2025 Spring Stats 101B

MEMORY STUDY

Ziteng Cheng
Hang Yin
Quanliang Chen
Jiarui Tang
Tsz Ching Cheng

Literature

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- Short-term memory performance is influenced by a range of physiological, psychological, and lifestyle factors. Among them, **emotional states** have been shown to significantly affect encoding and retrieval processes. For instance, positive affect has been associated with broader attentional scope and improved cognitive flexibility, potentially enhancing memory performance, while negative affect (e.g., sadness or anxiety) may impair attention and working memory capacity (Mitchell & Phillips, 2007; Storbeck & Clore, 2005).

- Beyond emotional state, sensory experiences such as **beverage temperature** may influence cognitive functioning through physiological arousal. Research suggests that warm beverages may trigger parasympathetic relaxation responses, while cold beverages can elevate alertness (Zald & Pardo, 2002).

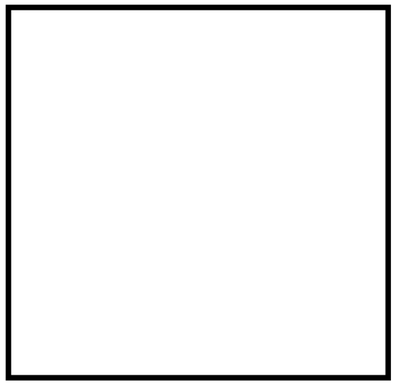
Research Question:

- Understanding how internal factors affect short-term memory is increasingly relevant in both educational and cognitive science contexts. Memory performance plays a crucial role in learning, decision-making, and daily functioning.
- While many studies have examined external influences such as sleep or stress, less is known about how internal lifestyle factors—like beverage temperature and emotional state—may impact memory capacity.

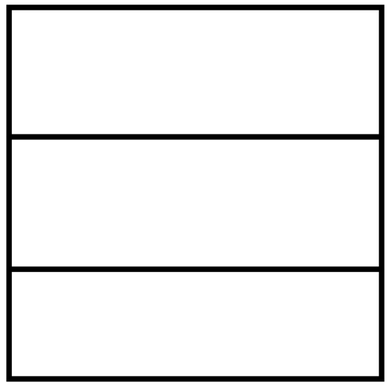
How do beverage temperature and emotional states independently and interactively influence short-term memory performance?

Design

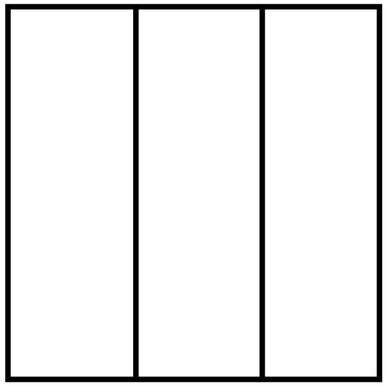
Response Variable:	memory test score		
beverage temperature:	cold milk	warm milk	hot tea
Emotional State:	happy	neutral	Sad
Blocking Factor:	Gender		



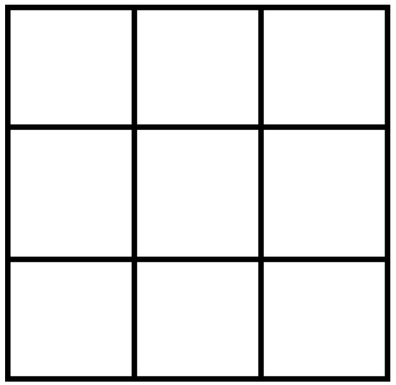
Benchmark



beverage temperature



Emotional State



Interaction

Sampling Methods:

- We implemented a four-step random sampling scheme using Python's built-in pseudo-random generator (seeded by system time).

1. First, we randomly selected one city.

2. Within that city, randomly chose a house. If the house was unoccupied, we go back to step 1.

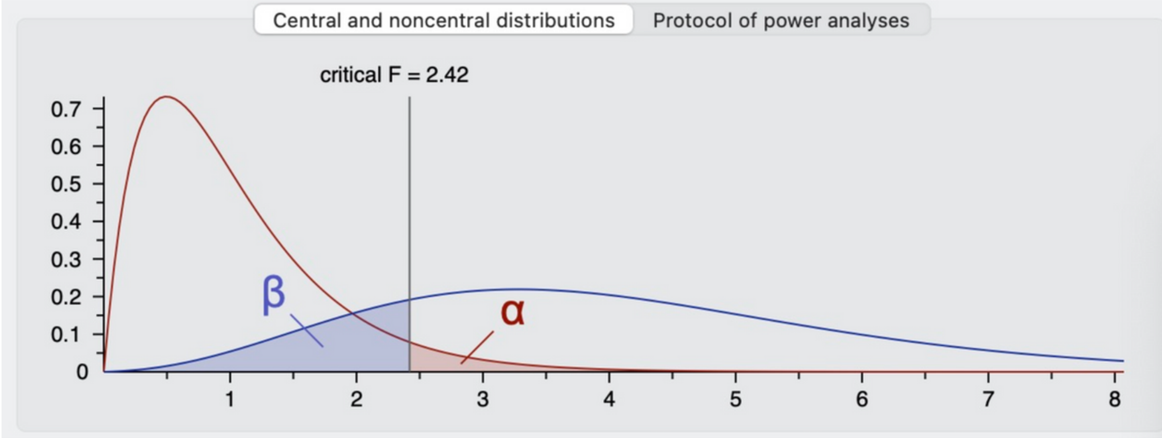
3. If it was occupied, we check all residents for age criteria; if no one met the age requirement, go back to step 1.

4. If the house contained at least one eligible individual, we randomly picked one and requested their consent. If they declined, go back to step 1. If they consented, that individual was enrolled and we proceeded to the next participant.

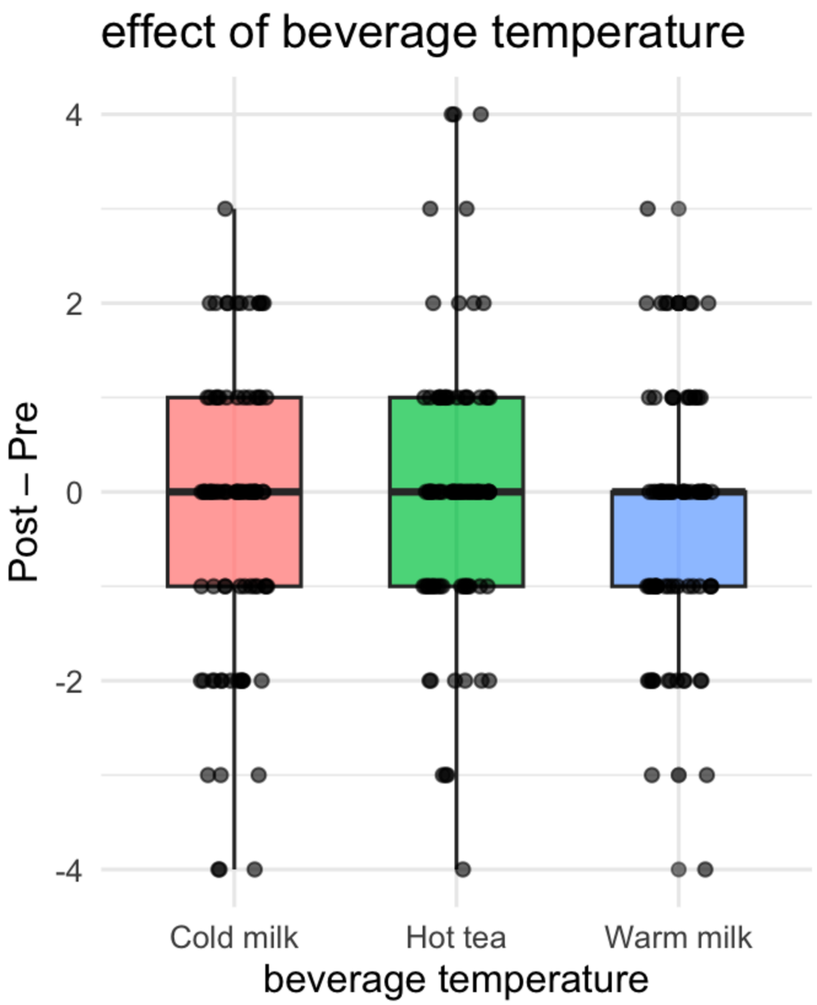
And then we have **261** subjects. Our experiment design has **9 groups**(9 treatment combinations). We use Python randomly generate 261 random number from 1-9(number indicating different treatment), assign each treatment to corresponding subjects.

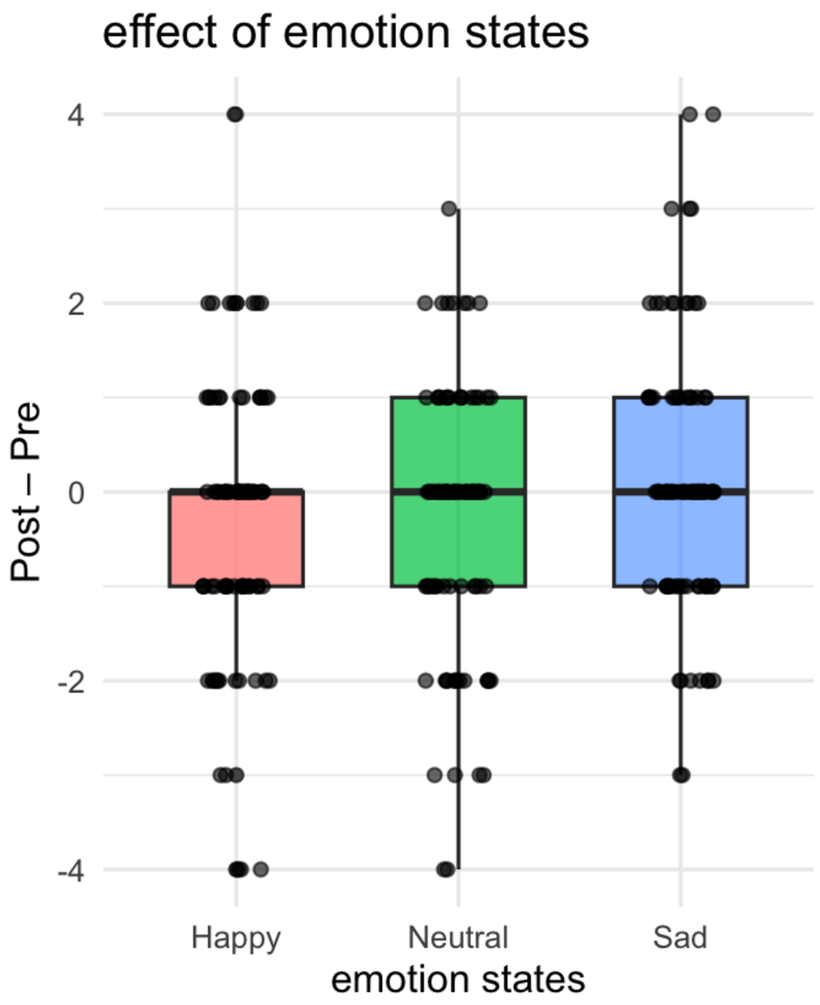
Sample Size Determination:

- Power of 80%
- Alpha: 0.05
- Effect Size: 0.25
- G-Power returned sample size of 197



Comparison


effect of beverage temperature
Post – Pre
4
2
0
-2
-4
Cold milk
Hot tea
Warm milk
beverage temperature


effect of emotion states
Post – Pre
4
2
0
-2
-4
Happy
Neutral
Sad
emotion states

ANOVA Result:

Two-Way ANOVA: *Beverage × Emotion States* effect for memory card test

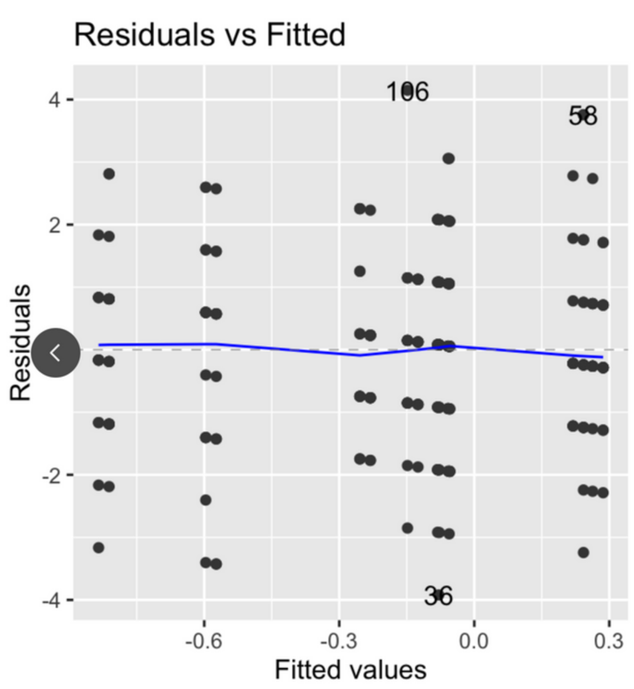
Source	Df	Sum Sq	Mean Sq	F	Pr(>F)
beverage temperature	2	4.008	2.004	0.989	0.373
emotion states	2	12.498	6.249	3.084	0.048
Gender	1	0.004	0.004	0.002	0.966
beverage temperature:emotion states	4	12.120	3.030	1.495	0.204
Residuals	251	508.611	2.026	NA	NA

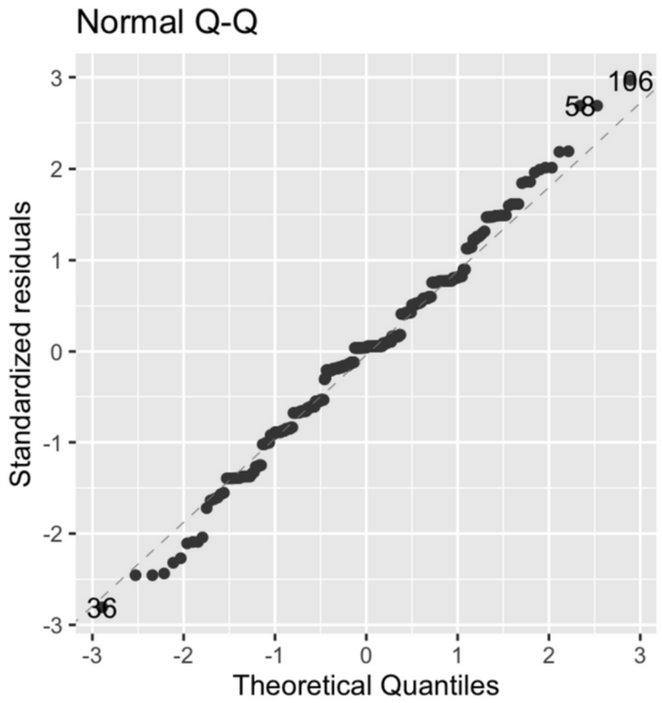
Note: α = 0.05

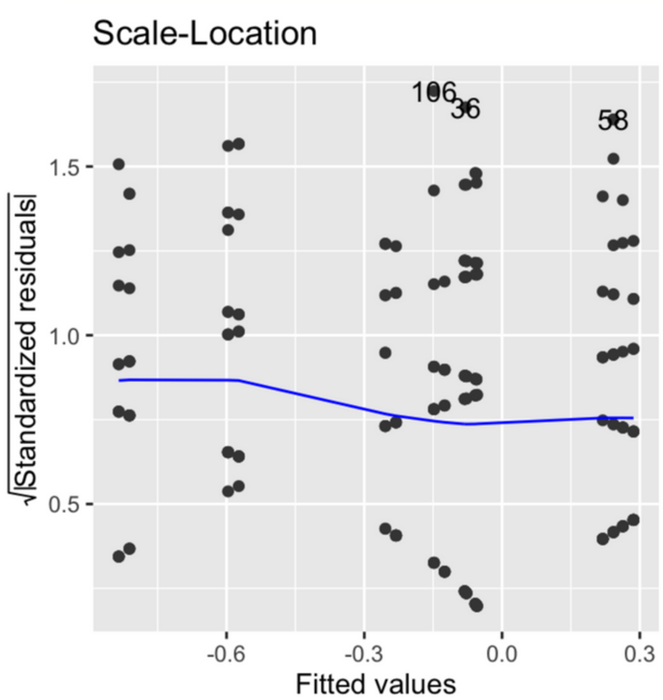
TukeyHSD – Emotion States Comparison

Comparison	diff	lwr	upr	p adj
Neutral-Happy	0.011	-0.498	0.521	0.998
Sad-Happy	0.471	-0.038	0.981	0.077
Sad-Neutral	0.460	-0.050	0.969	0.087

Residual Plots & Model Assumptions







Conclusions

- We assume a **significance level of α = 0.05**.
- The two-way ANOVA showed that **emotional state** had a statistically significant effect on memory performance, while beverage type and the interaction were not significant.
- However, when we followed up with a **Tukey** HSD post-hoc test, none of the pairwise emotion comparisons were statistically significant.
- This suggests that while overall differences among emotional groups exist, no single emotion pair showed a large enough difference to stand out after correcting for multiple comparisons.
- Therefore, **emotion may have a weak or distributed effect**, and the significant ANOVA result should be interpreted with caution.
- We don’t find any statistically significant factors in this experiment.

Future Research Questions

- **Would including more emotionally intense or diverse conditions (e.g., fear, joy, anger) reveal clearer differences in memory performance?**
- **How does the intensity or valence (positive vs. negative) of emotion impact cognitive performance more precisely?**
- **Does the timing of emotional induction (before, during, or after the memory task) influence its effect on memory?**
- **How long do emotional states need to persist to significantly affect short-term vs. long-term memory?**

References

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