Attentional blink with negative stimuli
—Serial or parallel processing?—

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In a rapid serial visual presentation (RSVP) task, the processing of a preceding target (T1) interrupts the response to a subsequent target (T2). This phenomenon is thought to indicate the temporal limitations of attention and is named attentional blink (AB). In previous studies two conflicting models have been proposed for the AB phenomenon: the serial processing model and the parallel processing model. The present study examined which could be more appropriate. We used negativity bias, which is a phenomenon that negative stimuli are more rapidly processed because they attract more attention than neutral stimuli. When T2 was negative the AB deficit decreased (Experiment 1). However, when T1 was negative the AB deficit increased (Experiment 2). Moreover, when both T1 and T2 were negative the AB deficits observed in Experiment 1 and Experiment 2 canceled each other (Experiment 3). It was therefore considered that the AB was due to attentional interference during parallel processing of RSVP items.

**Key words:** attentional blink, negativity bias, parallel processing model

Raymond, Shapiro and Arnell (1992) demonstrated a temporal limitation of human attention by using a rapid serial visual presentation (RSVP) task. When people were required to process a target (T1) this task interrupted the response to a subsequent target (T2) that appeared within approximately 500 ms of T1. The investigators named this phenomenon "attentional" blink (AB) because they found that the failure to detect T2 was caused not by sensory factors but by attentional factors. The models of AB which have been proposed in previous studies can be divided into 2 groups: whether failure to recognize T2 occurred as a result of delay and extinction of T2 representation caused by serially processing of RSVP items; or whether failure to recognize T2 occurred through interference during the parallel processing of the items.

In the present study we tested an AB task for which both of the present models would predict a different outcome. To be more specific, both of the present models predict that the AB deficit will decrease when T2 contains items which attract attention. This is because the serial processing model predicts the saliency items would show a lasting representation, whereas the parallel processing model predicts that these saliency items would tend to overcome interference from other items. However, both models would differ in the prediction of an AB deficit when the T1 items attract attention. The serial processing model would predict that the AB deficit would decrease because the saliency items could be processed quickly and therefore T2 would also be processed promptly. In contrast, the parallel processing model would predict that T1 would cause a strong interference with the neutral T2 and make the AB deficit increase.

We used negative words as attention-attracting items because many studies of other investigators have proposed that negative stimuli attract greater attention and are processed more rapidly. This phenomenon is called negativity bias (e.g., Cacioppo & Gardner, 1999). In addition, Ogawa and Suzuki (2001) have shown that a negativity bias appears in the AB. Therefore, we consider that negativity bias is an effective phenomenon with which to verify an AB model. In Experiment 1 we used negative words for T2 to reconfirm the appearance of a negativity bias in the AB. In Experiment 2 we used negative words for T1 to examine which was a more appropriate AB model. Experiment 3, using negative words for both T1 and T2, was performed to confirm the
proposition deduced from Experiments 1 and 2.

Method

Participants There were 21, 14, and 25 participants who took part in Experiments 1, 2, and 3, respectively.

Stimulus A list of negative and neutral two-letter Kanji words were selected from Gotoh and Ohta (2001). All of the words were controlled for visual complexity and familiarity.

Procedure The RSVP consisted of T1, T2, and distractors. All of the words subtended a visual angle of 2.5° in width and 1.25° in height. A white display was used for T1 and the other words were displayed as black against a gray field. Each word was presented for 80 ms with an interstimulus interval of 20 ms. The number of stimuli occurring before T1 ranged from 8 to 12, in a random order. A display of T2 occurred as the first, third or seventh item after T1, and each T2 position was termed Lag 1, Lag 3, or Lag 7, respectively. The participants were asked to identify the white target words and to detect the black target words that appeared at the beginning of the trial for 2,000 ms. In Experiment 1, neutral and negative T2 were presented. In Experiment 2, neutral and negative T1 were presented. In Experiment 3, both targets were neutral or negative. In all of the experiments the distractor words were neutral.

Results and Discussion

The dependent variable was the detection rate of T2, based only on trials in which T1 was identified correctly. To test the effect of the negative stimuli, a T2 Lag (Lag 1 vs. 3 vs. 7) × Affectivity (neutral vs. negative) within-subject ANOVA was carried out on each experiment. The T2 detection rates and the results of the post hoc analyses are presented in Table 1. Experiments 1 indicated that the negativity bias affected the AB. The results of Experiment 2 corresponded with predictions based on the parallel processing model. Therefore, it was suggested that RSVP items were processed in parallel and that an AB occurs due to an interference between T1 and T2. Experiment 3 indicated that the AB deficits shown in Experiments 1 and 2 canceled each other, which seemed to be a reasonable result. From the total results it was suggested that the AB was due to an attentional interference during parallel processing of RSVP items.

There are several studies supporting the serial model of the AB, however, and we believe these findings do not conflict with our results. It is assumed that emotional processing differs from identical processing and that these are performed in parallel. Therefore, with the assumption that emotional processes interfere with each other but identical processes are serial, the result of an investigation using emotional items, as used in our study, could imply that items are processed in parallel.

References