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ABSTRACT

This paper focuses on a study which replicates and extends earlier work employing a recognition memory paradigm to investigate children's memory and developmental changes in dominant word associations. On the recognition test the implicit associative response can lead to better memory for the original items (this is the hit rate), and it can also lead to errors on associates which are new items (this is the false-alarm rate). The paradigm predicts that children given instructions would make fewer errors on old items (higher hit rate) yet more errors on associates (higher false alarm rate). Children from second and sixth grades were presented lists of words orally and asked to state the meaning of each word and generate its associative antonym or synonym. Results indicate a number of methodological problems with a recognition memory paradigm where the false alarm rate is employed as an index of developmental change and suggests that the synonym-antonym developmental shift in memory organization should be treated with caution. (GO)

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A Reevaluation of Age-Related Changes in Associative Memory Organization

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This morning we want to present some of our research involving children's memory. These studies have led us to two tentative conclusions. First, it appears that synonym and antonym associations do not form different organizational bases for memory for children from 7-12 years of age, and second, that a recognition memory paradigm can have serious drawbacks for assessing developmental changes in memory.

Let me give you the background for these studies. Underwood (1965) employed a recognition memory paradigm to investigate the prominent associations that adults have to words. It has been proposed that subjects generate implicit associative responses when presented with stimuli that subsequently lead to errors on a recognition test. For example, if I ask you to remember the word dog and you think of the word beagle, you might later incorrectly recognize beagle as an Old word from the acquisition list. The cognitively-generated associative response is presumably the reason for this error. We should note also that you might be more likely to remember dog as an Old item too. On the recognition test the implicit associative response can lead to better memory for the original items - this is the hit rate - and it can also lead to errors on associates which are new items - this is the false-alarm rate.

So that's the basic paradigm. It has been employed by various people to investigate children's memory and the developmental changes in dominant word associations. We tried to replicate one study like this and ran into some issues that should be of interest to others investigating children's memory. Today, we shall discuss a study reported by Cramer in the Journal of Experimental Child Psychology, in 1973. She presented a list of words for second and sixth-grade children to remember. These words are shown in Table 1 of your handout. The ten Critical Stimulus words from either the synonym or

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antonym list were the acquisition items. Subjects in various groups were told to:

a) think of a word that means the same as the word you hear-synonym-same group.

b) think of a word that means the opposite of the word you hear-antonym-opposite group,

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c) or no special instructions other than to remember the words-neutral groups.

In the original study, the words were then presented on a tape-recorder at 5 sec intervals. After presentation, the child engaged in a four-minute interpolated activity and then received the recognition test. Referring again to Table 1, we see that the test list involved 30 words - ten original critical stimulus words, ten unrelated new control words, and five strong and five weak associates of the critical stimuli. These synonyms or antonyms were selected from the normative tables for frequency of occurrence of individual items. If some of these pairs such as doctor-physician strike you as potentially difficult for second-graders, then you understand part of the reason for our initial curiosity in this study.

So, the subjects in Cramer's study received this 30 item test list and their errors are shown in Table 2. As you can see, the children performed

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near ceiling levels. The second-grader's overall performance was 90% correct and the sixth-grader's was 94%. You might also notice that the error rates do not differ very much for any of the associate cells, except the sixth-grader's antonym-opposite group. One of the implications of ceiling performance is that there is only a small percentage of errors to associates across grades and conditions. For example, false alarm responses to associates for both grades accounted for only 9.5% of the total responses made in the original study. A generalization difference score was calculated by subtracting a subject's errors to control words from false alarms to associates. These generalization difference scores revealed higher scores for second-graders on synonyms and higher scores for sixth-graders on antonyms. This interaction was the basis for the hypothesized developmental differences in associative memory organization.

That's what Cramer did. What did we do differently? We changed only two things. First, we added more buffer words to the list so that the ten critical stimuli had four buffer words at both the beginning and end of the list. This was done to increase the task difficulty and attenuate the ceiling effects. Secondly, we presented the words to the children orally, instructed them to repeat each word aloud, and then asked subjects in the instructional groups to verbally state a word that meant the same as or opposite of the critical stimulus. This manipulation allowed us to observe directly if the child understood the instructions, if the child could generate an associative word, and if the child generated the associate word from the norms that Cramer included on the recognition test. In short, it made the covert associative response observable and measurable. I might say at this time that the manipulation was enlightening. Almost all children took much longer than five seconds to verbally produce an associate. We were surprised and amused at our rural Indiana children's creativity in this task. I would say "give me a word that means the opposite of get," the child would reply git and then come. We did have one rural child who, when asked for the associate to house, he responded out.

We had a longer list and recorded explicit associative responses of the child but kept everything else the same as the original study. We tested sixteen subjects in each of the eight groups - two neutral and two instructional in both second and sixth grade. We had two different random orders of the acquisition list and two of the recognition test. Sex was counterbalanced with lists and groups. We also employed the same four-minute interpolated task of circling numbers on a random number page.

What were the results? Let's look at the data tabulated like the original data. This is shown in Table 3. Our data is similar in many ways yet we did not replicate Cramer's results entirely. Our data does reveal

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approximately similar error rates to associates in all cells except one (here it's second-graders A-O while for Cramer, it was sixth-graders A-O). The subjects in our instructional groups had a higher hit rate for critical stimuli (old items) for both grades, while the original study found the effect only for sixth-graders. Our data also reveal fewer errors (generally) to control words in the instructional groups like Cramer's data. (Note: There were no grade differences in our study due to the elimination of young subjects' associative response production deficiency by eliciting associative responses verbally. The overall task difficulty was increased for both grades somewhat). So we "sort-of" replicated the original study in this table.

The problem is that the table is misleading and somewhat inappropriate. The paradigm predicts that the instructions should lead to fewer errors to old items (i.e., a higher hit rate) yet more errors to associates (i.e., higher false-alarm rate). If memory for the original items is strengthened by the instructions, then one would also predict fewerfalse alarms to control words in the instructional condition, which was observed in both studies. As if that isn't confusing enough, the synonym and antonym lists look like they differ in difficulty. The antonym conditions always produced more errors than the synonym groups ($p < .02$). This is especially apparent if you look at the hit rate to critical stimuli in both studies. These lists and, more importantly, items within lists, were not analyzed in the original study and do contribute to the effects observed. And last but not least, the paradigm does not consider an age-related change in response bias on the two-choice recognition test. We calculated d's for our data according to Hochaus' (1972) procedure and these are shown in Table 4.

Table 4 here

These scores reveal several interesting things, but let me point out that:

(a) the antonym conditions are slightly (not significantly) more difficult than the synonym conditions.

(b) instructional groups perfromed better than neutral groups ($p < .01$), and

(c) the instructions enhanced performance of the sixth-graders more than the second-graders ($p < .05$). Calculation of d's shows that item discriminability changes across word type, lists and grade. These changes are not accounted for by error scores, percent correct, or generalization difference scores.

We don't have time today to go into the generalization difference scores calculated by Cramer but let me mention why we think they are inappropriate. The score is derived by subtracting errors to control words from errors to associates. This assumes that errors to control words are homogeneous across groups. This is false, though, as shown by the error data and our d's (i.e., instructional groups have lower false alarm rates) as well as by inspection of Cramer's data in Table 2. The original study found no errors to control words in either synonym-same group! We tested the homogeneity of variance assumption for errors to control words among the eight groups in both our data and the original data (which was provided by P. Cramer). Errors were not randomly distributed across groups (significant F max tests) and therefore we conclude that the generalization difference score is unsuitable.

Well, let's turn quickly to the children's explicit associative responses. Table 5 shows the total number of associative words generated by children in

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each group that matched the associate word on the test. As you can see, it was much easier to generate antonyms than synonyms, although the difference is less for older subjects. Parenthetically, 38.6% of the synonym associates were accounted for by the pairs house-home and carpet-rug and 35.4% of the antonyms were on the pairs slow-fast and boy-girl. The most important data points of our study are shown in Table 5 where it can be seen that the proportions of errors (false-alarms) on associates that have been generated is the same for synonyms and antonyms within grades. Second-graders have a slightly higher probability of false alarming to associates but this does not mean that their performance is more controlled by these subject-generated words. On the contrary, second-graders make many more errors on associates that they haven't produced so that the probability that an error is really mediated by a generated associate is higher for sixth-graders. The fact that only half of the second-grader's errors are mediated by their associative responses certainly attenuates the importance of this proposed mechanism for young children's memory organization.

So, there doesn't appear to be any difference in the probability of making an error to a synonym or antonym of an old word, once the different probabilities of production of an associative response are controlled. Let me quickly tell you about two other studies that reach the same conclusion. We did basically the same study with a within-subject design to find out if individual children would "prefer" one relation over the other. There were no differences in total errors and, within grades, about equal numbers of subjects made more false alarms on synonyms than antonyms and vice versa. These data

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are shown in Table 6.

We also did a study where each subject's self-generated associate was inserted into the recognition test to control for equal occurrence of generated associative responses in the test list. (This was done for four antonyms and four synonyms/subject). This was a within-subject design also and there was little evidence for differential memory organization. The total numbers of errors to synonyms and antonyms for both 1st and 5th grade children were not significantly different.

We think our studies point out a number of methodological problems with a recognition memory paradigm where the false alarm rate is employed as an index of developmental change. There are many other problems with this widely accepted paradigm and we feel that results, such as the synonym-antonym developmental shift in memory organization, should be viewed with a great deal of skepticism.

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Table 1

Synonym and Antonym Lists, Critical Stimuli, Associates, and Controls from Cramer (1973)

Synonym List		Antonym List		
Critical Stimuli	Synonym Associates	Critical Stimuli	Antonym Associates	Control Words
baby	infant	get	give	lion
chair	seat	joy	sorrow	gun
doctor	physician	lift	drop	bath
sickness	illness	quietly	noisily	moon
tell	say	sweet	bitter	bread
blossom	flower	boy	girl	ocean
carpet	rug	long	short	pepper
city	town	on	off	thirsty
house	home	slow	fast	closer
joy	happy	white	black	hammer

Table 2

Mean number of errors to test items according to grade and group from Cramer (1973)

Grade Level

Instructional Group	Second			Sixth		
	CrS	A	C	CrS	A	C
Synonym-Neutral	1.19	1.12	0.31	0.81	0.62	0.12
Synonym-Same	1.25	1.06	0	0.38	0.44	0
Antonym-Neutral	2.44	0.94	0.44	1.44	0.81	0.25
Antonym-Opposite	2.44	1.00	0.31	0.94	1.62	0.06

Table 3

Mean number of errors to test items according to grade and group

Lindauer and Paris

Instructional Group	Grade Level: Second Crs	A	C	Sixth CrS	A	C
Synonym-Neutral	1.94	1.50	0	2.31	1.31	.19
Synonym-Same	1.25	1.50	.31	2.75	1.63	.06
Antonym-Neutral	2.31	1.56	.63	3.06	1.31	.44
Antonym-Opposite	1.69	2.25	.44	1.12	1.50	0

Table 4

d's for Second and Sixth Graders

Instructional Group	Grade: Second	Sixth
Synonym-Neutral	2.72	2.67
Synonym-Same	3.07	3.58
Antonym-Neutral	2.64	2.31
Antonym-Opposite	2.70	3.30

Table 5

Subject-Generated Associative Responses

	Total number Responses Generated, which matched test item associates	Percent of Generated associates missed on test	Percent errors mediated by associative responses
Second Grade			
Synonym-Same	29	34.5%	41.7%
Antonym-Opposite	69	29.0%	55.6%
Sixth Grade			
Synonym-Same	82	24.4%	77.0%
Antonym-Opposite	98	22.5%	91.7%

Table 6

Total number of errors to recognition items for Exp. II

	Second				Sixth			
	CrS	Synonyms	Antonyms	Controls	CrS	Synonyms	Antonyms	Controls
Exp. II - within Ss instructions to generate synonym and antonym associates.	27	22	20	1	24	18	17	0

Number of Ss making more recognition errors on one type of associate word than another

		Synonyms > Antonyms	Antonyms > Synonyms	Antonyms=Synonyms
Exp. II	2nd Grade	5	5	2
	6th Grade	4	4	4