A Review of “Iconic Memory Requires Attention” by Persuh, Genzer, & Melara (2012)

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Introduction

Introduction

What is iconic memory?

A preattentive store of visual information, such as letters, digits, colors, shapes, orientations, etc. (p. 1).

Introduction

Two paradigms:

- Partial-report
- Cued change detection task

*This study uses **both**.*

Introduction

Partial report requires the subject to report what was different between two conditions—in this study, it was used in Experiment 2, where the subjects were asked “V or H” in respect to a rectangle being vertical or horizontal.

Introduction

Cued change detection requires the subject to report whether (or not) there was a change between two conditions—it was used in Experiment 1 in this study.

Introduction

"People frequently **fail to notice** change between two visual images, even when the change is relatively **large**" (p. 1).

Possibly due to capacity limitations (Rensink et al., 1997), a disruption of iconic memory (Sperling, 1960), etc.

Introduction

In partial report conditions, subjects often say they **cannot remember** all the items on the display, even though they see all of them.

In Sperling's original work (1960), this was reflected in much **lower** performance in the whole-report condition than partial report.

Introduction

Spatial attention and the “neural correlates of visual awareness” function **independently** (p. 2).

This implies that much of what we attend to **never reaches** *conscious perception.*

Introduction

Block (1990, 2005) proposed a distinction between:

- "**Phenomenal**" consciousness – **detailed** and perhaps **limitless** in capacity
- "**Access**" consciousness – "**limited** to the '**consumer**' information residing in the brain's systems …" (Persuh et al., 2012, p. 2)

Introduction

Several prior experiments have **supported** the phenomenal / access distinction.

However, none have manipulated **attention**.

The purpose of this study was to add attention to the model, possibly **clarifying** whether attention is needed to create iconic representations.

Materials and Methods

Materials and Methods

TWO (2) experiments!

Materials and Methods

EXPERIMENT **ONE** Participants (p. 2):

24 undergrad students, 12 male, 12 female

Ages 18-32 (*M* = 19.3)

City College of the City University of New York

Normal or corrected-to-normal vision and no head trauma or psychiatric or neurological illness

Materials and Methods

Apparatus for BOTH experiments (p. 2):

16” CRT monitor (Sony Model G220)

100 Hz refresh rate (refreshes every 10 ms)

This monitor is often used in studies of this type.

Materials and Methods

Experiment ONE: Two types of tasks (p. 2):

Visual search task (easy and hard)

Change detection task

FIVE CONDITIONS, initially presented in a specific order to assess subjects' baseline abilities.

Materials and Methods

1. Change detection task (200 X)
2. **Easy** visual search task (200 X)
3. **Hard** visual search task (200 X)
4. Change detection **AND** easy visual search (400 X)
5. Change detection **AND** hard visual search (400 X)

Materials and Methods

- Trials were presented in blocks of 50 with short breaks in between.
  - Only ONE condition was used in each block.
- 28 blocks and 1400 trials were conducted (per subject).
  - Blocks 1-3 were single-task, blocks 4-5 were dual-task, and blocks 6-28 alternated (counterbalanced).

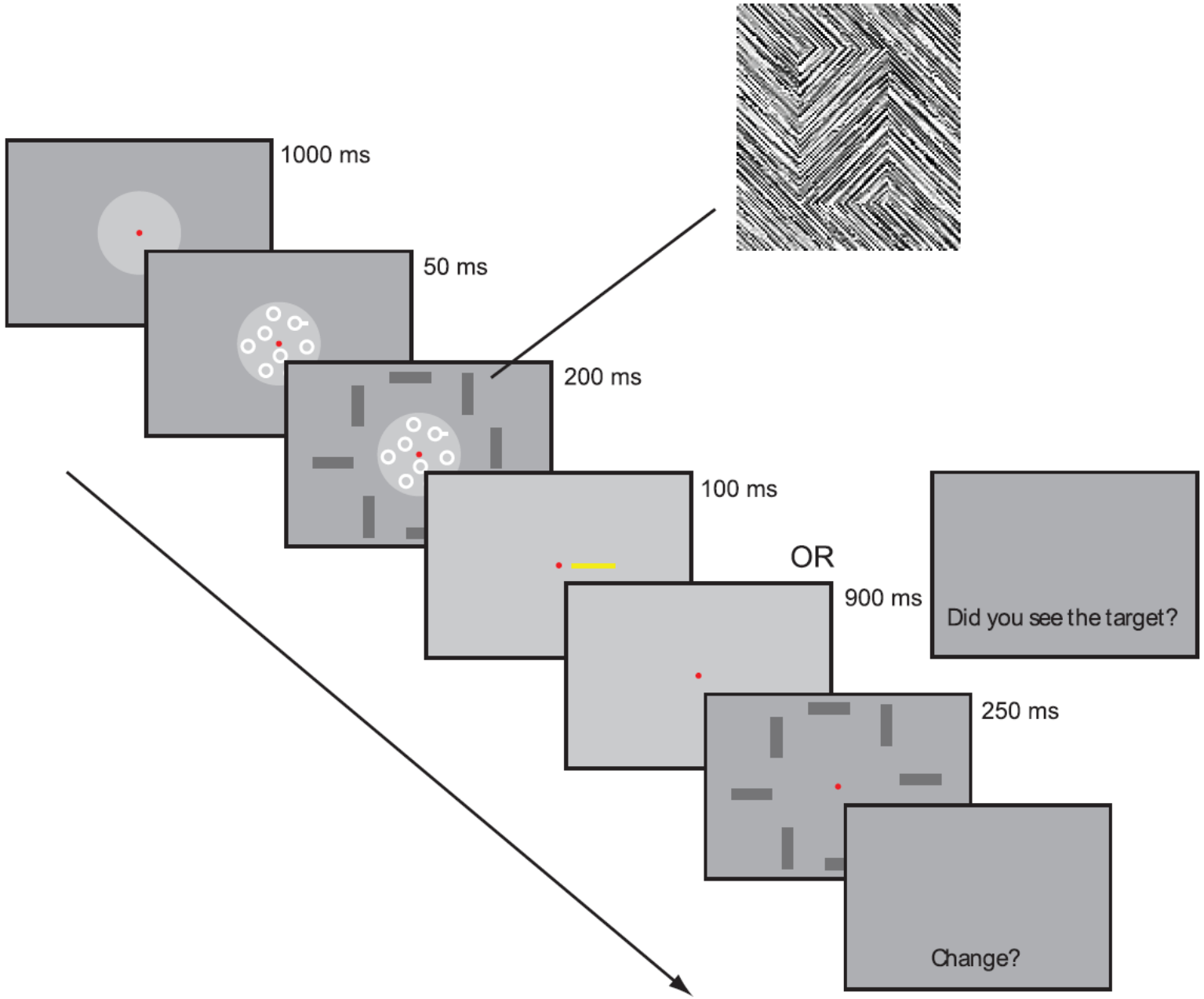


FIGURE 1 | An example of a trial sequence in Experiment 1. Here, visual search is easy and the change detection task includes a change. Rectangles in vertical or horizontal orientation were composed of texture identical to background (inset).

Materials and Methods

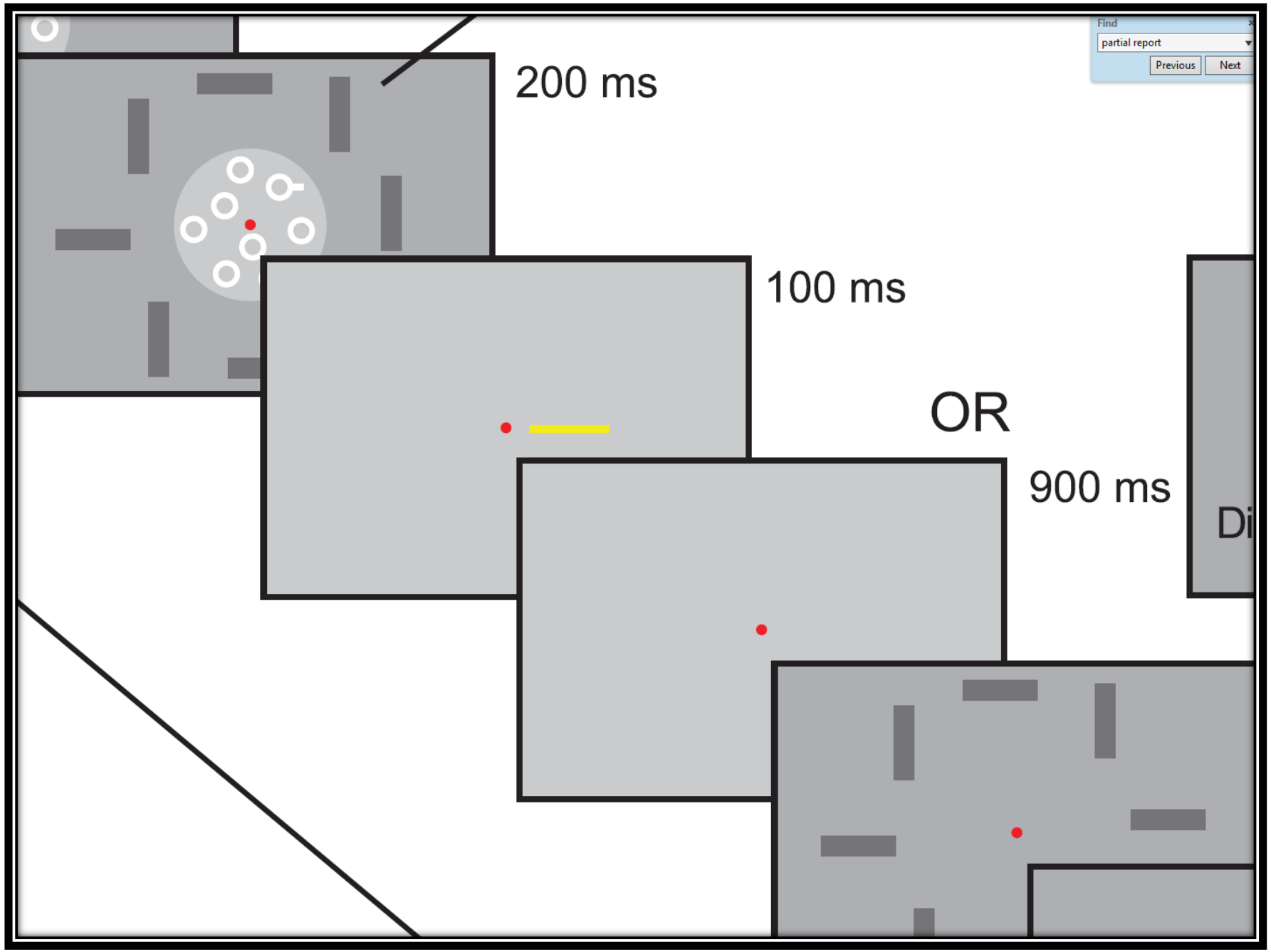
- The circles and rectangles were shown in all 5 conditions. However, frames 4-6 from Figure 1 were omitted in conditions 2 and 3 (visual search alone).
- No time limit was placed on the final response in any of the trials.

Materials and Methods

1. Change detection involved the participants detecting a change in orientation (vertical or horizontal) in 1 of 8 darker rectangles on the monitor.

Materials and Methods

1. Following a 200 ms display of the rectangles in their **initial** position, a yellow line cue was shown for 100 ms, followed by 900 ms of “silence,” and then 250 ms of the rectangles in their **final** position, with the subject then being asked whether the rectangle in the position of the yellow line changed orientation (or not). (None of the other rectangles were eligible to be changed.)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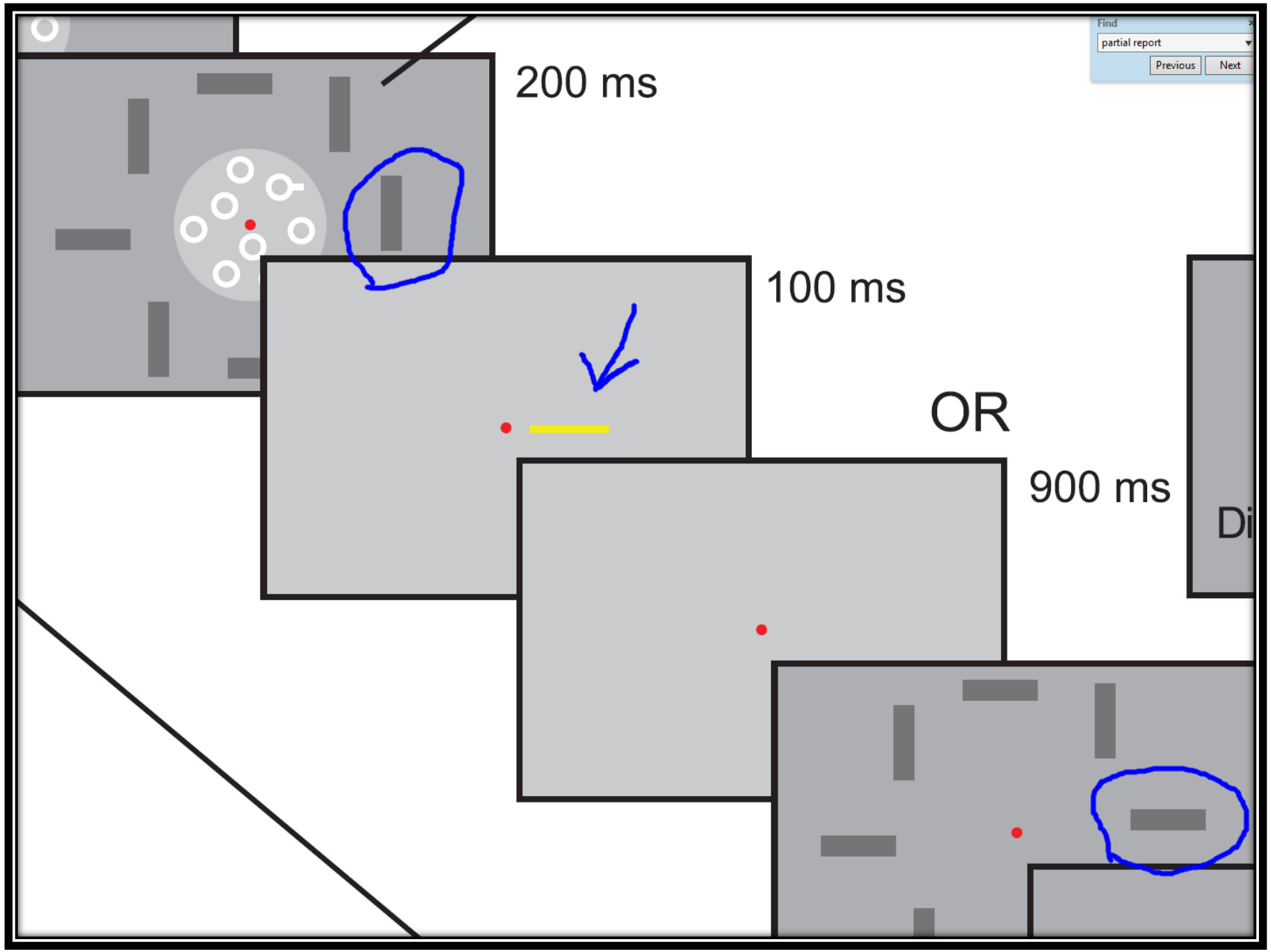
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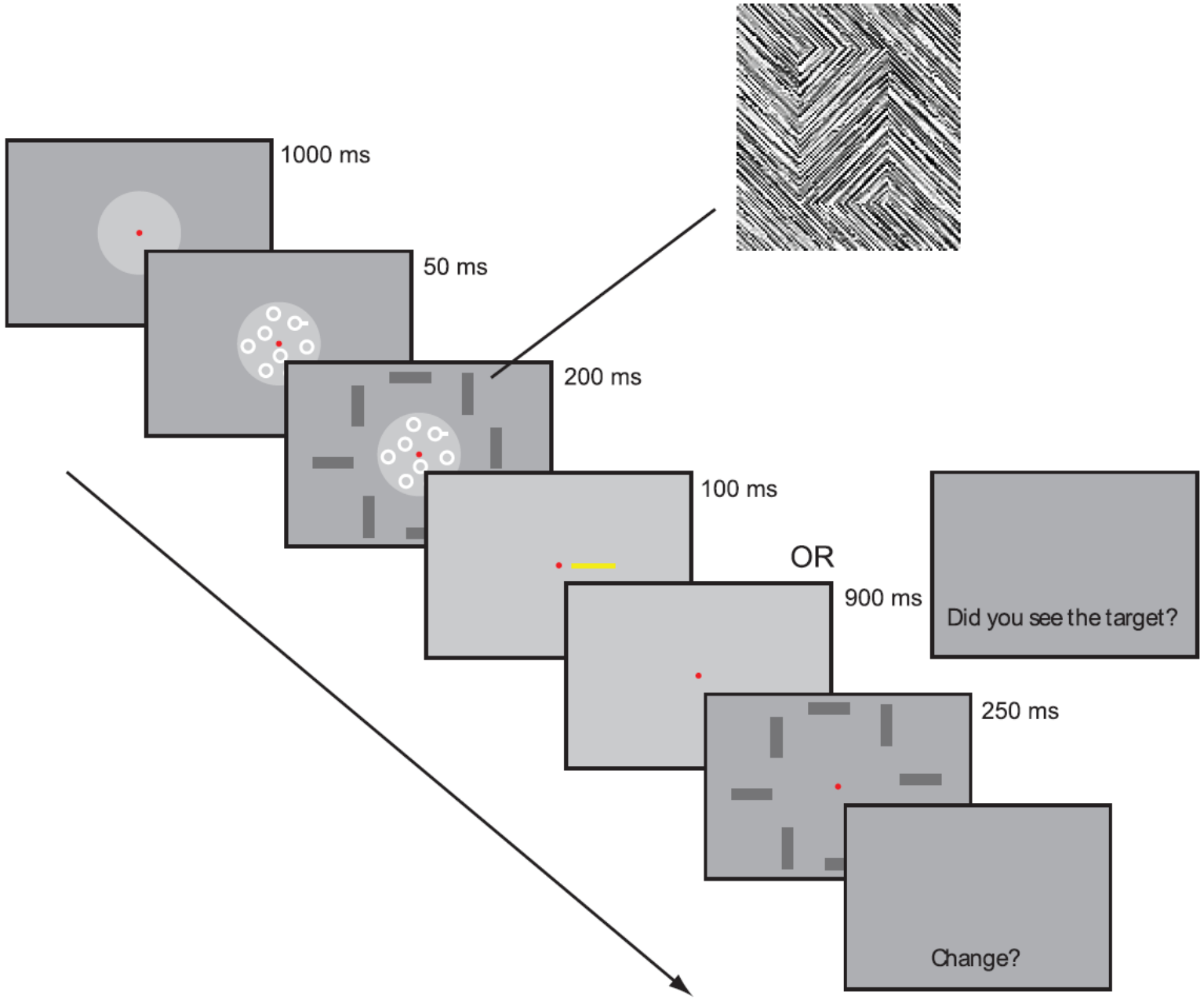
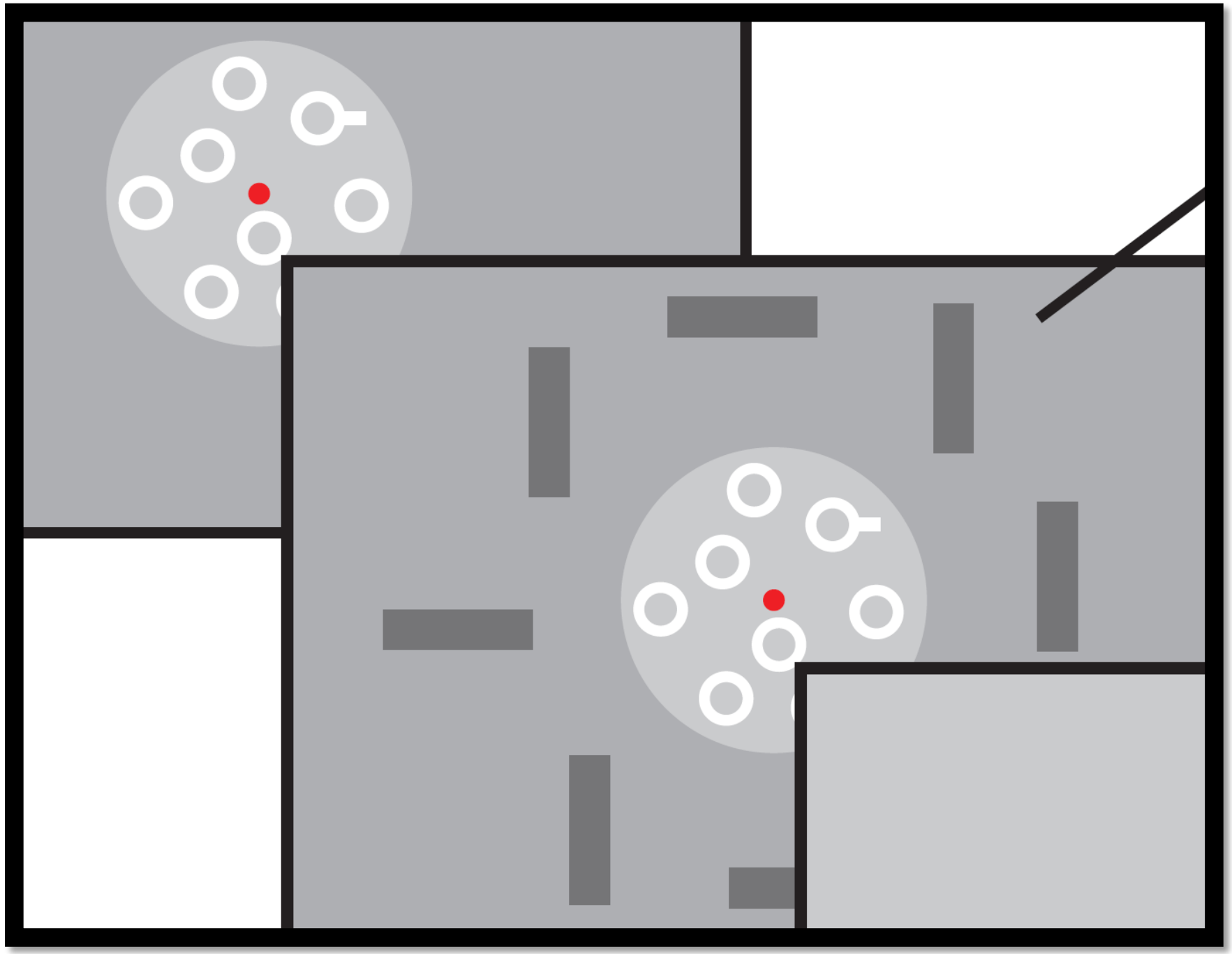
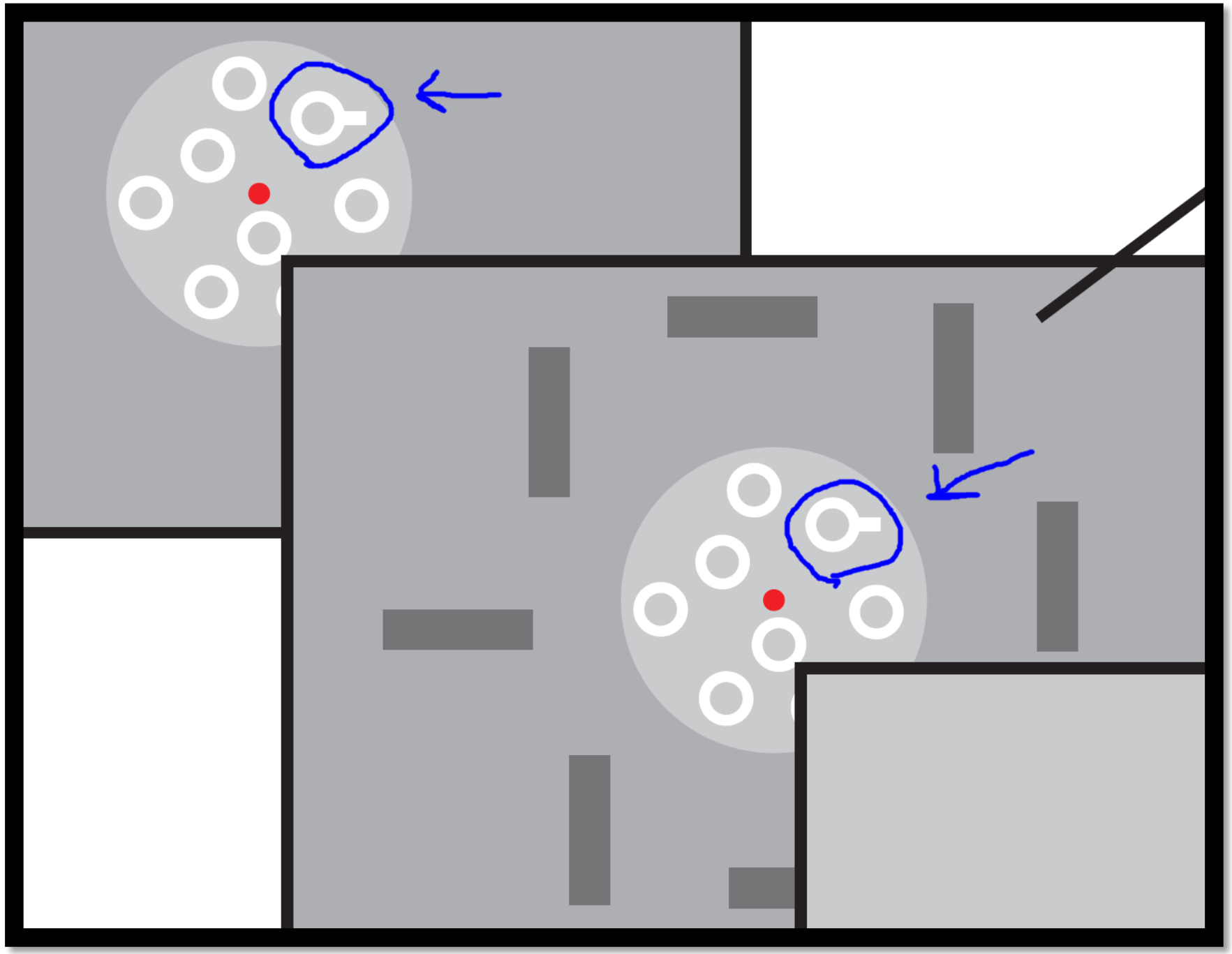


FIGURE 1 | An example of a trial sequence in Experiment 1. Here, visual search is easy and the change detection task includes a change. Rectangles in vertical or horizontal orientation were composed of texture identical to background (inset).

Materials and Methods

2. The easy visual search involved noticing whether one of the 8 white circles near the center of the monitor had a white bar attached to it. In this condition, subjects were then immediately asked, “Did you see the target?” (Recall that the circles were displayed continuously for 250 ms, with rectangles appearing in milliseconds 51-250.)





Materials and Methods

In the “visual search alone” conditions (2 and 3), the monitor **immediately** displayed “Did you see the target?” after the circles were shown—the three other frames (100 ms with yellow cue line, 900 ms “silence,” and 250 ms rectangles) were **omitted**.

Materials and Methods

3. The hard visual search was like condition 2, but involved noticing whether one of the 8 white circles near the center of the monitor ***did not have*** a white bar attached to it (while at least 7 circles did). In this condition, subjects were then asked, “Did you see the target?”

Materials and Methods

4. The change detection **AND** easy visual search condition involved a combination of conditions 1 and 2, where subjects were asked “Change?” OR “Did you see the target?” at the end of each trial, **without foreknowledge** of which question would be asked.

Materials and Methods

4. This means subjects were asked to **simultaneously** attend to BOTH the circles (visual search) and the rectangles (change detection), with no extra time given.

Materials and Methods

5. The changed detection **AND** hard visual search condition involved a combination of conditions 1 and 3, and was identical to condition 4 except for the search task involving determining if a circle ***did not have*** a white bar attached to it.

This was, by far, the **most difficult** condition.

Materials and Methods

In both dual tasks, the search prompt appeared with probability **0.6** (and the change detection prompt with probably 0.4), “to ensure that **performance** on the search task was maintained” (p. 3).

200 ms = 1/5 second

Possibly the amount of time it takes to pronounce the first syllable of “Mississippi.”

50 ms = 1/20 second

One frame in a motion picture: 1/24 second (41.667 ms)

A typical LCD monitor has a 1/60 second (60 Hz; 16.667 ms) refresh rate

The monitor the experimenters used was a 16” CRT (cathode ray tube) Sony G220 monitor with a 1/100 second (100 Hz; 10.0 ms) refresh rate

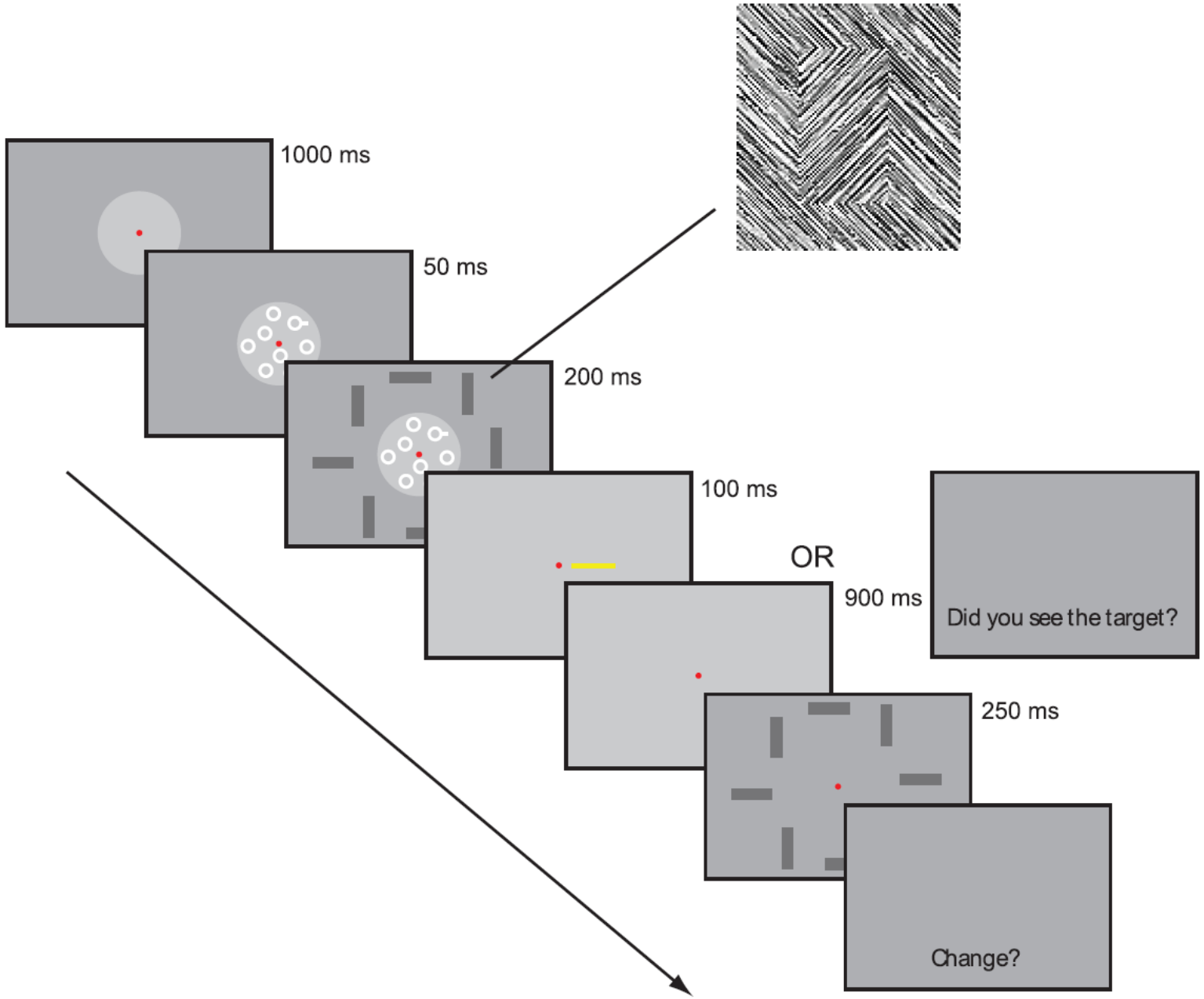


FIGURE 1 | An example of a trial sequence in Experiment 1. Here, visual search is easy and the change detection task includes a change. Rectangles in vertical or horizontal orientation were composed of texture identical to background (inset).

Materials and Methods

Click here for an animated GIF similar to Figure 1, recreated by Richard Thripp.

The timing may not be rendered with precise accuracy, but should give you a rough conceptualization of the experiment.

Materials and Methods

Because the results of Experiment 1 were "**extremely robust**," the authors "elected to test relatively fewer participants in Experiment 2" (p. 3) – ¼ the participants – **6** instead of **24**.

No participants in Experiment 2 participated in Experiment 1.

Materials and Methods

EXPERIMENT **TWO** Participants (p. 3–4):

6 (!) undergrad students, 3 male, 3 female

Ages 20–33 (*M* = 24.7)

City College of the City University of New York

Normal or corrected-to-normal vision and "neurologically normal" (note: head trauma and psychiatric illness were not addressed)

Materials and Methods

EXPERIMENT **TWO** was identical to Experiment 1, except for:

- 1) The introduction of a checkerboard pattern mask displayed for 50 ms over the search array after the display of circles and rectangles (p. 4). The purpose of the mask was to interrupt the potentially persisting iconic image.

Materials and Methods

EXPERIMENT **TWO** was identical to Experiment 1, except for:

- 2) Change detection was replaced with partial-report—a cue appeared for 200 ms and subjects were then asked “V or H?” with regard to the orientation of the previously displayed rectangle at the cue location (p. 4).

Materials and Methods

EXPERIMENT **TWO** was identical to Experiment 1, except for:

- 3) Dual tasks required attending to both circles and rectangles as before, with the task indicated immediately after the pattern mask (p. 4).

Materials and Methods

The purpose of experiment 2 was to address several possible alternate explanations that could be provided for the results from experiment 1 (p. 5).

Results

Results

Experiment One:

Accuracy for **easy** visual search alone:
M = 98.88%, SD = 2.59%

Accuracy for **hard** visual search alone:
M = 69.40%, SD = 5.54%

Accuracy for **change detection** alone:
M = 87.85%, SD = 5.90%

Results (Experiment One)

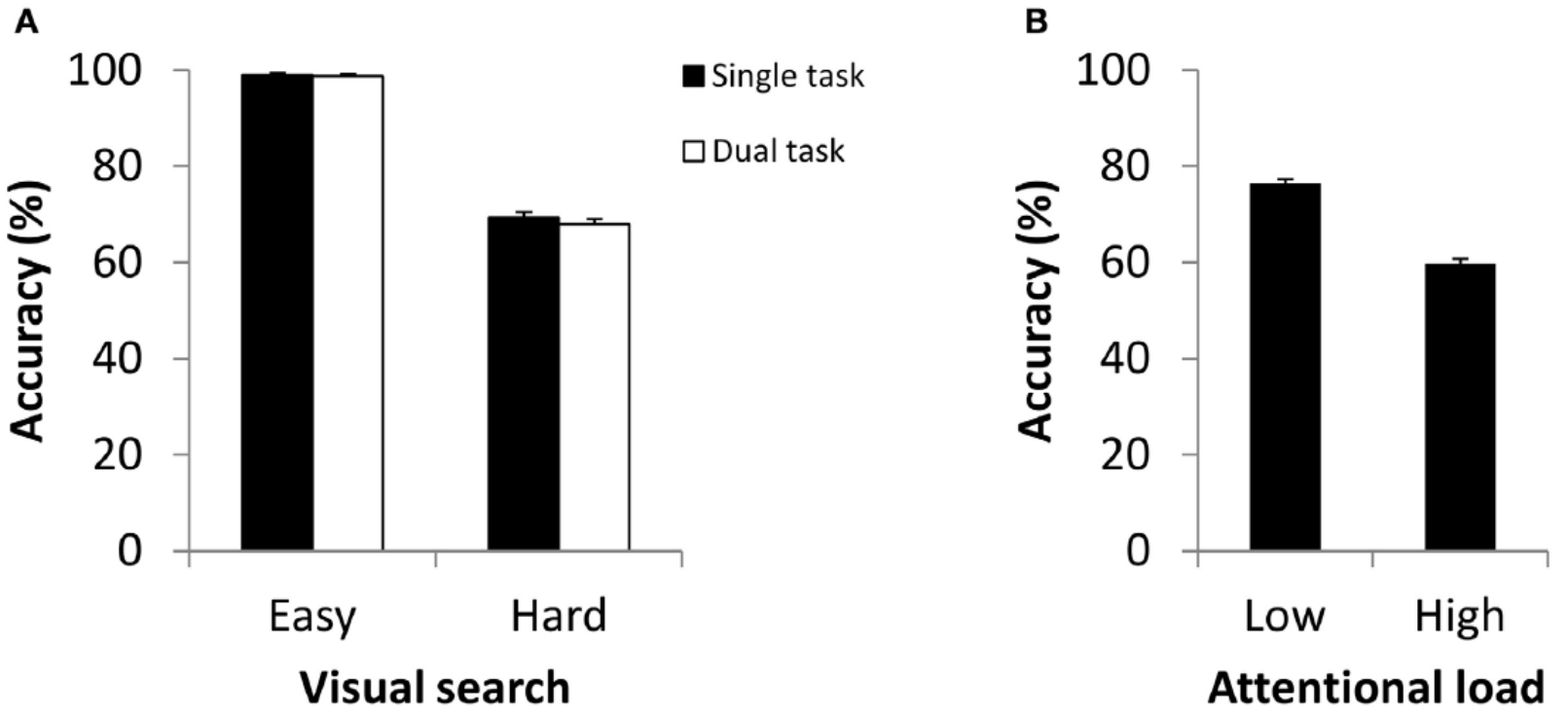


FIGURE 2 | (A) Accuracy for visual search for single and dual tasks as a function of search type in Experiment 1. **(B)** Change detection accuracy in dual tasks as a function of attentional load in Experiment 1.

Results

Accuracy during dual tasks was **identical** for both easy and hard visual searches!

However, it was highly significantly different with respect to change detection…

Results (Experiment One)

Accuracy for **change detection** alone:
M = 87.85%, SD = 5.90%

Accuracy for change detection when conducted WITH **easy** visual search:
M = 76.35%, SD = 7.16%

Accuracy for change detection when conducted WITH **hard** visual search:
M = 59.83%, SD = 5.43%

Results

"Importantly, each of the individual participants revealed an identical pattern of performance" (p. 4) – in **both** experiments!

These results agree with the idea that iconic memory of object orientation is hindered by a lack of attentional resources (p. 5).

Results

Experiment Two:

Accuracy for **easy** visual search alone:
M = 99.42%, SD = 0.49%

Accuracy for **hard** visual search alone:
M = 68.33%, SD = 5.95%

Accuracy for **partial report** alone:
M = 81.92%, SD = 6.78%

Results (Experiment Two)

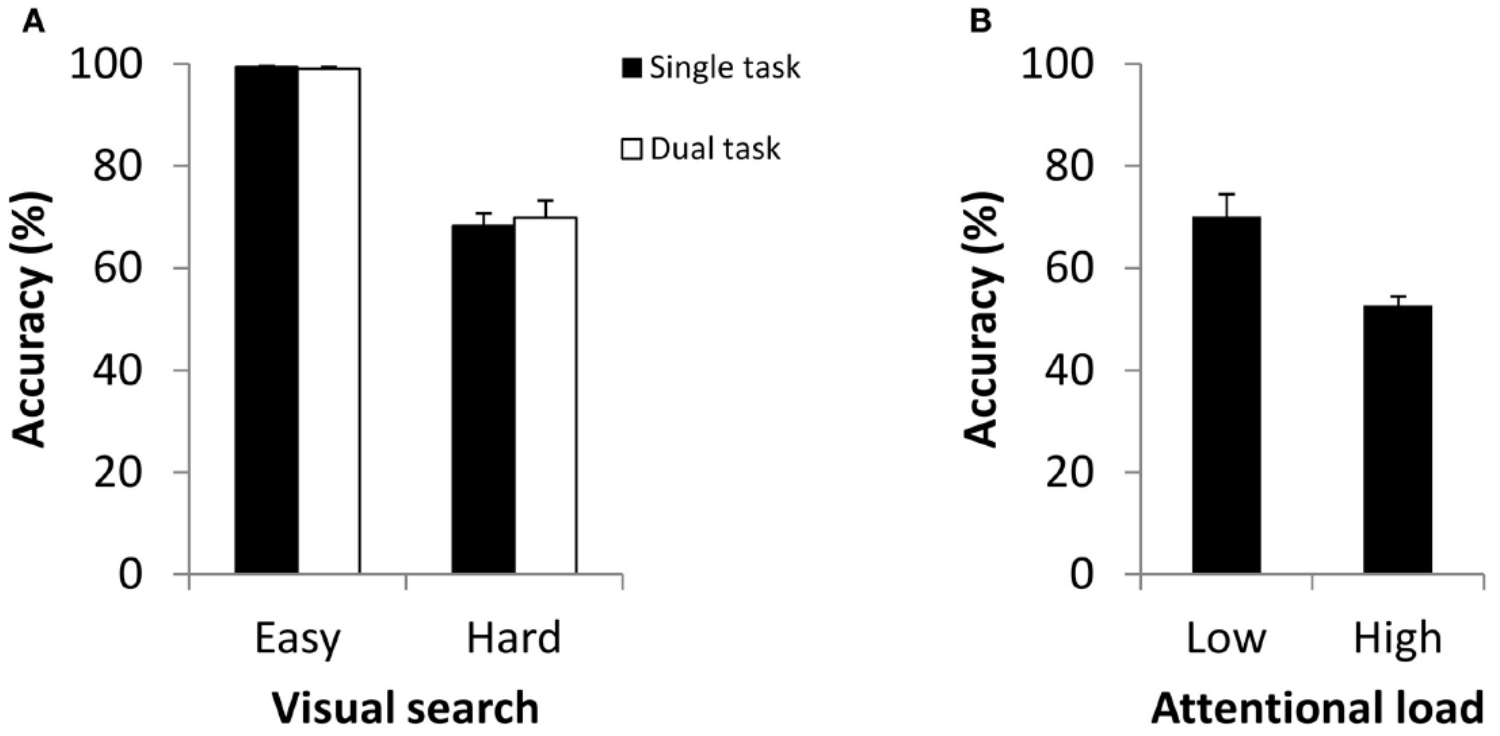


FIGURE 3 | (A) Accuracy for visual search for single and dual tasks as a function of search type in Experiment 2. **(B)** Partial-report accuracy in dual tasks as a function of attentional load in Experiment 2.

Results (Experiment Two)

Accuracy for **partial report** alone:
M = 81.92%, SD = 6.78%

Accuracy for partial report when conducted WITH **easy** visual search:
M = 70.08%, SD = 10.88%

Accuracy for partial report when conducted WITH **hard** visual search:
M = 52.70%, SD = 4.41%

Results

Experiment Two:

The results were consistent with experiment 1, which “effectively **rules out**” the alternate explanations of “disruption to comparison processes and ineffectiveness of reporting cue” (p. 5), confirming the authors’ expectations.

Discussion

Discussion

- "These results suggest that, without attention, participants consolidate in iconic memory only **gross representations** of the visual scene" (p. 6).

- The authors' found highly significant and uniform results between both experiments.

Discussion

- For change detection / partial reporting, since the rectangle that would be changed was **random** and **unknown** to the subject, looking at the **center** of the display was the best strategy, according to the authors (p. 7).

Discussion

- Between single and dual-task conditions, visual search accuracy remained the **same** in both experiments, despite more attention being required in the dual-task conditions!
- *This suggests that iconic memory (required for change detection but not for visual search) is a form of **phenomenal consciousness** and is **highly sensitive** to attentional load.*

Discussion

- The authors **varied** the delay from the initial display to the response prompt: 900 ms in experiment 1 vs. 200 ms in experiment 2, testing the “hypothesis of decay in iconic memory,” but found the **same** performance pattern, implying that attentional load impacted memory formation, **not** memory decay.

Discussion – Limitations

- Implications based on the results of experiment 2 may be limited due to **small** sample size (*n* = **6**).

- Several **alternate** explanations for certain results are discussed (p. 6-7), but largely addressed.

Conclusion

Conclusion

- Iconic memory is traditionally “considered pre-attentive,” yet the authors have demonstrated it is **disrupted** by a scarcity of attention.

- The authors conclude that phenomenal consciousness **requires** attention, despite being distinct from it.

End