Intermodality judgments of signal duration[1]

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Abstract

Ss were asked to make both inter- and intramodal comparisons of the durations of lights and tones, in a two-alternative, forced-choice situation, with signal durations between 0.5 sec. and 1.6 sec. The probability of a correct judgment was higher for intra- than for intermodal comparisons and was highest for intra-auditory comparisons. For intermodal pairs of signals with durations 0.5 sec. and 0.6 sec., there was a greater than chance probability of judging the visual signal longer than the auditory.

Problem

Several recent articles have presented evidence that human Ss judge auditory signals to be longer than visual signals of equal duration, when both are compared with subjective temporal norms (Goldstone, Broadman, & Lhamon, 1959; Behar & Bevan, 1961; Goldstone & Goldfarb, 1964a). Additional evidence that auditory durations are judged longer than visual durations has been reported (since the present experiment was performed) by Goldstone & Goldfarb (1964b) in a study which required direct comparative judgments of tones and lights.

The present study also has been concerned with direct intermodal, as well as intramodal, comparisons of the durations of tones and lights. However, where Goldstone & Goldfarb asked their Ss to use a 9-category scale, ranging from very much shorter to very much longer, for comparing the second signal of a pair with the first, the present study required a 2-alternative (longer or shorter) forced-choice comparison.

Method

The Ss were 12 male college students. All were free from gross visual or auditory impairment as determined by an informal interview. S sat wearing earphones, approximately 24 in from a display panel in a dimly lighted, sound attenuated room. The auditory signal, a 1000 cps tone, was presented through the earphones (Permoflux, D4S-17) at an intensity of 86 db (re 0.0002 dynes per cm^2). The tone was gated with about a 40 msec. rise and fall time. A white noise (100K cps, low pass) background was presented through the earphones at an intensity of 56 db. The light source for the visual signal, a glow-modulator tube (Sylvania, R1131C), presented at an intensity of about 10 millilamberts (measured by a Pritchard Photometer) was mounted behind and was viewed through a 7 mm-diameter lens on the display panel.

Each of the 12 Ss was tested for a total of 24 experimental sessions. Each session consisted of 512 trials. On each trial two signals of unequal durations were presented; the first signal was longer on half of the trials and shorter on the other half. S's task was to judge which of the two signals was longer by pressing one of two response switches mounted on the display panel.

Three different pairings-of-durations were investigated: 0.5 sec. with 0.6 sec., 1.0 sec. with 1.1 sec., and 1.5 sec. with 1.6 sec. [D(0.5), D(1.0), and D(1.5), respectively]. Only one of the three pairings was presented during a single experimental session; thus, the 24 sessions consisted of eight sessions with each of the three pairings.

Each signal consisted of a light or a tone, so that on any given trial S was presented either two lights (S_{VV}), two tones (S_{AA}), a tone followed by a light (S_{AV}), or a light followed by a tone (S_{VA}). The sequence of events on the trial and their durations were as follows: noise alone, 1.0 sec. (ready period); first signal plus noise, varied duration; noise alone, 0.8 sec.; second signal plus noise, varied duration; noise alone 2.0 sec. (response period); no noise 2.0 sec. (intertrial interval).

The eight types of trials, consisting of the four stimuli (S_{VV}, S_{AA}, S_{AV}, and S_{VA}) times the two orders of presenting the signals (first or second signal longer), were presented throughout a given session in a sequence that was randomized within blocks of 128 trials, with 16 of each of the trial types in each block.

Results and Discussion

In Figs. 1 and 2 each data point is an average of the performance of the 12 Ss. Figure 1 shows the probability of a correct response, $Pr(R_C)$, plotted over the eight sessions for each of the four stimuli. In Fig. 1b the S_{AA} curve for D(1.0) conforms with the results commonly obtained with pairs of auditory signals, showing that the difference threshold [based on $Pr(R_C) = 0.75$] is approximately one-tenth of base durations near 1 sec., $\Delta t/t = 0.1$ (Woodrow, 1950). The evidence in Fig. 1 that performance becomes more accurate as the incremental duration becomes larger, relative to the base duration (with the incremental duration constant at 1.0 sec., $\Delta t/t$ becomes larger as D goes from 1.5 to 0.5), is also consistent with the results of previous research.

Discrimination of signal duration was most accurate when two auditory signals were compared. For each value of D, the S_{AA} curve is higher than the other curves over each of the sessions. Additional evidence of the superior accuracy in judging two auditory signals is given by the individual Ss' $Pr(R_C)$ across sessions for each D-value. A majority of the 12 Ss performed most accurately to S_{AA}, as follows: 9 with D(0.5), $p < 0.001$; 10 with D(1.0), $p < 0.001$; and 8 with D(1.5), $p < 0.01$; where p was obtained with the binomial test.

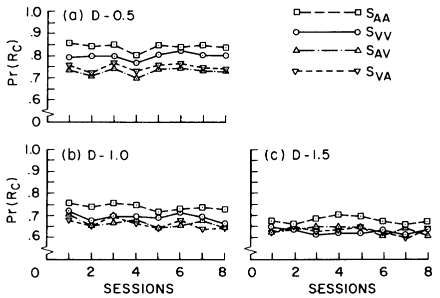

Fig. 1. Probability of a correct response.

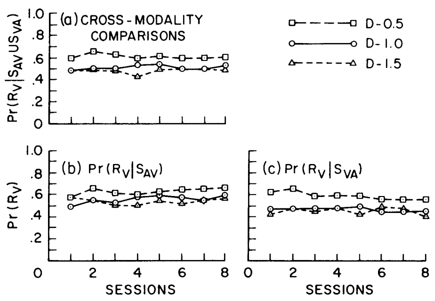

Fig. 2. Probability that the visual signal was judged longer.

Next most accurate were judgments comparing the durations of two visual signals. For D(0.5) the S_{VV} curve stands completely above either the S_{VA} or S_{AV} curves. The D(1.0) and D(1.5) graphs, however, show that this superiority decreased as D became longer.

Figure 2a presents the probability that the visual signal was judged longer, given a stimulus requiring a cross-modality comparison, $Pr(R_V|S_{AV} \cup S_{VA})$. The figure shows that with D(0.5) the visual signal was judged longer than the auditory in every session. Data for Ss as individuals with D(0.5) indicate that for 11 of the 12 Ss, the probability of judging the visual signal longer than the auditory was above 0.5 ($p < 0.01$). With D(1.0) and D(1.5), the bias toward judging the visual signal as longer diminished. There is, in fact, a suggestion that with D(1.5) the bias has been reversed; within six of the eight sessions, the average probability (over Ss) of judging the visual signal longer is less than 0.5 and across sessions only four of the 12 Ss judged the visual signal longer more often than the auditory ($p > 0.10$). The relationship between $Pr(R_V)$ and D holds, regardless of the order of presentation of the visual and auditory signals. This is shown by Figs. 2b and 2c which present $Pr(R_V|S_{AV})$ and $Pr(R_V|S_{VA})$.

The results of the intermodal comparisons of the present experiment do not support the conclusion of Goldstone & Goldfarb (1964b) that auditory signals are judged longer than visual signals. The interval durations and signal intensities of the two studies seem to have been comparable. However, the difference in the number of trials between the two studies may have contributed to the discrepant results; Goldstone & Goldfarb require 100 intermodal comparisons per S, while in the present study 6144 were required. It may be important to note that over the first 128 intermodal comparisons of the present study, which are comparable to the 100 trials per S of Goldstone & Goldfarb, $Pr(R_V)$s were 0.58 for D(0.5), 0.48 for D(1.0), and 0.47 for D(1.5), all of which are lower than the respective $Pr(R_V)$s over the total 6144 trials. The different dependent variables employed in the two studies may also have contributed to the difference in the results. These differences between the two studies, along with differences observed due to treatments within the present study, viz, differences in $Pr(R_V)$ between the different D-values and the intramodal difference between visual and auditory $Pr(R_C)$, suggest a complex relationship between time perception and sense modality.

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Note

1. The authors wish to thank Roanna Crawford for her assistance in collecting the data.