DOCUMENT RESUME

ED 083 567 CS 000 805

AUTHOR Goulet, L. R.
TITLE Age and School Experience as Factors in Rule Utilization: Use of a Simple Addition Rule. Final Report, Part 1.
INSTITUTION Illinois Univ., Urbana.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
BUREAU NO BR-1-E-124
PUB DATE 73
GRANT OEG-5-72-0020(509)
NOTE 12p.; See related document CS 000 806

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Age; Age Differences; Age Grade Placement; *Cognitive Processes; *Educational Experience; Educational Research; Grade 1; *Learning; *Paired Associate Learning; *Transfer of Training; Visual Perception

ABSTRACT

This study attempted to investigate the effects of school experience on performance on visual perception tests involving line figures and forms. The subjects were 120 first grade students selected from two public schools in the same community. The experiment involved an Experimental Treatments X Age X Time of Testing factorial design. All subjects learned two paired-associate lists consisting of picture-number pairs. In the rule treatment, list 1 consisted of five picture-number pairs; list 2 consisted of identical stimuli and responses, except that the integer paired with each stimulus was larger by one unit. Thus, list 2 could be learned rapidly if the subjects used a rule of add 1 for each pair acquired on list 1. The lists for the interference treatment were identical, except that the responses and stimuli from list 1 were randomly repaired on list 2. In the control treatment, list 1 and list 2 involved new stimuli and responses. The lists were presented on a Stowe memory drum at a 3:3-second rate by the anticipation method. Four random orders of the lists were presented to minimize serial learning. The result confirmed that transfer performance, either from extra-experimental or experimental sources, is the major determinant of learning performance for young, school-aged children. (WR)

Final Report (Part 1)
Grant No. 1-E-124
Project No. OEG-5-72-0020 (509)

AGE AND SCHOOL EXPERIENCE AS FACTORS IN RULE UTILIZATION: USE OF A SIMPLE ADDITION RULE

L. R. Goulet

University of Illinois, Urbana-Champaign

Conventional approaches to the study of educational and/or developmental phenomena typically utilize either cross-sectional or longitudinal research designs. In a cross-sectional design, performance is assessed at a single point in time for each of two or more groups of children who differ in chronological age (and grade in school). Conventional longitudinal designs, involve repeated measurement where the children are tested at two or more points in time either within a school year (or in different school years). The uses and limitations of cross-sectional and longitudinal designs have been discussed at length in the context of studying developmental phenomena (Baltes, 1968; Schaie, 1965) and these limitations also hold for educational research. However when the cross-sectional and longitudinal designs are used for examining the influences of educational experiences, an additional source of confounding is potentially present, i.e., over the school year the child is not only exposed to the school program, he is "aging." That is not to say that the impact of or effects of exposure to the school curriculum can be considered to be independent of other CA-related influences on behavioral development. Rather, school learning must be considered to be one of the components in the developmental process. Nevertheless, when the major

purpose is to assess and evaluate the influence of educational experiences on performance, the effects of other CA-related factors must be assessed or controlled.

There are other important reasons for directly assessing the influences of educational experiences. For example, theories of cognitive development such as those of White (1965) and Kendler and Kendler (1962) assume that a shift away from a reliance rote-learning processes to an emphasis on higher-order skills for developmental differences in behavior over the period between five and seven years of age (Goulet, 1968, 1970). It is interesting to mention here that the aforementioned age period (i.e., between five years to seven years) has marked, in general, the first exposure to formal education. When carried to its logical extreme this implies that factors related to school experience rather than other age-related processes determine (at least ir part) the marked developmental changes in behavior which occur during this period.

It is perhaps most important to mention that performance on learning or problem-solving tasks is not uniformly related to age in a positive fashion. For example, the period between the ages of six and eight, as mentioned above, is generally considered to mark the development of strategies of problem-solving (Goulet and Goodwin, 1970; Weir, 1964), the spontaneous (unprompted) use of mnemonic or mediational aids in learning (e.g., Flavell, Beach, and Chinsky, 1964; Kendler and Kendler, 1962; Kendler, Kendler, and Marken, 1969) and hypothesis testing (e.g., Eimas, 1969; Yost, Siegel, and Andrews, 1962). However, there is increasing evidence that the availability and use of such skills can interfere with

children's performance if they are used inappropriately or inefficiently (Goulet, 1970b; Goulet and Goodwin, 1970; Hall, 1970; Loomis and Hall, 1968; Kausler, 1970; Koppenaal, Krull, and Katz, 1964; Weir, 1964).

The availability of these types of data suggest that negative effects of developmental factors (unrelated to school experience) can offset the (expected) positive effects attributable to schooling. Therefore, comparisons of behavior over the school year may suggest reduced, null, or perhaps negative effects of schooling if the separate effects of school experience and age are not estimated. Admittedly, the research cited above has not factorially varied the age and time of testing (school experience) factors and the results from a study incorporating these variables could yield results indicating positive effects of both variables (Schaie, 1972), negative effects of both variables, or a combination of positive and negative effects.

The present design capitalized on the fact that children entering first grade differ in chronological age. It was thus possible to choose independent samples of subjects at the same grade level (i.e., with the same school experience) who differ in chronological age. Furthermore, by testing the samples at different points in the school year it was possible to match the Ss on chronological age and vary the amount of schooling. This procedure permitted age and amount of schooling to be varied in a factorial design. Furthermore, the children were tested under conditions where school learning was expected to have a positive effect on performance (the transfer and use of the addition rule of "add one" and where interference (negative transfer) was expected.

METHOD

Design. The experiment involved an Experimental Treatments (three levels) X Age (two levels) X Time of Testing (two levels) factorial design. All Ss learned two paired-associates lists consisting of picture-number pairs. In the Rule treatment, List 1 consisted of five picture-number pairs; List 2 consisted of identical stimuli and responses except that the integer paired with each stimulus was larger by one unit. Thus, List 2 could be learned rapidly if Ss used a rule of "add 1" for each pair acquired on List 1. The lists for the Interference treatment were identical in all respects to those for the Rule treatment except that the responses and stimuli from List 1 were randomly repaired on List 2. Thus, List 2 for the Interference treatment had no conceptual or rule-based solution. In the Control treatment, List 1 and List 2 involved new stimuli and responses.

Lists. List 1 consisted of five picture-single digit number pairs. The responses consisted of the integers 0, 1, 2, 3, and 4 or 5, 6, 7, 8, and 9 for different groups of Ss. The stimuli consisted of 1 in. x 1 in. line drawings of familiar objects (e.g., car, apple, spoon, etc.) selected to minimize conceptual similarity. List 2 consisted of four paired-associates involving the responses 1, 2, 3, and 4 or 6, 7, 8, and 9. The stimuli were identical on List 1 and List 2 in the Rule and Interference treatments except that the pair with the lowest integer in the list (0 or 5 for different treatments) on List 1 was deleted on List 2. List 1 and List 2 were related in the Rule treatment in the following manner: Each of the stimuli on List 1 were randomly paired with a specific

integer on List 1 and with the next highest integer on List 2. Thus mastery of List 2 could be accomplished through the consistent use of a rule of "add one." The stimuli and responses on List 1 were randomly repaired to construct List 2 for the Interference treatment, a condition known to lead to pronounced negative transfer in young children (e.g., Wilcox and Baumeister, 1970).

Different sets of lists were constructed such that one half the Ss in each treatment learned a List 1 involving the integers 0-4, with the remaining half learning a List 1 involving the integers 5-9. Similarly, List 2 involved the integers 1-4 or 5-9 in different lists. Following standard methodology, List 2 was identical across treatments.

Subjects. The Ss were 120 first grade children selected from two public schools in the same community. Two "young" groups and two "old" groups were identified. The two young ($\bar{X}$ CA = 6.40 yrs.) groups were matched according to their age at the time of testing. Thus, the young group assigned to the later testing period entered school at a younger age than the young group tested early in the school year. The same conditions held for the two old ($\bar{X}$ CA = 6.85 yrs.) groups.

Procedure. The testing was accomplished at two points in the school year (October 15th - November 15th and March 15th - April 15th) separated by five months. The Ss in the four Age and Time f Testing conditions were randomly assigned to one of the three experimental treatments with the restriction of equal Ns in each treatment. The Lists were presented on a Stowe memory drum at a 3:3-sec. rate by the anticipation method. A 3-sec. intertrial interval was used. Four different random

orders of the lists were presented to minimize serial learning. The Ss were taken to a criterion of three consecutive perfect trials on each of List 1 and List 2. A practice list of two pairs (form-letter pairs) was used to introduce Ss to the requirements of the paired-associates task. Prior to List-1 learning, Ss were told that they have to learn which number goes with each picture shown and that the numbers were 0, 1, 2, 3, 4 (or 5, 6, 7, 8, 9). The Ss were also informed about the set of numbers prior to List 2 but no information concerning the relation of List 1 and List 2 was provided.

RESULTS

List-1 learning. Table 1 provides summary data for trials to criterion on List 1 for the eight treatments. These data were analyzed with a 2 x 2 x 2 factorial design with Age at Time of Testing (Young, Old), Time of Testing (Fall, Spring) and Conditions (Rule, Interference, Control) as the three factors. Conditions was a "dummy" variable since the differences between the Rule and Interference treatments were not functional until the initiation of List-2 learning. None of the main effects nor interactions approached significance (All Fs < 1.63).

Table 1

Trials to Criterion on List 1

		Rule		Interference	
Time of Testing		Fall	Spring	Fall	Spring
Chronological	Y	17.5	21.8	204	251
Age	O	19.5	17.0	16.3	20.3

List-2 learning. Table 2 provides summary data for Errors to Criterion on List 2. As expected, the analysis of variance for these data revealed a statistically significant main effect for Conditions, $F(2,72) = 6843$, $p < .01$. Errors were greatest for the Interference

---

Insert Table 2 about here

---

treatment relative to the Control treatment ($p < .01$), whereas the mean difference between the Rule and Control treatments was not significant. The analysis also revealed two significant interactions, i.e., those between Age and Conditions, and between Time of Testing and Conditions. The Age X Conditions interaction ($F(2,72) = 15.78$, $p < .001$) revealed that performance on the Interference treatment was better for the older than for the younger children ($p < .01$) with no difference being evident for either for the Rule or Control treatments.

For the Time of Testing X Conditions interaction ($F(2,72) = 3.20$, $p < .05$) performance on the Rule list was better for the spring-tested than for the fall-tested children ($p < .05$), whereas the reverse was true for the Interference treatment ($p < .05$). No difference in means was evident on the Control list for the fall- and spring-tested children.

Table 2

Mean Errors to Criterion for Treatment Groups on List Z (A

		Young		Old	
Time of Testing		Fall	Spring	Fall	Spring
Conditions	Rule	18.0	10.2	22.8	7.1
	Interference	29.8	37.5	24.4	29.1
	Control	10.9	11.6	8.5	14.9

DISCUSSION

The results of the study provide an interesting pattern of results. Both the Age at Time of Testing and the Time of Testing were related to performance on the experimental treatment. Nevertheless they influenced performance in a different manner. That is, in the Rule treatment, performance was positively related to Time of Testing, whereas chronological age was unrelated to performance. With regard to performance on the Interference treatment, Time of Testing was inversely related to errors on List Z whereas the relation between Age and errors was positive. The latter results are especially revealing in that over the period of testing in the present study the influences related to Time of Testing and Age were in opposition. These data suggest that the more typical comparison of the performance of school children early in the school year and later in the school year would reveal essentially no differences in performance. The present data permit such a comparison, i.e., the contrast between the performance of the young, fall-tested, and the old, spring-tested children (See Table 2). And, as implied from the above reasoning, the data revealed essentially identical performance for the two groups on the Interference treatment.

That is not to say that performance on the Interference treatment is affected by the same processes. That is, the data suggest that age is related to the magnitude of associative interference, whereas Time of Testing may perhaps be related, at least in part, to the spring-tested Ss attempting to apply the "add 1" rule in learning the Interference List.

In other words, the absence of a negative relationship between Age and performance on the Rule treatment implies that this factor was not influential in learning the list. It is therefore unlikely that the inappropriate use of the "add 1" rule was influential in affecting performance on List Z in the Interference treatment.

It is interesting to note that Age and Time of Testing were essentially unrelated to performance under conditions where no relationship existed between prior learning and the demands of the present task. That is, rate of learning on List 1 and for List Z on the Control treatment was unrelated to performance. These results confirm the general suggestions made by Kausler (1970) that transfer performance, either from extra-experimental or experimental sources is the major determinant of learning performance for young, school-aged children.

REFERENCES

Baltes, P. B. Longitudinal and cross-sectional sequences in the study of age and generation effects. Human Development, 1968, 11, 145-171.

Goulet, L. R. Training, transfer and the development of complex behavior. Human Development, 1970, 13, 213-240.

Goulet, L. R. & Goodwin, K. S. Development and choice behavior in probabilistic and problem-solving tasks. In H. W. Reese and L. P. Lipsitt (Eds.) Advances in Child Development and Behavior, Vol. 5, New York: Academic Press, 1970, 213-254.

Hall, V. C. Acquisition and transfer differences between kindergarteners and second graders on aurally and visually presented paired-associates using an A-B, A-C design. Journal of Experimental Child Psychology, 1969, 7, 400-406.

Kausler, D. H. Retention-forgetting as a nomological network for developmental research. In L. R. Goulet and P. B. Baltes (Eds.) Life-span Developmental Psychology: Research and Theory. New York: Academic Press, Inc., 1970, 305-353.

Kendler, H. H., Kendler, T. S., & Marken, R. Developmental analysis of reversal and half-reversal shifts. Developmental Psychology, 1969, 1, 318-326.

Koppenaal, R. J., Krull, A., & Katz, H. Age, interference, and forgetting. Journal of Experimental Child Psychology, 1964, 1, 360-375.

Loomis, D. J., & Hall, V. C. The effects of age and overlearning in an A-B, A-C design using high- and low-H value. Journal of Verbal Learning and Verbal Behavior, 1968, 7, 182-188.

Schaie, K. W. A general model for the study of developmental problems. Psychological Bulletin, 1965, 64, 92-107

Weir, M. W. Developmental changes in problem-solving strategies. Psychological Review, 1964, 71, 473-490.

White, S. H. Evidence for a hierarchical arrangement of learning processes. In L. P. Lipsitt and C. C. Spiker (Eds.) Advances in Child Development and Behavior. Vol. 2. New York: Academic Press, 1965, 187-220.

Wilcox, S. J. & Baumeister, A. A. Transfer of verbal paired associates in mentally retarded individuals and normal children as a function of interlist similarity. Journal of Experimental Child Psychology, 1970, 10, 277-286.

Yost, P. A., Siegel, A. E., & Andrews, J. M. Nonverbal probability judgments by young children. Child Development, 1962, 33, 769-780.