Supplemental Materials

The Effects of an Afternoon Nap on Episodic Memory in Young and Older Adults

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Table S1. Mean performance on memory tests (standard deviations in parentheses) across older adults recruited from the Alzheimer's Disease Research Center (ADRC) and the general public.

	ADRC		**GENERAL PUBLIC**		**ANOVA Results**	
	Nap Condition (*n* = 23)	Wake Condition (*n* = 12)	Nap Condition (*n* = 6)	Wake Condition (*n* = 4)	Group Main Effect	Group by Condition Interaction
Encoding Phase Hits (24 possible)	9.52 (3.42)	8.42 (5.11)	8.50 (3.83)	9.50 (3.11)	$F < 1$, $p = .98$	$F < 1$, $p = .48$
Free Recall Hits (100 possible)	6.30 (4.26)	5.17 (2.52)	3.67 (3.27)	5.00 (2.58)	$F = 1.10$, $p = .30$	$F < 1$, $p = .36$
Free Recall False Alarms	2.61 (2.33)	6.33 (9.48)	3.83 (3.82)	3.25 (2.99)	$F < 1$, $p = .65$	$F = 1.16$, $p = .29$
Recognition (total)	.69 (.06)	.68 (.07)	.66 (.06)	.73 (.06)	$F < 1$, $p = .70$	$F = 2.37$, $p = .13$

Table S2. Mean performance on memory tests (standard deviations in parentheses) across healthy older adult wake, healthy older adult sleep, and older adult sleep apnea participants. The participants in the sleep apnea group had previously received a diagnosis of sleep apnea or showed an AHI > 15 on their Session 1 qualifying nap; participants in the healthy adult sleep group showed an AHI < 5.

	Healthy Adult Wake Group (n=16)	**Healthy Adult Sleep Group (n=13)**	**Sleep Apnea Participants (n=16)**	**ANOVA**
Encoding Phase Hits (24 possible)	8.69 (4.61)	9.38 (3.80)	9.25 (3.30)	F < 1, p = .88
Free Recall Hits (100 possible)	5.13 (2.44)	5.69 (4.15)	5.81 (4.31)	F < 1, p = .86
Free Recall False Alarms	5.56 (8.34)	2.69 (2.02)	3.00 (3.16)	F = 1.28, p = .29
Recognition (total)	.69 (.07)	.69 (.06)	.68 (.07)	F < 1, p = .83

Table S3. Proprietary computational software MATLAB® v.R2013a (MathWorks®, Natick, MA) was used to complete all quantitative EEG analyses on the first 24 young adults in the nap condition during Session 2. EEG data were collected with impedances below 10,000 ohms (and when achievable under 5,000 ohms) at a sampling rate of 500 Hz. Prior to analysis, we manually excluded 30-second epochs that contained artifacts. To obtain relative spectral power results, frequency content from channels C3-A2 and C4-A1 were processed using the discrete fast-Fourier transform. To obtain power density spectra for each frequency band (delta: 0.5-4.0Hz, theta: 4.25-7.75Hz, alpha: 8.00-11.75Hz, and sigma: 12.00-16.00Hz), the Welch's[1] power spectral density was calculated using 50% overlap of Hamming tapers (4 seconds) and 0.25 Hz frequency resolution, averaged over each 30 second epoch of NREM sleep. For sleep spindle computations we developed an adaptation of the automated spindle detector methodology established by Ferrarelli and colleagues.[2] More specifically, EEG data were band-pass filtered between 12 and 15 Hz and the absolute amplitude of the band-pass filtered signal was used to detect spindle activity in one-second non-overlapping moving windows using lower and upper thresholds (2 and 8, respectively) multiplied by the average amplitude of the absolute value of the entire band-pass filtered signal. Band-pass filtered C3-A2 and C4-A1 signal exceeding threshold values were identified as spindle activity. Spindle density was separated by N2 (n=24) and N3 (n=20) sleep stages (as well as combined across N2 and N3 stages) such that we divided the total number of spindles by the number of minutes in the respective sleep stage.

	Mean (SD)	***Correlation with Free Recall Hits***	***Correlation with Recognition D-Prime***
Relative Delta	80.28 (10.41)	$r(22) = -.18$	$r(22) = .17$
Relative Theta	10.81 (5.14)	$r(22) = .17$	$r(22) = -.11$
Relative Alpha	5.65 (4.03)	$r(22) = .24$	$r(22) = -.21$
Relative Sigma	3.26 (1.83)	$r(22) = .02$	$r(22) = -.22$
Spindle Density - N2	3.15 (2.26)	$r(22) = -.20$	$r(22) = .01$
Spindle Density - N3	1.39 (1.34)	$r(18) = -.36$	$r(18) = -.13$
Spindle Density - N2 and N3 combined	2.38 (1.95)	$r(22) = -.25$	$r(22) = -.16$

Note: All quantitative EEG correlations with free recall hits and d-prime recognition performance were nonsignificant ($p > .10$).

Table S4. Older adult group correlations between Session 2 polysomnography measures and memory retention. Note that the older adults did not demonstrate a significant nap/wake condition effect for either free recall hits or d-prime recognition performance, which was our a priori criterion for determining whether to conduct correlational analyses. We have provided the below correlational analyses within the older adult nap condition (n = 29) solely for archival purposes.

	Correlation with Free Recall Hits	***Correlation with Recognition D-Prime***
Total Sleep Time (minutes)	$r(27) = -.20$	$r(27) = -.28$
Sleep Efficiency (%)	$r(27) = -.17$	$r(27) = -.21$
Wake After Sleep Onset (minutes)	$r(27) = .05$	$r(27) = .12$
Sleep Onset Latency (minutes)	$r(27) = .31$	$r(27) = .16$
N1 (minutes)	$r(27) = -.15$	$r(27) = -.004$
N2 (minutes)	$r(27) = -.16$	$r(27) = -.17$
N3 (minutes)	$r(27) = .10$	$r(27) = -.19$
REM (minutes)	$r(27) = -.25$	$r(27) = -.32^{\dagger}$
Apnea-Hypopnea Index	$r(27) = .13$	$r(27) = -.03$
Mean SaO2 (%)	$r(27) = .24$	$r(27) = .15$

† indicates $p < .10$

Supplementary References

1. Hayes MH. Statistical Digital Signal Processing and Modeling. John Wiley & Sons; 2009.

2. Ferrarelli F, Huber R, Peterson MJ, et al. Reduced sleep spindle activity in schizophrenia patients. Am J Psychiatry. 2007;164:483-92.