Gotta Know 'Em All: Exploring the Role of (Pokémon) Familiarity on Visual Working Memory

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Introduction

Memory operates dynamically, intermixing what we already know in the stimuli that we encounter on a daily basis. However, **working memory (WM)** has historically focused on defining capacity limits (where only a small number of objects can be stored in our WM), using simple stimuli of basic colors and shapes – unreflective of WM in day-to-day applications.

More recent research has started to emphasize the importance of considering the interaction effects of long-term memory (LTM) on WM, and significant evidence shows that WM increases when the stimuli presented is familiar or "meaningful" (have strong established LTM representations).

Additionally, research from Brady and Störmer (2022) showed a novel interaction effect where meaningful objects undergo deeper processing when they were presented one-by-one in a display instead of all-at-once.

This current study aims to explore these familiarity interactions with WM using a novel stimuli, Pokémon, initially tested by Xie and Zhang (2017).

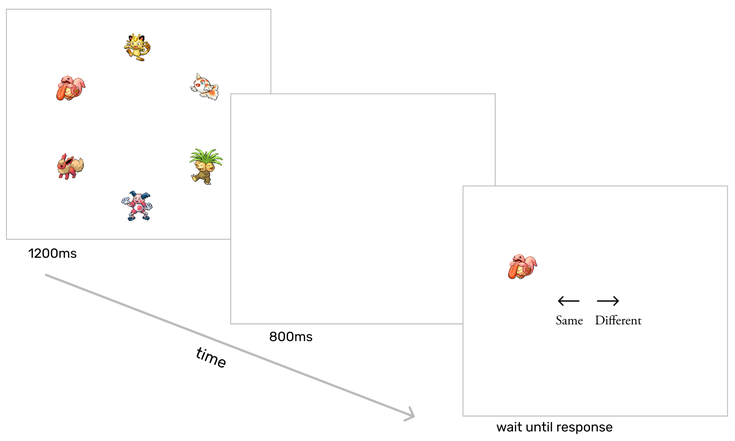
Hypotheses

H1: WM performance in the change detection task and N-back test will be *increased* for participants with high Pokémon familiarity

H2: The two presentation modes (sequential and parallel) will interaction effect with familiarity, where high familiarity participants will have better WM performance in sequential conditions, and low familiarity participants will perform better in parallel conditions (within their familiarity group)

Methods

Change detection task



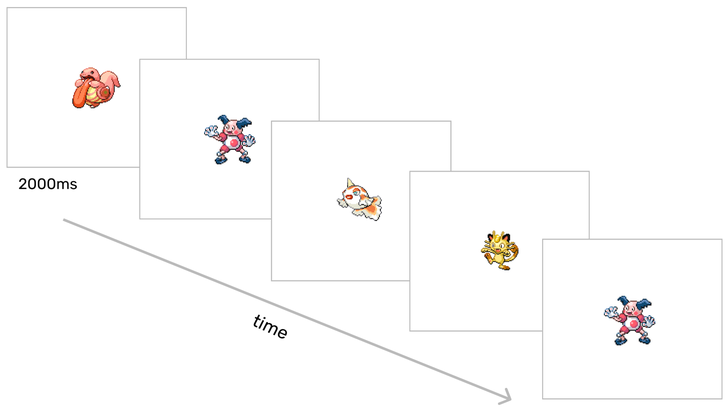
The change detection task visuals are modeled above. Participants were required to try and remember the set of 6 Pokémon images before a short break, and they then had to answer if the cued Pokémon was the same as or different from the image set shown before the break.

Parallel presentation: All 6 Pokémon images in the set were presented simultaneously (displayed for 1200ms)

Sequential presentation: Pokémon were presented one-by-one starting from the 12 o'clock position, in a clockwise order (each image displayed for 200ms then followed by a 200ms inter-stimulus interval)

N-back task

After the change detection task, participants completed an N-back test with the same set of image stimuli. Stimuli would appear one-by-one (as below) and participants were required to make a decision whether it was the same as or different from *N* images ago. *N* could either be 1, 2, or 3.



Measuring familiarity

After the two experiment tasks, participants completed a survey to rate every Pokémon image that appeared (N = 74) on a 5-point Likert scale as well as completing a naming task for the Pokémon.
These two values were averaged per participant, and then a median split (1.93 out of 5)** was applied to form a familiar and unfamiliar with Pokémon group.
**Note that the median is relatively low

Data analysis

- mixed-effects ANOVA used for all group-level analyses
- mixed-model logistic regression calculated for individual-level analyses

Results

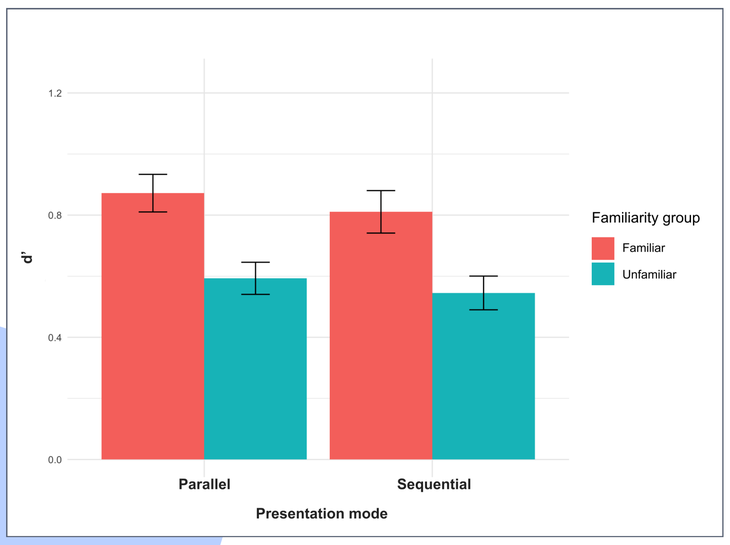
H1 ✓: WM performance is better for familiar participants

Performance in both change detection ($F(1,34) = 12$, $p < .001$, $\eta p2 = .261$) and N-back ($F(1,34) = 4.12$, $p < .05$, $\eta p2 = .108$) tasks was better for high familiarity participants

This also held true in participant-level analyses using a mixed-model logistic regression($\beta = .343$, $p = .042$), indicating the generalizability of this finding as a whole

H2 ✗: There were no interaction effects between familiarity and presentation mode

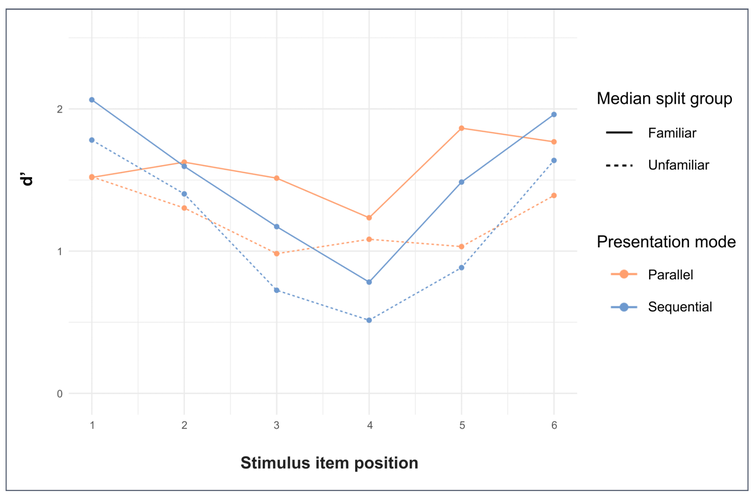
No interaction effects were found ($F(1,34) = .042$, $p = .839$, $\eta p2 = .001$) so it cannot be concluded that familiar stimuli encoded sequentially are processed more deeply.



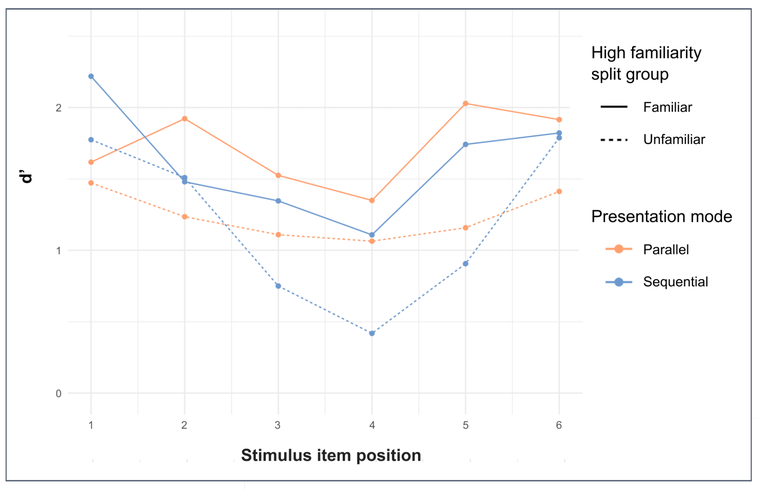
Serial position effects

Order effects were analyzed across presentation modes:

- serial position (recency and primacy) effects found in sequential conditions (indicated by the U-shaped line)
- no position effects were found for parallel conditions (relatively flat line across all positions)



LOW median split→ re-analyze with high familiarity split



Initial pattern for a **reduced serial position effect** when participant familiarity is set to a higher boundary ⟶ suggests that there are additional effects of higher familiarity that the median split was not able to detect

Discussion

1. Strong evidence found to support the theory that VWM is improved for stimuli that are familiar
   - consistent with predicted hypothesis and established research in this topic
2. No evidence found to support sequential encoding leading to deeper processing for familiar items
   - possible that presentation mode may not be meaningful towards its interaction with familiarity, rather it guides a different encoding strategy that favors 2-AFC (used by Brady and Störmer (2022)) vs. same/different (used here)
3. Initial support for **WM resource model** where familiar stimuli consume less WM resources, resulting in better WM performance as there are more resources available to remember more stimuli
   - evidenced by a reduced serial position effect where the middle items in sequence perform worse (larger dip in d')
   - participants who are highly familiar with Pokémon are able to better conserve WM resources for subsequent stimuli
   - WM resource distribution is more evenly spread in parallel conditions, indicating that participants are either able to more evenly spend WM resources when presented with a lot of stimuli or they are randomly attending to a few select stimuli

Limitations and future direction

- Eye-tracking to gain insights into how WM resources are distributed in parallel conditions
- Increase the sample size of participants familiar with Pokémon to have a clearer distinction between the two groups

References

Brady, T. F., & Störmer, V. S. (2022). The role of meaning in visual working memory: Real-world objects, but not simple features, benefit from deeper processing. Journal of Experimental Psychology: Learning, Memory, and Cognition, 48, 942–958. https://doi.org/10.1037/xlm0001014

Xie, W., & Zhang, W. (2017). Familiarity increases the number of remembered Pokémon in visual short-term memory. Memory & Cognition, 45(4), 677–689. https://doi.org/10.3758/s13421-016-0679-7