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ABSTRACT

This study investigates the relationship between temporal organization and the rate at which discrimination-reversal learning mastery occurs within sixth-grade students. Subjects were 22 male and 30 female students from a predominantly white, middle class rural school. Temporal behavior was assessed with a task that had subjects reproduce standard time intervals. Three forms of discrimination-reversal learning were employed: original learning, a first reversal shift, and a second reversal shift. Mastery of each form consisted of the subject choosing on each trial between two stimulus objects varying in two dimensions until a mastery criterion level of eight consecutive correct trials was reached. Results indicate that: (1) temporal performance tends to be less variable than learning performance; (2) a significant, negative correlation exists between mean time and mean learning scores; and (3) relatively fast learning is associated with relative overestimation of time whereas relatively slow learning is associated with relative underestimation of time. These results contrast with previously reported results within adult subjects wherein relative underestimation was associated with fast learning and overestimation with slow learning. These contrasting results may be the manifestation of a developmental temporal pattern which shifts from a predominantly inhibitory trend during childhood towards a predominantly excitatory trend in adulthood. (Author/SB)

Temporal Organization and Learning within Sixth-Grade Students

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ABSTRACT

The present study represents an attempt to investigate the relationship between temporal organization and the rate at which discrimination-reversal learning mastery occurs within sixth-grade students.

The results indicate that: a) temporal performance tends to be less variable than learning performance, b) that a significant, negative correlation exists between mean time and mean learning scores and c) that relatively fast learning is associated with relative overestimation of time and that relatively slow learning is associated with relative underestimation of time.

These results are in contrast with previously reported results within adult subjects wherein relative underestimation was associated with fast learning and overestimation with slow learning. These contrasting results may be the manifestation of a developmental temporal pattern which shifts from a predominantly inhibitory trend during childhood towards a predominantly excitatory trend in adulthood.

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Temporal Organization and Learning within Sixth-Grade Students

One of the most basic, ubiquitous and undeniable realities in the field of educational psychology is that within any given group of students who are required to learn almost any given task, different students will learn at different rates. In 1974, Bloom concluded that one can reasonably expect as much as a 5 to 1 ratio in the rate at which different individual learners will achieve mastery in certain tasks.

The primary purpose of the present paper is to present evidence which links the rate at which schoolchildren master a discrimination-reversal learning task to overall, temporal organization within those students.

In 1971, I reported the results of previous work which indicated that the rate at which adult, male human subjects master a complex form of discrimination-reversal learning is associated with overall temporal organization in such a way that underestimators of reproduced time learn the original learning task in significantly less trials than do overestimators of reproduced time. The present study represents an attempt to extend this earlier work which was carried on among male adult subjects to include the results of measuring temporal behavior and discrimination-reversal learning behavior within schoolchildren and within both sexes.

A review of the literature indicates that the present study appears to be the first attempt that has been made to study discrimination-reversal learning rates as a function of overall temporal organization within schoolchildren.

SUBJECTS AND PROCEDURES

The subjects were 54 students, 22 males and 32 females, who comprised the entire sixth grade population of a small, predominantly white, middleclass rural community in south central New Jersey. All subjects participated in

both parts of the experiment; the data of two female subjects were later eliminated from analysis because they failed to learn the original learning phase of the discrimination, thus, 52 subjects, 22 males and 30 females constituted the final sample.

Temporal behavior was assessed by means of the method of reproduction in each student individually by presenting each subject with 15 standard intervals of time, randomly and equally divided amongst 10, 15 and 20 second time intervals. The task was to have each subject reproduce each standard time interval by observing how long a small flashbulb was lit by the examiner and then reproducing the standard time interval by lighting the same bulb for a judged amount of equal time.

Discrimination-reversal learning was assessed by using "small" and "large" in the size dimension, "white" and "black" in the color dimension and "square" as an invariant form dimension across all stimulus combinations. Three forms of discrimination-reversal learning were employed: original learning (OL); a first reversal shift (RL1) and a second reversal shift (RL2). OL consisted of the subject choosing on each trial between two stimulus objects varying in each dimension until a mastery criterion level of 8 consecutive correct trials was reached with "large" as the correct response. When OL criterion was reached the first reversal shift (RL1) was tp "small" as the correct response and it was learned to the same criterion level as in OL. If both OL and RL1 were mastered, then a second reversal shift was instituted. The second reversal shift (RL2) was a shift in which the correct response became "white" and in which the same mastery criterion level as in OL and RL 1 was applied.

RESULTS AND DISCUSSION

As may be seen in Table 1 of the handout sheet, the overall temporal results for the 52 subjects who reached OL criterion-mastery indicate that the group as a whole was extremely accurate in its reproduction of the 10 second standard time interval (the mean reproduction value for N=52 being 10.01 seconds). The 15 second interval was underestimated by a mean of 0.62 seconds and the 20 second interval was underestimated to a slightly greater extent (the mean reproduction value of 18.86 seconds being a mean underestimation of 1.14 seconds). The first conclusion of the present study is that overall temporal behavior among schoolchildren (average age 12.01 years) is such that reproduced standard time intervals tend to be underestimated (as indicated by the mean time value of 14.42 seconds which would have been 15.00 if perfectly accurate). This result is consonant with previously reported means by the present author of 14.76 seconds mean time for the method of reproduction and 14.08 seconds mean time for the method of production amongst 82 male, adult subjects.

Table 1 also contains the standard deviations which appear to increase slightly from 10 to 15 to 20 seconds. However, the use of an old measure, "V" the coefficient of variation, (which is the ratio of the S.D. divided by the mean), shows that the relative amount of variability actually decreases slightly as the size of the interval increases.

The results of the discrimination-reversal learning tasks are displayed in Table 2 which reveals the fact that 52 subjects learned the OL phase; that 49 subjects learned both OL and RL 1; and that 35 subjects reached criterion-mastery levels of performance in OL, RL 1 and RL 2. The table contains mean

numbers of trials to criterion, standard deviations and V,s (the coefficients of variation). A comparison of the values of V in Table 1 and in Table 2 reveals that the relative amounts of variability within the learning results tend to be about 3 times larger than the relative amounts of variability within the temporal results. One possible interpretation of this finding that learning behavior tends to be more variable than temporal behavior is that perhaps the processes necessary for successful discrimination-reversal learning performances are more varied and more complex than those necessary for relatively accurate reproduction of time.

The results contained in both Table 1 and Table 2 were analyzed for sex differences. No significant differences were discovered between the mean performance levels of boys and girls in neither temporal, nor in learning behavior.

Table 3 represents an attempt to establish an associative link between temporal behavior and the rate at which sixth-graders learn a discrimination-reversal task. Table 3 contains the Pearson Product Moment correlation coefficients among the 8 major variables of the present study for the 35 subjects who reached all 3 learning criteria. The single correlation which summarizes the most data is the correlation between mean time and mean learning scores whose value is $r=-.52$ ($df=33$; $p<.01$). Previous work by the present author had indicated a correlation of $r=+.45$ among 82 male adult subjects. Thus, the results of the present study indicate that a significant, negative correlation exists between mean time and mean learning scores amongst sixth-grade schoolchildren. Comparing the present findings to the previously reported results amongst adults, it appears that fast learning is associated with relative underestimation among male adults and that fast learning, in constrast, is

associated with relative overestimation among schoolchildren of both sexes. One possible interpretation of these findings is offered to you today in terms of the hypothesis which I have elsewhere developed that underestimation of time is associated with a tendency towards the predominance of excitatory processes in excitation-inhibition balance and that overestimation is associated with a predominance towards the use of inhibitory processes. Using these hypotheses one can speculate upon the possible existence of a developmental pattern in the rate at which neural information processing occurs which leads to relatively faster learning rates in those schoolchildren who can more readily employ inhibitory processes and in those adults who can more readily employ excitatory processes. May it not be that the critical process necessary for fast learning rates shifts from inhibition in childhood towards excitation in adulthood.

The data in Table 4 represents an attempt to further specify the correlational evidence that fast learning in sixth-graders is associated with overestimation of reproduced time. In order to increase the data base, the analysis was performed on the 52 subjects who reached OL criterion. "Fast learners" are subjects who learned OL in 8, 9, 10 or 11 trials - there were 27 subjects in this group. "Slow learners" took 12 or more trials to reach criterion. The results in Table 4 may be summarized in the following way: 1) that fast learners, as expected, indeed learned OL in statistically significantly fewer trials than slow learners; 2) that fast learners are significantly different in their temporal behavior (i.e. they are overestimators of the group grand mean while slow learners are underestimators of the group grand mean of 14.42 seconds); 3) that the fast learners have a significantly lower amount of individual underestimations below the standard, 4) that fast learners are not

significantly different in terms of exactly accurate estimates and 5) that fast learners have a significantly higher amount of overestimations above the standard.

The results of Table 4 provide the evidence for the conclusion that when 52 sixth-grade subjects, of both sexes, all of whom are learners of the same task, are divided along the dimensions of the rate at which the learning occurred, the fast learners are significantly greater overestimators of time than are the slow learners.

In conclusion, the present study provides evidence to support the statement that among 6th grade schoolchildren the temporal correlates of discrimination-reversal learning are such that relatively fast learning rates are associated with relative overestimation of reproduced time, and that, relatively slow learning rates are associated with relative underestimation of reproduced time.

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TABLE 1 - TEMPORAL RESULTS (N=52)

	MEAN	S.D.	V
10 Seconds	10.01	1.11	.111
15 Seconds	14.38	1.36	.095
20 Seconds	18.86	1.69	.090
Mean Time	14.42	1.02	.071

TABLE 2 - LEARNING RESULTS

	OL (N=52)			RL_1 (N=49)			RL_2 (N=35)		
	TRIALS	S.D.	V	TRIALS	S.D.	V	TRIALS	S.D.	V
OL	12.64	4.00	.317	12.43	3.98	.320	12.74	4.55	.357
RL_1	-	-	-	14.24	5.24	.368	14.46	5.03	.348
RL_2	-	-	-	-	-	-	18.57	6.96	.375
Mean Learning	12.64	4.00	.317	13.35	3.29	.246	15.25	3.26	.214

TABLE 3 - INTERCORRELATIONS (N=35)

	1	2	3	4	5	6	7	8
1. 10 Seconds	-	.40*	.52**	.78**	-.27	-.16	-.10	-.28
2. 15 Seconds		-	.29	.71**	-.17	-.04	-.25	-.28
3. 20 Seconds			-	.83**	-.44**	-.40*	-.23	-.58**
4. Mean Time				-	-.39*	-.29	-.26	-.52**
5. OL					-	.06	-.05	.46**
6. RL_1						-	.03	.56**
7. RL_2							-	.70**
8. Mean Learning								-

*P <.05

**P <.01

TABLE 4 - TEMPORAL CORRELATES OF LEARNING (N=52)

	FAST LEARNERS (N=27)	SLOW LEARNERS (N=25)	t	p
Trials OL	10.33	15.12	5.17	.0001
Mean Time	14.74	14.07	2.46	.009
Sum (-)	6.78	8.64	2.12	.019
Sum (0)	2.78	3.24	0.82	N.S.
Sum (+)	5.44	3.12	3.34	.0008