Questioning the Necessity for Rehearsal in Auditory Distraction Effects During Serial Recall

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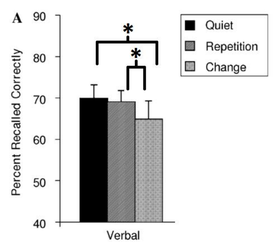
Abstract

Irrelevant auditory stimuli can impair serial recall. Empirically-supported explanations propose that auditory stimuli changing appreciably from item to item interfere with the sub-vocal rehearsal of the visual stimuli. Importantly, the deleterious effect of changing irrelevant sounds is reduced by eliminating order information from the recall task (e.g., a missing item task). However, despite a common assumption in the literature, the conflict of order maintenance between the visual stimuli and the to-be-ignored auditory channel may or may not implicate interference with sub-vocal rehearsal. Across two experiments, rehearsal was severely limited using silent articulatory suppression and rapid serial visual presentation. Results indicated that while silent articulatory suppression eliminated the effects of irrelevant sounds, rapid serial visual presentation did not. This difference implicated order processes other than rehearsal as the possible cause of auditory distraction, suggesting that current theoretical explanations for auditory distraction effects are incomplete.

Introduction

- **The irrelevant sound effect (ISE)** – In the presence of changing state irrelevant auditory information, performance on serial order recall is worsened[1]
- **Rehearsal** – the sub-vocal articulation of to-be-remembered (TBR) items
- Removal of order from the auditory environment (steady-state sounds)[2] or from the task (missing item tasks)[3] result in almost a complete elimination of the effect



*Adapted from Lange (2005)

- Current theories of auditory distraction hypothesize rehearsal interference as the cause of the ISE[1]
- Two methods to influence rehearsal:
  1. **Articulatory suppression (AS)** – verbalization during a memory task thought to block rehearsal[4]
     - AS is closely linked to the ISE[4]
     - However, no direct link between rehearsal and the ISE has been established
  2. **Presentation rate**– rapid presentation of TBR stimuli
     - Rehearsal unfolds over time[5]
     - Faster presentation of TBR items lowers recall[6]

Present Study

- Can rehearsal blocking techniques result in the elimination of the ISE?

Possible hypotheses

- Presentation of TBR items too fast for rehearsal will eliminate the ISE similar to AS, implicating rehearsal as the cause of the ISE

  OR
- The ISE will persist even when items are presented too quickly for rehearsal, implicating an additional order process(es) in the ISE.

Methods

- 2 x 2 x 3 mixed model design
  - 2 **rehearsal blocking** (no blocking & blocking) – within
  - 2 **task** (presentation rate & AS manipulations) – between
  - 3 **auditory condition** (silence, steady-state, changing-state) – within
- 122 participants completed a serial recall task
  - Presentation rate manipulation task – 70 participants
    - 250 ms (blocking) v. 1000 ms (non-blocking)
  - AS manipulation task – 52 participants
    - Silent recitation of the alphabet (blocking) v. no articulation (non-blocking)

Results

- ANOVA for all **non rehearsal blocking** trials across both tasks
  - Significant main effect of auditory condition for non-rehearsal blocking trials F (2,240) = 41.24, $p < 0.001$
    - Silence & steady-state > changing-state
  - No significant main effect of task, F (1,120) = 0.46, *ns*
  - No significant interaction, F (2,240) = 1.51, *ns*
- ANOVA for all **rehearsal blocking** trials across both tasks
  - Significant main effect of auditory condition for rehearsal blocking trials F (2,240) = 23.93, $p < 0.001$
    - Silence > steady-state > changing-state
  - No significant main effect of task, F (1,120) = 3.47, *ns*
  - Significant interaction, F (2,240) = 11.11, $p < 0.001$

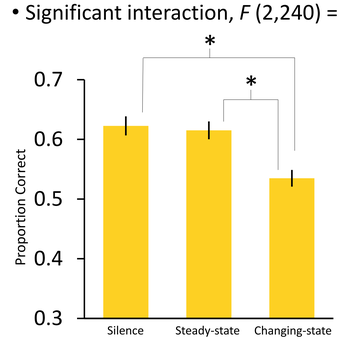


Figure 1. The effect of auditory condition without rehearsal blocking, collapsed across task

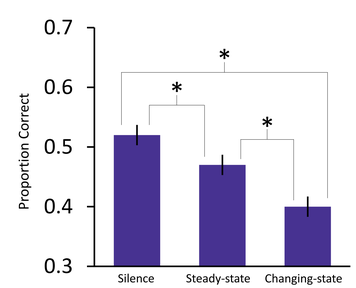


Figure 2. The effect of auditory condition when rehearsal is blocked by presentation rate

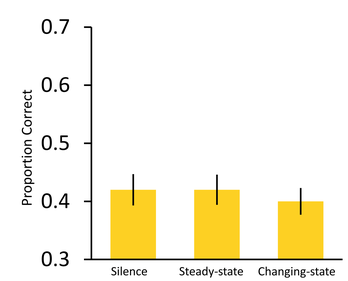


Figure 3. The effect of auditory condition when rehearsal is blocked by AS

- When analyzed separately by task, there were main effects of presentation rate (M = .60 *std*. = .17, M = .47 *std*. = .13) and articulatory suppression (M = .58 *std*. = .22, M = .41 *std*. = .20).

Discussion

- While articulatory suppression does eliminate the ISE, presenting items too quickly to allow for rehearsal does not
- The order = rehearsal assumption does not withstand empirical examination
- Despite the importance of order in the ISE, the cause remains unknown
- The relationship between AS and the ISE persists, but that relationship is not one caused by shared rehearsal blocking
- An order process blocked by AS but not by presentation rate is likely the cause of the ISE
- One possible explanation is the blocking of a motor response during perception under AS may block automatic order processes occurring at perception[7]

Conclusions

- The ISE is not caused by rehearsal interference
- The ISE is likely caused by an order process that is blocked by AS, but not by rapid presentation

References

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