Prospective Memory and Sleep Quality

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Abstract: Sleep is a state in which the human mind and body are rested, while prospective memory helps humans remember future tasks or plan future events.[1] This study used the Comprehensive Assessment of Prospective Memory (CAPM) and the Sleep Quality Questionnaire (PSQI) to assess whether sleep quality affects prospective memory performance. The results showed that participants with PSQI scores between 6 and 21 had significantly lower CAPM scores than those between 0 and 5. Therefore this paper shows poor sleep quality, as measured by PSQI scores, was associated with a higher frequency of prospective memory failure. This result suggests better sleep quality is associated with better performance in prospective memory. Prospective memory is crucial to our daily life, and loss of prospective memory can have dire consequences. For example, people with diabetes forget to take their daily insulin injections. That's why research on prospective memory is essential.

Keywords: memory, sleep quality, memory performance

1.   Introduction

Memory is a very important part of human cognition, which is analyzed and studied by scientists in many fields and helps humans to store, acquire and search for known information. Memory is also essential to our daily life. For example, memory is needed for learning, work, and everyday life.

Likewise, prospective memory is important as remembering to perform a predetermined future action at a future time. It involves responding to a specific event or performing a particular task and upcoming events in the future.[1] For example, a friend's birthday or a holiday.

Studies have shown that people who sleep better usually also perform better in prospective memory, suggesting a potential link between prospective memory and sleep.[2] So prospective memory is a factor that has been found to impact sleep quality significantly. With this possible link, studying the relationship between prospective memory and sleep quality could help us provide insights and comments on improving daytime performance and sleep patterns and promoting health.

Sleep is equally important to humans as it is an active process that helps the brain consolidate and integrate memories.[3] So sleep is a critical physiological process for humans, and it is essential for maintaining mental health and physical health. However, sleep is also susceptible to influences such as our daily routines and lifestyles can affect sleep.

This study hypothesizes that the change in sleep quality will negatively affect prospective memory. The bad the sleep quality, the poorer the prospective memory will be. Our study perspective is the correlation between memory and sleep quality.

2.　Method

Participant: A standard sample of 129 participants aged 17 to 28 was recruited. Unfortunately, 7 participants did not meet the age criteria for the trial, and 7 had problems filling in the data incorrectly during the filling-in as the warming process, so we removed the data for 14 participants. So, our final sample size was 115 participants combined with 50 Males and 65 Females. Participants were recruited from the investigator's own school or social network as a sample. Individuals were then excluded based on the actual profile of the participant. Most participants were from China, with about half being from the Chinese international student population.

The Pittsburgh Sleep Quality Index (PSQI) and the Comprehensive Assessment of Prospective Memory (CAPM) were used to determine whether Sleep quality change will negatively affect Prospective memory; the lower the sleep quality, the less the prospective memory will be. The Comprehensive Assessment of Prospective Memory Questionnaire (CAPM) is a self-report questionnaire used to assess prospective memory, and it takes approximately 15-20 minutes to complete both questionnaires.

The CAPM questionnaire has a three-section atmosphere, and by then, the focus of this study was fit in section A, Section A has 39 questions. The scale used in this questionnaire is a 5-point scale, with 1 representing "Never", 2 representing "Rarely", 3 meaning "Occasionally", 4 representing "Often", and 5 representing "Frequently". often", and 5 for "frequently", and the questionnaire has a different option of "N/A" so that participants can select "N/A" if they do not feel like answering the question or if the rating does not apply to them. "N/A".

The Pittsburgh Sleep Quality Index (PSQI) questionnaire has 7 components and 25 questions. It takes approximately 10 minutes to complete the questionnaire. PSQI questionnaire is related to the participant's daily sleep habits during the past month.[4] The independent variable of this study is PSQI mean score, and The dependent Variable is CAPM mean score.

3.　Measure

The final score was calculated by summing the ratings of the items completed by the participant on a scale of 1-5, dividing by the sum of the items, and subtracting the things for which the participant selected "N/A". The higher the final score of the participant portfolio, the more frequently the PM failed. The final score was calculated by summing the participant's rating on 1-5 for all completed and dividing by the total number of items less the N/A items.

4.　Procedure

Informed consent was obtained from all participants after an ethical review of the study by the relevant university committee. The questionnaire was created through "Questionnaire Star" and a QR code was generated. The QR code was sent to the participants via WeChat or other social networking software, and they clicked to submit the questionnaire after completing it.

5.　Analysis

To find out the correlation between sleep quality and prospective memory by analyzing the data of the two questionnaires. All statistical analyses will be performed using IBS SPSS.

6.　Result

This experiment invited 115 college students, 65 females, and 50 males, to participate in the investigation. Participants measured PSQI and CAPM scores by self-report, and the researchers calculated the mean PSQI and CAPM scores separately. An independent samples t-test was used in

the study to compare the prospective memory CAPM scores of participants with two different PSQI scores (0-5, 6-21). The test results showed that future memory scores for PSQI scores of 0-5 were significantly lower than those of participants with PSQI scores of 6-21.

	Psqi mean score	N	mean	Std. Deviation	Std. Error Mean	
Capm mean score	0-5	40	2.02	.44	.069	
Capm mean score	6-21	75	2.50	.77	.089	

Figure 1: Mean score of PSQI questionnaire and CAPM questionnaire.

Figure 1 shows that PSQI mean scores of 0-5 (n=40) and PSQI mean scores of 6-21 (n=75) were measured as CAPM scores, respectively. The data showed a t-value of -4.29 and a p-value less than 0.001; the t-test revealed. The difference between the two groups had a medium effect size, with a Cohen's d value of 0.67. The difference in prospective memory scores between the two groups had a medium effect size, with a Cohen's d value of 0.67. the difference in future memory scores between the two groups had a 95% confidence interval (CI) of -0.71 to -0.26.

T-Test

Group Statistics

	psqimeanscore	N	Mean	Std. Deviation	Std. Error Mean
capmmeanscore	1	40	2.0214	.43735	.06915
	2	75	2.5038	.76909	.08881

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
capmmeanscore	Equal variances assumed	14.232	<.001	-3.659	113	<.001	<.001	-.48242	.13183	-.74359	-.22124
	Equal variances not assumed			-4.286	112.480	<.001	<.001	-.48242	.11255	-.70542	-.25941

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
capmmeanscore	Cohen's d	.67332	-.716	-1.110	-.320
	Hedges' correction	.67783	-.712	-1.103	-.318
	Glass's delta	.76909	-.627	-1.022	-.228

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure 2: Independent sample t-test of PSQI and CAPM mean score.

Figure 2 shows the analysis results showed that the independent sample t-test analysis used in this study supported the hypothesis: "The change of sleep quality will negatively affect prospective memory. the bad the sleep quality, the Our study perspective the correlation between memory and sleep quality." This result demonstrates that poor sleep quality, as measured by PSQI scores, is associated with a higher frequency of prospective memory failure, and that participants with PSQI scores of 6-21 had more poor prospective memory than participants with PSQI scores of 0-5.

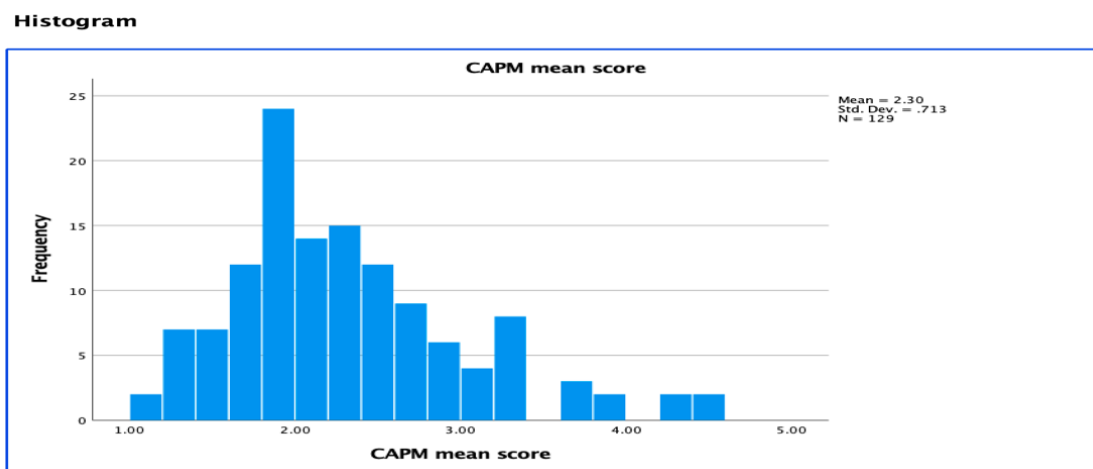|		CAPM mean score	PSQI mean score
N	Valid	129	129
	Missing	0	0
Skewness		.937	−.678
Std. Error of Skewness		.213	.213
Kurtosis		.784	−1.564
Std. Error of Kurtosis		.423	.423

Figure 3: Statistics.

Figure 4: CAPM mean Score.

Figure 3 and Figure 4 show Skewness = .937, which means this is a positive skewness.

7. Discussion

Through independent sample t-test, the experimental result agrees with our hypothesis. Our expected outcome is that the worse the quality of sleep, the poorer the prospective memory. The higher the PSQI final score of the participant portfolio, the more frequently the Prospective Memory failed.

Other studies have also supported our results. For example, an analysis showed that participants with better sleep quality had higher prospective memory performance than those with poorer sleep quality. [5] Another study showed that sleep quality was positively associated with forthcoming memory performance in older adults.[6]

Another possible explanation is that poor sleep quality may lead to increased tiredness and decreased alertness, which can negatively affect cognitive processes such as attention and memory. This can result in a reduced ability to remember to perform intended actions at specific times or in response to particular cues.

In conclusion, maintaining good sleep quality is essential for preserving the prospective memory function.

The limitation of this experiment is that all participants are college students aged between 17-28, and almost all participants are Chinese, which does not represent all adult groups.

For future study since our study was limited to 17-28 years old and all university students were Chinese, we hope to invite more participants of different ages from different countries for future

studies so that the findings can be more informative and can be demonstrated in all age groups and nations.

8.   Conclusion

The study found a significant correlation between sleep quality, as measured by the PSQI score, and prospective memory performance. Prospective memory is essential for many daily activities, such as remembering to take medication, attend appointments, or complete tasks on time.

In summary, the study provides evidence that poor sleep quality is associated with a higher frequency of prospective memory failures. So, we suggest keeping a good sleep quality for preserving forthcoming memory function and overall well-being. We hope this study will give you a better understanding of the complex interactions between sleep and perspective and how to apply this knowledge to improve memory functions.

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Appendix

The Comprehensive Assessment of Prospective Memory (CAPM).

Appendix Y: The Comprehensive Assessment of Prospective Memory (CAPM)

Note. Thank you to Jennifer Fleming for permission to use the CAPM in this study.

Section A and B

Section A rating scale:

1 = *never*, 2 = *rarely (once/month)*, 3 = *occasionally (2-3 times/month)*, 4 = *often (once/week)*, 5 = *very often (daily)*, NA = *not applicable*.

Section B rating scale:

1 = *not a problem at all*, 2 = *a slight problem*, 3 = *a moderate problem*, 4 = *a serious problem*, 5 = *a very serious problem*, NA = *not applicable*.

Items

1. Forgetting to buy an item at the grocery store
2. Forgetting an appointment with your doctor or therapist
3. Leaving the iron on
4. Forgetting to put the garbage bin out
5. Forgetting a change in your daily routine (e.g. turning up to a regular meeting when the regular meeting day has been changed)
6. Not locking the door when leaving home
7. Walking into a room and forgetting why you went there
8. Mistakenly following your old routine, when it has been changed (e.g. putting out rubbish at the wrong time when the collection day has been changed)
9. Forgetting to water pot plants or the garden
10. Forgetting to pass on a message
11. Forgetting to take tablets at the prescribed time
12. Forgetting to take clothes off the line
13. Forgetting to have a shower or bath
14. Performing a routine activity twice by mistake (e.g. putting two lots of coffee in a cup)
15. Forgetting to eat a meal
16. Forgetting to get money from the bank
17. Accidentally forgetting to put an article of clothing on when you get dressed (e.g. forgetting to put your socks on)
18. Forgetting to take your wallet or purse with you when you leave the house

SELF-REPORTED PROSPECTIVE MEMORY

19. Problems remembering future personal dates, such as birthdays

20. Accidentally forgetting a grooming activity (e.g. brushing your hair, shaving)

21. Forgetting to make a telephone call you intended to make

22. Forgetting to do cleaning chores

23. Leaving water taps on

24. Not remembering to bank a cheque

25. Leaving out an ingredient you planned to use while cooking or preparing a meal

26. Accidentally forgetting to brush your teeth

27. Arriving at a shop and forgetting what you planned to buy

28. Forgetting to mention a point you intended to make during a conversation

29. Forgetting to put petrol in your car

30. Not remembering to pay bills

31. Having to check whether you have done something you have planned to do

32. Forgetting to do the laundry

33. Forgetting to meet a friend at the pre-arranged time

34. Leaving the stove on

35. Forgetting to post a letter

36. Not remembering to check the water levels/tyre pressure of your car

37. Forgetting to check your calendar or diary

38. Forgetting to turn the heater off

39. Forgetting to take your diary

The Pittsburgh Sleep Quality Index (PSQI).

PSQI
Pittsburgh Sleep Quality Index

Name: _____   Date: _____

The following questions relate to your usual sleep habits during **the past month only.**
Your answers should indicate the most accurate reply for the **majority** of days and nights in the past month.

Please answer all questions.

1   During the past month, when have you usually gone to bed at night?   Usual bed time   _____

2   During the past month, how long (in minutes) has it usually taken you to fall asleep each night?   Number of minutes   _____

3   During the past month, when have you usually gotten up in the morning?   Usual getting up time   _____

4   During the past month, how many hours of *actual sleep* did you get at night? (This may be different than the number of hours you spend in bed.)   Hours of sleep per night   _____

For each of the remaining questions, check the one best response. Please answer *all* questions.

5   During the past month, how often have you had trouble sleeping because you...

	Not during the past month (0)*	Less than once a week (1)*	Once or twice a week (2)*	Three or more times a week (3)*
a. cannot get to sleep within 30 minutes	☐	☐	☐	☐
b. wake up in the middle of the night or early morning	☐	☐	☐	☐
c. have to get up to use the bathroom	☐	☐	☐	☐
d. cannot breathe comfortably	☐	☐	☐	☐
e. cough or snore loudly	☐	☐	☐	☐
f. feel too cold	☐	☐	☐	☐
g. feel too hot	☐	☐	☐	☐
h. have bad dreams	☐	☐	☐	☐
i. have pain	☐	☐	☐	☐
j. other reason(s), please describe				

_____

_____

_____

_____

How often during the past month have you had trouble sleeping because of this?	☐	☐	☐	☐

* Scores for each question in a column are in brackets, i.e. if you would answer 'Less than once a week' for question 5a, your score for that question would be '1'

SQI page 1 of 4

BC2007 2021-PSQI

PSQI
Pittsburgh Sleep Quality Index

Name: _____ Date: _____

	Very good (0)*	Fairly good (1)*	Fairly bad (2)*	Very bad (3)*
6 During the past month, how would you rate your sleep quality overall?	☐	☐	☐	☐

	Not during the past month (0)*	Less than once a week (1)*	Once or twice a week (2)*	Three or more times a week (3)*
7 During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?	☐	☐	☐	☐
8 During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	☐	☐	☐	☐

	No problem at all (0)*	Only a very slight problem (1)*	Somewhat of a problem (2)*	A very big problem (3)*
9 During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?	☐	☐	☐	☐

	No bed partner or room mate**	Partner/room mate in other room**	Partner in same room, but not same bed**	Partner in same bed**
10 Do you have a bed partner or room mate?	☐	☐	☐	☐

If you have a room mate or partner, ask him/her how often in the past month you have had...

	Not during the past month**	Less than once a week**	Once or twice a week**	Three or more times a week**
a. loud snoring	☐	☐	☐	☐
b. long pauses between breaths while asleep	☐	☐	☐	☐
c. legs twitching or jerking while asleep	☐	☐	☐	☐
d. episodes of disorientation or confusion during sleep	☐	☐	☐	☐
e. other restlessness while you sleep; please describe	☐	☐	☐	☐

_____
_____
_____
_____
_____
_____

* Scores for each question in a column are in brackets, i.e. if you would answer 'Fairly bad' for question 6, your score for that question would be '2'
** Question 10 is not scored (but still needs to be answered)

PSQI page 2 of 4

BC2007 2021-PSQI