

# Negative compatibility effect at post-categorical level

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In contrast to the conventional compatibility effect, Negative Compatibility Effect (NCE) refers to the phenomenon of slower RTs in the compatible condition than in the incompatible condition. Two experiments employed a Stroop-like task in which the target and task-irrelevant stimulus were dissimilar in terms of shape and color. While conventional compatibility effects were found when the task-irrelevant stimulus and target were spatially close, NCE was observed when they were separated. Moreover, NCE was not response-modality dependent (oral / manual). These results cannot be explained by the hypothesis that NCE is caused an inappropriate allocation of spatial attention due to the similarity in shape between target and task-irrelevant stimulus (Bavelier et al., 2000). Thus, NCE seems to reflect inhibitory processing at the post-categorical level.

Keywords: negative compatibility effect, stimulus-response compatibility effect, Stroop-like task

## Introduction

In the negative compatibility effect (NCE), target performance is slower for a compatible task-irrelevant stimulus (T-IS) than an incompatible task-irrelevant stimulus (Braind, 1994; Bavelier et al., 2000). Bavelier et al. (2000) suggest that NCE is an effect at a pre-categorical level and that this is dependent on a similarity in shape between target and T-IS.

However, the finding of slower RTs for targets and T-IS dissimilar in shape in a compatible condition within a Stroop-like task by Kahneman and Henik (1981, Experiment 2) (surprisingly, not discussed by them) clearly casts doubt over this hypothesis.

In light of this independency of shape-similarity, we propose that, like the negative priming effect (e.g., Tipper, 1985), NCE is in fact a post-categorical level effect. That is, NCE may be due to inhibitory processing of T-IS representations. Two experiments with a Stroop-like task were conducted to test this proposal.

## Experiment 1

In order to investigate whether NCE is a post-categorical level effect, we employed a Stroop-like task in which the target and T-IS were dissimilar in shape.

According to our proposal, the distinction between conventional compatibility effect (hereafter referred to as positive compatibility effect; PCE) and NCE will depend on the physical distinctiveness between targets and T-IS. This is because, as Driver and Tipper (1989) suggest, automatic activation for a T-IS representation will decrease with increasing physical distinctiveness, with inhibitory processing for these apparently constant.

Defining physical distinctiveness in the present study as the degree of spatial separation between the target and T-IS, we predict that PCE will be found when separation is small. On the other hand because the activation of T-IS representation becomes negative as distinctiveness increases, NCE will occur when the degree of separation is large.

## Method

**Participants.** Nine students participated in this experiment.

**Apparatus.** A frame buffer (VSG 2/3: Cambridge Research Systems, UK), a voice key, and IBM-PC computer were used.

**Stimuli.** One of three color Kanji-words or a neutral Kanji-word presented in white color was used as T-IS. The color words were 赤 (red), 緑 (green), and 黄 (yellow). The target was a square presented at the center of the screen. Its color was either red, green or yellow.

**Procedure.** Participants were asked to name the color of the target as quickly as possible, while ignoring the T-IS which was presented either above or below the target.

Physical distinctiveness was manipulated by varying the degree of spatial separation between the target and T-IS ( $0.5^\circ$ ,  $1^\circ$ ,  $3^\circ$ ,  $5^\circ$ ). The relationship between target color and task-irrelevant word was also manipulated, yielding a compatible (T-IS nominally the same as target color), a neutral (T-IS is non-color word), and an incompatible (T-IS nominally different from target color) conditions.

## Results and Discussion

Figure 1 shows mean RT as a function of task-irrelevant compatibility and degree of separation. When separation was  $0.5^\circ$  and  $1^\circ$ , the RT in the compatible condition was faster than that in the incompatible condition. This tendency disappeared at  $3^\circ$ . In contrast, when separation was  $5^\circ$ , the RT in the compatible condition was significantly slower than that in the incompatible condition. PCE occurred at  $0.5^\circ$  and  $1^\circ$  whereas NCE occurred at  $5^\circ$ .

These results are consistent with our predictions concerning whether a compatibility effect is positive or negative is a function of the separation between target and T-IS, suggesting that NCE is an effect at the post-categorical level.

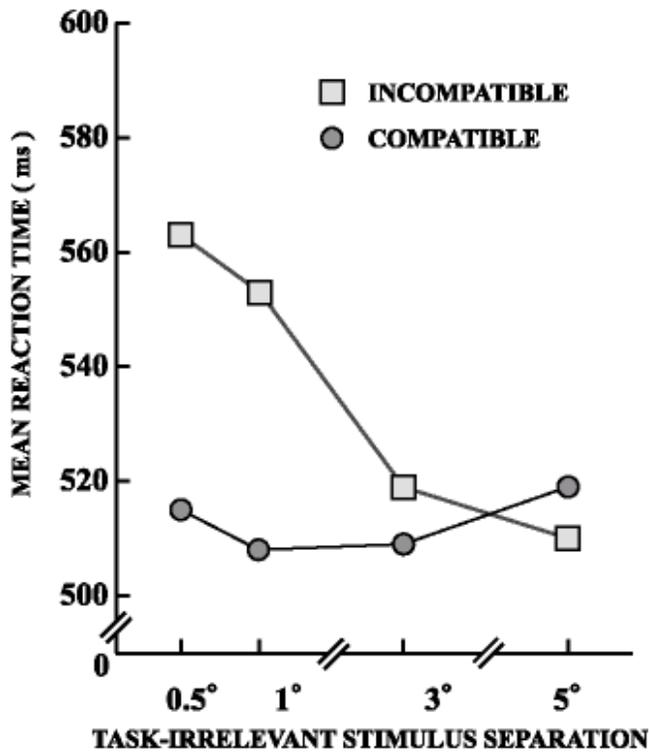


Figure 1. Mean reaction time as a function of task-irrelevant stimulus compatibility and the separation between target and task-irrelevant stimulus

## Experiment 2

Experiment 2 was conducted in order to replicate the results of Experiment 1 with different response modality (i.e., manual response). If NCE is due to inhibitory processing of the T-IS representation, we may expect the same result as Experiment 1 with manual responses.

### Method

**Participants.** Twenty students participated in this experiment.

**Apparatus.** In this experiment, a keyboard was used for responses instead of a voice key.

**Stimuli.** The stimuli were identical to Experiment 1 except that a neutral word was not used.

**Procedure.** The procedure was also identical to that used in Experiment 1, except for the following points: key-press was used for responding; participants were instructed to maintain strict accuracy; and separation between target and T-IS was kept constant at 5°.

### Results and Discussion

Table 1 shows mean RT as a function of T-IS compatibility. The RT in the compatible condition was significantly slower than that in the incompatible condition. The finding of an NCE in Experiment 2, with manual key-response, adds further support to our hypothesis.

Table 1. Mean reaction time in ms and standard deviation as a function of task-irrelevant stimulus compatibility in Experiment 2

	COMPATIBLE	INCOMPATIBLE
Mean	518	505
SD	99	86

## General Discussion

According to Bavelier et al. (2000), the similarity between the target and T-IS in the compatible condition induces these shapes to be grouped together. This grouping leads to an inappropriate allocation of attention over the display, resulting in slower target performance. Therefore, Bavelier et al.'s (2000) hypothesis does not predict NCE when the target and T-IS are dissimilar in terms of either shape or color.

We assume that PCE and NCE result from competition between automatic activation and inhibitory processing of T-IS representations at the post-categorical level. This hypothesis is capable of explaining the majority of findings related to NCE (e.g., Briand, 1994; Bavelier et al, 2000; Kahneman & Henik, 1981), and predicts that the distinction between PCE and NCE hinges on the degree of separation between target and T-IS.

## Reference

- Bavelier, D., Deruelle, C., & Proksch, J. 2000 Positive and negative compatibility effects. *Perception & Psychophysic*, **62**, 100-112.
- Briand, K. A. 1994 Selective attention to global and local structure of objects: Alternative measures of nontarget processing. *Psychological Research*, **55**, 264-269.
- Driver, J., & Tipper, S. P. 1989 On the non-selectivity of selective seeing: Contrasts between interference and priming in selective attention. *Journal of Experimental Psychology: Human Perception and Performance*, **15**, 304-314.
- Kahneman, D., & Henik, A. 1981 Perceptual organization and attention In Kubovy, M. & Pomerantz, J. R. (Eds.), *Perceptual organization*. Hillsdale, NJ: Lawrence Erlbaum Associates. Pp. 181-212.
- Tipper, S. P. 1985 The negative priming effect: Inhibitory effects of ignored primes. *Quarterly Journal of Experimental Psychology*, **37**, 571-590.