A Comparison of Working Memory for Auditory, Visual, and Taste

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Introduction

- Working Memory (WM) is the part of short-term memory that is concerned with immediate conscious perceptual and linguistic processing.
- Most research exclusively uses either language, vision, or sound to measure memory
- Daniel & Katz (2017) demonstrated WM for tastes and how it, like vision and hearing, is prone to memory interference through time
- The n-Back task is used to assess WM and executive functioning.
  - Requires participants to continually update memory representations
- The purpose of the present experiment was to test memory functions (capacity, interference) across sensory modality

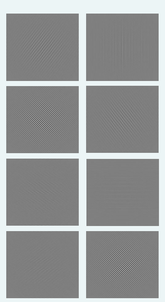
Hypotheses

- Hypothesis 1: Memory will be different across sensory modality
  - Vision vs. Hearing vs. Taste
- Hypothesis 2: Increased task difficulty will decrease memory accuracy
  - 1-Back performance greater than 2-Back performance
- Hypothesis 3: Increased task difficulty will differentially affect memory across sensory modality
  - All sensory modalities will decrease with 2-Back

Methods

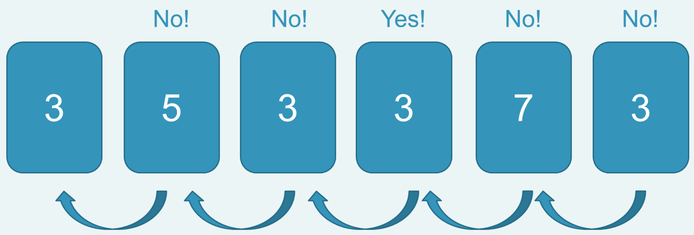
Procedure

- Participants (N = 24) were recruited using SONA, an online website in which individuals could sign up for a time slot to participate
  - Mean age = 20.42
  - SD age = 1.96
  - E Prime 3.0 presented and recorded stimuli
- Shown stimuli sequentially and asked to respond based on familiarity
  - "Was this the stimulus you experienced 1 (or 2) trial ago?"
- Respond "yes" or "no" for each trial
- Given practice trial using letters
- 27 trials per sensory modality, in pseudo-random order
  - 17 distractors (e.g., the correct response is "no")
  - 10 targets (e.g., the correct response is "yes")
- Stimuli was presented at random, eliminating possible bias in response.

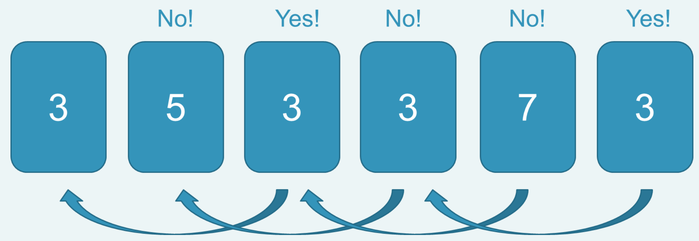
sights	sounds	tastes
	640 hz 760 hz 880 hz 1000 hz 1280 hz 1520 hz 1760 hz 2000 hz	4% sucrose 8% sucrose 2% quinine 4% quinine 4% saline 8% saline 3% umami 6% umami

Trial Progression

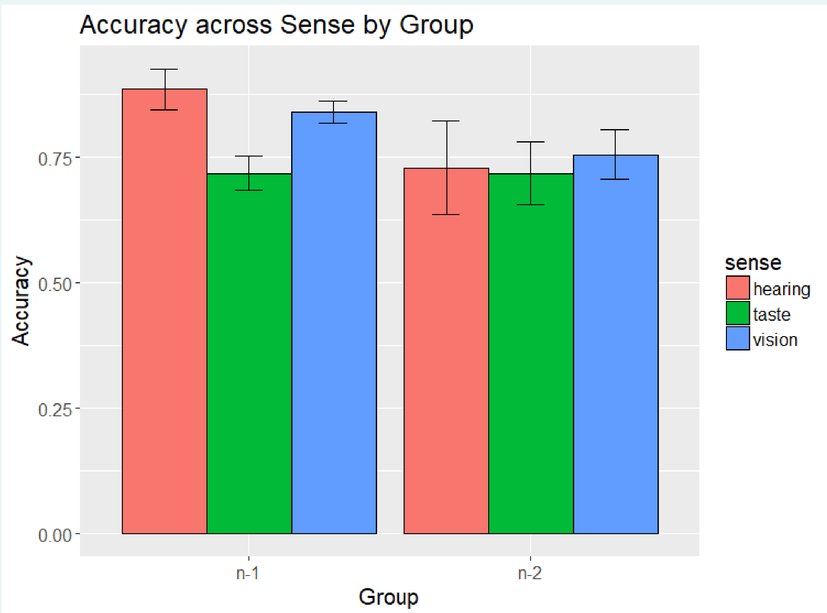
n-1 Back



n-2 Back

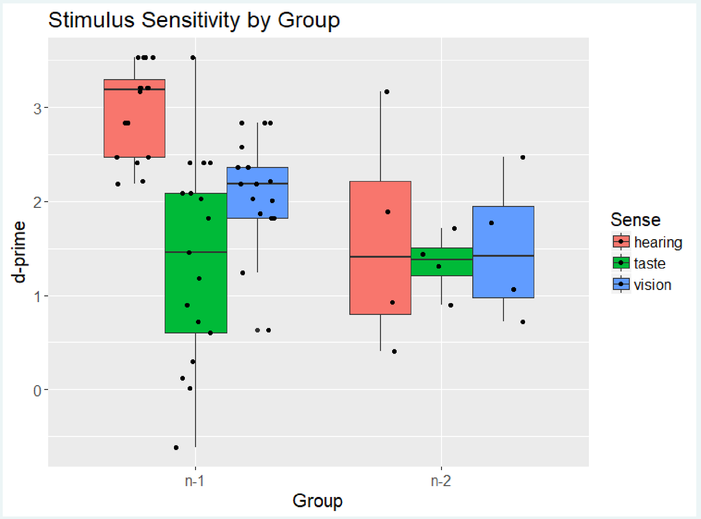


Results



- Recognition differences at the n-1 back condition based on sensory modality
  - Recognition best for hearing; worst for taste
- As task difficulty increases (longer retention interval, intervening stimulus)…
  - Recognition is poorer; fewer differences across senses

Results



- Sensitivity analysis (zHits – zFalse Alarms) shows differences between senses and group
  - Takes into account the role of Targets vs. Distractors
- **n-1 Back**: hearing and vision show higher sensitivity, but these differences go away at the **n-2 Back** condition
  - Less sensitivity overall at the **n-2 Back** condition

Discussion

- Participants can reliably update WM across senses
  - Even when an intervening stimulus is introduced (n-2 Back)
  - First demonstration of n-Back task with tastes
- **Hypothesis 1:** WM differs across sensory modality
  - Hearing shows highest recognition and sensitivity
  - Taste shows lowest recognition and most variable sensitivity
- **Hypothesis 2:** Lower recognition accuracy for n-2 Back condition
  - Recognition dropped for all senses compared to n-1 Back
- **Hypothesis 3:** Increased task difficulty taxed WM across all senses
  - But not all senses were impacted equally:
  - Taste may not have been as influenced by the intervening stimuli
- These findings show that when language is not available, WM operates similarly across sense
  - But only during difficult conditions

Future Directions

- Continue data collection
  - Expand sample size for n-2 Back and start n-3 Back condition
- Adapt similar approach to other memory tasks (digit-span, recall)
- What is the mediating role of language?
  - Test for differences in verbalizable stimulus set and nonverbalizable
- Expand WM testing for full range of senses (e.g., touch, smell)