DOCUMENT RESUME

ED 101 526 EC 071 314

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TITLE Direction Following of Retarded and Nonretarded Adolescents: A Comparative Study. Working Paper No. 271.
INSTITUTION Parsons State Hospital and Training Center, Kans.
PUB DATE May 72
NOTE 38p.; For related information, see EC 071 317

EDRS PRICE MF-$0.76 HC-$1.95 PLUS POSTAGE
DESCRIPTORS Adolescents; *Educable Mentally Handicapped; Exceptional Child Research; *Learning Characteristics; *Listening Comprehension; Mentally Handicapped; *Receptive Language; Sequential Learning
IDENTIFIERS Directions; *Project MORE

ABSTRACT

Ability to follow imperatives with one to five separate directives was measured in 18 retarded (mean IQ 50) and 18 nonretarded adolescents. Recorded were the number and sequence of directions correctly followed as well as the types of errors made. The retarded adolescent demonstrated deficiencies in following two, three, and four directives, while the scores on one and five directives were not significantly different in the two groups. The retarded group scored lower on sequential performance of directive, suggesting possible differences in the two groups' acquisition strategies. (CL)

PARSONS RESEARCH CENTER

Working Paper # 271 May 1972

DIRECTION FOLLOWING OF RETARDED AND NONRETARDED ADOLESCENTS: A COMPARATIVE STUDY

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Abstract

Retarded and nonretarded subjects were presented sets of directives (imperative sentences) each containing one, two, three, four, or five separate directives. Subjects were required to respond to the verbal stimuli with overt motor behavior which corresponded to the semantic structure of the verbal stimuli, i.e., subjects were instructed to follow the directives communicated to them in sentence form. The results indicated that retarded adolescents have a behavioral inadequacy in correctly following directions when the directives are distributed into sets of two, three, and four. The performances of single directives and sets of five were not significantly different for the two groups. The retarded subjects also demonstrated deficiencies in their ability to perform sets of two, three, and four. The performances of single directives and sets of five were not significantly different for the two groups. The retarded subjects also demonstrated deficiencies in their ability to perform sets of two, three, and four directions in the sequence in which they were presented.

Direction Following of Retarded and Nonretarded Adolescents: A Comparative Study[1]

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Parsons Research Center

Introduction

Verbal behavior can be divided into two aspects: (1) production of language, such as written or spoken language, and (2) responding to language as a discriminative stimulus, such as following directions or instructions. Although equally important, these two aspects of language have not received equal attention among researchers of language disorders and learning disabilities in mentally retarded populations. While some research efforts have emphasized the importance of verbal directions or instructions for the establishment and maintenance of behavior (Ayllon and Azrin, 1964; Zimmerman, Zimmerman, and Russell, 1969; Whitman, Zakaras and Chardos, 1971), this important area of investigation has been largely neglected (cf., Whaley and Malott, 1971, Chapter 13).

For the mentally retarded in particular, many of the most critical language functions can be subsumed under the category of direction following behavior. That is, it may be more important for a retarded child or adolescent to be able to do what he is asked--to respond appropriately to language as a stimulus--than to be able to speak with clarity, precision, and flexibility. This may be especially true for those retarded persons who wish to be successful in a community setting instead of an institution. Success in the community ordinarily involves competitive employment in an unskilled or semi-skilled job.

Therefore if the retarded are to find a place in the community, their success would depend, to a large extent, upon their ability to follow simple directions or instructions--to respond in the appropriate manner to the verbal behavior of a speaker or some other source of language.

The research reported herein is an attempt to assess deficits in the direction following behavior of retarded adolescents. Directions consisting of simple imperative sentences were presented orally to retarded adolescents as well as to nonretarded high school students. Subjects were given single directives comprised of one imperative sentence as well as sets of directives including as few as two and as many as five imperative sentences. Correctness of the responses to the directives was assessed in terms of the appropriateness of the behavior to the verbal instruction. For example, a directive, such as *Put the large button under the paper*, was considered correctly performed only if the subject placed a large button under a paper.

It is the primary aim of the present study to identify the extent and nature of the deficiencies in the direction-following behavior of moderately retarded adolescents. A further purpose is to specify target areas for language training programs emphasizing the control of behavior by directions or instructions.

Method

Subjects

Two groups of subjects were employed. One group consisted of 18 residents of Parsons State Hospital and Training Center on whom the following data was obtained: mean CA = 16.0 years, range = 14.1 to 17.3 years; WISC or WAIS full scale mean IQ = 50, SD = 4.9. This data includes prorating of WISC full scale scores into IQ's following Ogden (1960). The data obtained for the other group of 18 subjects enrolled in regular classes in a community high school in Parsons, Kansas was mean CA = 15.8 years, range = 14.2 to 17.9 years; Lorge-Thorndike IQ: verbal mean = 101, SD = 5.4; numerical mean = 99, SD = 4.8. The high school students were paid $1.00 each for their participation in the experiment.

Materials

Stimulus materials consisted of 98 directives in sentence form and a bookshelf containing 25 common objects. The bookshelf (64" x 36") was constructed with five shelves of varying depths permitting maximum visibility of objects on the shelves. Only the second, third, and fourth shelves were used to hold objects. Numbered locations on the shelves facilitated object placement (see Appendix A).

A total of 98 imperative sentences were constructed from a list of 29 nouns, 10 verbs, 7 adjectives, and 5 prepositions (see Appendix B). Each of the sentences had one of three basic structures: verb + noun phrase + prepositional phrase; verb + two noun phrases; or a verb + prepositional phrase. The 98 sentences generated were then distributed

into sets so that one or more sentences (directives) were presented serially to the subject as a complex stimulus unit prior to his direction following. Each subject was presented 45 sets of directives containing one, two, three, four, and five separate sentences with 20, 10, 6, 5, and 4 presentations, respectively, of each set. A complete listing of the 98 experimental sentences, in the order and distribution presented, are given in Appendix C.

Procedure

Prior to the experimental phase of the experiment, all subjects were screened to ensure proper word-object association and mastery of the separate component responses designated in the directives, for example: point, show, and place. Each subject was examined and evaluated with respect to his or her identification of the empirical referents of all nouns, verbs, adjectives, and prepositions listed in Appendix B. This was accomplished by asking subjects to point to referent objects and attributes for the nouns and adjectives, and to perform the actions designated by the verbs and prepositions. If a subject erred, the appropriate behavior was modeled by the experimenter while he repeated the directive component. The same component was then repeated for the subject. If the subject erred a second time, he or she was dropped from the experiment. Three retarded subjects were dropped from the study on this basis.

All eighteen nonretarded and ten retarded subjects correctly identified the referent objects and attributes of the nouns and adjectives, and performed the actions designated by the verbs

and prepositions without modeling and repetition on two consecutive tests on all parts of speech in Appendix B. Eight of the retarded subjects needed repetition and modeling of several directive components.

Following screening, subjects were tested individually in the presence of two experimenters: an interacting experimenter (IE) and a noninteracting experimenter (NE). Both experimenters simultaneously, but independently, recorded data for each subject: however, only the IE interacted verbally with the subjects.

As each subject entered the experimental room, he or she was greeted by the IE who said:

> *I am your teacher and he (pointing to the NE) is your other teacher. We're going to play a game. I want you to sit in your chair while I ask you to do some things. Then, you do what I tell you in the right order. Do the best you can. Listen carefully.*

Immediately following the above introduction, each subject was instructed to respond to a directive set containing two imperative sentences, which served as an example and was not recorded. If this set was performed appropriately, the IE proceeded with the experimental session. If the subject erred in the performance of the example, the IE repeated the sample directives, provided the subject with feedback concerning the appropriateness of his responses, and proceeded with the first experimental set if the subject's behavior was appropriate. If the subject erred once again, the NE modeled the desired behavior and the IE asked the subject

to attempt following the sample directive once again. Regardless of the appropriateness of this final example, the IE proceeded to present the first experimental directive.

Forty-five sets (including single directive sets) comprising 93 separate directives were presented orally by the IE to each subject. Each presentation of a set was preceded by the IE saying, *This time I'm going to ask you to do n things* (n depended on the number of separate directives in a forthcoming set). Each set was presented in its entirety before the subject was permitted to respond. The following time intervals, after the presentation of the last directive in a set, were allowed for the initiation of the subject's direction-following behavior:

1) 5 sec. for single directives;
2) 10 sec. for two directive sets;
3) 15 sec. for three directive sets;
4) 20 sec. for four directive sets; and
5) 25 sec. for five directive sets.

If a subject exceeded these limits he was asked to begin his performance of the directive(s) at that time.

Each performance of a directive was observed and recorded by the IE and the NE. Each appropriate performance of a directive, regardless of ordinal position, was reinforced by the IE with a single plastic token; a correct performance in the proper ordinal position was reinforced with two plastic tokens placed in front of the subject immediately following the performance of a set of directives. The tokens were exchanged for pennies at the end of the experimental session.

Results

The data were analyzed in terms of the number and the sequence of directions--the separate imperative sentences--correctly followed by the retarded and nonretarded adolescents. In addition, the type and number of errors in the direction-following behavior of both groups were analyzed and compared. Since each subject was presented more than one set of directives containing a particular number of separate directives, the average performance of each subject on a particular set was considered a single data point for convenience in analysis and reporting of the correctness and sequence data. Thus, the number of observations contributing to a group mean is the product of the number of subjects (N) and the number of times (i.e., 20, 10, 6, 5, and 4 times respectively for single,-two,-three,-four,-and five-directive sets) the subjects were presented a particular set.

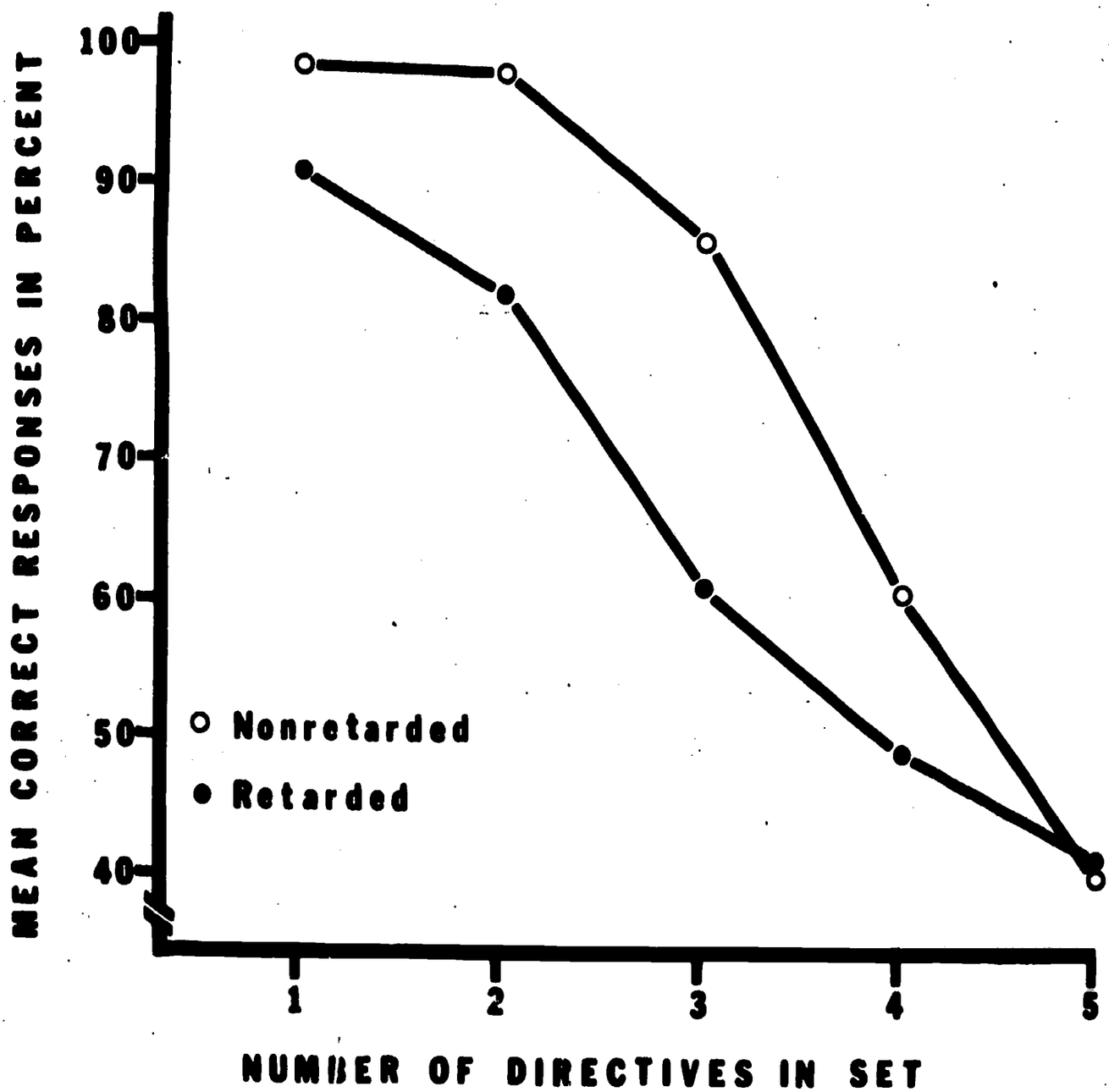
The performance data for four subjects from each group were randomly selected in order to assess the interobserver reliability with which the two experimenters rated the correctness of the subjects' response to the various sets of directives. Reliability--computed by dividing the number of agreements by the number of agreements plus the number of disagreements-- exceeded 0.95 in all eight cases selected.

Correctness

Figure 1 shows the percentage of correct performances as a function of the distribution of the directives in terms of sets. Values plotted represent group means calculated from individual percentage scores. A 2 x 5 (Groups x Sets) analysis of variance of these scores revealed statistically significant main effect of groups, $F(1, 34) = 13.26$, $p < .005$, and sets, $F(4, 136) = 203.81$, $p < .001$, as well as a significant Groups x Sets interaction, $F(4,136) = 9.03$, $p < .001$. The significant effect of sets, reflected in Figure 1 by the downward slope of both curves, indicates that appropriate performance in direction following diminished to a degree which depended on the distribution of the directives into sets. This significant interaction between groups and sets should be interpreted with some caution. It is possible that the interaction is partially the effect of task artifacts resulting in "ceiling" effects in the nonretardeds' performance of single and two directive sets (see Figure 1). Baumeister (1967) described the problems associated with interpretation of interactions when such "ceiling" effects are present.

A major concern of the present study is the analysis of differences in direction-following behavior of the two groups as a function of variations of the task variables, i.e., sets. Inspection of Figure 1 indicates that marked performance differences exist between the groups in the sets containing two, three, and four directives. Newman-Keuls comparisons revealed significant differences ($p < .01$) between group means for the two,-three,-and four-directive sets but not for single directives or sets containing five.

FIGURE 1



Mean correct performances in percent of single directives, and two-, three-, four-, and five-directive sets for the two groups.

It is interesting to note that while both groups appear to have equal difficulty in performing five directive sets, the actual performance of the retarded group is superior to that of the nonretarded group.

The mean number of directives performed appropriately for a single presentation of a set are presented in Table 1. These values

TABLE 1

Mean Number of Directives Followed Correctly for a Single Presentation of a Set

Directives in Set	Retarded		Nonretarded	
	Mean	SD	Mean	SD
2	1.65	0.30	1.95	.07
3	1.86	0.58	2.52	0.33
4	1.97	0.64	2.46	0.53
5	2.07	.69	2.04	.59

were obtained by averaging each individual's performance on each directive set and computing group means from these averages. Mean performance of the retarded group seems to increase, although only slightly, as more directives are presented in a single set such that the maximum performance is in response to five-directive sets. This result is hardly suprising except when compared with the mean performance of the nonretarded group. The nonretarded group seems to perform optimally when presented with three directives. As can be seen in Table 1, their performance diminished when either one or two more directives were added to a set already consisting of three directives.

TABLE 2

Number of Subjects Appropriately Performing a Complete Set of Directives at Least Once

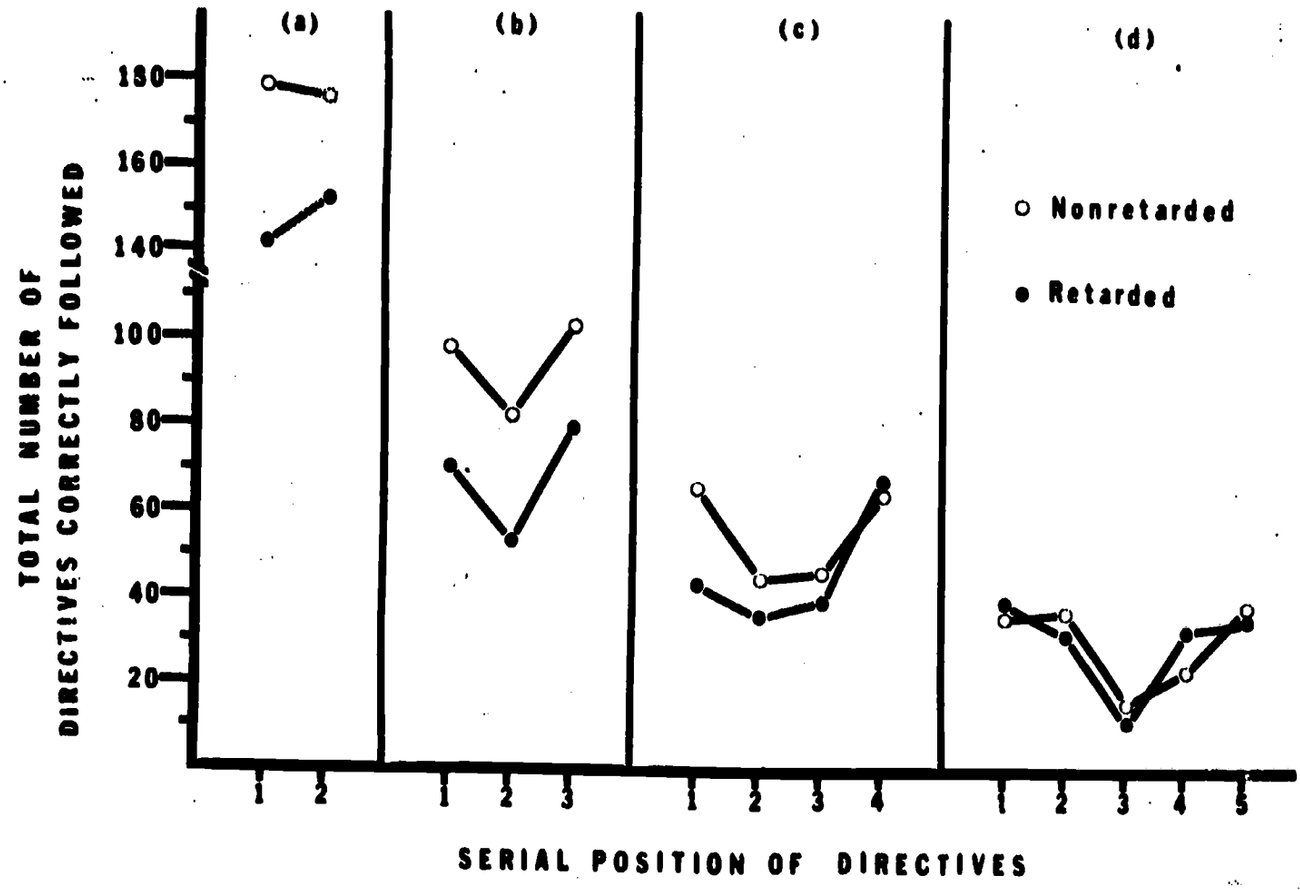
Directives in Set	Retarded	Nonretarded
2	18	18
3	11	18
4	5	11
5	0	1

In Table 2, the number of subjects correctly performing a complete directive set at least once during the experimental session is presented. This group comparison is of more than passing interest since it is often more important to consider whether or not an entire series of directives has been complied with, rather than the number of directives correctly performed within a set. The comparison in the table is consistent with above mentioned results in demonstrating that the major differences in the groups exist in the performance of three and four directive sets. One subject in the nonretarded group, and no subjects in the retarded group appropriately performed a five-directive set. Obviously, the demands of a series of five directives were beyond the abilities of retarded and nonretarded adolescents alike.

The final analysis of the correctness data involved the distribution of directions correctly followed over the ordinal position of the directive. The total number of directives correctly followed as a function of the serial position of the directive within a set is shown for the two groups in Figure 2. Serial position curves for two-, three-, four-, and five-directive sets are plotted.

Overall the most noteworthy aspect of the performances, reflected in the curves of Figure 2, is the striking similarity of serial position effects (i.e., performances of the directives with disproportionate difficulty depending upon the ordinal position of the directive) between the two groups. This is best shown in the curve depicting the performance of three-directive sets. Both groups more frequently responded to the first and last directive than the middle directive of a three-directive set. This primary and recency effect is evident in the performance of four- and five-directive sets as well. The curves in Figure 2 suggest what may be a somewhat stronger recency effect evident in the performance of the retarded group than that of the nonretarded group. In all directive sets the last directive is performed correctly more frequently than the first directive--a fact most strikingly illustrated in the data for the four-directive sets. The unequal ease with which the last directive is apparently performed is not evident in the performance of the nonretarded group.

FIGURE 2



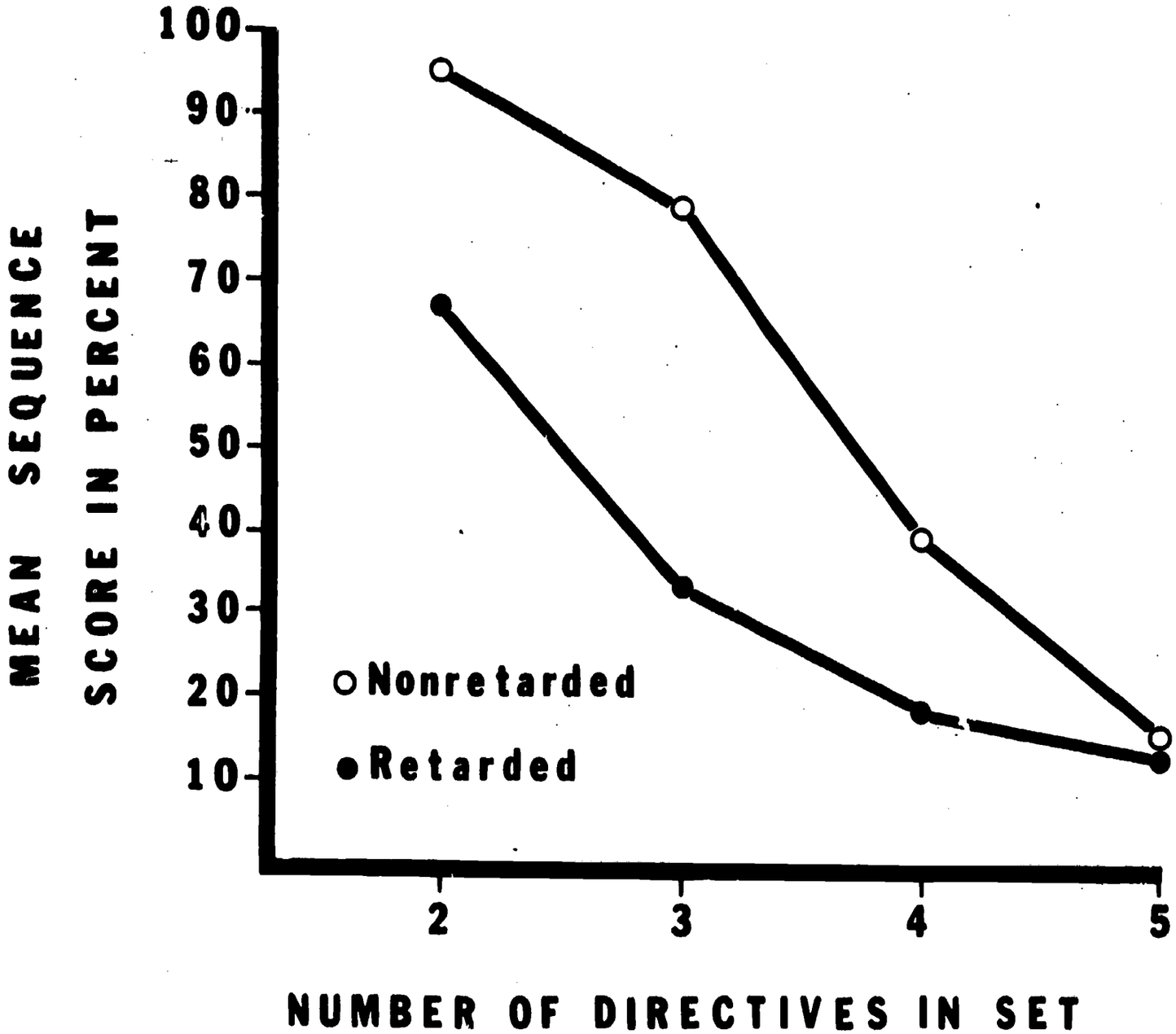
Total number of directives correctly followed by the two groups as a function of the serial position of the directives for (a) two-, (b) three-, (c) four-, and (d) five-directive sets.

Sequence

The sequence in which directives were appropriately followed was scored in terms of an index reflecting the extent of deviation from the proper sequence of directives within a set. A score was recorded for every appropriately performed directive only if it was preceded by another directive which properly belonged earlier in the sequence. For example, a three-directive set properly sequenced in the order 1, 2, 3 was scored 2 + 1 = 3 indicating that two directives (2 and 3) properly occurred later in the sequence than Directive 1, and that one directive (3) properly occurred later in the sequence than Directive 2. Similarly, a five-directive set sequenced in the proper order (i.e., 1, 2, 3, 4, 5) was scored 4 + 3 + 2 + 1 = 10 reflecting the fact that four directives (2, 3, 4, 5) occurred properly sequenced later than Directive 1, three directives occurred after Directive 2, etc. An improperly sequenced set of directives, such as a four-directive set performed in the order 4, 2, 3, 1 was scored 0 + 1 + 0 = 1 indicating that only Directive 3 followed a directive which occurred earlier in the proper sequence. Omissions and incorrectly followed directives occurred quite frequently in the performance of both groups and were not scored. For example, a three-directive set performed in the order 1, 2, 3 received the same score (i.e., 2 + 1 = 3) as a four-directive set performed in the order 1, 2, 4, although Directive 3 was omitted in the latter set.

Table 3 and Figure 3 summarize the sequence data. The mean sequence index scores for single presentation sets are presented in Table 3.

FIGURE 3



Mean sequence scores in percent for two-, three-, four-, and five-directive sets for the two groups.

TABLE 3

Mean Sequence Index Score
for a Single Presentation of a Set

Directives in Set	Retarded		Nonretarded	
	Mean	SD	Mean	SD
2	0.66	0.23	0.95	0.03
3	0.94	0.70	2.35	0.53
4	1.12	0.92	2.31	1.22
5	1.26	0.84	1.51	0.76

values in the table were obtained by averaging each subject's performance on each directive set and computing group means from these averages. Figure 3 shows index scores for the two groups in terms of mean percentages. An analysis of variance of these scores was performed demonstrating statistically significant group, $F(1, 34) = 30.17$, $p < .001$, and set, $F(3, 102) = 186.55$, $p < .001$, effects, as well as a significant interaction (Group x Set), $F(3, 102) = 17.77$, $p < .001$. Group means differed significantly ($p < .05$) for all but the five-directive sets.

Generally, the sequence data summarized in Table 3 and Figure 3 is consistent with the correctness data presented earlier. Again the mean absolute performance on a single set for the retarded group is enhanced (see Table 3) as more directives are presented in a single set. On the other hand, optimal sequencing occurs with the presentation of three-

directive sets in the nonretarded group--even though the index score potentially obtainable for a four- or five-directive set (i.e., six or ten respectively) exceeds that obtainable for a three-directives set.

In terms of a relative measure (see Figure 3) both groups demonstrated sequencing performance which depended on the number of directives presented in a set. Inspection of Figure 3 suggests that the differences between the groups in the sequencing of directives is confined to sets containing less than five directives; the groups' performance on five-directive sets are comparable. The greatest difference between the groups occurred on three-directive sets.

Errors

The type and frequency of errors committed by the two groups are presented in Table 4. Six types of errors were tabulated. Type I and II errors represent instances of inappropriate substitutions for the correct object or action designated in the directive. Type III errors reflect instances when the subject performed an action completely at variance with the directive: for example, the subject showed the experimenter a red airplane when the designated directive called for the behavior of cutting a piece of paper. Type IV errors represent incorrect substitutions for a directed modifier: such as, the subject held a white ribbon when holding a red ribbon was directed. Type V errors represent substitutions for the correct preposition. Finally, Type VI errors represent omissions--instances when the subject did not attempt to follow the directive.

Inspection of the overall total for each type of error (column totals) indicates that the errors committed by the retarded subjects exceed in every category those committed by the nonretarded subjects. Type VI errors are by far the most frequent in both groups. A comparison of the

TABLE 4

Frequency and Type of Errors Committed by the Retarded (MR) and Nonretarded (N)

Number of Directives in Set	Error Type													
	I Incorrect Object		II Incorrect Action		III Incorrect Object and Action		IV Incorrect Modifier		V Incorrect Preposition		VI Omission		Total	
	MR	N	MR	N	MR	N	MR	N	MR	N	MR	N	MR	N
1	10	1	1	0	0	0	1	0	10	0	13	2	35	3
2	24	8	15	0	2	0	6	0	4	0	13	0	64	8
3	27	11	26	19	8	4	4	0	4	4	51	11	120	49
4	33	33	18	20	18	12	7	5	6	8	98	74	180	152
5	37	33	27	29	17	16	7	6	14	7	138	126	240	217
Total	131	86	81	68	45	32	25	11	38	19	313	213	639	429

row totals, total errors within each directive set, reveals that the differences between the two groups are largely confined to one-, two-, and three-directive sets. The nonretarded group, for instance, committed a total of only 11 errors in one- and two-directive sets compared to a total of 99 for the retarded group. The differences between groups in four- and five-directive sets, on the other hand, are less marked.

Discussion

On the basis of the foregoing results it is possible to make several statements concerning differences and similarities in the direction-following behavior of retarded and nonretarded persons of similar chronological age. To begin with, retarded adolescents appear to demonstrate behavioral deficiencies when compared to nonretarded adolescents in correctly following directions when directives are distributed into sets of two, three, and four. The performance of single directives and five-directive sets for the two groups were not significantly different. As mentioned already, however, any differences between the two groups in the performances of single directives and sets of five directives may have been at least partially veiled by ceiling and floor effects respectively

The retarded subjects in our experiment also demonstrated deficiencies in their ability to perform sets of two, three, and four directions in the order in which they were presented. Both retarded and nonretarded seemed to have equal amounts of difficulty in performing five-directive sets in the proper sequence. This difference between the groups in the ability to reproduce sequences of behaviors in the order in which they were directed is intriguing and, perhaps, may provide insights for theories of memory and memory models concerned with serial order in the learning (acquisition), retention (storage), and recall (retrieval) of complex speech (Wickelgren, 1969; Halwes and Jenkins, 1971).

Taken together, the correctness and sequence data suggest that the two groups may be employing different strategies in remembering several directives. It has been recently emphasized that reasonable evidence for differential cognitive processing of information can be gleaned from significant Group by Condition interactions in analysis of variance (cf., Belmont and Butterfield, 1969). Analysis of both measures, correctness and sequence, yielded significant Group by Set interactions. However, such evidence unfortunately does not indicate the nature of such differential cognitive processing.

Several investigators have postulated that retarded individuals are deficient in aspects of short-term memory concerned with active engagement in the acquisition of information to be remembered. For example, it has been suggested that the retarded are deficient in:

1) an ability to spontaneously organize input information (Spitz, 1963);
2) an effective rehearsal strategy for processing information for later recall (Ellis, 1963);
3) secondary memory (Ellis, 1968; Waugh and Norman, 1965);
4) an active acquisition strategy or simply, active memory (Belmont and Butterfield, 1969).

Although the present study was not specifically designed to isolate such deficits, the results do provide some indirect evidence for a lack of active participation in the sentences to be remembered, i.e., directives to be performed.

Evidence for differential acquisition strategies is suggested by the comparison of mean group performances of sets of directives--the average number of directives performed correctly and in sequence as a function of the size of the set (see Table 1 and 3). On *a priori* grounds, one might expect that as more directives are added to a single

presentation set, more directives will be correctly performed (limited, of course, by memory span constraints). At the least, increasing the size of the set should enhance performance to a point; greater demands in terms of even more directives presented should lead to asymptotic performance levels. Ellis (1970) has presented evidence for such asymptotic performance, constant retention as lists of numbers increase in length from three to nine. In short, what is suggested is a logical, admittedly simplistic, explanatory model for directive retention: increased input permits increased acquisition, storage or retention, and potentially increased retrieval of directive information.

Inspection of Tables 1 and 3 will reveal that only the performance of the retarded group fits this model. The mean number of directives correctly performed (Table 1) and the mean index scores (Table 3) for this group increased directly as a function of the number of directives in a presentation set. Such monotonic relationships were predictable from the model, and perhaps, suggest a simple monotonic function relating amount of input and memory output governing the retarded's direction following.

Clearly, the model does not predict the performance of the nonretarded group. Optimal performance for this group occurs in response to sets containing only three directives. It is as if additional directives beyond three interferes with retention and direction following.

A plausible, highly tentative explanation congruent with recent accounts of short-term memory deficiencies in retarded individuals may be offered to account for the difference between the performance of the two groups. It may be argued that the retarded in the present study failed to rehearse and/or organize the incoming directives to a degree of efficiency comparable to that of the nonretarded individuals. It follows that additional input beyond three directives may not have inter-

fered with active, ongoing organizational and/or rehearsal strategies in the nonretarded subjects, but may have interfered with such strategies in the nonretarded subjects. Notwithstanding the highly speculative nature of this hypothesis, it is possible to account for the differential interference of organizational and/or rehearsal strategies involved in retention of the directives. The authors are currently engaged in research which may lend some empirical validity to this hypothesis.

Although there seems to be an indication of a stronger recency effect (correct performance of directives presented at the end of a set) than primacy effect (correct performance of directives presented at the beginning of a set) in the retarded group, the general trend of the serial position data (see Figure 2) does not warrant any strong statements concerning differences between the two groups. To our knowledge recency and primacy effects in performances in response to directions or instructions have not been investigated prior to the present study.

The comparison of the groups with respect to the frequency and type of errors committed in inappropriate direction-following behavior (see Table 4) presents a somewhat different pattern of group differences than comparisons on the basis of correctness data. Taking into consideration only those directives which were inappropriately performed, group differences are most pronounced for single directives, two-and three-directive sets (see row totals in Table 4). On the basis of the correctness data the differences between retarded and nonretarded individuals' performance of directives seem to be restricted to sets of two, three, and four directives. In this matter, it suffices to emphasize the importance of different measures of the same behavior. Both correctly and incorrectly performed directives considered, it can be concluded that retarded

adolescents behavioral deficiencies in the performance of verbal directions can be largely restricted to two-and three-directive sets.

Several conclusions can be drawn on the basis of the present results with respect to language training programs focusing on the control of behavior by verbal directions or instructions. To begin with, direction-following behavior deficits in the retarded adolescents in relation to nonretarded adolescents are largely confined to the performances of sets of two-, three-, or four-directives. These results define the extent of the deficiencies and suggest that the scope of future training programs be restricted to a specific range of separate instructions or directives. Although the nature is not as easily identified as the extent of the performance deficits, effective rehearsal strategies in the retarded can be strongly implicated. As discussed earlier, there is a suggestion in the present data that retarded adolescents are deficient in their ability to spontaneously organize or rehearse incoming information for future use. Specific training programs designed to teach effective rehearsal strategies which will allow retarded persons to perform more competently in following directions are currently being developed by the authors. Moreover, direction following involves the memory and understanding of language information. These aspects of information processing underlying direction following are also under investigation by the authors as the next step in developing training programs to ameliorate direction-following inadequacies of retarded persons.

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Footnote

[1]This research was supported by Grant HD 00870-08A1 from the National Institute of Child Health and Human Development. Ingo Keilitz was partially supported by PHS Training Grant HD 00183 from the NICHHD to the Kansas Center for Research in Mental Retardation. The authors are grateful to R. Don Horner for his valuable comments and suggestions during the preparation of this report and to Mona Bland, Clark Miller, and Pam Tucker for help in running the subjects.

APPENDIX A

Numbered Locations and Arrangement of Objects on Shelves

Second Shelf

# 2	# 4	# 6	# 8	# 10
2 cups	grapes	2 balls	2 plates	2 toothbrushes
# 1	# 3	# 5	# 7	# 9
2 cows	2 spoons	2 keys	safety pin	pocket knife

Third Shelf

# 11	# 13	# 15	# 17
cards	crayons	ruler	bracelet
# 12	# 14	# 16	# 18
indian	stamp	3 cars	pencil

Fourth Shelf

# 19	# 20	# 21	# 22	# 23	# 24	# 25
2 pans	magazine	fly swatter	book	toothpaste	handkerchief	paper

APPENDIX B

List of Nouns, Verbs, Adjectives, and Prepositions Used to Generate Experimental Sentences

Nouns

1. cups
2. paper
3. cows
4. spoons
5. grapes
6. book
7. key
8. table
9. ball
10. pans
11. magazine
12. your head
13. cards
14. crayons
15. plate
16. indians
17. stamp
18. toothpaste
19. safety pin
20. ruler
21. handkerchief
22. pocket knife
23. cars
24. toothbrushes
25. fly swatter
26. other teacher
27. bracelet
28. pencil
29. me

Verbs

1. point
2. hand
3. close
4. take
5. draw
6. bring
7. hold
8. pick
9. drop
10. unfold

Adjectives

1. green
2. big
3. small
4. blue
5. black
6. all
7. one

Prepositions

1. on
2. over
3. in front of
4. next to
5. beneath

APPENDIX C

Experimental Sentences and Behavioral Description of Appropriate Performances

1. Put the big cow on the table	*Place big cow in contact with an upper surface of table.*
1. Hand me the car	*Object must be extended within reach of IE.*
1. Close the magazine	*Opening and then reclosing something that is already opened, or closing something.*
1. Take the other teacher the green car.	*Object must be extended with reach of NE.*
1. Draw on the paper	*Any graphic representation.*
1. Bring me the cows	*Pick up object and place it within reach of IE.*
2. Hold one ball over the grapes	*Hold one ball higher than the grapes in the same vertical plane but not touching.*
1. Point to the Indian	*One or more fingers placed in front of or touching object.*
2. Hold the small ball	*Small object must be grasped.*
1. Pick up the pocketknife	*Object must be held higher than original position.*
2. Put the ball in front of the Indian	*Place the ball on the floor or table or hold it in front of the Indian.*
3. Drop the blue toothbrush	*Object must be picked up and then released.*
1. Unfold the handkerchief	*Any action resulting in the removal of one or more folds.*
2. Hand me the grapes	*Object must be extended within reach of IE.*
3. Take the other teacher the ruler	*Object must be extended within reach of NE.*
4. Bring me the key	*Pick up object and place it within reach of IE.*
1. Point to the paper	*One or all fingers placed in front of or touching object. Object cannot break contact with original surface.*
2. Pick up the safety pin	*Object must be held higher than original position.*
3. Put all the pans next to the pocketknife	*Move both objects so that the objects are within 3 1/2" of each other.*
4. Hold the magazine	*Object must be grasped.*
1. Drop the grapes	*The object must be picked up then released.*
2. Hand me the black car	*Object must be extended within reach of IE.*
3. Put the paper beneath the spoon	*Place the paper beneath any part of the spoon.*
4. Drop the ruler.	*Object must be picked up then released.*
5. Take the othe teacher the ball	*Object extended within reach of NE.*

1. Point to all the keys	*One or more fingers placed in front of or touching object.*
1. Put a pan beneath a cup	*Place or hold the pan beneath any part of the cup.*
1. Draw on the magazine	*Any graphic representation.*
1. Close the book	*Close or open and close object.*
1. Put the black car next to the grapes	*Move object so that the objects are within 2 1/2" of each other.*
1. Point to the small ball	*One or more fingers placed in front of or touching the smallest object.*
2. Bring me the handkerchief	*Pick up object and place it within reach of IE.*
1. Put the blue toothbrush in front of the other teacher	*Place or hold the blue toothbrush on the floor or table in front of the other teacher.*
2. Take the other teacher the spoon	*Object must be extended within reach of NE.*
1. Pick up the safety pin	*Object must be held higher than original position.*
2. Hold up the stamp	*Object must be grasped.*
1. Hold one cup over your head	*Hold one cup higher than and in proximity of S's head.*
2. Take the other teacher the grapes	*Object must be extended within reach of NE.*
3. Hand me the ruler	*Pick up object and place within reach of IE.*
1. Drop the magazine	*Pick up object, then release it.*
2. Put the green car on the paper	*Place green car in contact with upper surface of paper.*
3. Close the magazine	*Close or open and close object.*
4. Bring me the key	*Pick up object and place within reach of IE.*
1. Take the other teacher the Indian	*Object must be extended within reach of NE.*
2. Point to the toothpaste	*One or more fingers placed in front of or touching object.*
3. Pick up the fly swatter	*Object must be held higher than original position.*
4. Unfold the handkerchief	*Removal of one or more folds.*
5. Hold up the big plate	*Object must be grasped.*

1. Put one cow on the crayons	*One cow must be placed in contact with upper surface of crayons.*
1. Bring me the pocketknife	*Pick up object and place within reach of IE.*
1. Take the other teacher the small pan	*Object must be placed within reach of NE.*
1. Close the book	*Close or open and close object.*
1. Hold the ruler over your head	*Hold ruler higher than and in proximity with head.*
1. Bring me the green car	*Pick up object and place within reach of IE.*
2. Hand me the spoon	*Pick up object and place within reach of IE.*
1. Unfold the paper	*Removal of one or more folds.*
2. Take the other teacher the big plate	*Object must be placed within reach of NE.*
1. Hold up the cards	*Object must be grasped.*
2. Point to the stamp	*One or more fingers must be placed in front of or touching object.*
3. Put the blue car in front of me	*Blue car must be placed on floor or table or held on face side of IE.*
1. Pick up the safety pin	*Object must be held higher than original position.*
2. Drop the pocketknife	*Object must be picked up then released.*
3. Bring me the Indian	*Object must be extended within reach of IE.*
1. Drop the fly swatter	*Object must be picked up then released.*
2. Hold up the black cow	*Object must be grasped.*
3. Put the toothpaste next to the handkerchief	*Objects are moved so that they are within 2 1/2" of each other.*
4. Take the other teacher the grapes	*Object must be placed within reach of NE.*
1. Take the other teacher the crayons	*Object must be placed within reach of NE.*
2. Draw on the paper	*Any graphic representation.*
3. Bring me the book	*Object must be placed within reach of IE.*
4. Put all the balls beneath the paper	*All balls must be placed beneath any part of the paper.*
5. Point to the toothbrushes	*One or more fingers placed in front of or touching object.*

1. Unfold the handkerchief	*Any action resulting in the removal of one or more folds.*
1. Drop the fly swatter	*Object must be picked up then released.*
1. Pick up a car	*Object must be held higher than original position.*
1. Put all the plates beneath the toothpaste	*Place all the plates beneath any part of the toothpaste.*
1. Hold up the black cow	*Object must be grasped.*
1. Point to the stamp	*One or more fingers placed in front of or touching the object. Object cannot break contact with original surface.*
2. Put a pan next to the blue toothbrush	*Move the pan or both objects so that the objects are within 2 1/2" of each other.*
1. Bring me the small cup	*Pick up object and place within reach of IE.*
2. Draw on the paper	*Any graphic representation.*
1. Take the other teacher the book	*Object must be extended within reach of NE.*
2. Hand me the cow	*Object must be extended within reach of IE.*
1. Hold up the safety pin	*Object must be grasped*
2. Point to the cards	*One or all fingers placed in front of or touching object. Object may not break contact with original surface.*
3. Close the book	*Close the object or open and reclose an already closed object.*
1. Put the grapes in front of the other teacher	*Place the grapes on the floor or table or hold it in front of the other teacher.*
2. Pick up a spoon	*Object must be held higher than original position.*
3. Bring me one pan	*Pick up object and place it within reach of IE.*
1. Drop the green car	*Object must be picked up then released.*
2. Hold the key over your head	*Hold the key higher than the top of the head but in same vertical plane and not touching.*
3. Hand me the Indian	*Object must be extended within reach of IE.*
4. Take the other teacher the pocketknife	*Object must extend within reach of NE.*
1. Take the other teacher the big ball	*Object must be extended within reach of NE.*
2. Put the ruler on the magazine	*Place ruler in contact with the upper surface of the magazine.*
3. Hold up the hankerchief	*Object must be grasped.*
4. Drop a key	*Object must be picked up then released.*
5. Point to the paper	*One or more fingers placed in front of or touching object.*