

The Role of Competition in Repetition Blindness

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Repetition Blindness

Repetition blindness (RB) was first described as a deficit in reporting two identical items that appear close together in time (Kanwisher, 1987). Several theories have been proposed to account for this deficit, each of which is able to describe the basic finding of RB and the lag effect - RB decreases as the time between the identical items (C1 and C2) increases. But there are other factors associated with RB that are not comprehensively accounted for by any one theory.

Motivation for a New Theory of RB

Effect of RB on Filler Items

Luo and Caramazza (Experiment 1; 1996) used spatial RSVP and brief simultaneous visual presentation (BSVP) to investigate RB. Repeated items appeared in positions 2 and 4 or in positions 3 and 5. Results revealed a benefit for filler items adjacent to C2. It was suggested that this benefit occurs because the repeated item is not encoded.

Effect of Filler Items on RB

Whittlesea & Masson (Experiment 1; 2005) varied the filler items while holding the critical items at a constant temporal lag. Participants were asked to look for repeated words (repetition detection task).

Filler	Trial Structure	Hits	FAs
Blank	C1 C2	.99	.02
Symbols	@#%\$& C1 @#%\$& C2 @#%\$&	.78	.04
Same Word	WHITE C1 WHITE C2 WHITE	.58	.10
Different Words	word 1 C1 word 2 C2 word 3	.10	.01

Results from these experiments suggest that RB involves an interaction between all of the items present in the display.

Competition Hypothesis

Two processes are involved in RB: type activation and competition. Forward masking in RSVP produces sharpening of repeated type activations, i.e., the signal is strengthened and the noise is weakened. Representations of adjacent items then compete for access to limited-capacity awareness based on summed neural activation, with higher-activation items winning the competition.

Repetition produces a more accurate type representation, but the summed activity of the type is lower than for repeated items. RB occurs because repeated items are frequently out-competed by adjacent nonrepeated items; therefore, they fail to access awareness.

Type Activation

Signal and noise nodes - Each item is represented by a signal node and noise nodes. Random noise is added to each to simulate limited processing due to RSVP.

Forward masking - Forward masking adds noise to the representation and decays slowly over time. Because of this the first item in the RSVP stream adds noise to the second item, adds less noise to the third item, etc..

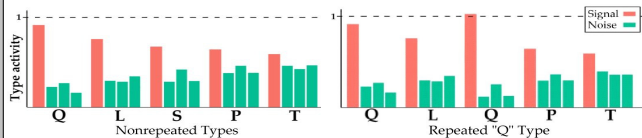
Backward masking - In RSVP each item is masked by the following item. If an item has low activation it may be overwritten by the following item.

Firing rate for each item

$$A_j(t) = A_j(t) + (1 - d) A_j(t - 1)$$

A = Activation t = Serial position of item A_j = Input activation d = Decay parameter

Correct type is output when signal exceeds noise by a criterion c.



Competition

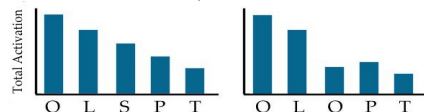
Attention Parameter - Temporal attention is directed toward the RSVP stream when participants try to report the items in order.

Backward Masking - Mask following the RSVP stream competes with item five.

Total Activation - Attention is added to the summed signal and noise for each item.

$$A_{tot}(t) = \sum_j A_j(t) + att(1 - ad)^{(t-1)}$$

A_j = Total type activation att = Attention parameter ad = Attentional decay parameter

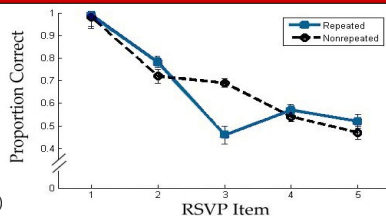


Predictions

- * Repetition Blindness for C2
- * Facilitation for the item preceding C2 because it will out-compete C2
- * No facilitation for the item following C2 because it will have less noise therefore less summed neural activation

Experiment 1: Five-item RSVP stream

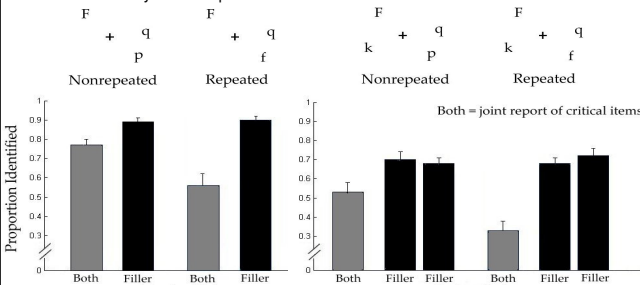
Design
Repeated items in RSVP positions 1 and 3. Average exposure duration was 117 ms per letter. After the list, participants reported as many items from the list as possible.



Results
The data confirmed each of the predictions (RB & benefit for item 2)

Experiment 2: Simultaneous Display

Design - 3-4 items appeared simultaneously around an invisible circle (22 mm radius). Items were displayed 300 ms then masked. Participants were asked to report as many items as possible.



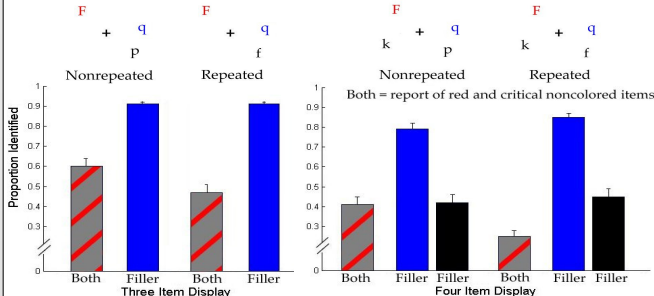
Results

- * RB was obtained in the simultaneous display
- * No increased report was found for filler items in repetition trials
 - ~ Order of encoding was uncontrolled so the same filler was not always encoded before C2: Effect could be distributed among fillers.

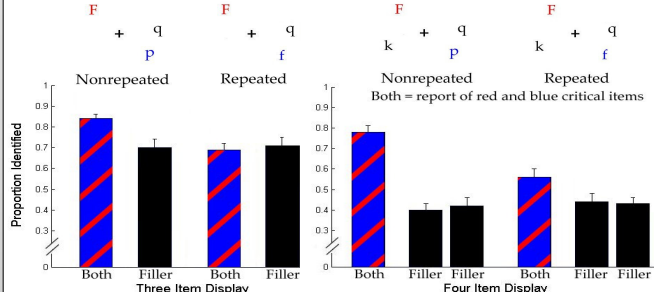
Experiment 3: Color Simultaneous Display

Design - Same as Experiment 2 except that one letter appeared in red and one letter appeared in blue. Participants were instructed to report the colored items first.

Red Critical / Blue Filler



Red Critical / Blue Critical



Results

- * RB was obtained when participants were asked to first report the items in color even when *both* repeated items were in color
- * A benefit for filler items in repeated trials returned when participant report was prioritized based on item color
 - ~ Not significant in three item displays
 - ~ Significant in the four item display with red and black critical items (Blue filler encoded before the black repeated letter)
 - ~ Same trend, although not significant, when critical items were red and blue

Conclusions

- * The order in which repeated items are encoded affects report of filler items
 - ~ This and other findings are not well accounted for by current RB theories
 - ~ They are accounted for and predicted by the competition hypothesis
- * Results suggest that items compete with one another for access to awareness
- * Repeated items have less summed neural activity thus compete less effectively for access to awareness

References

- Kanwisher, N.G., (1987). Repetition blindness: Type recognition without token individuation. *Cognition*, 27, 117 - 143.
- Luo, C.R. & Caramazza, A., (1996). Temporal and spatial repetition blindness: Effects of presentation mode and repetition lag on the perception of repeated items. *Journal of Experimental Psychology: Human Perception and Performance*, 22, 95 - 113.
- Whittlesea, B.W.A., & Masson, M.E.J., (2005). Repetition blindness in rapid lists: Activation and inhibition versus construction and attribution. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31, 54 - 67.