

The Role of Perceptual and Verbal Cues in Discrimination
Learning, Concept-Shift Tasks in Aphasic and Normal Adults

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The presumed involvement of verbal mediation within an individual's conceptual ability is demonstrated when solving discrimination learning, concept-shift paradigms. In 1982, VanDemark showed that verbal mediation serves to organize, categorize and focus behavior. The ability to use verbal mediation leads to more rapid learning of concepts and concept shifts. The impairment of language function would be reflected in any task in which verbal mediation was prerequisite to more accurate or efficient performance. This is true whether the task involves verbal or perceptual stimuli.

The typical methodology used to study concept learning ability in aphasia includes a set of discrimination learning, concept-shift tasks. The basic task consists of two stages: preshift and postshift. For example, in preshift, the subject would learn to respond to a certain stimulus cue, (blue); and in postshift, the subject would be reinforced for choosing another cue, (red). A within-class shift (as for color), is an intradimensional shift. A between class shift (from color to shape, as in "blue" to "triangle") is an extradimensional shift. These were the stimuli used in VanDemark and Jordan's study (1978) investigating learning ability in aphasia.

The literature to date has provided a framework which is relevant to the present study. Tikofsky and Reynolds (1967), showed that normal subjects are faster learners than aphasic subjects. VanDemark and Jordan (1978) showed similar findings. Muma (1978) stated that different learning strategies are observed in the population during these concept-shift learning tasks. Muma and Harpur *et. al.*, (1978), during separate studies, demonstrated the likelihood that verbal mediation was used to solve discrimination learning and concept shift tasks correlated with children's linguistic competency. The relationship between verbal mediation and language disorder in adults needs to be clarified. Numerous investigations have shown that adults with normal language learn intradimensional shifts more rapidly than extradimensional shifts. From this, it is reasonable to assert that the study of concept-learning, concept-shift can provide insight into linguistic processes in aphasic adults.

The present study investigated similarities and differences between aphasic and normal adults during concept-learning, concept-shift tasks. If aphasic subjects have deficits in verbal mediation, then their performance should be different from their normal counterparts.

1. Subjects who use verbal mediation should find it more difficult to respond to the perceptual aspects of stimuli.
2. Intradimensional, or within-class shifts should be easier than extradimensional, or between-class shifts for subjects who use verbal mediation.
3. Subjects who use verbal mediation should find it more difficult to make the extradimensional shift from perceptual to verbal cues than from verbal to perceptual cues.

SUBJECTS

Two groups of subjects participated in the study. The experimental group consisted of 40 aphasic adults drawn from the University of Michigan Residential Aphasia Clinic and from several stroke clubs in the Detroit metropolitan area. The control group consisted of 40 neurologically unimpaired adults. The control and experimental groups were further divided into 4 groups of 20 subjects: 10 normal subjects and 10 aphasic subjects, matched by sex and age. Table 1 describes years of education and the mean age of the aphasic and normal subjects in each group. Groups I - IV were also counterbalanced for severity of aphasia on the Boston Diagnostic Aphasia Examination rating and on the percentile ranking from the Porch Index of Communicative Abilities.

Table 1. Age and Years of Education in the Control and Experimental Subjects.

Sub-Group	Age		Years of Education	
	Aphasic	Normal	Aphasic	Normal
I	57.1	49.2	10.75	14.2
II	55.0	52.0	12.3	13.3
III	49.9	47.0	13.2	13.8
IV	50.8	50.0	12.7	14.2

PROCEDURES

The discrimination learning task included the presentation of two stimuli. With the first set of stimuli, each array included either the word red in red ink and the word blue in blue ink, or the word red in blue ink and the word blue in red ink. Position combined with the stimuli created four possible arrays, which were presented to the subject in random order. A black "X" in a white background served as the reinforcer, indicating that the choice was indeed correct. As illustrated in Table 2, either the word red or red ink was arbitrarily designated as the correct choice in the preshift task. If the correct response was not learned in 40 trials during the preshift task, participation in the experiment was terminated. When 5 consecutive correct responses were made in the preshift task, the subjects were presented with a new set of stimuli and the task continued as in preshift, with either the word yellow or yellow ink as the correct choice.

Table 2. Group I-IV Stimulus Conditions in the Pre- and Post-shift Task.

Sub-Group	Shift	Pre-	Post-
I	ID	word red	word yellow
II	ED	word red	yellow ink
III	ID	red ink	yellow ink
IV	ED	red ink	word yellow

The following results were anticipated.

1. Normal subjects are faster learners than aphasic subjects (Tikofsky and Reynolds, 1962; Arrogoni and DeRenzi, 1964).
2. Intradimensional shifts are easier than extradimensional shifts for normal subjects, and are of equal difficulty for aphasic subjects (VanDemark, 1980, 1982).
3. Normal subjects find the verbal aspects of stimuli more salient. Aphasic subjects tend to choose the perceptual aspects of the stimuli more often than the normal subjects (Milton, Wertz, Katz and Prutting, 1981).
4. Months post onset, age, sex, severity, type of aphasia are not correlated with performance in the concept-learning, concept-shift tasks (VanDemark and Jordan, 1978).
5. More linguistically competent children are more likely to choose the verbal aspects of the stimuli than the less linguistically competent children, and they prefer intra- to extradimensional shifts.
6. As verbal maturity increases, tendency to use perceptual cues decreases.

RESULTS

Table 3 summarizes the mean number of trials for each subject group. Results of univariate one-way ANOVAs indicated that differences in number of trials to learn the preshift task was not significant between aphasic and normal subjects. As difficult as it is to believe from looking at the data, the statistics tell us that all subject groups performed equally well on all the pre-shift tasks. ANOVA testing for the postshift trials suggested significant differences.

Table 3. Mean Number of Trials for Pre- and Post-shift Tasks.

Sub-Group	Subject Type	Pre \bar{X}	Post \bar{X}		Shift
I	Aphasic	12.0	7.1	ID	word-word
	Normal	15.3	5.8		
II	Aphasic	15.4	8.3	ED	word-color
	Normal	11.7	14.0		
III	Aphasic	9.6	7.8	ED	color-word
	Normal	7.3	6.0		
IV	Aphasic	12.4	11.4	ID	color-color
	Normal	9.6	13.9		

Post-hoc t-tests were calculated between aphasic and normal subjects, between verbal and perceptual stimulus dimensions, and between extra- and intradimensional shift paradigms. The number of trials required to learn the postshift task did not differ significantly between aphasic and normal adults, although the difference between postshift means approached significance for group II (extradimensional shift, word-to-color), ($t = 1.85$, $p = .08$). When both verbal and perceptual cues were combined, the aphasic subjects required fewer trials to learn the extradimensional shift (8.05) than the intradimensional shift (9.45), while the normal subjects required fewer trials to learn the intradimensional shift (9.85) than the extradimensional shift (10.0). Although this is consistent with the literature, neither difference was significant (Table 4).

Table 4. Analyses of variance: Post Shift Trials.

Source	SS	DF	MS	F	P
Subgroups	788.89	7	112.70	5.4331	.0000
Groups	1493.5	72	20.743		
Total	2282.4	79	(Random effects statistics)		

When verbal and perceptual cues were considered separately for each shift paradigm, significant differences were found. Regardless of the type of shift, normal subjects required significantly more trials to learn the postshift response to the perceptual cue, color of ink, than the postshift to the verbal cue, color name ($t_{\text{aph}} = -3.23$, d.f. = 18, $p = .004$; $t_{\text{nor}} = -4.07$, d.f. = 18, $p = .007$). Aphasic subjects, however, showed no significant difference in postshift to either perceptual or verbal cues (Table 5).

Table 4. Pre- and Postshift Tasks.

Source	SS	DF	MS	F	P
Subgroups	1489.8	7	212.83	4.3211	.0005
Groups	3546.2	72	49.25		
Total	5036.0	79			

Previous studies (VanDemark and Jordon, 1978, 1980; VanDemark, 1982) have reported that both aphasic and normal subjects learned the postshift task in fewer trials than the preshift task regardless of the type of shift. Figure 1 shows aphasic and normal subjects' performance. Inspection of the figure indicates that aphasic subjects took fewer trials in the postshift in every case. This was not true for normal subjects. In groups II and IV, where the postshift task required the subject to respond to the perceptual cue, color of ink, the normal subjects required more trials to learn the shift.

Table 5. Comparison of Ranked Performance of Number of Trials to Complete Postshift Tasks.

Group	Normal Subjects Type of Shift	Trials	Group	Aphasic Subjects Type of Shift	Trials
I	ID word-word	5.8	I	ID word-word	7.1
III	ED color-word	6.0	III	ED color-word	7.8
IV	ID color-color	13.9	II	ED word-color	8.3
II	ED word-color	14.0	IV	ID color-color	11.4

In summary: (1) it took longer for all subjects to learn the intradimensional shift from color to color than the extradimensional shift from color to word. (2) The intradimensional shift was easier than the extradimensional shift for normal subjects when dealing with verbal cues, but not when dealing with perceptual cues. (3) It took longer for normal subjects to learn the extradimensional shift from word to color than from color to word. It made no difference for the aphasic subjects. (4) Aphasic subjects learned all postshift tasks in fewer trials than the preshift task. Normal subjects took longer to learn the perceptual cue in the postshift task.

DISCUSSION

The more linguistically competent a subject is, the more difficult it is to respond to the perceptual aspects of stimuli. Data from the present study

Discrimination-Learning, Concept-Shift Task

X = normal
subjects

O = aphasic
subjects

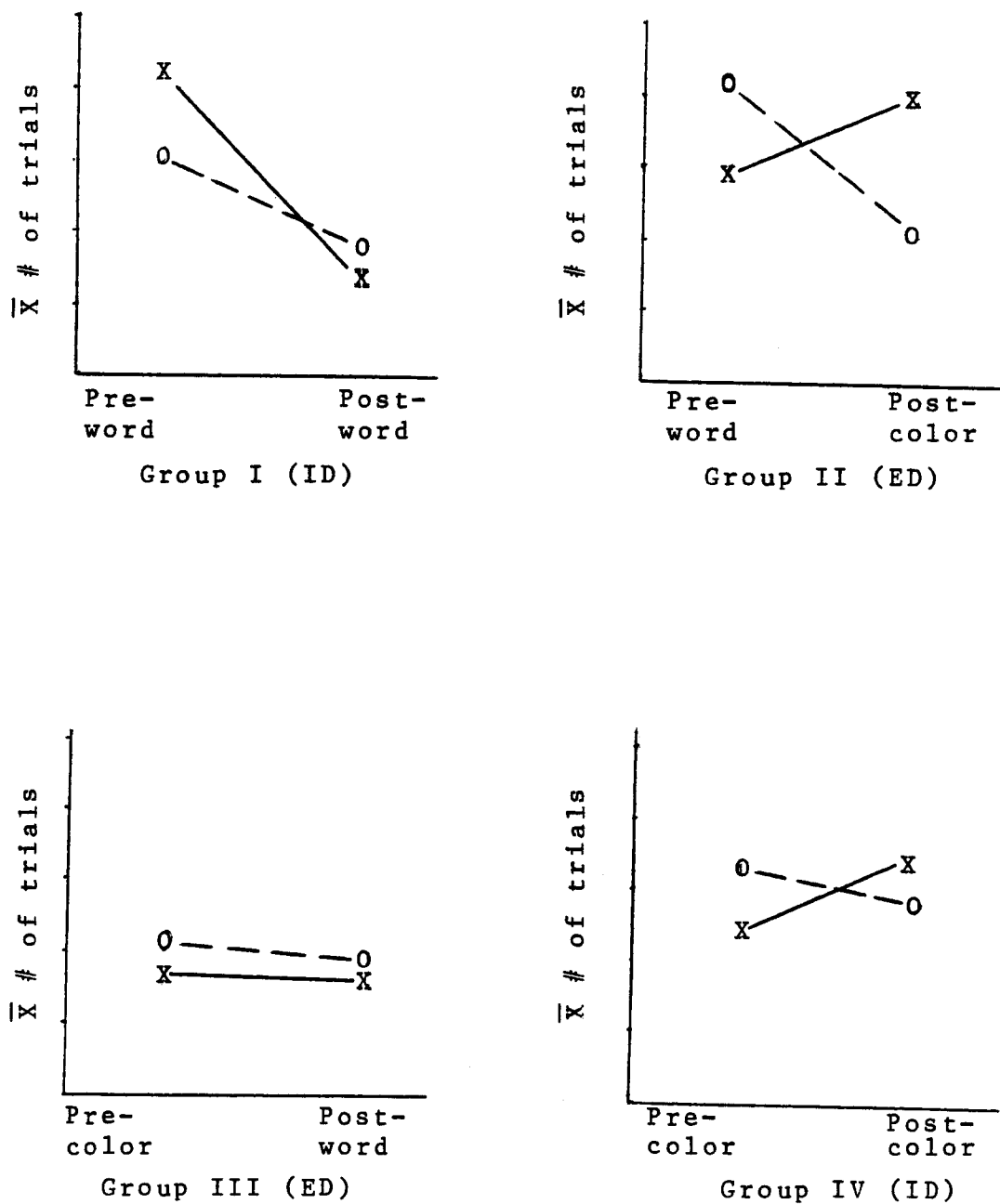


FIGURE 1. Mean number of trials for aphasic and normal subjects as a function of the pre- and post-shift stimulus cues (word, color).

show that both groups used verbal mediation in problem-solving. Normal subjects appeared to rely more heavily upon it, since they found it more difficult to respond to the perceptual aspect of the stimuli and performed slightly better during intradimensional shifts.

If verbal mediation was used in problem solving, extradimensional shifts would be more difficult than intradimensional shifts. Normal subjects' performance was influenced more by the type of stimulus they had to learn. They tended to test the more salient attribute first regardless of whether the shift was intra- or extradimensional. According to the present data, the verbal cue was the most salient and was tested first. This pattern was not so strong with aphasic subjects.

It was expected that subjects who use verbal mediation would have more difficulty identifying the perceptual cues when a competing verbal stimulus was also present. When normal subjects were reinforced for choosing the verbal cue (word red) in the preshift task, they required more trials than the aphasic subjects to shift to the perceptual cue (yellow ink) in the postshift task. Reinforcement of the word red in the preshift task would logically lead the subjects to search for a word (or verbal cue) in the postshift task. The significant increase in the number of trials to complete the extradimensional shift from word to color may have been a result of a competing verbal cue from the preshift task. Again, it appears that the verbal cue was more salient for normal subjects, and this competing cue from preshift made it more difficult to shift to a perceptual cue.

If verbal mediational ability in aphasic adults is slowed, yet otherwise intact, their expected performance would be similar to normal subjects but slower. Aphasic subjects performed most like normals when the postshift was simple--a within-class shift. When the complexity of the task increased, aphasic subjects tended to respond equally well to perceptual and verbal cues. Different mediational strategies may have been used by aphasic and normal subjects. Perceptual and verbal cues were equally salient for aphasic subjects, but verbal cues were salient for normal subjects.

A clinical analogy can be found where with simpler tasks, aphasic subjects perform more like normals, but with slower rate. When complexity increases, different mediational strategies are used in problem solving. Clinically, aphasic patients who do not demonstrate perceptual or verbal preferences may have difficulty learning verbal labels in categorizing or in performing more difficult cognitive tasks.

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DISCUSSION

- Q: Did you ask your aphasic subjects to tell you the mediator?
- A: No, the task was completely nonverbal, using a trial and error response methodology.
- Q: Oh. so at no time did you say, "What's going on here, and tell me what you were using to make your choice?"
- A: No, I quickly moved to the next paradigm. Many of the subjects, however, would express them verbally, for example some would say "red" when in fact they were picking "r-e-d". So you saw verbal language being used.
- Q: Inability to name the mediator in a task wouldn't necessarily mean that they weren't using it.
- A: Exactly, and in dealing with aphasic patients I would not rule out verbal expression difficulties in saying them.
- Q: Did you run a correlation or look for any relationships between performance on those tasks and your diagnostic batteries used on any of the aphasic patients?
- A: Severity was counterbalanced so that between each group there were not significant differences between the aphasic subjects. A within groups comparison among aphasic subjects' severity type of aphasia and performance would lead me to more information. I haven't done that yet.
- Q: It would be interesting to see if performance on the task related to language severity.
- A: Oh, definitely and those are among the questions that need further investigation.
- Q: What would you guess?
- A: I would guess of course, that more severe patients would not be able to learn the task as well because of deficits with verbal mediation. The three people who did not learn the task in the preshift tended to have poorer auditory comprehension. The relationship between language performance and performance on discrimination learning concept-shift tasks is rather complex.
- Q: Have you looked at whether their performance was influenced by the intrahemispheric localization of the lesion?
- A: No.
- C: It might be worthwhile doing that, because all of the previous research on shifting behavior show that it's really an intrahemispheric phenomenon and folks that have difficulty on these types of tasks have frontal lesions. It's not surprising to find out that language severity does not correlate with performance on these tasks. In fact, quite often the more severe frontal lesion patients have more difficulty on these tasks, although they have less language deficits.