compensatory strategies at the inter-individual level. The first category includes environmental prearrangements such as ensuring good room climate, and organizational factors, such as the possibility of adjournment. Room temperature and light settings have indeed been found to affect tiredness and work performance (Azmoon et al., 2013; Zhang et al., 2010). The second category includes instantaneous strategies negotiators rely on individually to handle tiredness during the negotiation. Politicians reported the importance of self-monitoring in order to intervene when tiredness increases, and physical activity as important compensational strategies. This accords with findings showing that sleep-deprived participants have been found to be able to self-monitor declining cognitive performance (Baranski et al., 1994; Baranski & Pigeau, 1997). Exercising (Scott et al., 2006; Taheri & Irandoust, 2020) and napping, whether in advance or during breaks (Lumley et al., 1986; Waterhouse et al., 2007) can help to buffer the negative effects of SD. The third category on the inter-individual level describes strategies that buffer tired-

ness by interacting with colleagues or the other party. The widely mentioned strategy to use breaks is in line with previous research based on the group-monitoring hypothesis (Abrams et al., 2006), which found that teams, having the benefit of compensating and motivating dynamics, as compared to individuals were relatively unaffected by impairing factors such as SD (Faber et al., 2017; Frings, 2011). Moreover, the beneficial effect of distraction breaks on negotiation processes and agreement quality has been confirmed before in non-sleep-deprived negotiators (Harinck & De Dreu, 2008; Olekalns & Smith, 2005). In summary, the results provide novel insights and a first comprehensive analysis of compensatory efforts commonly used and considered effective by experienced negotiators.

## General Discussion

Negotiations ranging from private matters via labour negotiations to issues of international security often extend into the night, but do sleep-deprived negotiators reach worse outcomes? Both theoretical considerations (see Häusser et al., 2022) and—as we show—lay conceptions (Study 4) point in this direction. In three experiments, we provided first-time empirical tests of the effects of SD on joint economic negotiation outcomes. Against the prediction that individual impairments due to SD carry over to the quality of negotiation agreements in interactive (Study 1 and 2) and proposed agreements for observed negotiations (Study 3), we consistently found no statistically significant effects of SD on joint economic outcomes. Given the robust evidence with medium- to large-sized effects for negative effects of SD on motivation and cognitive capacities (cf. Lim & Dinges, 2010; Mathew et al., 2021), and research emphasizing the role of motivation and cognitive capacities on negotiation outcomes, we did not expect a less than medium-sized effect (lay expectations of Study 4 are in line with this). While we cannot fully exclude small effects, we deem them beyond theoretical or practical value. Given that negotiation outcomes are multi-determined in real-world contexts, the relevance of very small effects of SD in negotiations would likely be marginal. Additionally, there is moderate to strong evidence—as shown by the Bayesian meta-analyses—that our data are in favour of the null hypothesis relative to the alternative hypothesis (Aczel et al., 2018; Lee & Wagenmakers, 2013).

Furthermore, our findings suggest that SD negotiators could have increased task-related effort as an adaptive decision process to counteract performance deficits (see also Massar et al., 2019). The results of Study 3—in which individuals observed a negotiation and proposed an agreement on their own—support the idea of a voluntary increase in effort and focus.

Moreover, the findings about how SD affects individual performance may not be easily transferred to complex social situations (cf. Faber et al., 2017; Faber & Häusser, 2022). Multifaceted social decision-making situations such as negotiations imply specific situational demands (e.g., communication, consideration of other-regarding motives), which possibly modulate the impact of individual-level impairments. The process and outcomes of negotiations are

fundamentally relational (see, for example, the *Relational Process Modell of Negotiation* by Elfenbein, 2021), and group dynamics such as mutual motivation could probably help to buffer the negative effects of SD (see also Baranski et al., 2007; Frings, 2011).

Building on the findings of the qualitative interviews (Study 5), future research could explore the effectiveness of specific strategies to counter the negative effects of SD in negotiation and their effectiveness in reaching high-quality agreements in experimental and real-life settings. Our results hint in the direction of creating an appropriate environment, and individual strategies, such as self-monitoring and focus. Beyond that, inter-individual dynamics such as group monitoring and breaks for informal exchange could also help to buffer the negative effects of SD.

So where does this leave us? Do the findings mean that the theoretical argument, building on individual-level impairments, for a negative effect of SD (cf. Häusser et al., 2022), as well as lay conceptions (see Study 4), are simply wrong? Even if increased effort and specific compensation strategies could offset the negative effects, such compensation may not be sustainable in the long run and can lead to the negotiator's exhaustion and jeopardize well-being and health (Hockey, 1997, 2011).

## Limitations

Although the present studies revealed robust and convergent evidence, it is not without limitations. In particular, it could be argued that the study designs may not have been optimal for detecting the hypothesized effects, as the most pronounced effects of sleep deprivation typically occur after severe total sleep deprivation (Harrison & Horne, 2000; Hockey et al., 1998; Koslowsky & Babkoff, 1992). However, although we cannot rule out that more severe forms of sleep deprivation may have an effect, the sleep deprivation induced in our studies is within the boundaries of sleep deprivation “in the wild” and thus of higher ecological validity.

Furthermore, our studies focused on single-round negotiations, where participants knew the experiment's duration. The anticipation of rest after this negotiation could have influenced compensatory effort (*end-spurt-effect*, cf. Haslam, 1983; Mikulincer et al., 1989). Given the demanding nature of compensatory strategies, we would expect a breaking point for these compensatory efforts ultimately affecting joint and socio-economic outcomes negatively (e.g., feelings about the negotiation process, see Curhan et al., 2006; L. L. Thompson, 1990). Compensatory effort is inherently strenuous and only a temporary measure to mitigate performance decrements. Over time, as for example, after longer negotiation periods or after several days of negotiating under partial sleep deprivation, negotiators might reduce effort by resorting to less complex information-processing strategies (Hockey et al., 1998). Moreover, compensatory effort cannot fully counteract all underlying impairments (cf. Earle et al., 2015; Hockey, 2013). For instance, although primary task performance may remain unaffected by sleep deprivation, secondary activities, often suffer (cf. Dinges & Kribbs, 1991; Hockey et al., 1998). In negotiation

Table 4. Qualitative Results of Study 5: Categories of Compensation

Categories		Description	Exemplary quote
<b>Preconditions of compensation</b>			
<b>External factors</b>	<i>Environment</i>	Lightning, air quality, temperature, catering, retreats	An important point is that the negotiation situation is properly set up. From the space which you are in (...), the temperature, the air quality (...), the catering situation, whether there are beverages or food (...) the environment, you cannot change it in the negotiation situation, but you can, if you are interested in success, set it up in advance.
	<i>Adjournment</i>	Possibility to adjourn	Or it makes sense to adjourn again and say (...) "Come on, let's sleep on it another night or half a night and sit back down together again in a day or two"
<b>Negotiation characteristics</b>	<i>Agenda</i>	Setting a negotiation agenda	There are also attempts (...) to structure the days' agendas in advance: There are topics, (...)—we call it the green list—(...) that are written on it merely as a formality so that you then don't have to call them up again, (...) and are waved through. This has also led to a considerable easing of the days' agendas, as a lot of time goes by just introducing your point, even if everyone else already thinks it is correct.
	<i>Professional preparation</i>	Professional preparation of documents and line of argument	(...) it is always part of it, that you prepare (...) the content of such negotiations very, very well. So that you (...) if you know that it will take a long time and be difficult, that you simply have good documents and (...) that you have prepared possible compromising formulations and such things well (...).
<b>Individual factors</b>	<i>Subjective importance/expertise</i>	Familiar, urgent, or interesting negotiation topics, focusing on one's area of expertise, splitting responsibilities	[Whether sleep deprivation leads to restrictions is] of course still a question of the topic. There are topics that you can discuss at night, at midnight, and you won't get tired (...) if it is an emotional topic, or one that particularly interests you, then you won't get tired so quickly either.
	<i>Physical and mental preparation</i>	General physical fitness, mental balance, resting and napping in advance	Don't eat heavy and much before, maybe take a short five or ten-minute walk before. (...) also to calm the brain a bit, to arrive fresh into the negotiation. That is a very important point.
<b>Inter-individual factors</b>	<i>Advisor systems</i>	External team can provide expertise and support on demand	I can of course then organize a support group outside of the negotiation room. One that supports me on that matter (...). With that, you can take the burden off yourself during the situation when it gets late and tiring (...). Because you cannot integrate them directly into the negotiation, but they can do a lot of the groundwork.
<b>Individual level of compensation</b>			
<b>Conscious nutrition</b>		Consuming water, psycho-stimulants (e.g., coffee), sweets; abstinence from alcohol, large amounts of coffee, heavy meals	So, in my opinion, being conscious about what you eat is very helpful. (...) And then personally I always drink a lot of water and try to eat relatively little because that naturally contributes to fatigue coming from the stomach.
<b>Cardiovascular activation</b>		Stretching, standing up, change of sitting position, fresh air, cold water on the face, chewing gum, breathing exercise	As far as the situation allows for it, simply get up, briefly go out, go back in, so that (...) by this activity (...) the body is reactivated.
<b>Resting</b>		Napping/ resting during breaks	Otherwise, (...) you just have to see whether you maybe need to be radical and say: "So, I now need 5 minutes. I'm sorry, I've just reached a low point. Can we take a break?"
<b>Self-monitoring</b>		Tracking and assessment of own performance to be able to intervene and suppress impairments	(...) it is important to have a good self-assessment. To be able to assess for yourself how far you are still able to think reasonably clearly, to act clearly and to express yourself clearly.
<b>Active participation</b>		Following the negotiation, active	As long as you actively think and actively engage, the effects of exhaustion and tiredness, of lack of concentration, rush in much

Categories		Description	Exemplary quote
		participation, taking leadership	later for you than for those who mostly do not interact but rather only are present.
<b>Inter-individual Level</b>			
<b>Change of negotiation subject</b>		Negotiation of non-controversial or easy issues to break a deadlock and to invigorate the negotiation dynamics	To say "We're not getting any further here." On the one hand, it tires out and above all, it may harden the fronts for the other points. So, you then first take something less controversial or not really entirely relevant. To calm down, you just work on another point.
<b>Appointing a leader</b>		A leader to suggest breaks, admonish in cases of negligence, enforce negotiation rules and moderate conflicts	(That) depends very much on the negotiator, to what extent he [she] sets the direction or brings it together or gives a friendly warning: "So, please concentrate again now, we'll be finished soon!"
<b>Group monitoring and support</b>	<i>Motivational</i>	Mutual goal for agreement, willingness to compromise, encouragement, openly addressing tiredness	And I have colleagues with whom I'll talk about the situation, i.e. articulate and name what currently is going on: "Are you also so tired?" "Oh, I can't go on." (...) And it is sort of a good outlet when you say this to someone and they confirm that: "It really has been very long now."
	<i>Professional</i>	Taking turns and helping each other out to enable short breaks	"[I] have colleagues there with whom I have already often been through something like this before so that everyone can already tell when the other has reached a low point. And then [someone else] quite simply takes over, (...) so that they can catch their breath for a few minutes. (...) Sometimes in such a way that the others don't even notice. You know, you can definitely get it under control. This interaction in a homogeneous group.
<b>Breaks</b>	<i>Breaks for reflection</i>	strengthen in-group dynamics, allow for a constructive summary of what has been negotiated so far and for planning further strategies, prevent premature concessions	It is very important to reflect because you have to hold your own negotiating delegation together. Breaks are important for this. (...) Although a break here does not mean that you go to sleep somewhere, but that you reflect on arguments that have come from the opposing side of the negotiation that you reflect on your own position and see where there are opportunities to move. And maybe also save you from rash approaches.
	<i>Breaks for distraction</i>	Informal exchange, small talk, joking within the negotiation context	(...) You can tell when the group, no matter how heterogeneous its views are, works well together on a human level, that they really motivate each other to carry on. And if it comes to something private, or an experience that may have, yes, amused you that day. A story. (...) That brings a personal closeness and wakes you up.

Note. Qualitative Results of Study 5: Categories of compensatory strategies with exemplary quotes of politicians.

contexts, this might manifest as a narrowing of attention to primary task goals or the adoption of strategies aimed at simplifying information exchange and processing (Hockey, 1997; Hockey et al., 1998). If compensatory effort is responsible for the lack of (at least) medium effects (which we deem the most plausible interpretation), future research should investigate the limits of these efforts, particularly their impact on performance stability over time and potential impairment of secondary negotiation outcomes (for example socio-economic evaluations, see above). Future research should therefore assess SD's impact in prolonged and open-ended negotiations, like overnight or multi-round negotiations under (partial) SD, to pinpoint when compensational efforts ultimately fail.

## Conclusion

Our analyses provide first-time insights into negotiations under SD. The results of three experimental studies, laypeople's beliefs, and the expert interviews suggest that SD does not impair negotiation outcomes as we (and laypeople) expected. We suggest that compensatory effort might occur and suppress the emergence of negative consequences of SD on negotiation outcomes.

### Transparency and Openness

We report how we determined our sample sizes, all data exclusions, and all manipulations. Exclusion of measurements and preregistered analyses are reported. Data were

analyzed using IBM SPSS for Windows. We provide data and codebooks on OSF: [https://osf.io/47agt/?view\\_only=caef24094e924bba9eb5abbc48e0df6a](https://osf.io/47agt/?view_only=caef24094e924bba9eb5abbc48e0df6a)

We provide the study material (e.g., negotiation materials & negotiation video of Study 3) on request.

Three of the studies were pre-registered on OSF: Study 2:

[https://osf.io/x8mgj/?view\\_only=271656baf6f647c0a49d78e1fc4a9cbf](https://osf.io/x8mgj/?view_only=271656baf6f647c0a49d78e1fc4a9cbf)

Study 3: [https://osf.io/u8paj/?view\\_only=480750a3a1034fe9a9b07ac0deb01f52](https://osf.io/u8paj/?view_only=480750a3a1034fe9a9b07ac0deb01f52)

Study 4: [https://osf.io/9d68m/?view\\_only=4ed71a53cbb344759b628245354c2fa2](https://osf.io/9d68m/?view_only=4ed71a53cbb344759b628245354c2fa2)

### Competing Interests

The authors declare no competing interest.

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### Author Contributions

J.A.H., J.H., E.H., and N.F. conceptualized research; E.H., J.H., and J.A.H. conducted the studies and curated the data; E.H. administered the project and analyzed data; E.H., J.A.H., J.H., and N.F. wrote the paper.

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## References

- Abrams, D., Hopthrow, T., Hulbert, L., & Frings, D. (2006). "Groupdrink"? The effect of alcohol on risk attraction among groups versus individuals. *Journal of Studies on Alcohol*, 67(4), 628–636. <https://doi.org/10.15288/jsa.2006.67.628>
- Aczel, B., Palfi, B., Szollosi, A., Kovacs, M., Szaszi, B., Szecsi, P., Zrubka, M., Gronau, Q. F., van den Bergh, D., & Wagenmakers, E.-J. (2018). Quantifying support for the null hypothesis in psychology: An empirical investigation. *Advances in Methods and Practices in Psychological Science*, 1(3), 357–366. <https://doi.org/10.1177/2515245918773742>
- Alhola, P., & Polo-Kantola, P. (2007). Sleep deprivation: Impact on cognitive performance. *Neuropsychiatric Disease and Treatment*, 3(5), 553–567. <https://psycnet.apa.org/record/2008-02717-005>
- Anderson, C., & Dickinson, D. L. (2010). Bargaining and trust: The effects of 36-h total sleep deprivation on socially interactive decisions. *Journal of Sleep Research*, 19(1 Pt 1), 54–63. <https://doi.org/10.1111/j.1365-2869.2009.00767.x>
- Azmoon, H., Dehghan, H., Akbari, J., & Souri, S. (2013). The relationship between thermal comfort and light intensity with sleep quality and eye tiredness in shift work nurses. *Journal of Environmental and Public Health*, 2013. <https://doi.org/10.1155/2013/639184>
- Baranski, J. V. (2007). Fatigue, sleep loss, and confidence in judgment. *Journal of Experimental Psychology: Applied*, 13(4), 182–196. <https://doi.org/10.1037/1076-898X.13.4.182>
- Baranski, J. V., & Pigeau, R. A. (1997). Self-monitoring cognitive performance during sleep deprivation: Effects of modafinil, d-amphetamine and placebo. *Journal of Sleep Research*, 6(2), 84–91. <https://doi.org/10.1111/j.1365-2869.1997.00032.x>
- Baranski, J. V., Pigeau, R. A., & Angus, R. G. (1994). On the ability to self-monitor cognitive performance during sleep deprivation: A calibration study. *Journal of Sleep Research*, 3(1), 36–44. <https://doi.org/10.1111/j.1365-2869.1994.tb00102.x>
- Baranski, J. V., Thompson, M. M., Lichacz, F. M., McCann, C., Gil, V., Pastò, L., & Pigeau, R. A. (2007). Effects of sleep loss on team decision making: motivational loss or motivational gain? *Human Factors*, 49(4), 646–660. <https://doi.org/10.1518/001872007X215728>
- Barnes, C. M., Gunia, B. C., & Wagner, D. T. (2015). Sleep and moral awareness. *Journal of Sleep Research*, 24(2), 181–188. <https://doi.org/10.1111/jsr.12231>
- Bazerman, M. H., Moore, D. A., & Gillespie, J. J. (1999). The human mind as a barrier to wiser environmental agreements. *American Behavioral Scientist*, 42(8), 1277–1300. <https://doi.org/10.1177/00027649921954868>
- Ben-Simon, E., Vallat, R., Barnes, C. M., & Walker, M. P. (2020). Sleep loss and the socio-emotional brain. *Trends in Cognitive Sciences*, 24(6), 435–450. <https://doi.org/10.1016/j.tics.2020.02.003>
- Berkhout, S. W., Haaf, J. M., Gronau, Q. F., Heck, D. W., & Wagenmakers, E. J. (2024). A tutorial on Bayesian model-averaged meta-analysis in JASP. *Behavior Research Methods*, 56(3), 1260–1282. <https://doi.org/10.3758/s13428-023-02093-6>
- Brett, J., & Thompson, L. (2016). Negotiation. *Organizational Behavior and Human Decision Processes*, 136, 68–79. <https://doi.org/10.1016/j.obhdp.2016.06.003>
- Curhan, J. R., Elfenbein, H. A., & Xu, H. (2006). What do people value when they negotiate? Mapping the domain of subjective value in negotiation. *Journal of Personality and Social Psychology*, 91(3), 493–512. <https://doi.org/10.1037/0022-3514.91.3.493>
- De Dreu, C. K. W., Beersma, B., Stroebe, K., & Euwema, M. C. (2006). Motivated information processing, strategic choice, and the quality of negotiated agreement. *Journal of Personality and Social Psychology*, 90(6), 927–943. <https://doi.org/10.1037/0022-3514.90.6.927>
- De Dreu, C. K. W., & Carnevale, P. J. (2003). Motivational Bases Of Information Processing and Strategy in Conflict and Negotiation. *Advances in Experimental Social Psychology*, 35, 235–291. [https://doi.org/10.1016/s0065-2601\(03\)01004-9](https://doi.org/10.1016/s0065-2601(03)01004-9)
- De Dreu, C. K. W., & Gelfand, M. J. (Eds.). (2008). *The psychology of conflict and conflict management in organization*. Lawrence Erlbaum Associates.
- De Dreu, C. K. W., Koole, S. L., & Oldersma, F. L. (1999). On the seizing and freezing of negotiator inferences: Need for cognitive closure moderates the use of heuristics in negotiation. *Personality and Social Psychology Bulletin*, 25(3), 348–362. <https://doi.org/10.1177/0146167299025003007>
- De Dreu, C. K. W., Koole, S. L., & Steinel, W. (2000). Unfixing the fixed pie: A motivated information-processing approach to integrative negotiation. *Journal of Personality and Social Psychology*, 79(6), 975–987. <https://doi.org/10.1037/0022-3514.79.6.975>
- De Dreu, C. K. W., Nijstad, B. A., & van Knippenberg, D. (2008). Motivated information processing in group judgment and decision making. *Personality and Social Psychology Review*, 12(1), 22–49. <https://doi.org/10.1177/1088868307304092>
- Dickinson, D. L., McEvoy, D. M., & Bruner, D. M. (2022). The impact of sleep restriction on interpersonal conflict resolution and the narcotic effect. *Journal of Economic Behavior & Organization*, 194, 71–90. <https://doi.org/10.1016/j.jebo.2021.12.003>
- Dienes, Z. (2011). Bayesian versus orthodox statistics: Which side are you on? *Perspectives on Psychological Science*, 6, 274–290. <https://doi.org/10.1177/1745691611406920>
- Dinges, D. F., & Kribbs, N. B. (1991). Performing while sleepy: Effects of experimentally-induced sleepiness. In T. H. Monk (Ed.), *Sleep, sleepiness and performance* (pp. 97–128). John Wiley & Sons.

- Dorrian, J., Lamond, N., & Dawson, D. (2000). The ability to self-monitor performance when fatigued. *Journal of Sleep Research, 9*(2), 137–144. <https://doi.org/10.1046/j.1365-2869.2000.00195.x>
- Earle, F., Hockey, B., Earle, K., & Clough, P. (2015). Separating the effects of task load and task motivation on the effort–fatigue relationship. *Motivation and Emotion, 39*(4), 467–476. <https://doi.org/10.1007/s11031-015-9481-2>
- Elfenbein, H. A. (2021). Individual differences in negotiation: A relational process model. *Organizational Psychology Review, 11*(1), 73–93. <https://doi.org/10.1177/2041386620962551>
- Engle-Friedman, M. (2014). The effects of sleep loss on capacity and effort. *Sleep Science, 7*(4), 213–224. <https://doi.org/10.1016/j.slsci.2014.11.001>
- Faber, N. S., & Häusser, J. A. (2022). Why stress and hunger both increase and decrease prosocial behaviour. *Current Opinion in Psychology, 44*, 49–57. <https://doi.org/10.1016/j.copsyc.2021.08.023>
- Faber, N. S., Häusser, J. A., & Kerr, N. L. (2017). Sleep deprivation impairs and caffeine enhances my performance, but not always our performance: How acting in a group can change the effects of Impairments and Enhancements. *Personality and Social Psychology Review, 21*(1), 3–28. <https://doi.org/10.1177/1088868315609487>
- Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G\* power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191. <https://doi.org/10.3758/BF03193146>
- Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin, 51*(4), 327–358. <https://doi.org/10.1037/h0061470>
- Frings, D. (2011). The effects of group monitoring on fatigue-related einstellung during mathematical problem solving. *Journal of Experimental Psychology: Applied, 17*(4), 371–381. <https://doi.org/10.1037/a0025131>
- Froman, L. A., & Cohen, M. D. (1970). Compromise and logroll: Comparing the efficiency of two bargaining processes. *Behavioral Sciences, 15*(2), 180–183. <https://doi.org/10.1002/bs.3830150209>
- Fulmer, I. S., & Barry, B. (2004). The smart negotiator: Cognitive ability and emotional intelligence in negotiation. *International Journal of Conflict Management, 15*(3), 245–272. <https://doi.org/10.1108/eb022914>
- Gordon, A. M., Carrillo, B., & Barnes, C. M. (2021). Sleep and social relationships in healthy populations: A systematic review. *Sleep Medicine Reviews, 57*, 101428. <https://doi.org/10.1016/j.smrv.2021.101428>
- Hafner, M., Stepanek, M., Taylor, J., Troxel, W. M., & van Stolk, C. (2017). Why Sleep Matters-The Economic Costs of Insufficient Sleep: A Cross-Country Comparative Analysis. *Rand Health Quarterly, 6*(4), 11. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5627640/>
- Harinck, F., & De Dreu, C. K. W. (2008). Take a break! Or not? The impact of mindsets during breaks on negotiation processes and outcomes. *Journal of Experimental Social Psychology, 44*(2), 397–404. <https://doi.org/10.1016/j.jesp.2006.12.009>
- Harrison, Y., & Horne, J. A. (1999). One night of sleep loss impairs innovative thinking and flexible decision making. *Organizational Behavior and Human Decision Processes, 78*(2), 128–145. <https://doi.org/10.1006/obhd.1999.2827>
- Harrison, Y., & Horne, J. A. (2000). The impact of sleep deprivation on decision making: A review. *Journal of Experimental Psychology: Applied, 6*(3), 236–249. <https://doi.org/10.1037//1076-898X.6.3.236>
- Haslam, D. R. (1983). The incentive effect and sleep deprivation. *Sleep, 6*(4), 362–368. <https://doi.org/10.1093/sleep/6.4.362>
- Häusser, J. A., Halfmann, E., & Hüffmeier, J. (2022). Negotiating through the night: How sleep deprivation can affect negotiation processes and outcomes. *Negotiation and Conflict Management Research. https://ncmr.lps.library.cmu.edu/article/id/575/*
- Häusser, J. A., Leder, J., Ketturat, C., Dresler, M., & Faber, N. S. (2016). Sleep deprivation and advice taking. *Scientific Reports, 6*(1), 24386. <https://doi.org/10.1038/srep24386>
- Häusser, J. A., Stahlecker, C., Mojzisch, A., Leder, J., van Lange, P. A. M., & Faber, N. S. (2019). Acute Hunger does not always undermine prosociality. *Nature Communications, 10*(1), 4733. <https://doi.org/10.1038/s41467-019-12579-7>
- Hockey, G. R. J. (1997). Compensatory control in the regulation of human performance under stress and high workload: A cognitive-energetical framework. *Biological Psychology, 45*(1–3), 73–93. [https://doi.org/10.1016/s0301-0511\(96\)05223-4](https://doi.org/10.1016/s0301-0511(96)05223-4)
- Hockey, G. R. J. (2011). A motivational control theory of cognitive fatigue. In P. L. Ackerman (Ed.), *Cognitive fatigue: Multidisciplinary perspectives on current research and future applications* (pp. 167–187). American Psychological Association. <https://doi.org/10.1037/12343-008>
- Hockey, G. R. J. (2013). *The psychology of fatigue: Work, effort and control*. Cambridge University Press. <https://doi.org/10.1017/CBO9781139015394>
- Hockey, G. R. J., Wastell, D. G., & Sauer, J. (1998). Effects of sleep deprivation and user interface on complex performance: A multilevel analysis of compensatory control. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 40*(2), 233–253. <https://doi.org/10.1518/001872098779480479>
- Horne, J. A. (1988). Sleep loss and “divergent” thinking ability. *Sleep, 11*(6), 528–536. <https://doi.org/10.1093/sleep/11.6.528>
- Hüffmeier, J., Zerres, A., Freund, P. A., Backhaus, K., Trötschel, R., & Hertel, G. (2019). Strong or weak synergy? Revising the assumption of team-related advantages in integrative negotiations. *Journal of Management, 45*(7), 2721–2750. <https://doi.org/10.1177/0149206318770245>

- JASP Team. (2020). *JASP* (Version 0.13.1) [Computer software]. <https://jasp-stats.org/>
- Kappes, C., Häusser, J. A., Mojzisch, A., & Hüffmeier, J. (2020). Age differences in negotiations: Older adults achieve poorer joint outcomes in integrative negotiations. *Journal of Experimental Psychology: General*, *149*(11), 2102–2118. <https://doi.org/10.1037/xge0000762>
- Koslowsky, M., & Babkoff, H. (1992). Meta-analysis of the relationship between total sleep deprivation and performance. *Chronobiology International*, *9*(2), 132–136. <https://doi.org/10.3109/07420529209064524>
- Lee, M. D., & Wagenmakers, E.-J. (2013). *Bayesian cognitive modeling: A practical course*. Cambridge university press.
- Lim, J., & Dinges, D. F. (2010). A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychological Bulletin*, *136*(3), 375–389. <https://doi.org/10.1037/a0018883>
- Luchins, A. S. (1942). Mechanization in problem solving: The effect of Einstellung. *Psychological Monographs*, *54*(6), i–95. <https://doi.org/10.1037/h0093502>
- Lumley, M., Roehrs, T., Zorick, F., Lamphere, J., & Roth, T. (1986). The alerting effects of naps in sleep-deprived subjects. *Psychophysiology*, *23*(4), 403–408. <https://doi.org/10.1111/j.1469-8986.1986.tb00653.x>
- Massar, S. A. A., Lim, J., & Huettel, S. A. (2019). Sleep deprivation, effort allocation and performance. *Progress in Brain Research*, *246*, 1–26. <https://doi.org/10.1016/bs.pbr.2019.03.007>
- Mathew, G. M., Strayer, S. M., Bailey, D. S., Buzzell, K., Ness, K. M., Schade, M. M., Nahmod, N. G., Buxton, O. M., & Chang, A.-M. (2021). Changes in subjective motivation and effort during sleep restriction moderate interindividual differences in attentional performance in healthy young men. *Nature and Science of Sleep*, *13*, 1117–1136. <https://doi.org/10.2147/NSS.S294409>
- Mayring, P. (2014). *Qualitative content analysis: Theoretical foundation, basic procedures and software solution*. Beltz. <http://nbn-resolving.de/urn:nbn:de:0168-ssoa-395173>
- Mazei, J., Hüffmeier, J., Freund, P. A., Stuhlmacher, A. F., Bilke, L., & Hertel, G. (2015). A meta-analysis on gender differences in negotiation outcomes and their moderators. *Psychological Bulletin*, *141*(1), 85–104. <https://doi.org/10.1037/a0038184>
- McShane, B. B., & Böckenholt, U. (2017). Single-paper meta-analysis: Benefits for study summary, theory testing, and replicability. *Journal of Consumer Research*, *43*(6), 1048–1063. <https://doi.org/10.1093/jcr/ucw085>
- Mikulincer, M., Babkoff, H., Caspy, T., & Sing, H. C. (1989). The effects of 72 hours of sleep loss on psychological variables. *British Journal of Psychology*, *80*(2), 145–162. <https://doi.org/10.1111/j.2044-8295.1989.tb02309.x>
- Moran, S., Bereby-Meyer, Y., & Bazerman, M. (2008). Stretching the effectiveness of analogical training in negotiations: Teaching diverse principles for creating value. *Negotiation and Conflict Management Research*, *1*(2), 99–134. <https://doi.org/10.1111/j.1750-4716.2007.00006.x>
- Neale, M. A., & Bazerman, M. H. (1992). Negotiator cognition and rationality: A behavioral decision theory perspective. *Organizational Behavior and Human Decision Processes*, *51*(2), 157–175. [https://doi.org/10.1016/0749-5978\(92\)90009-V](https://doi.org/10.1016/0749-5978(92)90009-V)
- Olekalns, M., & Smith, P. L. (2005). Cognitive representations of negotiation. *Australian Journal of Management*, *30*(1), 57–76. <https://doi.org/10.1177/031289620503000104>
- Petty, R. E., & Wegener, D. T. (1999). The elaboration likelihood model: Current status and controversies. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 42–72). The Guilford Press.
- Philibert, I. (2005). Sleep loss and performance in residents and nonphysicians: A meta-analytic examination. *Sleep*, *28*(11), 1392–1402. <https://doi.org/10.1093/sleep/28.11.1392>
- Pilcher, J. J., & Walters, A. S. (1997). How sleep deprivation affects psychological variables related to college students' cognitive performance. *Journal of American College Health*, *46*(3), 121–126. <https://doi.org/10.1080/07448489709595597>
- Pruitt, D. G. (1983). Strategic Choice in Negotiation. *American Behavioral Scientist*, *27*(2), 167–194. <https://doi.org/10.1177/000276483027002005>
- Pruitt, D. G., & Carnevale, P. J. (1993). *Negotiation in Social Conflict*. Thomson Brooks/Cole Publishing Co.
- Pruitt, D. G., & Lewis, S. A. (1975). Development of integrative solutions in bilateral negotiation. *Journal of Personality and Social Psychology*, *31*(4), 621–633. <https://doi.org/10.1037/0022-3514.31.4.621>
- Raiffa, H. (1982). *The art and science of negotiation: How to resolve conflicts and get the best out of bargaining*. Harvard University Press.
- Reynolds, A. C., & Banks, S. (2010). Total sleep deprivation, chronic sleep restriction and sleep disruption. *Progress in Brain Research*, *185*, 91–103. <https://doi.org/10.1016/B978-0-444-53702-7.00006-3>
- Rogers, N. L., Dorrian, J., & Dinges, D. F. (2003). Sleep, waking and neurobehavioural performance. *Frontiers in Bioscience-Landmark*, *8*(6), 1056–1067. <https://doi.org/10.2741/1174>
- Sadeh, A., Sharkey, M., & Carskadon, M. A. (1994). Activity-based sleep-wake identification: An empirical test of methodological issues. *Sleep*, *17*(3), 201–207. <https://doi.org/10.1093/sleep/17.3.201>
- Sattler, S., Häusser, J. A., & Faber, N. S. (2023). Working with a sleep-deprived or a cognitively enhanced team member compromises motivation to contribute to group performance. *European Journal of Social Psychology*. <https://doi.org/10.1002/ejsp.2971>
- Scott, J. P. R., McNaughton, L. R., & Polman, R. C. J. (2006). Effects of sleep deprivation and exercise on cognitive, motor performance and mood. *Physiology & Behavior*, *87*(2), 396–408. <https://doi.org/10.1016/j.physbeh.2005.11.009>

- Sharma, S., Bottom, W. P., & Elfenbein, H. A. (2013). On the role of personality, cognitive ability, and emotional intelligence in predicting negotiation outcomes: A meta-analysis. *Organizational Psychological Review*, 3(4), 293–336. <https://doi.org/10.1177/2041386613505857>
- Swann, C. E., Yelland, G. W., Redman, J. R., & Rajaratnam, S. M. W. (2006). Chronic partial sleep loss increases the facilitatory role of a masked prime in a word recognition task. *Journal of Sleep Research*, 15(1), 23–29. <https://doi.org/10.1111/j.1365-2869.2006.00495.x>
- Taheri, M., & Irandoust, K. (2020). Morning exercise improves cognitive performance decrements induced by partial sleep deprivation in elite athletes. *Biological Rhythm Research*, 51(4), 644–653. <https://doi.org/10.1080/09291016.2019.1576279>
- Ten Velden, F. S., Beersma, B., & De Dreu, C. K. W. (2010). It takes one to tango: The effects of dyads' epistemic motivation composition in negotiation. *Personality and Social Psychology Bulletin*, 36(11), 1454–1466. <https://doi.org/10.1177/0146167210383698>
- Thompson, L. L. (1990). Negotiation behavior and outcomes: Empirical evidence and theoretical issues. *Psychological Bulletin*, 108(3), 515–532. <https://doi.org/10.1037/0033-2909.108.3.515>
- Thompson, L. L. (1991). Information exchange in negotiation. *Journal of Experimental Social Psychology*, 27(2), 161–179. [https://doi.org/10.1016/0022-1031\(91\)90020-7](https://doi.org/10.1016/0022-1031(91)90020-7)
- Thompson, L. L., & Hastie, R. (1990). Social perception in negotiation. *Organizational Behavior and Human Decision Processes*, 47(1), 98–123. [https://doi.org/10.1016/0749-5978\(90\)90048-E](https://doi.org/10.1016/0749-5978(90)90048-E)
- Thompson, L. L., & Hrebec, D. (1996). Lose–lose agreements in interdependent decision making. *Psychological Bulletin*, 120(3), 396–409. <https://doi.org/10.1037/0033-2909.120.3.396>
- Thompson, L., Peterson, E., & Brodt, S. E. (1996). Team negotiation: An examination of integrative and distributive bargaining. *Journal of Personality and Social Psychology*, 70(1), 66–78. <https://doi.org/10.1037/0022-3514.70.1.66>
- Tryon, W. W. (2004). Issues of validity in actigraphic sleep assessment. *Sleep*, 27(1), 158–165. <https://doi.org/10.1093/sleep/27.1.158>
- Van Dongen, H. P. A., Maislin, G., Mullington, J. M., & Dinges, D. F. (2003). The cumulative cost of additional wakefulness: Dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep*, 26(2), 117–126. <https://doi.org/10.1093/sleep/26.2.117>
- Van Dongen, H. P. A., Rogers, N. L., & Dinges, D. F. (2003). Sleep debt: Theoretical and empirical issues. *Sleep and Biological Rhythms*, 1, 5–13. <https://doi.org/10.1046/j.1446-9235.2003.00006.x>
- Walton, R. E., & McKersie, R. B. (1965). *A Behavioral Theory of Labor Negotiations. An Analysis of a Social Interaction System*. McGraw-Hill.
- Waterhouse, J., Atkinson, G., Edwards, B., & Reilly, T. (2007). The role of a short post-lunch nap in improving cognitive, motor, and sprint performance in participants with partial sleep deprivation. *Journal of Sports Sciences*, 25(14), 1557–1566. <https://doi.org/10.1080/02640410701244983>
- Weaver, M. (2015, July 13). *Greece crisis: What are the effects of sleep deprivation on decision-making?* The Guardian. <https://www.theguardian.com/news/reality-check/2015/jul/13/greece-crisis-what-are-the-effects-of-sleep-deprivation-on-decision-making>
- Webster, D. M., Richter, L., & Kruglanski, A. W. (1996). On leaping to conclusions when feeling tired: Mental fatigue effects on impressionary primacy. *Journal of Experimental Social Psychology*, 32(2), 181–195. <https://doi.org/10.1006/jesp.1996.0009>
- Whitney, P., Hinson, J. M., Jackson, M. L., & Van Dongen, H. P. A. (2015). Feedback blunting: Total sleep deprivation impairs decision making that requires updating based on feedback. *Sleep*, 38(5), 745–754. <https://doi.org/10.5665/sleep.4668>
- Wickens, C. D., Hutchins, S. D., Laux, L., & Sebok, A. (2015). The Impact of Sleep Disruption on Complex Cognitive Tasks: A meta-analysis. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 57(6), 930–946. <https://doi.org/10.1177/0018720815571935>
- Wilhelm, P., & Schoebi, D. (2007). Assessing mood in daily life. *European Journal of Psychological Assessment*, 23(4), 258–267. <https://doi.org/10.1027/1015-5759.23.4.258>
- Zerres, A., Hüffmeier, J., Freund, P. A., Backhaus, K., & Hertel, G. (2013). Does it take two to tango? Longitudinal effects of unilateral and bilateral integrative negotiation training. *Journal of Applied Psychology*, 98(3), 478–491. <https://doi.org/10.1037/a0032255>
- Zhang, H., Arens, E., Kim, D., Buchberger, E., Bauman, F., & Huizenga, C. (2010). Comfort, perceived air quality, and work performance in a low-power task–ambient conditioning system. *Building and Environment*, 45(1), 29–39. <https://doi.org/10.1016/j.buildenv.2009.02.016>

## Supplementary Materials

### Peer Review Communication

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### Response Letter

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