Supplementary

Title: Sleep inconsistency between weekends and weekdays is associated with changes in brain function during task and rest

Rui Zhang [a*], Dardo Tomasi [a], Ehsan Shokri-Kojori [a], Corinde E. Wiers [a], Gene-Jack Wang [a], Nora D. Volkow [a,b]

[a] *National Institute on Alcohol Abuse and Alcoholism, Laboratory of Neuroimaging, National Institutes of Health, Bethesda, MD 20892-1013, USA*

[b] *National Institute on Drug Abuse, National Institutes of Health, Bethesda, MD 20892-1013, USA*

***Corresponding author:**

Rui Zhang

Laboratory of Neuroimaging

National Institute on Alcohol Abuse and Alcoholism

National Institutes of Health

10 Center Drive, Room B2L124: MSC 1013

Bethesda, MD 20892-1013, USA

Tel. +1 (301)-402-5861

E-mail address: rui.zhang@nih.gov

Age, gender, sleep and sleep inconsistency

Age was negatively associated with average sleep timing (i.e older participants have on average a more advanced sleep timing) ($r=-.349$, $p=.008$). Females slept longer than males ($t=2.74$, $p = .008$). There were no significant correlations between age, gender and sleep inconsistency (all $|r|<.26$, all $p>.05$).

Age, gender and VAT behavioral performances

Increased age predicted lower accuracy (3-ball: $\beta=-.51$, $t=-3.95$, $p < .001$; 4-ball: $\beta=-.44$, $t=-3.19$, $p = .003$). Males responded faster than females in the 2-ball condition ($\beta=-.32$, $t=-2.23$, $p = .026$). All other effects were not significant.

Age, gender and VAT activation

The main effect of age on VAT activation was significant in the left middle frontal gyrus (Talairach peak -24, 22, 36, K=50, F= 22.28), the right angular gyrus (Talairach peak 42, -66, 28, K=43, F= 26.35), left culmen (Talairach peak -8, -28, -8, K=26, F= 20.51), left anterior cingulate (Talairach peak -12, 28, 24, K=24, F= 20.63) and left parahippocampal gyrus (Talairach peak -30, -44, -10, K=21, F= 26.52). Age was positively correlated with VAT activation (i.e. less deactivation) in these regions (all $r>.31$).

The main effect of gender on VAT activation was significant in the right caudate (Talairach peak 16, -18, 20, K=22, F= 19.70) and left middle frontal gyrus (Talairach peak -40, 54, -4, K=21, F= 18.02). The activations in these regions was higher in females than males (all $t>2.12$, all $p<.04$).

Age, gender and RSFC

Lower connectivity between the right SFG and left cerebellum (MNI peak -34, -66, -30, cluster FDR: P= .005, K=41, t=-5.61) was associated with increased age. No other effects survived p< .01, cluster corrected.

Comparison of longer vs. shorter WE sleep duration relative to WD

We compared absolute differences of sleep duration between WE and WD and VAT performance in participants who showed longer vs. shorter WE sleep duration than WD. Nonparametric Mann-Whitney U Test was used to examine group differences in non-normally distributed variables: absolute sleep inconsistency and VAT accuracy (Kolmogorov Smirnov test $p<0.05$), and independent T-tests were used for normally distributed VAT RTs. Absolute sleep duration differences between WE and WD were statistically significantly higher in participants who showed longer WE sleep (mean rank=31.92) than in participants with shorter WE sleep (mean rank=22.35) than WD, U = 237, z = -2.103, p = .035. No significant group differences were found in VAT performance. The lack of group differences in VAT performance can reflect the relatively small sample sizes in the two groups. It is also possible that participants with shorter WE sleep relative to WD in the current study might have had limited deficits in VAT performances.

We also separately examined the relationship between absolute sleep duration differences between WE and WD and VAT performances in the two groups. A tendency towards beneficial effect of longer WE sleep on VAT performance was observed: participants who had longer WE sleep, larger sleep consistency (WE-WD) showed a trend for an association with better performance (3-ball: $F(4,31)=1.94$, $p=.129$, adjusted

R^2=.097, β=.31, t=1.77, p = .087). In contrast, among participants who showed shorter WE sleep than WD, larger sleep inconsistency (WD-WE) correlated with worse VAT performance (4-ball: F(4,13)=3.16, p=.051, adjusted R^2=.337, β=-.49, t=-2.41, p = .032).