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A STUDY ON THE DIFFERENCE IN VISUAL AND AUDITORY TEMPORAL JUDGEMENT

By
MASATO FURUKAWA (古川真人)

(Department of Psychology, Tohoku University, Sendai)

Visual and auditory comparisons of unfilled intervals, ranging from 0.5 sec to 1.25 sec, were studied, using 3 male graduate students. The method used was an adjustment method. As the result there were few remarkable differences between visual and auditory temporal judgements under the condition of unfilled interval.

Introduction

The role of sensory modality in determining the nature of temporal judgment has attracted a good deal of public attention in recent years. Several studies have shown that human *S*s judged visual filled intervals to be shorter than objectively equal auditory intervals (Goldstone & Lhamon, 1971, 1972; Goldstone, 1968). Also, using unfilled intervals delimited by auditory clicks or visual flashes, the modality effect was found by the absolute method which used a 9-category scale (Goldstone & Goldfarb, 1963). On the other hand, other conflicting data were reported by Tanner, Patton and Atkinson (1965), who employed a two-category, forced-choice, direct comparison of intramodal and crossmodal lights and sounds. And no auditory-visual difference was observed when unfilled intervals were used (Goldstone, 1964) with the method of comparative judgment (judging longer or shorter, given two duration). In an attempt to examine whether the modality effect is unique for methods which include verbal mediums or not, Goldstone (1968) asked his *S*s to produce or reproduce a signal of specific filled duration (one to four seconds) intra- and intermodality. His results again demonstrated the auditory-visual differences. However, even by adopting the same method, some contradictory results were reported that no visual-auditory differences were observed (Brown & Hitchcock, 1965; Hirsh, Bilger, & Deatherage, 1956). These results suggest that the relationship between temporal judgment and sensory modality seems to be considerably complex. Still more, Berglund et al. (1969) emphasize that comparisons of sensory modalities are of no use unless the perceived intensities between the channels under investigation are equated. Kohfeld (1971) already insisted that subjective matching of intensity, which Goldstone and other used, is not the equivalent of the decibel matches which was used in his experiment. Accordingly, the present experiment was designed to investigate the difference in visual and auditory temporal judgement with minimizing the possible artifacts derived especially from procedures and stimulus conditions.

Method

Apparatus: Fig. 1 shows the block diagram of the apparatus with stimulus arrangement of both simple reaction time experiment and temporal judgement. Condtrol and timing of stimulus events, which contain pulse duration, standard interval, time between the durations of two empty intervals, and comparison interval, were made by a 6-channel preset digital timer and a delayed pulse generator and always checked by the dual beam oscilloscope. The time interval between second comparison stimulus was changed by a delayed pulse generator which was manipulated by the *S*s with a variable resistor, and displayed on a digital time counter at the nearest millisecond. This variable resistor was gradually adjusted by rotating a single shaft. It may be possible that *S* uses kinesthetic and proprioceptive cues from the manipulation itself since *S* is asked to directly manipulate the comparison stimulus. In order to expect higher accuracy, this variable resistor provided *S*s with a great number of turns in adjustment.

The light source as the visual signal, a glow-modulator tube (R1131C), which was amplified by a power amplifier up to +120V, was viewed monocularly through an artificial pupil of 2 mm in diameter using the Maxwellian view optical system. The

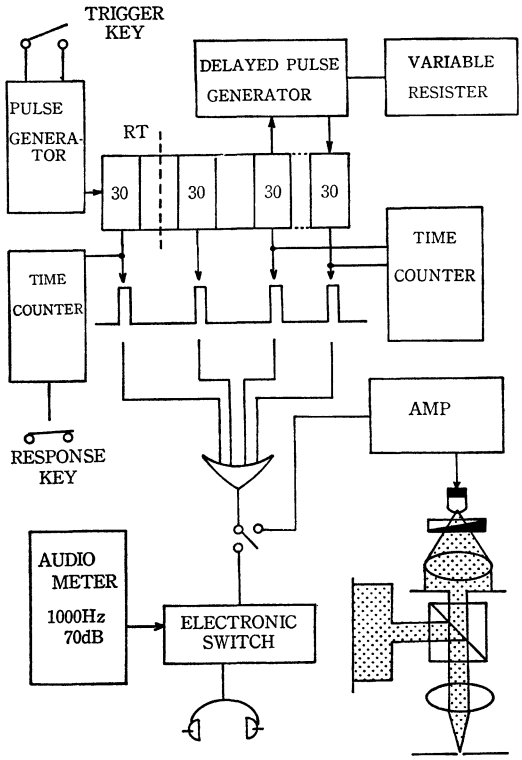

Fig. 1. Block diagram of the apparaus used for measuing RTs and temporal judgements.

luminance of the flash was changed by the circular neutral density wedge. The visual signal with a duration of 30 msec was a circle of white light having a visual angle of 10°, on a dim back ground.

An audiometer served as the source of the auditory signal. The auditory signal, a 1000-Hz tone, with a duration of 30 msec was monaurally presented through a headphone at an intensity of 70 dB (SPL). Its signal was set by an electronic switch with rise and decay time of 1 msec.

Procedure: The experimental procedure consisted of two parts: The first of these consists in arrangement for matching the visual and auditory stimulus intensity using simple visual and auditory reaction time. The *S* was asked to place his index finger upon a telegraph key under *E*'s verbal ready signal, and respond by removing the finger as rapidly as possible after the onset of a light stimulus having three luminance levels or a tone stimulus having one constant intensity level, respectively.

For each *S* the total of 80 trials, 20 trials at each of the four stimulus conditions respectively, were administered under counterbalanced-order of presentation.

Five times from the initial trial at each of stimulus conditions were eliminated from data analysis as they were regarded as practice trials. Forepreiods were randomized from 1 to 3 sec, and time between trials was approximately 5 sec.

The second part in the experiment procedure was as follows. A method of adjustment was used to measure temporal judgment for each *S*. Two empty intervals, a standard interval and a comparison interval were presented.

S was told that a pair of unfilled interval would be presented to him in succession, one of which was a standard, the duration of which would remain constant, and the other was the comparison, the duration of which he would be able to change. And *S* was told to take as long as he wished to make his decisions, and that he would be allowed to hear or see the pair of unfilled intervals as many times as he desired. When *S* was satisfied with his adjusting himself to the variable unfilled intervals as long as the standard, *S* signaled *E* to record the value.

Four intervals of .5, .75, 1.0, and 1.25 sec were used. Subject YK judged 1 sec interval. TS judged those intervals from .75 to 1.25 sec. MF gave judgments for all of the intervals in this series. Twenty trials in total, containing 10 ascending and 10 descending trials alternately, were administered for each of visual and auditory condition respectively. The order of presentation of the modality conditions which were counterbalanced was alternated at every two trials. A standard stimulus which consisted of two discrete tones or flashes, with duration 30 msec, was always presented 2 sec before the comparison stimulus which consisted of other two discrete tones or flashes. Time interval between trials was about 7 sec.

S was not told about the accuracy of his performance. And *S* was asked to try not to count or tap or such rhythmical physiological nature as respiration or heart rate during any trial. Experimental sessions lasted for approximately 2 h and 30 min typically. Finally, at the end of experiment, simple RTs were again measured for

each *S* with the visual and auditory stimulus presented during the present experiment.

Three male graduates ranging in age from 23 to 29 years took part in the present experiment. The author was one of them.

Results and Discussion

As shown in Fig. 2, the data in terms of mean RTs in visual and auditory signals were obtained. The vertical lines indicate the magnitude of the standard deviations. Three kinds of level of the visual intensity increased from L_1 to L_3 which were selected at an equal distance with the arbitrary log unit. The mean visual RT equivalent to the mean auditory RT was verified with the optical wedge attenuation curve. In other words, the luminance of visual stimulus matching the intensity of auditory stimulus was computed by the transmittance of the neutral density filter. The stimulus presented during the following temporal judgment experiment was thus determined for each individual S separately.

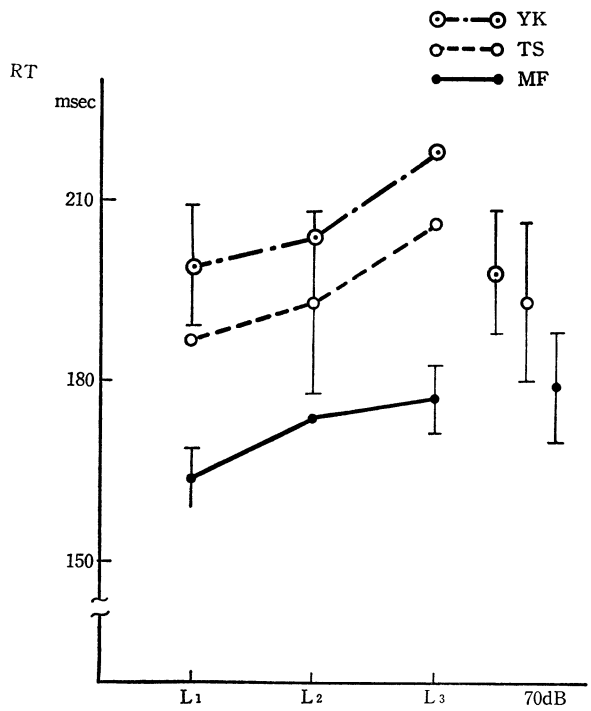

Fig. 2. Mean RTs for visual and auditory signals.

Fig. 3 compares mean auditory and visual temporal judgment under the standard 1 sec duration. The values plotted in Fig. 3 were calculated by averaging the 8 ascending and 8 descending trials for each modality condition. The vertical lines indicate the magnitude of the standard deviations.

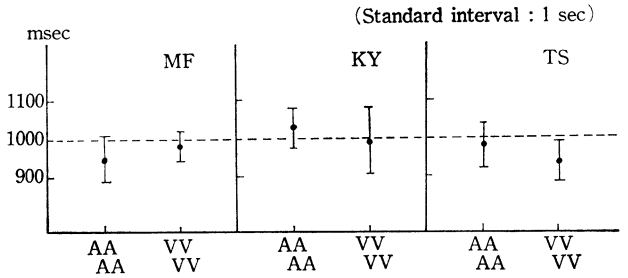

Fig. 3. Intra-modal comparison of auditory and visual unfilled intervals.

Although the result indicated no consistent trend among three *S*s, the magnitude of the difference between conditions, when viewed as a whole, was very slight at first sight. Namely, for MF, auditory duration was slightly longer than visual duration by 42.1 msec. Instead, a tendency towards longer judgments of visual duration was obtained for the remaining two *S*s (by 31.8 msec and 51.5 msec, respectively).

Because of differences in the method and stimulation in the present study, there are no other directly comparable data. However, the general tendency found here was not in agreement with the findings of Goldstone (1968) and Behar et al. (1960, 1961), who reported the magnitude of the difference over 200 msec using the production and reproduction method with no verbal category scaling as well as the method of single stimuli.

In addition, as shown in Fig. 4, the mean values and standard deviations at each of three standard (.5, .75, and 1.25 sec) were obtained using the same experimental procedure. MF judged auditory duration consistently longer than visual duration under all interval conditions. And again, the amount of modality difference, which had the maximum difference 48.3 msec under the standard .5 sec, was very small. For TS, visual duration was slightly longer than auditory, as in the previous result, by 32.2 msec under the standard .75 sec. This *S*, however, made a longer judgent of auditory duration by 15.6 msec under the satnadard 1.25 sec.

These results imply clearly that the amount of the modality difference appears to be consistently slight under the specific unfilled interval condition while relative dissimilar tendencies may be seen between *S*s in regard to the direction of change of the modality difference. In addition, the present results predict that modality effect as often pointed out would arise from any different methodological disparities. Usually, it has been considered that the production and reproduction method are accompanied with motor-response system during any trial, e.g., arm movement, key pressing, and tapping. Also in these methods *S*s' unsatisfactory and false judgment were apt to get mixed in because the value they judged only once at each trial was also computed. It was possible that these variables may have affected the previous discrepant results. It seemed that in the present method these variables were in part eliminated.

At the end of the present experiment, after sufficient practice trials, 10 RTs of

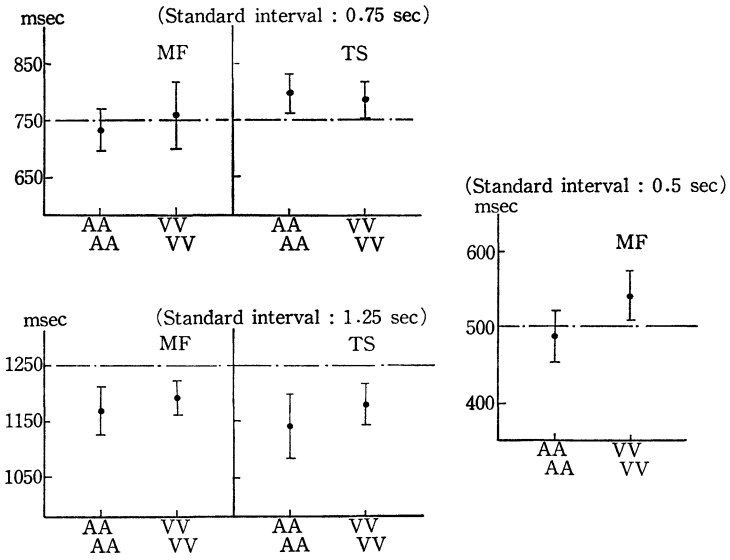

Fig. 4. Intra-modal comparison of auditory and visual unfilled intervals.

Table 1. Mean RTs for auditory and visual signals in each *S*. Parenthesized figures are *SD*s.

	TONE	LIGHT
KY	190.3(15.8)	184.5(14.0)
TS	184.8(18.7)	182.2(10.6)
MF	173.1(15.6)	171.9(11.8)

(Unit: msec)

each modality were obtained from 3 *S*s. Table 1 presents the mean RT and standard deviations for each *S*. As seen from this table, the result confirmed that visual and auditory stimulus intensity was approximately equal during the experimental session for all *S*s.

Although the possibility still remains that previously demonstrated modality effects are unique in intervals filled by sounds or lights lasting continuously over a period of time, the present results as a whole showed that there were few remarkable differences between visual and auditory temporal judgment under the condition of unfilled intervals.

On the basis of these results, it is necessary to define in detail the variables that influence the modality difference in temporal judgment. Further investigation will be required to define more clearly the relation of method, sensory modality, and stimulus pattern.

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