Online Supplementary

Itemized Analysis of Sleep Quality and WM in Study 1

The global PSQI score consists of assessments (sub-scores) of different aspects of sleep patterns. It is possible to identify specific items in PSQI that may be related to *K* (see Supplementary Table S1). Among the 7 sleep sub-scores, latency (how long does it take for one to fall into sleep) and sleep efficiency (the amount of time asleep given the total amount of time in bed) were both significantly correlated with WM K, such that people with longer sleep latency (r = -.22 [-.39, -.04], p = .021) or lower sleep efficiency (r = -.21 [-.38, -.02], p = .028) showed smaller *K*. In contrast, none of these sleep quality sub-scores significantly correlated with *SD* (all *ps* > .05).

Supplementary Table S1. Itemized correlations between sleep quality and other variables of interests in Study 1

	WM Capacity(r)	p	WM Precision(r)	p	Depression(r)	p
Duration	-.16	.09	.01	.89	.22	.02
Disturbance	-.04	.69	.09	.32	.35	<.001
Latency	**-.22**	**.02**	.03	.72	.28	< .01
Day dysfunction	-.13	.19	.07	.49	.50	<.001
Sleep efficiency	**-.21**	**.03**	.04	.64	-.003	.98
Overall quality	-.18	.06	.17	.08	.41	<.001
Need of Medication	.02	.82	.04	.65	.22	.02

Path Analysis Based on Full Scales of PHQ-9 and PSQI in Study 1

Multicollinearity (i.e., high correlation between predictors) is intrinsically problematic for assessment of independent contributions of depressed mood and sleep quality to other outcome variables (e.g., Alvaro, Roberts, & Harris, 2014). When measures of depressed mood and sleep quality contain conceptually overlapping items, the multicollinearity issue is further inflated. For example, in Study 1, without taking out overlapping items, the correlation between PHQ-9 and PSQI scores was .54 ($p < .001$, considered as a large effect), in contrast to the correlation of .38 ($p < .01$, medium effect) after taking out overlapping items. Although depressed mood and low sleep quality may be intrinsically related, the high correlation in the full scale can also be contaminated by confounds in measurement.

This issue of multicollinearity in the full scales PHQ-9 and PSQI indeed reduced the predictive power of both predictors on K. Specifically, in a simple multiple regression, the full-scale PHQ-9 ($\beta = -.16$, $p = .13$) and PSQI ($\beta = -.19$, $p = .08$) scores failed to reach statistical significance for predicting K. This contrasts with the significant predictive power of both factors on K after overlapping items were removed (as discussed in the main text). Thus, we speculated that the lack of significant findings in the full-scale PHQ-9 and PSQI was due to inflation of multicollinearity caused by a measurement confound.

Indeed, some previous studies used measures of depressed mood and sleep quality that contain no overlapping items. For example, Gregory and colleagues (2011) used the Short Mood and Feelings Questionnaire (SMFQ, Angold et al., 1996) to measure depressed mood and PSQI to measure sleep quality. None of the items in the SMFQ are related to sleep quality. It would be interesting to generalize the current findings of PHQ-9 and K to SMFQ.

In addition to the removal of the overlapping items on PHQ-9 and PSQI, the path analysis takes into account the correlated nature between depressed mood and sleep quality. That is, we examined the contribution of depressed mood and PSQI after taking out the overlapping items through a regression approach. This approach can tell us whether depressed mood can predict K while holding sleep quality constant (thus statistically controlling sleep quality), and whether sleep quality can predict K while holding depressed mood constant. Although this approach may not be optimal (as discussed in Miller & Chapman, 2001), it is still useful in revealing the relationship among depressed mood, sleep quality, and WM capacity by minimizing measurement confounds.

Test of Mediation Effect in Study 1

To test whether the effect of sleep quality on WM capacity was mediated by depressed mood, we performed the Sobel's test (Sobel, 1982) to determine if the inclusion of depressed mood as a potential mediator would significantly reduce the relationship between sleep quality and WM capacity. We used the short-form sleep quality and depressed mood scores in the model to reduce multicollinearity from overlapping measurement items (Alvaro et al., 2014). While the direct effect of sleep quality on K remained statistically significant ($\beta = .20$, $p = .047$), the mediation effect of depressed mood on the relationship between sleep quality and K failed to reach significance ($z = 1.73$, $p = .082$).

Additional Analysis Based on Group Means

We also performed additional analysis to evaluate the possible independent contribution of depressed mood and sleep quality on K in Study 1. Specifically, we looked at people with high PSQI (by convention PSQI > 5) and low PHQ-9 (by convention PHQ-9 <10) and vice versa) based on conventional cut-offs. Supplementary Table S2 summarizes the mean K for each cell.

The relationship between PSQI and WM K is clear in that sleep problem alone (second row, PHQ <= 10) leads to a reduction in K (from 3.28 to 2.94, $t_{(101)} = 2.28$, p = .024). However, we do not have subjects who scored high in PHQ-9 but low in PSQI. In addition, in the group of “bad sleepers” (PSQI > 5), the participants who had more depressed mood (PHQ-9 > 10) had a lower K (2.74) compared to participants had less depressed mood (K = 2.94), suggesting that depressed mood could also result in a reduction in K independent of sleep quality. However, this statistical comparison failed to reach significant level (t <1), given a small sample size in the high PHQ-9 and high PSQI cell (N = 7). Nonetheless, the data pattern is in line with the independent predictive power of depressed mood and sleep quality on K. The regression approach that includes all groups of participants may thus permit greater statistical power to detect these effects.

Supplementary Table S2. Additional Analysis based on Group Means

	PSQI (>5)	PSQI (<=4)
PHQ (> 10)	K = 2.74, N = 7	N = 0
PHQ (<= 10)	K = 2.94, N = 44	K = 3.28, N = 59

Performance on Control Tasks in Study 2

Supplementary Table S3. Correlations between variables of interest and circular SD in the motor and perception tasks in Study 2.

	Circular SD Motor (*r*)	*p*	Circular SD Perception (*r*)	*p*
Capacity	.0007	.997	-.27	.14
SD	.27	.13	.31	.09
Age	.22	.23	.17	.36
Sleep quality	-.11	.55	.17	.35
Depression	.04	.82	.02	.91

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