Interaction of the Stroop effect with auditory stimuli

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Abstract

We examined the impact of presentation of voice stimuli on the Stroop effect.
We operated spatial location and meaning of visual words in terms of space, meaning of auditory stimuli, and the stimuli-onset asynchrony (SOA) between visual and auditory stimuli. Furthermore we operated two modes of responses between key-press and vocal responses. Consequently, we obtained four significant effects; congruency of visual stimuli, meaning of auditory stimuli, response mode and SOA. The impact of auditory stimuli was greater when the visual stimuli preceded the auditory stimuli in vocal-response mode. It suggests that auditory stimuli make activation of semantic representation faster than visual words.

Shimada, H. (1990) carried out the experiment on the influence of the auditory words on visual color-naming. (Shimada, H.). This experiment included the world's first finding of the interference effect between auditory color-words and visual color-naming; the intermodal Stroop effect. We tried to extend this interference effects into spatial information processing in the present experiment. And we tried to examine the mutual interference among spatial location, word meaning, and auditory word in this experiment. We investigated how information processing on location of stimulus interacted with semantic processing of words as stimuli, and futhermore how it interacted with vocal stimuli as distractors. We varied SOAs (stimulus onset asynchonies) between visual words and auditory words. We investigated time course and difference in memory activation between visual and auditory information.

Two dimensions of visual target words were mixed in trials; the location of either right or left and meaning of words (which indicated correspondent location or not). The Japanese word (either "MIGI (right)" or "HIDARI (left)") was used as visual stimulus. In the similar ways, the vocal words included either "MIGI (right)" or "HIDARI (left)".

Method

Subjects were ten students from Kobe University. Subjects performed the tasks in private sound-proof rooms through wireless LAN connected with the control PC in the next room in the experiment. The experiment was conducted using computers running E-Prime software (Version 1.1; Psychology Software Tools, 2002).

Stimuli

We used the white point of 4mm as the gaze point in the diameter displayed at the center of the monitor for the visual stimuli. And, the words stimuli were displayed at a position 10 mm away right and left from the gaze point respectively. Japanese word of either " HIDARI (left)" or " MIGI (right)" including the Chinese character (Kanji) was displayed as visual stimuli, and the display area was 16 mm x 16 mm. Figure 1 shows the visual stimuli used. The auditory stimuli as auditory Japanese words were generated through Microsoft Text-to-speech engine, and the auditory stimuli were presented through the headphones. They consisted of either " MIGI (right)" or "HIDARI (left)".
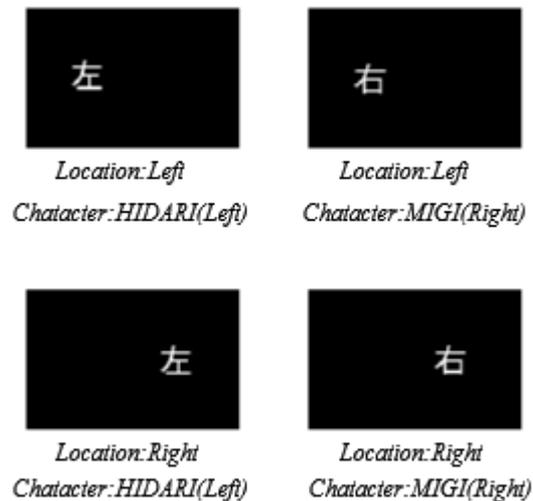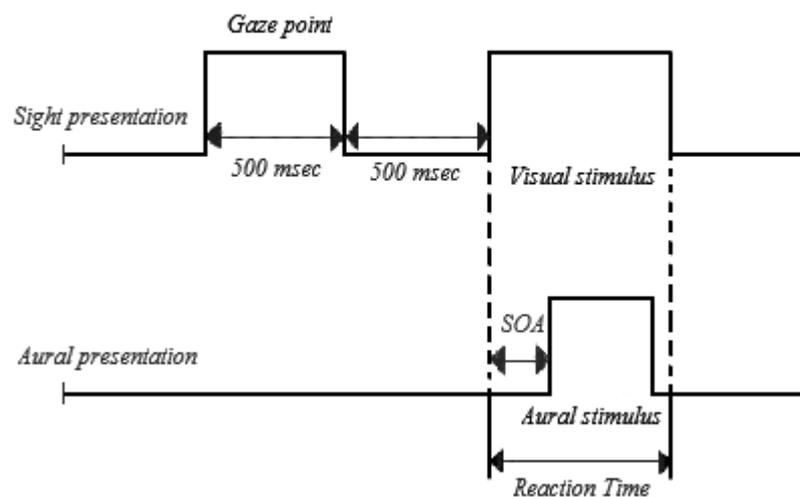
Fig.1 Visual Stimuli

Fig.2 Experimental Procedure

The subjects were divided into two groups (the keyboard reaction and the vocal reaction) as between-subjects. In both keyboard reaction condition and the voice reaction condition, variables of SOA consisted of the following five conditions.

- The auditory stimuli preceded the visual stimuli in 200ms (-200ms).
- The auditory stimuli preceded the visual stimuli in 100ms (-100ms).
- The auditory stimuli and the visual stimuli were presented at the same time (0ms).
- The auditory stimuli followed the visual stimuli in 100ms (100ms).
- The auditory stimuli followed the visual stimuli in 200ms (200ms).

In other way, we operated three independent variables; spatial location (right or left) of word, meaning (right or left) of word, and meaning (right or left) of auditory word.

Thus, three independent variables made eight conditions (within-subject variables). Each condition included ten trials (8 x 10 = 80). Total 400 trials consisted of 80 trials in five SOA conditions (80 x 5 = 400). Moreover, five SOA conditions as between-block factors were

counterbalanced by the circulation method.

Procedure

The gaze point presented during 500 ms at the center of the screen, and the blank (nothing was displayed) was inserted during 500ms. The subjects had to make response as early as possible whether the visual stimuli was presented in left from the gaze point or presented in right.

The subjects made response to location of visual stimulus through vocal reaction or through key press (between subjects). Reaction time (RT) was defined as the time from onset of visual stimulus to onset of subject's reaction (key-press or vocal response).

The disappearing blank was inserted at the same time in 3000 ms, the gaze point was displayed again, and the auditory and the visual stimuli were repeated. A wrong reaction was excluded from the result. Figure 2 shows the experiment schedule.
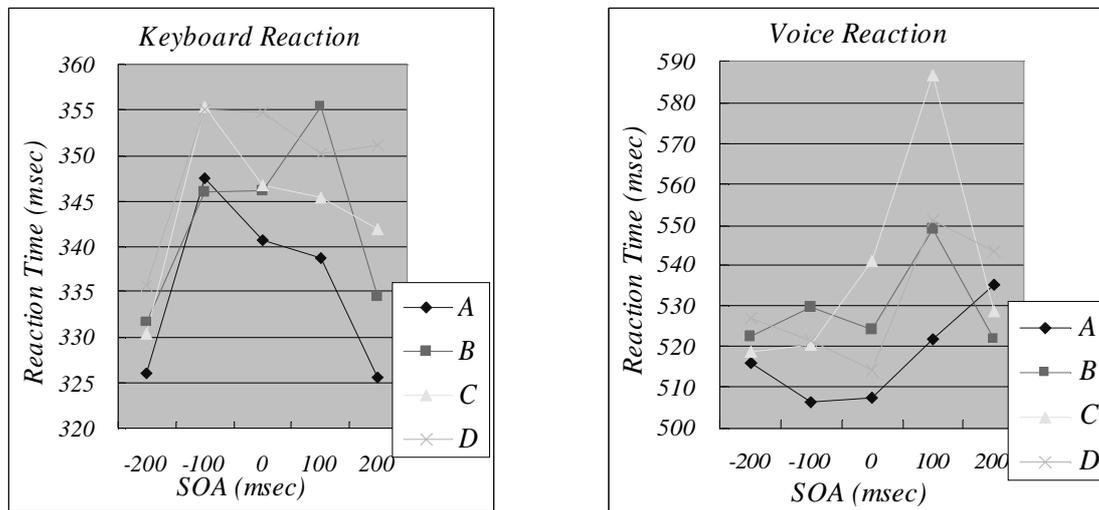
Results and Discussion

Fig.3 Response Time

Table.1 Relation between Dimensions

	Location-Word	Word-Voice	Voice-Location
A	Congruent	Congruent	Congruent
B	Congruent	Incongruent	Incongruent
C	Incongruent	Congruent	Incongruent
D	Incongruent	Incongruent	Congruent

Fig 3 shows that RTs varied in SOAs and the relationship between three variables; location, word, and voice (auditory stimulus). Table.1 shows the relationship in detail. Each explanatory note (A, B, C, and D) in Fig.3 is corresponded to the relationship between

dimensions in each trial in Table 1 (in the follows; condition A, B, C, and D). The relations between three variables existed. The higher increased congruency between three dimensions, the faster reaction to the stimulus was facilitated. In contrast with it, if there was incongruency, each reaction got weaker and slower. Therefore, the higher congruency between Word and Voice in condition A received faster response time (RT). Condition C received the biggest interference (slow reaction) in voice (vocal) response. And furthermore, Condition C was very slow especially in the vocal reaction in SOA 100 ms. These results were similar to the findings of Shimada, H. (1990); "When the voice stimulation delays 100 msec and presented for the visual stimulation, the influence of the voice stimulation to the visual stimulation grows most". It was suggested that memory access from auditory stimulus might be faster in 100 ms than memory access from visual word.

References

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