The Temporal Dynamics of Visual Attention in Processing Facial Emotion

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Introduction

In rapid serial visual presentation, identification of the second of two targets is impaired when it closely follows the first target. This attentional blink (AB) effect suggests limited capacity in processing successive visual stimuli in working memory. Awh et al. (2004) found that face identity Target 2 was immune to the AB when performed together with a digit Target 1. They proposed a *multi-channel model* in which digit processing utilizes a featural channel, leaving the configural channel available for face processing. The present study examined whether the processing of facial emotion (via the configural channel) facilitates the bypassing of capacity limitations for a word (via the featural channel), producing no AB effects. We further examined whether AB effects will increase when Target-2 difficulty is increased (requiring more processing resources).

General Methods

We presented a series of 16 images (including Target 1 and Target 2), successively at a single location. Each was presented for 100 ms.

Face Stimuli: 108 faces (18 female actors; 18 male actors) expressed angry, happy, and neutral emotions. The neutral faces were used as distractors and the emotional faces were used as targets. Different genders of faces were used for targets and distractors, varied across participants.

Target 1 (T1): Determine the target face emotion (happy vs. angry) by pressing the "1" or "2" key on a response box (unspeeded)

Target 2 (T2): Determine the emotional word (happy vs. angry) in Exp1 and the non-emotional word (berry vs. apple) in Exp2 by pressing the "4" or "5" key on a response box (unspeeded).

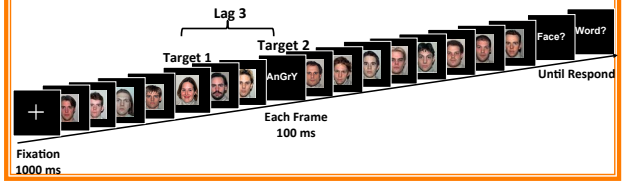
Lag: Target 2 word appeared 1, 3, or 7 positions following Target 1 face.

Target 2 Difficulty: The word was in consistent lowercase (e.g., "happy"; the easy condition) or in mixed case (e.g., "HaPpY"; the difficult condition).

Congruency: The emotional congruity between facial emotions and words was congruent (e.g., both angry) or incongruent (e.g., a happy face with a word "angry").

Dependent Measures: Target 1 and Target 2 accuracy; the AB effect on Target 2 accuracy (***Lag 7 - Lag 3***).

Event Sequence:



Predictions

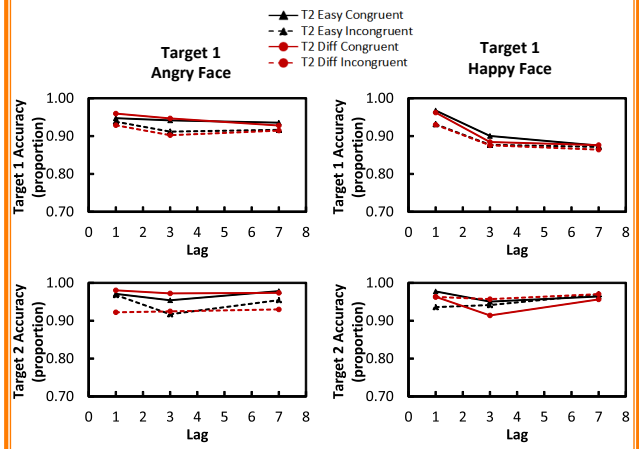
According to the multi-channel model, facial emotion and words are processed via different channels, allowing them to bypass capacity limitations and produce no AB effects in easy and difficult conditions.

Experiment 1

We examined whether the AB effect was eliminated with a facial emotional Target 1 (assuming to occupy the configural channel) and a word Target 2 (assuming to occupy the feature-based channel).

Participants: N=62 (46 females; age range: 18-44); half searched for a female Target 1 face and half searched for a male Target 1 face.

Results and Discussion



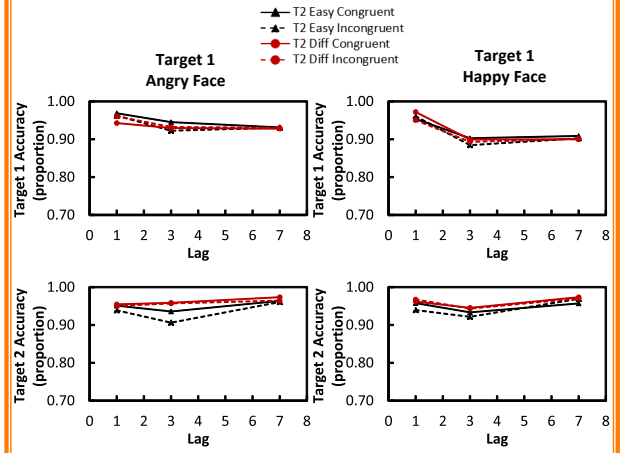
The main effect of Lag on Target 2 accuracy was significant, $F(2,120)=13.78$, $p<.0001$. Pairwise comparisons revealed that Target 2 accuracy at Lag 3 (.937) was significantly lower than Lag 1 (.953) and Lag 7 (.959), $Fs(1,61)\geq17.21$, $ps<.0001$. These findings suggest that a small but significant AB effect of .022 was observed. The interaction between Lag and Task 2 difficulty was not significant, $F(2,120)=1.86$, $p=.16$, indicating that the AB effect was not modulated by Task 2 difficulty.

Experiment 2

The small AB effect in Exp1 may be due to the emotional congruency between the two tasks, promoting parallel processing. Exp2 therefore used non-emotional words for Task 2 but similar in frequencies and letter length ("berry" as "angry" vs. apple as "happy"). To directly compare between equal numbers of trials across experiments, we kept the "congruency" variable (now a dummy variable).

Participants: N=48 (29 females; age range: 18-26); half searched for a female Target 1 face and half searched for a male Target 1 face.

Results and Discussion



As in Exp1, the main effect of Lag on Target 2 accuracy was significant, $F(2,92)=14.13$, $p<.0001$. Pairwise comparisons revealed that Target 2 accuracy at Lag 3 (.938) was significantly lower than Lag 1 (.953) and Lag 7 (.967), $Fs(1,47)\geq12.70$, $ps<.001$. These findings suggest that a small but significant AB effect of .029 was observed. The interaction between Lag and Target 2 difficulty was significant, $F(2,92)=3.81$, $p=.0258$, indicating that the AB effect was larger in the easy Target 2 condition (.038) than the difficult Target 2 condition (.019).

Discussion

We tested the multi-channel model for facial emotion process using a facial emotional discrimination task (assuming to occupy the configural channel) and a word discrimination task (assuming to occupy the featural channel). We found that processing facial emotion produced a small but significant AB effect on word processing in both experiments, a finding inconsistent with the multi-channel model. The AB effect was not modulated by Target 2 difficulty in Exp1 but it was in Exp2, suggesting that the emotional congruency between two targets promoted parallel processing. Thus, the processing of facial emotion does not facilitate the bypass of capacity limitation for a non-facial object. We argued that there is a structural limitation (i.e., a bottleneck) in processing successive visual stimuli in working memory.