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Illusory Flashes can Speed up Responses

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INTRODUCTION

When two modalities deliver conflicting information, perception in one modality can be altered in order to ensure a coherent representation of the assumed underlying physical source. An impressive example of such a perceptual modulation is the sound-induced flash illusion (SIFI; Shams, Kamitani, & Shimojo, 2000). The SIFI can occur when a single brief flash is combined with two auditory beeps. In this case, participants often report seeing two consecutive flashes. We examined whether this audio-visual illusion is restricted to perceptual processes or can also affect behavior. Specifically, we tested whether or not participants respond faster when they perceive an illusory double-flash as compared to when they perceive a single flash. As a control, we also included a condition in which two consecutive flashes were physically presented. A redundancy gain has previously been shown for such physically redundant signals (redundant signals effect; RSE; Miller, 1982). If the RSE depends on the number of percepts rather than on the number of physical stimuli, redundancy gains should be observed for illusory double flashes as well as for those that are physically presented.

METHOD

Twenty-six students of the University of Tübingen participated in a simple reaction time (RT) task. In each go trial, either two consecutive flashes (redundant-target trials) or a single flash (single-target trials) were presented (Fig. 1). In single-target trials, either an early single-flash or a late single-flash was presented. The onset time of the early single-flash matched the onset time of the first flash in redundant-target trials relative to the end of the foreperiod. The onset time of the late single-flash matched the onset time of the second flash in redundant-target trials relative to the end of the foreperiod.

Participants were instructed to respond as rapidly as possible to the onset of any flash. In catch trials, no flashes were presented and participants had to withhold their response. Furthermore, at the end of each go trial, participants indicated the number of perceived flashes.

Crucially, we additionally manipulated auditory stimulation. In the flash-only condition, no auditory stimuli were presented. In this condition, we calculated the **stimulus-based RSE** as the difference between RT in the faster single-flash condition and RT in the redundant-flash condition (Fig. 2).
In the flash-beep condition, two auditory beeps were presented in addition. In this condition, the SIFI could occur in trials with presentation of a single flash. Specifically, in these trials auditory stimulation could result in an illusory perception of two consecutive flashes. Thus, to determine the **illusion-based RSE** we calculated the difference between RT in single-target trials in which participants reported seeing only one flash (i.e., no SIFI) and RT in single-target trials in which participants reported seeing two consecutive flashes (i.e., SIFI, Fig. 2).

RESULTS

Fig. 3 shows mean RT in go trials as a function of Stimulation (flash-only, flash-beep) and Redundancy (faster single, redundant). The factor Stimulation was significant, $F(1,25) = 67.58$, $MSE = 761.88$, $p < .05$, reflecting shorter RT in trials with auditory stimulation (303 ms) than in trials without auditory stimulation (348 ms). The factor Redundancy was significant, $F(1,25) = 7.51$, $MSE = 243.43$, $p < .05$. Participants responded faster in the redundant-target conditions (321 ms) than in the faster single-target conditions (329 ms). Crucially, the interaction of Redundancy and Stimulation was not significant, $F < 1$. The stimulus-based RSE (9 ms) and the illusion-based RSE (8 ms) were of virtually identical sizes. Additional *t*-tests revealed that both the stimulus-based RSE, $t(25) = 2.27$, $p < .05$, and the illusion-based RSE, $t(25) = 2.20$, $p < .05$, differed significantly from zero.

CONCLUSION

In the present experiment, both a stimulus-based and an illusion-based RSE were observed. This result strongly supports the notion that redundant information results in an RT benefit irrespective of whether redundant stimuli are physical present or illusorily perceived. Thus, an illusory double-flash can influence behavior and speed up responses in the same manner as a physically presented double-flash.

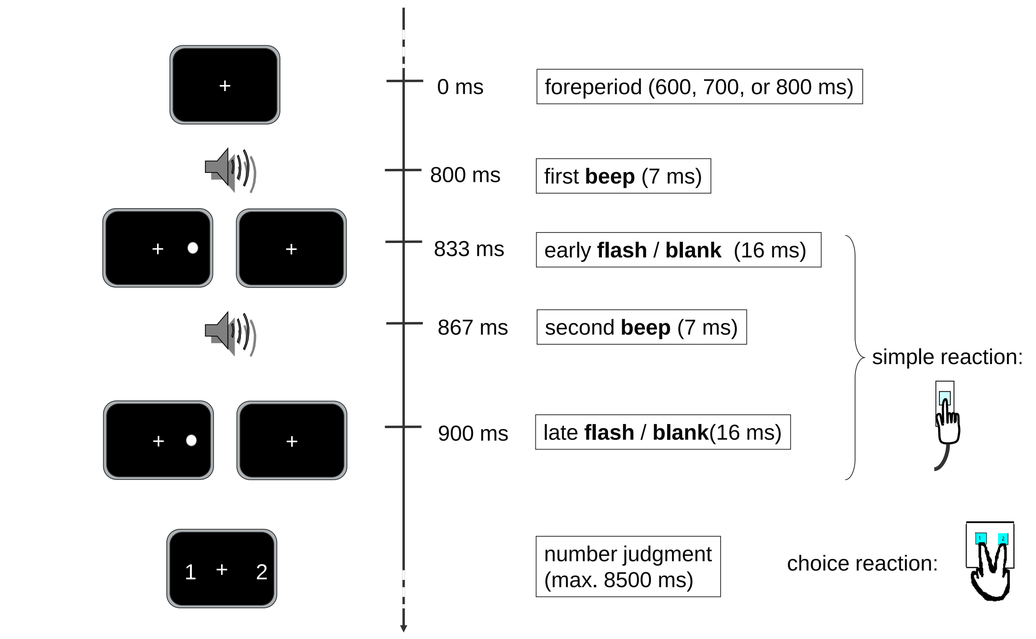

Fig. 1. Schematic illustration of a go trial in the flash-beep condition. Two auditory beeps were presented together with either a single flash or two consecutive flashes. Participants were asked to respond as quickly as possible to the onset of any flash. Afterwards they indicated the number of perceived flashes.

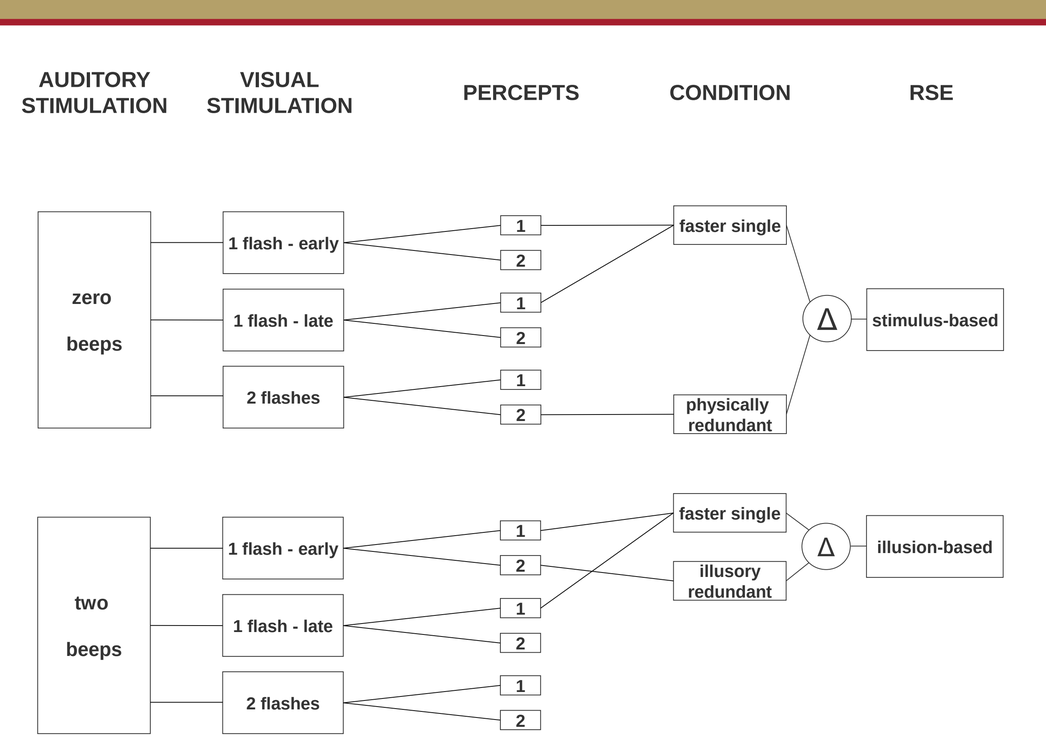

Fig. 2. In the flash-only condition (upper half), the stimulus-based RSE was defined as the difference between the faster single-target condition and the physically redundant-target condition. In the flash-beep condition (lower half), the illusion-based RSE was defined as the difference between the faster single-target condition and the illusory redundant-target condition. Δ = difference; RSE = redundant signals effect.

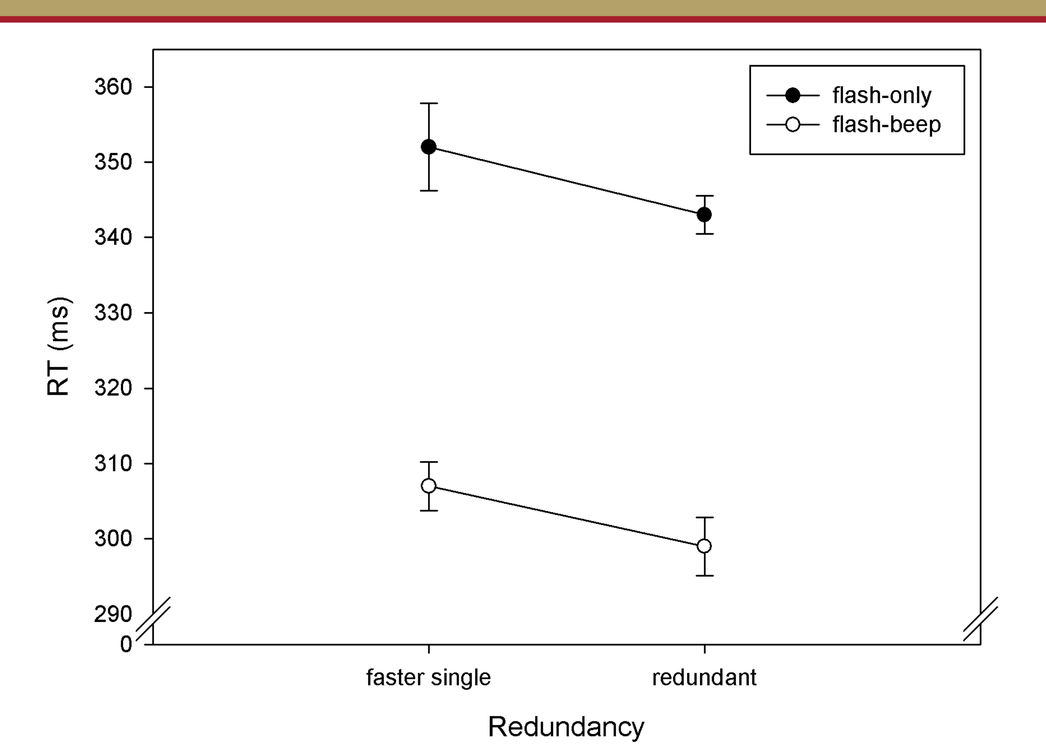

Fig. 3. Mean reaction time in go trials as a function of Redundancy and Stimulation.

References: Miller, J. (1982). Divided attention: Evidence for coactivation with redundant signals. *Cognitive Psychology, 14*, 247-247.
Shams, L., Kamitani, Y., & Shimojo, S. (2000). What you see is what you hear. *Nature, 408*, 788.

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