Free recall, subjective organization, and learning to learn at three age levels*

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Free recall and subjective organization were studied with children in Grades 3, 5, and 7. Each S was presented with 10 trials on each of four different sets of associatively unrelated line drawings of common objects. Recall increased with age level, but subjective organization increased only slightly. There was some evidence of learning to learn effects for recall but not for subjective organization. Recall and subjective organization were correlated for Ss of Grades 5 and 7 but not 3. The absolute amounts of subjective organization were relatively small for all age groups.

The analysis of the organization of free recall sequences provides a useful technique for tracing the development and extent of certain cognitive-memorial abilities of children. One kind of cognitive-memorial ability which has been hypothesized to play an important role in the free recall of unrelated materials is that of subjective organization (e.g., Tulving, 1968). While the investigation of subjective organization has primarily focused on the memorial behavior of adult Ss, the few studies involving children indicate that young Ss also employ at least some subjective organization (e.g., Laurance, 1966). The present study was primarily designed to determine if children of several age levels could learn to improve generally their recall and subjective organization performance when given extended practice over a series of sessions, in each of which different sets of materials were presented for free recall.

METHOD

The Ss were 60 randomly selected children from an elementary and an intermediate-level school located in an area of middle-income racially mixed families in Honolulu, Hawaii. Twenty Ss (10 boys and 10 girls) in Grades 3, 5, and 7 each were tested. The mean ages of the Ss were 8.90 (range: 8.50-9.92), 10.82 (range: 10.42-11.25), and 12.96 (range: 12.33-13.83) for Grades 3, 5, and 7, respectively.

*Supported by a grant from the University of Hawaii Research Council and presented, in part, at the meeting of the Society for Research in Child Development, Santa Monica, Calif., March 1969. We are grateful for the assistance of: Jeanette Crouch, experimenter; H. Izumo and staff of Noelani Elementary School; D. R. Leech and staff of Stevenson Intermediate School; the University of Hawaii Statistical and Computer Center for computer time; Craig S. Kowalski for data analysis.

Four sets of 16 items each were composed of line drawings of common objects familiar to children.[1] The interitem free associations among the one-word nouns denoting the objects within each list were minimized, and the Thorndike-Lorge word frequencies were equated across lists. Each S learned a different one of the four lists on each of 4 days during the same school week. The order of presentation of the lists was counterbalanced so that an equal number of Ss in each grade received each of the four lists in each of the four daily test sessions. Ten alternating presentation-recall trials were given on each list. Equal numbers of Ss within each grade, and within each subgroup receiving a different sequential order of the four lists, were started in two different places in the sequence of the 10 trials prepared for each list. The 16 items of each list were randomized on each of the 10 trials such that no item was immediately preceded or succeeded by any other item more than once throughout the 10 trials of a list. In addition, no item occupied the same serial position more than once. The line drawings were photographed and made into slides which were projected at a 2-sec rate, of which 1 sec was occupied by the slide changing. Throughout the experiment, the S named each slide as it was presented. Recall was oral, and each recall period was 2 min. The instructions stressed that S was to try to remember as many of the names of the pictures as possible, but that the order of recall was unimportant. The E provided verbal reinforcements for the S's performance during recall periods and used various prompts to elicit more responses when an S stopped recalling. At the first test session, Ss were presented with a five-item practice list of objects associatively unrelated to any of the experimental items.

RESULTS AND DISCUSSION

Duplicate and intrusion responses were omitted in computing all measures. The mean number of duplicate responses per trial across days for Grades 3, 5, and 7 was 2.54 (SD = 2.53), 2.24 (SD = 2.04), and 2.38 (SD = 2.10), respectively. Intrusion responses were minimal (mean per trial = .06, .05, and .05 for Grades 3, 5, and 7, respectively), suggesting that proactive interference was not an important influence, although about one-half of the intrusions at each age level that did occur were members of prior lists. The four lists were approximately equally learnable when examined independently of the order of presentation of the lists. Recall performance per trial for each grade on each day is presented in Fig. 1. The mean recall per trial for each grade across days was 10.77, 11.87, and 13.00 for Grades 3, 5, and 7, respectively. A 3 (grades) by 4 (days) by 10 (trials) by 2 (sex) analysis of variance applied to the recall data yielded significant main effects of grades [$F(2,54) = 25.84$, $p < .001$] and trials [$F(9,486) = 248.33$, $p < .001$] but only a marginally significant main effect of days [$F(3,162) = 2.32$, $.05 < p < .10$]. A significant Days by Trials interaction [$F(27,1458) = 5.52$, $p < .001$] reflects the consistently poorer performance on the early trials of Day 1 in each age group relative to performance on the succeeding days. The interaction most likely reflects warm-up effects. Subjective organization was measured by the number of bidirectional observed minus expected intertrial repetitions, (O-E)ITR (Gorfein, Blair, & Rowland, 1968). Mean (O-E)ITR scores are presented in Fig. 2 for successive trial pairs for each grade on each day. The mean (O-E)ITR scores per trial pair for each grade across days was .363, .483, and .700 for Grades 3, 5, and 7, respectively. A 3 (grades) by 4 (days) by 9 (successive trial pairs) by 2 (sex) analysis of variance applied to the (O-E)ITR scores yielded a significant main effect of trials [$F(8,432) = 6.65$, $p < .001$], a marginally significant main effect of grades [$F(2,54) = 3.04$, $.05 < p < .10$], and sex [$F(1,54) = 3.54$, $.05 < p < .10$ (girls > boys)], but the main effect of days was not significant [$F(3,162) < 1$]. A significant interaction of Days by Sex [$F(3,162) = 3.26$, $p < .025$] reflected the tendency for boys to perform better on Days 2 and 3 relative to Days 1 and 4, whereas for girls this relationship was reversed. Table 1 presents Pearson product-moment correlations based on each S's mean

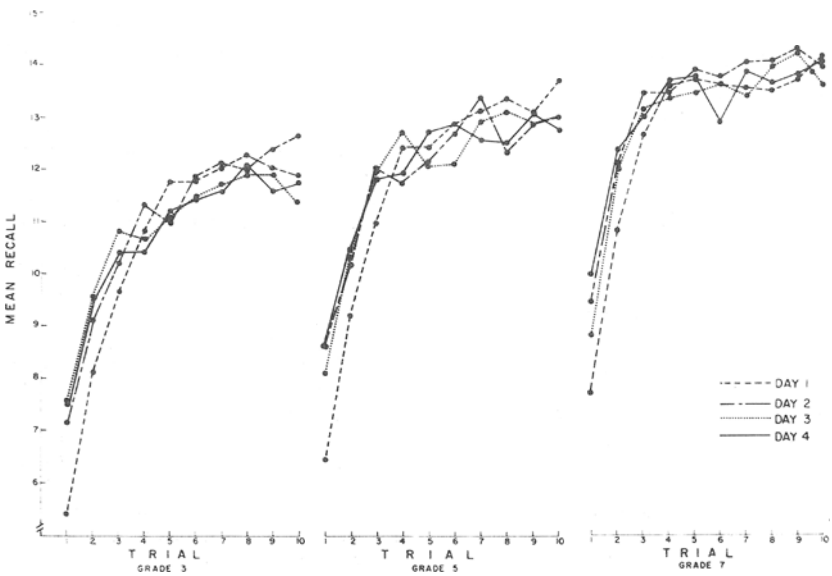

Fig. 1. Mean recall per trial for each grade on each of the 4 days.

recall and (O-E)ITR scores for each day in each age group. As the table indicates, significant positive correlations were found for Grades 5 and 7 but not for Grade 3. It should be noted that the absolute amount of (O-E)ITR obtained, even in Grade 7, is rather low relative to the maximum possible. Nevertheless, t tests indicated that the mean (O-E)ITR scores significantly exceeded zero for each grade on each day.

In summary, the amount of recall increased with the age level of the Ss, but there was only a relatively small increase across days. Subjective organization increased somewhat with age level, but there was no evidence of a systematic increase across days. Thus, the results generally provide little evidence of learning to learn in recall or subjective organization at the three age levels tested. Although Mayhew (1967) has provided evidence of learning to learn effects with adults, even with such Ss, the extent of learning to learn effects are relatively small. On the other hand, even with younger children than those employed in the present study, learning to learn effects can be obtained by consistently and contiguously presenting sets of stimuli together (Moely & Shapiro, 1971). In addition, great care was exercised in the selection of items for the present study to minimize any interitem associations. Conceivably, if preestablished lists of highly subjectively organized units were employed (Bell & Shapiro, 1971), young children might exhibit more evidence of learning to learn. Thus, as the production deficiency hypothesis suggests, special stimulus situations might be devised, under which certain cognitive skills might be displayed which would otherwise not spontaneously appear (e.g., Flavell, Beach, & Chinsky, 1966).

The fact that recall and subjective organization were correlated for Ss of Grades 5 and 7 but not Grade 3 generally confirms an earlier study by Laurance (1966). However, despite the evidence that young Ss employ subjective organization, it should be noted that the absolute amounts of subjective organization were relatively low, relatively high levels of recall sometimes preceded any substantial increase in subjective organization, and the Ss in Grade 3 substantially increased their recall across trials, although these increases were not correlated with increases of subjective organization. These results, which have also been noted elsewhere (e.g., Shapiro & Bell, 1970), are difficult to reconcile with the hypothesis that subjective organization is the primary means by which Ss learn to increase their recall performance beyond their immediate memory span in multitrial free recall of unrelated lists (e.g., Tulving, 1968). At any rate, it would appear profitable to undertake a more careful analysis of the theoretical and empirical underpinnings of the prevailing articulation of the organizational hypothesis of memory.

Table 1
Correlations Between Mean Recall and (O-E)ITR Scores

	Day 1	Day 2	Day 3	Day 4
Grade 3	+0.18	−0.10	+0.33	+0.11
Grade 5	+0.24	+0.53*	+0.45*	+0.63†
Grade 7	+0.58†	+0.36	+0.52*	+0.44*

*$p < .05$, †$p < .01$

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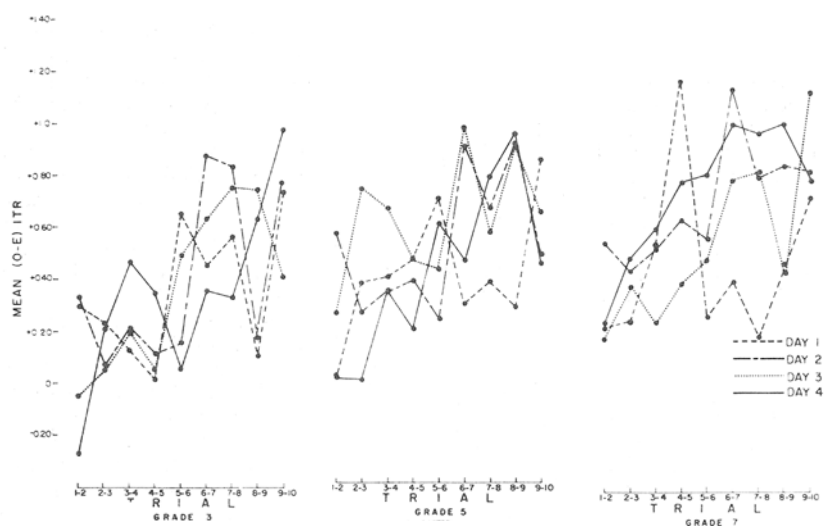

Fig. 2. Mean (O-E)ITR scores for successive trial pairs for each grade on each of the 4 days.

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NOTE

1. The items comprising the lists were: (1) pin, butterfly, dress, balloon, sun, queen, bulb, mountain, cigarette, apple, hand, fan, fish, church, window, hammer; (2) moon, banana, door, leaf, woman, ocean, knife, feather, foot, nail, truck, drum, match, house, bee, tie; (3) scissors, arrow, soldier, letter, soap, brush, train, ball, carrot, bread, shoe, flower, piano, dog, ear, table; (4) track, cat, gun, sock, clock, chain, eye, basket, tree, car, book, chair, candy, violin, king, butter.

A human analogue of discrimination contrast

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In the present study, one group of human Ss received differential reward conditioning for accurately tracing numbered-nonnumbered star patterns, whereas a second and third control group received either just small or large reward in both discriminanda, respectively. The present study replicated the findings of previous animal contrast studies in that a significant negative S— contrast effect, as well as a trend towards a negative S+ contrast effect, was shown.

Previous alley studies (e.g., Bower, 1961; Ludvigson & Gay, 1966) have shown that performance of rats to the negative discriminandum (S—) in differential conditioning is influenced by the reinforcement contingencies associated with the positive discriminandum (S+). Generally, these studies demonstrate that the S— performance of differentially reinforced (discrimination) groups is depressed, relative to that of nondiscrimination control groups receiving small reinforcement in both "S+" and "S—" (negative S— contrast effect).

Also, previous studies have shown a significant depression (Henderson, 1966; MacKinnon, 1967) of S+ speeds for discrimination Ss, relative to that of nondiscrimination control Ss receiving large reinforcement in "S+" and "S—" (negative S+ contrast effect). Little information is available concerning how human Ss respond to stimuli associated with contrasting magnitude of reward. Hence, the present study attempted to investigate S+ and S— contrast effects in human Ss.

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METHOD

The Ss were 12 male and 12 female undergraduate students enrolled in the physiological psychology course at West Virginia Wesleyan College. The Ss were assigned randomly to each of three equal groups.

The materials consisted of 160 star patterns. Each S was required to trace 10 star patterns (10 trials) with his less-preferred hand. The S was given only 15 sec to complete as many 1-in. segments of each star (20 segments to a star) as he could without touching the border lines. The intertrial interval was 2 min. The discrimination group (Disc) received a large number of points (8) toward their course grade in the presence of a particular discriminandum (S+) and a small number of points (1) in the presence of another discriminandum (S—) for completing a segment of a star without touching the border. Following each trial, the Ss were informed in writing as to whether they had received a large or small number of points. For half the Ss, large (L) reward (8 points) was correlated with a numbered star (S+) and small (S) reward (1 point) was correlated with a nonnumbered star (S—). For the other half of the Ss, the contingencies were reversed. Hence, each S in Group Disc traced five S+ and five S— stars. It should also be mentioned that each S was assigned randomly to one of eight different schedules of reward (e.g., LSSLLSSLSL). In the small-reward control group (SC), Ss received a small reward (1 point) toward their course grade. In the large-reward control group (LC), eight Ss received large reward (8 points) for accurate completion of both discriminanda. Ss in the control groups were informed of the magnitudes of their rewards in the same manner as Ss in the discrimination groups. In order to control for trial position, eight different schedules of "S+" and "S—" were assigned randomly to control Ss, regardless of the fact that they did not receive differential reward. It should also be mentioned that course grade averages between groups at the time of testing were approximately the same, to insure greater probability of comparable motivation between