*Experimental Results*

*Social Jetlag is Independently Associated with Chronotype and Poor Memory for Extinguished Fear*

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**Supplementary Materials**

**Supplementary Methods**

*Participant Characteristics*

Participant exclusion criteria included current neurological, psychiatric, sleep or medical conditions; persons with a history of seizures or significant head trauma; current use of sleep-altering drugs; average sleep per night greater than 10 hours; inability or unwillingness to keep a recommended sleep schedule (*see below*); cigarette smoking, excessive caffeine and/or alcohol consumption.

*Sleep Assessment Period*

Participants completed 7-9 nights of actigraphy monitoring with the Actiwatch-2 (Philips Respironics, Bend, OR) worn on the non-dominant wrist. Participants pressed an event marker button on the device at bed-time and rise-time to delineate rest periods within which sleep/wake epochs were algorithmically scored. Evening-Morning Sleep Questionnaire (Pace-Schott *et al.*, 2005) bed- and rise-times were substituted when event button presses were missed. During the study period, naps, drugs and alcohol were proscribed, and 2AM bedtime curfew and 7-hr minimum sleep opportunity prescribed. All participants completed the Morningness-Eveningness Questionnaire (MEQ; Horne and Ostberg, 1978) to determine circadian preference.

*Weekday and Weekend Sleep Timing*

Social jetlag (SJ) was determined by subtracting weekday (Sunday-Thursday) from weekend (Friday and Saturday) mean actigraphy-determined sleep midpoint. All participants had two weekend and 5-7 weekday nights of actigraphy data. Sleep midpoint was defined as number of minutes past midnight based on the algorithmically scored sleep period. To measure differences in weekday and weekend sleep amount, we subtracted total sleep time (TST) on weekdays from TST on weekends. Average sleep midpoint and TST on weekdays and weekends is listed in Table S1.

*Fear Conditioning, Extinction Learning and Extinction Recall task*

Full task details are available in Pace-Schott *et al.* (2013). Specifically, participants completed a validated, computer-based 2-session fear conditioning (Conditioning), extinction learning (Extinction) and extinction recall (Recall) protocol (presented using SuperLab 4.0, Cedrus Corporation, San Pedro, CA) with continuous skin conductance monitoring. Conditioning and Extinction occurred during session 1 (between 7-10AM or 7-10PM) and Recall occurred during session 2. During Conditioning, two differently colored lamps (CS+1 and CS+2) were conditioned with a mild electric finger shock, while a third remained unconditioned (CS-). All colored lamps were superimposed onto a photograph of an office which served as the conditioning context. During Extinction, which immediately followed Conditioning, one CS+ (CS+E) was extinguished by repeatedly presenting it without finger-shock reinforcement. Presentations of the CS- were interspersed pseudo-randomly. Both CS during Extinction were superimposed onto a photograph of a conference room which served as the extinction context. The second CS+ (CS+U) remained conditioned, but un-extinguished. At Recall, which occurred 3-, 12- or 24-hr after Extinction, all 3 CS were presented without finger-shock reinforcement. Study phases were divided into two blocks with only one type of CS+ shown with interspersed CS- in each block. CS colors (red, blue or yellow) were counterbalanced across participants. For each stimulus presentation, the study context appeared on screen for 3 seconds with an unlit lamp, then the lamp lit up to one of the three colors (*see above*) and remained on-screen for an additional 6 seconds. Inter-stimulus interval was jittered 12-18 s.

*Skin Conductance Monitoring*

Skin conductance level (SCL) was measured as described in Pace-Schott *et al.* (2013). In brief, two adhesive electrodermal electrodes were attached to the hypothenar surface of the non-dominant hand and connected to the BIOPAC MP150 device (BIOPAC Systems, Inc., Goleta, CA). Data were collected using BIOPAC AcqKnowledge 3.9.2 and 4.1.1 data acquisition software for Macintosh. Event marks indicated CS onset, allowing for precise synchronization between stimuli presentation and stimulus-evoked skin conductance response (SCR). SCR was calculated by subtracting the mean SCL during the last 2 seconds of context-alone presentation from the peak SCL during the 6-second CS presentation. Non-conditioners were defined as those who showed less than 2 non-square root transformed SCRs greater than 0.05 µS to a CS+ during the conditioning phase.

*Physiological Reactivity*

SCRs were square-root transformed. Differential SCR (SCRd) was SCR to a CS+ minus SCR to its temporally corresponding CS-, which controls for non-specific (i.e. non-learned) responses to both stimuli. We calculated our index variables below using SCR and SCRd as each has a unique set of advantages. While SCR captures general reactivity, SCRd reflects only the pure component of memory for associative threat learning (Lockhart and Grings, 1963; Pineles et al., 2009).

*Extinction Memory Measures*

Memory for extinction was computed using the Extinction Retention Index (ERI; McLaughlin *et al.*, 2015) calculated as the mean SCR to the first 2 CS+ (trials least likely to be contaminated by new extinction learning) at Recall, normalized to maximum Conditioning phase SCR to the CS+ (i.e. maximum conditioned fear response learning). An additional differential ERI (dERI) was calculated using the above equation, but substituting in differential SCR (SCRd; CS+ minus its temporally corresponding CS-) to the first 2 CS+ for SCR. SCRd controls for non-specific (i.e. unreinforced) responses to stimuli.

**Supplementary Results**

*Time-of-Day and Delay effects*

To rule out a possible confound of time-of-day of extinction learning and/or recall delay, we conducted a 2 Time-of-Day of Extinction (morning or evening) x 3 Delay (3-, 12-, or 24-hours) analysis of covariance for extinction memory (ERI or dERI), including SJ as a covariate. For ERI, this analysis revealed no main effect of Time-of-Day of Extinction (F(1,65)=.56, p=.45, partial η2=.01), Delay (F(2,65)=.60, p=.55, partial η2=.02) or a Time-of-Day of Extinction by Delay interaction (F(2,65)=0.24, p=.79, partial η2=.01) when controlling for SJ. Similarly, for dERI, there was no main effect of Time-of-Day of Extinction (F(1,64)=.002, p=.97, partial η2<.001), Delay (F(2,64)=.60, p=.55, partial η2=.02) or a Time-of-Day of Extinction by Delay interaction (F(2,64)=1.39, p=.26, partial η2=.04) when controlling for SJ.

*Effects of Social Jetlag on General Reactivity*

To rule out the possibility that SJ was generally increasing reactivity to task stimuli across study phases, we correlated SJ with mean reactivity to conditioned stimuli during conditioning, extinction learning and extinction recall. SJ was not correlated with mean reactivity to CS+s during Conditioning, mean Extinction CS+E reactivity or Recall CS+U reactivity (first two presentations; CS+U represents the stimulus conditioned but not extinguished) (all *p*s>.44).

**Table S1.** Average weekday and weekend sleep timing.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | MWD | SD | MWE | SD | t | df | p |
| TST (mins) | 390.0 | 56.5 | 422.9 | 75.5 | -4.76 | 74 | <0.001 |
| Midpoint (mins past midnight)  | 288.8 | 57.1 | 351.6 | 67.9 | -8.52 | 74 | <0.001 |

Note. MWD, mean weekday; MWE, mean weekend;

**Supplementary References**

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