Intrusion Into Awareness of Words Unconsciously Registered in Visual Working Memory

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Introduction

This experiment tested whether unconsciously registered words are more likely than nonwords to disrupt processing in working memory (WM) and whether such stimuli are more difficult to suppress from awareness. We used a mirrored stereoscope to mask some to-be-remembered items and thereby make them invisible. Then we assessed whether type of masked item (words vs. nonwords) affected their ability to disrupt retention of other items that were visible. We predicted that invisible words would be more effective than nonwords because they might activate salient associations. We also predicted that our masking procedure would be less effective at rendering words invisible, because the words were more familiar to the participant than the random letters.

Method

The first author served as the participant (age: 22, gender: female). Her task was to fixate on the center of a computer screen viewed through a stereoscope and remember the location and identity of letters that were displayed. In each trial, the visible items were displayed first and then either the masked (invisible) items or else no items. On half of the trials with a masked item, the letters spelled a common, 3-letter word. The mask was an array of flashing, colored squares. After a 600-ms delay, a probe item would appear and the participant reported change or no change compared to the initial item in that same position. The participant then reported her degree of awareness of the masked item using a 1-4 scale (Perceptual Awareness Scale, PAS). This was followed by accuracy feedback.

The participant completed six sessions, which were never on the same day. Each session was composed of 20 blocks of 10 trials (200 total trials). Words and letters were composed from the SUBTLEXUS database and characterized as non-emotional. A two-way ANOVA was used to assess the effect of the masked item on accuracy, reaction time, and confidence of responses to probes of the visible items.
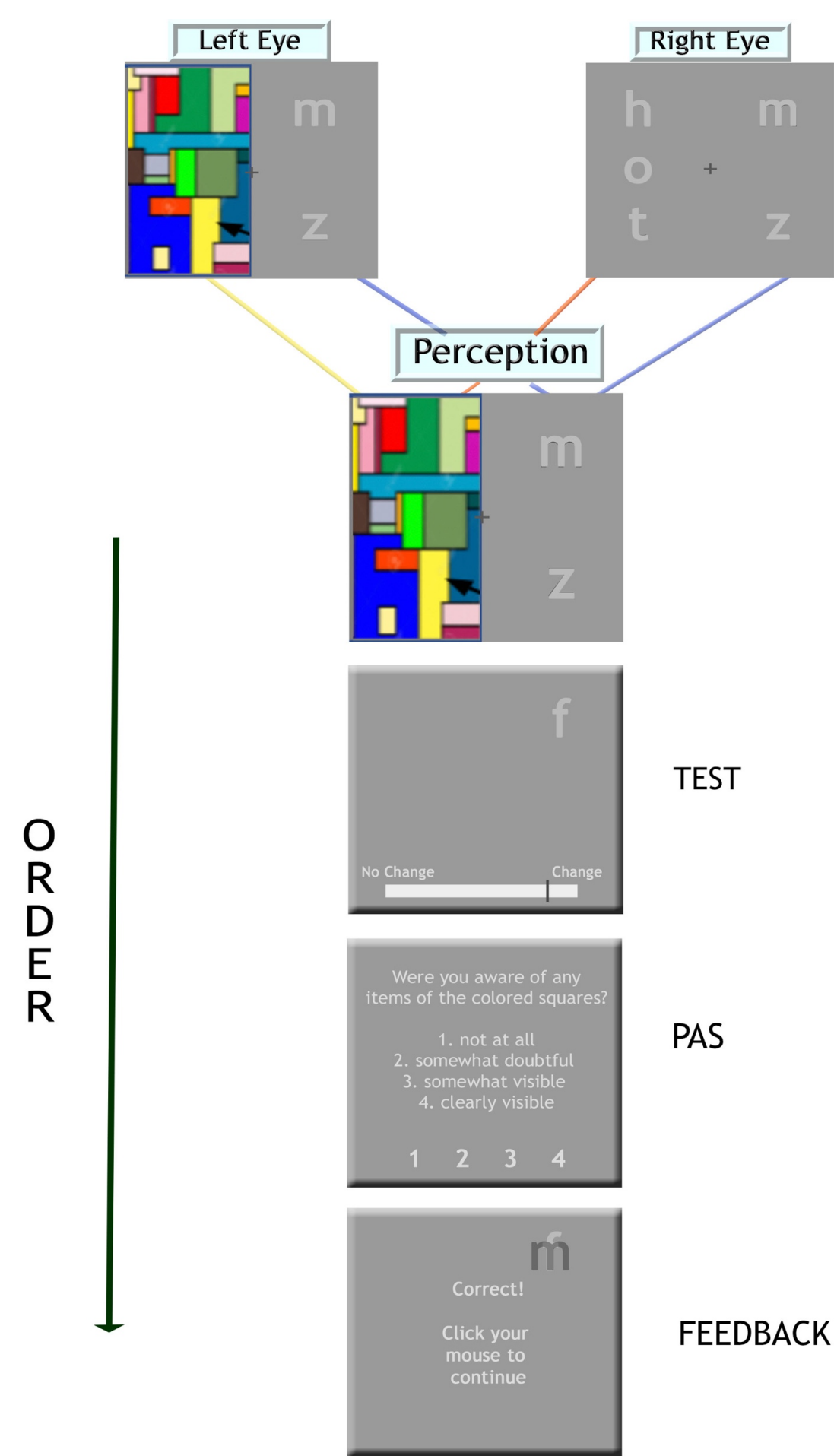

Figure 1: Example of a "word" trial with memory probe on the visible hemifield, or the non-masked side. The participant used the mouse to report (1) if the probe is different or same compared to the fixation period stimuli using a confidence bar (2) how aware they were of letters on masked (colored blocks) side.
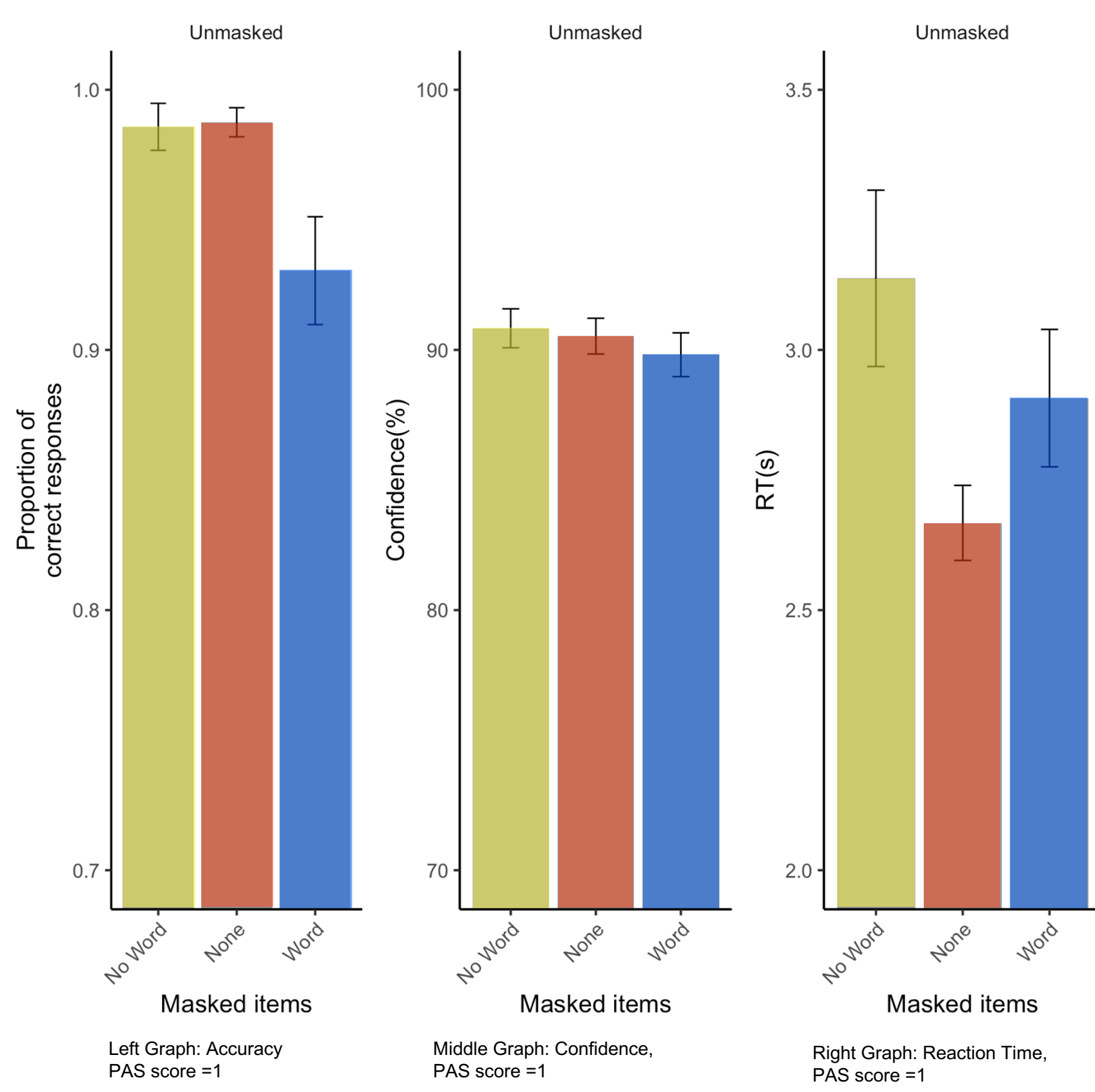

Figure 2: Here we assess accuracy, confidence of change, and reaction time of change report for trials which had a visible probe and reported no awareness of masked items.
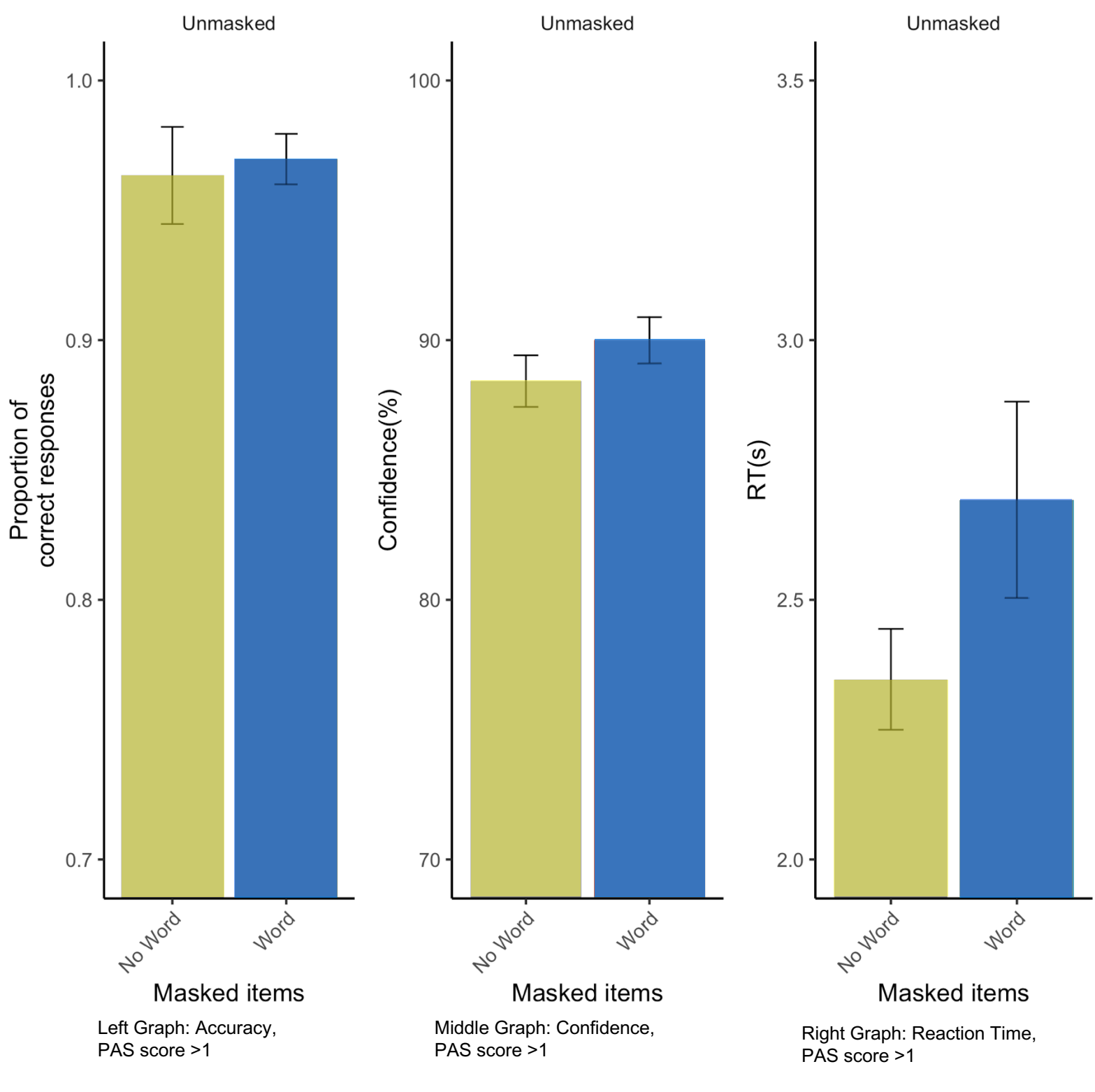
Figure 3: Here we assess accuracy, confidence of change, and reaction time of change report for trials which had a visible probe and reported awareness of masked items.

```
knitr::opts_chunk$set(fig.width=10, fig.height=10, fig.path='Figs/',
                      echo=FALSE, warning=FALSE, message=FALSE)
## ANOVA on accuracy, PAS = 1 Continue(width = 150)
## Group means and SD
##
##    ======= Means and SEM of PAS =======

##    invis    probe   mean    se
## 1 NonWord Unmasked 1.862  0.069
## 2    None Unmasked 1.000  0.000
## 3    Word Unmasked 2.008  0.071
```

Table 1: Means and SEM of PAS

Results

Accuracy for correctly identifying probes on the unmasked side showed a significantly higher proportion of correct responses for trials in which masked items were non-words or when there were no letters on the masked side (0.98 accuracy) as compared to trials in which the masked items were words (0.94 accuracy), $F_{(2, 10)}=6.12$, $p=0.018$ (Figure 1). In addition, mean PAS report of non-word and word items was about 2 (some awareness), compared to trials in which there actually was no masked item (mean PAS = 1, no awareness; see Table 1).

Discussion

These results support the findings of Underwood Barton (2018) that masked stimuli can interfere with the retention of visible items in working memory. The current study goes further in showing that masked letters spelling a word are more effective at producing such interference than are those that do not spell a word. This may be because meaningful letter patterns have a higher chance of triggering salient associations that could compete with visible items for processing resources. However, the similar awareness reports for non-words and words suggests that such associations did not influence the intrusion of masked items into awareness.

References

Underwood Barton, Amy (2018). Unconscious Information Processing in Working Memory [Unpublished doctoral dissertation]. University of Missouri-Columbia.