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Nonmonotonicity of temporal judgment of duration as a function of variability of size

SUCHOON S. MO
University of Southern Colorado, Pueblo, Colorado 81001

When the size of filled circle varied from trial to trial, the accuracy of judgment of the duration of circle was a monotonically decreasing function of duration. Reduction of the variability of size resulted in change of this monotonic function into a bow-shaped quadratic function, with the least accuracy at the midrange of durations.

Duration, unlike nontemporal attributes, forms both temporal and order relations. A longer duration not only is a shorter duration being prolonged, but also is longer in the sense of order relation. Therefore, two dimensions, the temporality and ordinality dimensions, may be conceptualized with respect to duration. Whether judgment of duration is based on the temporality or the ordinality dimension of duration has not been explicitly studied and is not known. This study attempts to determine how these two dimensions may contribute toward judgment of duration.

If judgment of duration is based on the temporality dimension of duration alone, then accuracy of judgment of a longer duration should be less than that of a shorter duration, for prolongation of error associated with a shorter duration would not improve accuracy. Consequently, accuracy of judgment of duration should be a monotonically decreasing function of duration. If, on the other hand, judgment of duration is based on the ordinality dimension of duration, then such montonicity should not be the case. The ordinality dimension is not unique to duration alone; it applies to nontemporal attributes as well. Accuracy of judgment of attributes forming ordered continua often tends to be a nonmonotonic bow-shaped function of continua (Ebenholtz, 1972). A previous study (Mo & Michalski, 1972a), in which a dark dot was tachistoscopically presented for duration judgment, showed that the accuracy of judgment of duration was a nonmonotonic function of duration, the midrange of durations being associated with the least accuracy. Although this finding supports the assumption that judgment of duration is based on the ordinality dimension of duration, it does not answer the question as to how the ordinality dimension, instead of the temporality dimension, becomes effective in determining judgment of duration.

It can be noted that at the initial period of duration, the complete information concerning the duration is not yet available, so that nontemporal information is more immediately and more completely available. When such nontemporal information lacks the ordinality dimension, as in repeated presentation of an identical single dot, judgment of duration would be predominantly influenced by the ordinality, not the temporality, dimension of duration. However, suppose that, instead of a single dot, a circle of variable size is presented in each trial for judgment of duration. When size varies from trial to trial, the ordinality dimension of size would generalize to the ordinality dimension of duration, creating interference of the task of judging duration. Therefore, judgment of duration, if it were to be made at all, would be determined by the temporality, not the ordinality, dimension of duration. Specifically, it can be predicted that when the stimulus size varies from trial to trial, the accuracy of judgment of duration is a monotonically decreasing function of duration. On the other hand, if the stimulus size is constant, such accuracy would be a nonmonotonic bow-shaped function of duration.

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METHOD

Eleven male and 19 female undergraduate volunteers were assigned to three groups of 10 subjects each. Their mean age was 22.2 years.

Five filled dark circles were presented, one in each trial, by means of a Lafayette Model U-1 tachistoscope. Their diameters were 10, 14, 18, 22, and 26 mm. Stimulus durations were .30, .35, .40, .45, and .50 sec. For all subjects, these five durations were presented randomly, each duration being presented for 10 trials, with the total number of trials being 50.

For the variable sequence group, the stimulus size varied from trial to trial randomly, each size being presented equally often as others. For the fixed sequence group, each size was presented in blocks of 10 consecutive trials. The sequence of these five blocks varied from subject to subject. For the constant sequence group, only one stimulus size was presented for the entire trials for each subject. The stimulus size varied from subject to subject.

Subjects were instructed to judge each duration and verbally report their judgment at the termination of each duration by saying either "one," "two," "three," "four," or "five," each number corresponding to the order of durations from the shortest to the longest duration. The rate of trial presentation was subject paced.

Table 1
Probability (p) of Correct Responses and Mean Estimate ($\bar{t}$) With Respect to Stimulus Duration and Stimulus Diameter

	Stimulus Duration (Seconds)									
	.30		.35		.40		.45		.50	
Group	p	$\bar{t}$	p	$\bar{t}$	p	$\bar{t}$	p	$\bar{t}$	p	$\bar{t}$
Variable	.50	1.87	.36	2.35	.34	2.79	.24	3.23	.19	3.52
Fixed	.56	1.74	.26	2.04	.33	2.66	.23	3.28	.34	3.80
Constant	.56	1.80	.41	2.39	.37	2.91	.27	3.53	.51	3.94

	Stimulus Diameter (Millimeters)									
	10		14		18		22		26	
Group	p	$\bar{t}$	p	$\bar{t}$	p	$\bar{t}$	p	$\bar{t}$	p	$\bar{t}$
Variable	.27	2.53	.31	2.66	.31	2.51	.37	2.90	.37	3.16
Fixed	.33	2.59	.34	2.80	.30	2.44	.36	2.62	.39	3.07
Constant	.40	2.91	.39	2.77	.46	2.86	.47	3.21	.40	2.82

RESULTS

Probability of correct responses and mean duration estimate with respect to stimulus duration and size, are presented in Table 1. For both the variable and fixed sequence groups, the mean estimate tends to increase toward the larger end of the range of sizes. However, the results of analysis of variance conducted show that this tendency is significant for the variable sequence group only, $F(4,36) = 3.37$, $p < .05$. This finding is in agreement with that of a previous study (Mo & Michalski, 1972b) in which the duration of a larger unfilled circle was overestimated in relation to a smaller circle when they were presented randomly, one in each trial. Absence of this tendency with respect to the first three smaller sizes may simply be due to the fact that the size of a circle increases as a square function of diameter.

Figure 1 represents probabilities of correct responses with respect to stimulus duration. It can be noted that accuracy of judgment of duration is a monotonically decreasing function of duration for the variable sequence group. This monotonicity becomes lost as the variability of stimulus size is reduced. The linear trend was shown to be significant beyond 5% level for all three groups, as indicated by the results of trend analysis by the use of orthogonal polynomials. As to the quadratic trend, the fixed sequence group, $F(1,36) = 7.58$, $p < .01$, and the constant sequence group, $F(1,36) = 16.61$, $p < .001$, show a significant trend, but not the variable sequence group. The effect of duration itself was significant beyond 5% level for all three groups.

Regarding the effect of stimulus size on accuracy of duration judgment, a slight tendency, although statistically insignificant, for the accuracy of judgment to increase as a function of size, is detected in Table 1 for the variable and fixed sequence groups. This tendency is concurrent with the tendency for relative overestimation of duration with respect to larger stimulus size. On the other hand, in the same groups, the accuracy of duration judgment is a decreasing function of duration. It may be speculated that the effects of stimulus duration and size are independent of each other.

DISCUSSION

In general, the predominant tendency is for accuracy of duration judgment to be a decreasing function of duration. When variability of stimulus size is reduced, such a decreasing function ceases to be monotonic and, instead, becomes a quadratic bow-shaped function. The original prediction is substantiated. Whether the ordinality or the temporality dimension of duration is crucial in determining the nature of duration judgment depends on the availability of prior information as to the ordinality dimension during the initial period of the duration, when the complete temporal information as to the duration is not yet available. Since the ordinality dimension is not unique to duration but applies to nontemporal attributes also, temporal judgment cannot be regarded as always temporal in nature, nor as being representative of temporality of experience. Judgment based on observation of clock is not necessarily dependent on the temporality dimension of clock. It may be as well dependent on the ordinality dimension of clock, and the ordinality dimension is not necessarily temporal.

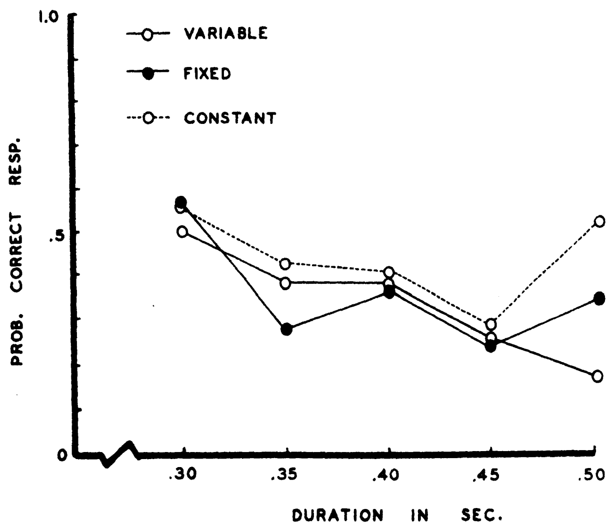

Figure 1. Probability of correct responses with respect to stimulus duration.

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