DOCUMENT RESUME

ED 025 888 48 EC 003 478

By-Semmel, Melvyn; Greenough, Diane

Comprehension and Imitation of Sentences by Mongoloid Children as a Function of Transformational Complexity. Studies in Language and Language Behavior, Progress Report Number VII.

Michigan Univ., Ann Arbor. Center for Research on Language and Language Behavior.
Spons Agency-Office of Education (DHEW), Washington, D.C.; Wayne County Intermediate School District, Detroit, Mich.
Bureau No-BR-6-1784
Pub Date 1 Sep 68
Contract-OEC-3-6-061784-0508
Note-14p.
EDRS Price MF-$0.25 HC-$0.80
Descriptors-*Cognitive Processes, Comprehension, *Exceptional Child Research, Generative Grammar, Kernel Sentences, *Language, *Mentally Handicapped, Mongolism, Negative Forms (Language), Trainable Mentally Handicapped, Transformation Generative Grammar, Transformations (Language), Verbal Stimuli, Verbal Tests

The effect of sentence complexity on the ability of 40 trainable mentally retarded mongoloids (median IQ 34.3) to comprehend and imitate verbally presented strings was examined in two studies. Comprehension ability was tested by asking each subject to indicate which of two pictures was being described in the sentence spoken by the examiner. Eight stimulus sentences were given for each pair of pictures, simple declarative or kernel, negative, passive, and negative passive. Kernel sentences were comprehended significantly more often than chance expectancy (p .08) but negative sentences less often than chance (p .02). Imitation of kernel sentences (obligatory transformations only) was significantly better than imitation of sentences in which optional transformations had been applied (p .05). No significant differences in accuracy of imitation were observed among the strings with optional transformations. Competence and performance variables were considered to affect the ability of trainables to deal with verbal stimuli and further studies emphasizing the negative marker are recommended. (Author)

COMPREHENSION AND IMITATION OF SENTENCES BY MONGOLOID CHILDREN AS A FUNCTION OF TRANSFORMATIONAL COMPLEXITY[1]

Melvyn Semmel and Diane Greenough

Center For Research on Language and Language Behavior

University of Michigan

Abstract

The effect of sentence complexity on the ability of 40 trainable mentally retarded (TMR) mongoloid Ss ($\bar{X}_{IQ} = 34.3$) to comprehend and imitate verbally presented strings was examined in 2 studies. Comprehension ability was tested by asking each S to indicate which of 2 pictures was being described in the sentence spoken by E. 8 stimulus sentences were spoken by E for each pair of pictures--simple declarative or kernel (K), negative (N), passive (P), and negative passive (NP) for each picture. S's ability to imitate sentences of varying levels of complexity was tested by having him repeat the sentences used in the comprehension task, with passive forms truncated so that stimuli would be nearly equal in length. Ss correctly comprehended kernel sentences significantly more often than chance expectancy but comprehended negative sentences less often than would be expected by chance. Imitation of kernel sentences (obligatory transformations only) was significantly better than imitation of sentences in which optional transformations had been applied. No significant differences in accuracy of imitation were observed among the strings with optional transformations. Results are discussed in terms of competence and performance variables which might affect the ability of TMR Ss to deal with verbal stimuli.

The relationship of the grammatical complexity of a sentence and the speed of comprehension among adult Ss has been studied by Gough (1965;1966). Slobin (1966) has reported findings with both normal adults and children. Using a procedure in which Ss indicated the truth-value of a sentence in relation to a picture presented by E, it was found that latencies of correct responses were of the following order: kernel < passive < negative < negative passive. These results were offered as evidence that speed of comprehension is inversely proportional to the number of transformations separating a sentence from its base structure. Simple declarative (kernel) sentences result from obligatory transformations of the base structure and are thought to be the simplest sentence forms (Chomsky, 1965). Addition of the semantic element of negation apparently creates more difficulty for comprehension than do grammatical transformations. Thus, Slobin and Gough found slowest comprehension rates when the negative (semantic) transformation was applied. Slobin also reported that chronological age (CA) interacts significantly with syntactic structure--suggesting developmental changes in linguistic competence. IQ and reaction time to sentences did not correlate significantly.

The present studies were designed to test whether these findings can be extended to trainable mentally retarded (TMR) children. The investigators were also interested in developing a method for the clinical study of language comprehension of TMR children. It was hypothesized that the hierarchy of difficulty reported by Gough and Slobin for comprehension and imitation of sentences would reoccur with TMR Ss and would be associated with CA but not with IQ (Lenneberg, Nichols, & Rosenberger, 1964).

Study I: Comprehension

Method

Subjects. Ss were 40 mongoloid children ranging in CA from 6 to 14 years ($\bar{X}$ = 135 mos., SD = 19 mos.) and enrolled in the program for the TMR in Wayne County Intermediate School District. Ss were characterized by their teachers as having no gross visual, auditory, or motor impairments. There were 21 males and 19 females in the sample. Binet IQ range was 22 to 62 ($\bar{X}$ = 34.3, SD = 9.6).

Procedure. Four pairs of pictures, each pair representing both aspects of a reversible situation, were used as stimuli. The pictures were brightly colored and mounted on 8 x 10" cards. The following situations were depicted: (a) Ball hitting clown, clown hitting ball, (b) Boy kicking girl, girl kicking boy, (c) Ball hitting flowers in pot, pot of flowers hitting ball, (d) Dog chasing cat, cat chasing dog.

For each pair of pictures, two kernel, i.e., declarative (K), two negative (N), two passive (P), and two negative passive (NP) sentences were presented to S. Order of presentation was randomized for each pair of pictures. The sentence stimuli used are presented in Table 1.

Insert Table 1 about here

Each S was tested by one of three Es in an empty classroom. After being seated at a small table across from E, S was encouraged to interact with E for approximately ten minutes so as to adapt to the experimental environment. Four pictures, one from each pair, were placed before S, who was asked to point to the one he liked best. The picture he selected determined which pair of stimuli was presented first. E then said, "See these pictures? Point to the one where..." and then gave the first sentence for that pair of pictures. Eight sentences were presented for each pair of pictures.

Responses were recorded as correct or incorrect. E also recorded the position of stimuli as they were placed before S so that position preference could be detected if present.

Results

The responses of nine Ss had to be discarded because they could not be induced to perform the task.

Analysis of responses in terms of the position of the picture selected revealed no tendency of Ss to favor a specific position or to follow a set pattern of responses.

Figure 1 shows the mean percentage of correct responses for the 31 Ss who completed the comprehension task as a function of sentence type.

Insert Figure 1 about here

The task required S to select one of a pair of pictures for each sentence given; the probability of the observed mean percentage of correct responses for each sentence type was determined by means of a binomial test, given a chance probability of success of $p = .50$.

The probabilities of the observed mean percentage of correct responses to passive ($\bar{X} = 48.4$, $SD = 27.62$, $p < .61$) and negative passive ($\bar{X} = 50.4$, $SD = 29.19$, $p < .87$) sentences were within chance levels. The probability of the observed mean percentage of correct responses was $p < .08$ for declarative sentences ($\bar{X}$ = 58.7, SD = 32.42) and $p < .02$ for negative declarative sentences ($\bar{X}$ = 37.6, SD = 29.15).

Kendall's coefficient of concordance, corrected for ties, was used to discover whether Ss' comprehension scores were ordered similarly across different levels of grammatical complexity. Significance levels were determined by calculation of χ^2. The coefficient of concordance obtained (ω = .415) was significant at the .05 level (χ^2 = 45.02). Since there was a significant association of scores across sentence types, a single comprehension score was used to test for association of IQ and CA with comprehension ability. The mean percentage of correct responses for each S across all sentence types was used as a summary score, and the association of CA and IQ with comprehension performance was tested by means of Kendall's tau, corrected for ties, with significance determined by calculation of z (Siegel, 1963). CA and IQ were significantly associated with each other (tau = −.23, σ_{tau} = .13, $p < .04$), but neither CA nor IQ were significantly associated with comprehension scores (tau_{CA} = −.05, σ_{tau} = .13, $p < .35$; tau_{IQ} = +.06, σ_{tau} = .13, $p < .32$).

Study II. Imitation

Method

Subjects. The same Ss were used for both the comprehension and imitation tasks.

Procedure. Following presentation of all eight stimulus sentences in the comprehension task (See Table 1), the pictures were removed and E said, "Now say just what I say. O.K.?" The eight sentences were repeated, with the passives and negative passives truncated by deletion of the "by" clause so as roughly to equate length of all the sentences.

Results

Responses of nine Ss were not available because they were unwilling to perform the task.

Figure 2 shows the mean percentage of correct responses to each sentence type for the 31 Ss who completed the imitation task.

Insert Figure 2 about here

The following orthogonal breakdowns were made of the hypotheses relative to comparisons among K, N, P, and NP sentences on the imitation task:

1. Imitation of kernel (K) sentences (obligatory transformations only) would be significantly better than the imitation of sentences to which one or more optional transformations were applied (N, P, and NP sentences).

2. Imitation of sentences to which one optional transformation was applied (N and P sentences) would be significantly better than imitation of sentences to which two optional transformations were applied (NP sentences).

3. Imitation of sentences to which a passive (P) transformation was applied would be significantly better than imitation of sentences containing a negative (N) transformation.

These hypotheses were tested through _a priori_ individual comparisons among sample means (Hays, 1963). The percentage of correct responses was used as the measure of performance ($\bar{X}_K = 40.3$, _SD_ = 43.22; $\bar{X}_P = 31.5$, _SD_ = 45.30; $\bar{X}_N = 33.9$, _SD_ = 41.90; $\bar{X}_{NP} = 27.4$, _SD_ = 37.56; MS error = 617.28, _N_ = 31). Table 2 shows the results of these comparisons.

Insert Table 2 about here

To a significant degree ($p < .05$), declarative sentences were more correctly imitated than were sentences to which optional transformations had been applied.

Kendall's coefficient of concordance, corrected for ties, was used to discover whether _Ss_' imitation scores were ordered similarly across different levels of grammatical complexity. Significance levels were determined by calculation of χ^2. The coefficient of concordance obtained ($\omega = .73$) was significant at the .01 level ($\chi^2 = 70.4$). Since the association of scores across sentence types was significant, the mean percentage of correct responses for each _S_ across all sentence types was used as a summary score in testing the association of IQ and CA with imitation ability. The association of CA and imitation scores was not significant (tau = $-.08$, $\sigma_{tau} = .13$, $p < .50$), but IQ and imitation were strongly associated (tau = $+.41$, $\sigma_{tau} = .13$, $p < .001$). Since CA and IQ are strongly associated with each other (tau = $-.23$,

$\sigma_{tau} = .13$, $p < .04$), it was decided to partial out the effect of CA from the IQ-imitation association as described in Siegel (1956). This step led to a lower imitation-IQ association ($tau_{I-IQ:CA} = .33$). The significance level associated with this coefficient is not known.

Discussion

Simple declarative sentences appear to be within the comprehension ability of the TMR Ss in this study. However, the negative sentences were comprehended less often than would be expected if Ss randomly selected pictures following sentence presentations. The results suggest that TMRs may react to negative declarative sentences by ignoring the negation transformation and responding to each sentence as if it were an affirmative declarative string--resulting in consistent selection of the wrong picture. This finding may be evidence of a lack of competence in the processing of sentences such that the effect of transformations on the base strings is not considered by S. The results also appear consistent with the prevalent hypothesis that TMRs do not attend to relevant cues (i.e., negative markers) in learning tasks (see Zeaman & House, 1963).

The mongoloid TMR Ss did not appear to comprehend the passive and negative-passive sentence stimuli presented to them. They either responded randomly to such strings or used decoding strategies which resulted in responses that were not correlated with those demanded by the task.

Neither IQ nor CA was significantly associated with comprehension. Thus, for TMR children, the ability tested is apparently not one which can be expected to develop with increasing CA or to be more pronounced at relatively higher IQ levels. However, since Slobin found a significant association of CA and comprehension in normal children but no association of IQ and comprehension, the failure to obtain an association of comprehension and CA may reflect the limited range of abilities of Ss in the study. With a wider range of scores and CAs there might be a significant association of CA and comprehension such as was found by Lenneberg, Nichols, and Rosenberger (1964).

With normal adults, Gough (1966) found no difference between comprehension of passive and truncated passives. It is not known, however, whether this result holds for the TMR Ss in the present study. An important factor in the inability of our TMR Ss to comprehend passive and negative passive sentences may well have been the length of these strings (eight words for passive strings, nine words for negative passive strings), which perhaps lay beyond their immediate memory span. However, since the P and NP sentences were comprehended better than the shorter N sentences (7 words), it appears unlikely that sentence length was the only factor influencing performance on the comprehension task.

In the comprehension task, even the declarative and negative strings were longer than the apparent ceiling levels of three words or four digits obtained in an unpublished study conducted by the investigators with the same Ss (Semmel & Greenough, unpublished). Ss were able to decode declarative sentences which were six words long, and they even appear to have decoded the seven-word negative strings, ignoring, to be sure, the negation transformation and treating the sentence as if it were an affirmative declarative string.

Performance on the task is highly dependent upon attention. There is considerable evidence that retarded individuals have greater difficulty in attending to tasks when their motivation or general level of arousal is low (Semmel, 1965; Denny, 1964). Nevertheless, differences in the comprehensibility of sentences as a function of syntactic and semantic structure were found with these TMR Ss; the paradigm used in the present study may therefore be useful for assessing linguistic abilities of TMR children in clinical situations.

The relevant variable in the imitation task appeared to be the presence or absence of optional transformations. Ss were able to imitate simple declarative sentences significantly better than sentences to which optional grammatical and/or semantic transformations had been applied. The results further indicate that IQ is significantly associated with imitation ability in mongoloid TMR Ss. This result differs from Lenneberg's, who found no such significant association among the mongoloid Ss in his sample (Lenneberg et al., 1964).

Sentence length may have been an important factor in the imitation task, with Ss unable to hold the longer, transformed sentences in immediate memory. However, the shortest sentence form in the imitation task was the truncated passive sentence (five words). Next longest were the simple declarative and negative passive forms (six words each). The longest form was the simple negative (seven words). So, if length of sentence stimuli affected imitation ability in this task, we would expect the scores to be ordered as follows P < (K = NP) < N. In fact, though, the declaratives were imitated significantly better than the sentences that included optional transformations. Differences among the other sentence types are not significant but in any case are not so ordered that the shortest sentences are imitated best. Instead, the seven-word negative is imitated better than the five-word passive which is, in turn, better imitated than the six-word negative passive.

Thus, there is some evidence that Ss made use of the syntactic structure of the sentence stimuli, perhaps coding the semantic relations and a base-structure-like description of the syntactic structure. With the TMR Ss in this study, utilization of such a technique to decode, store, and encode sentences is difficult when the sentences involve optional semantic and/or syntactic transformations.

Although Gough (1965; 1966) and Slobin (1966) found comprehension to be more difficult when the semantic negative transformation was applied than when the syntactic passive transformation was, there was no significant difference in S performance on the two types of strings in either the comprehension or imitation tasks of the present study. Since Slobin (1966) found that syntactic and semantic features of stimuli could account for performance of normal children with CA's of at least six years, Ss in the present studies may have been functioning at too low a level to utilize these linguistic factors completely.

The superior understanding and imitation of declaratives as against other types of sentences could also reflect a difference in the Ss' familiarity with the sentence types. Siegel (1963) studied the language behavior of adults and retarded children in interpersonal associations. The mean length of adult response (MLR) in such situations was considerably lower than the norms provided by Mildred Templin (1967) for utterances of normal eight-year-olds; adults also used fewer responses, shorter MLR's, and lower type-token ratios (TTR) with low-level than with high-level MR Ss. They also used significantly more questions. Adults associating with mongoloid TMR children may limit their verbal interaction to simple statements and questions and thus impoverish the verbal environment of such children. TMR children, having little acquaintance with complex sentences, would be reluctant to repeat them.

Thus, the factors of sentence length, syntactic and semantic complexity, and familiarity with sentence forms could, separately or in combination, account for the performance of the Ss in the present studies. All of these factors seem to contribute to the complexity of a sentence. Incorporation of transformations into a sentence generally increases the length as well as the syntactic and/or semantic complexity. An unfamiliar sentence form or a sentence with unusual, unfamiliar words is also a complex string and is difficult to decode and store.

The most significant finding in these two studies would appear to be that TMR children comprehend simple negative sentences as if they were affirmative declarative strings. It is not clear whether this phenomenon is the result of inadequate competence or performance.

Mongoloid TMR children may lack the competence to process a negative sentence into an underlying kernel plus semantic transformation. They may, instead, extract a kernel-like structure similar to that of the sentences they normally hear and exhibiting a relationship of agent to recipient opposite to that in the base string underlying the negative sentence. On the other hand, these children may have the competence to deal with negative sentences but fail to attend to the negative marker in the surface structure, and thus treat the sentence as if it were an affirmative string. Further studies in which the negative marker is strongly emphasized by the E through intonational stress and gesture may help determine whether it is primarily competence or performance variables that affect the comprehension of negative sentences.

Footnote

[1]This study was partially supported by the Wayne County Intermediate School District, Project U.S.O.E. #2438 and Contract OEC-3-6-061784-0508 with the U. S. Department of Health, Education, and Welfare, Office of Education, under the provisions of P. L. 83-531, Cooperative Research, and the provisions of Title VI, P. L. 85-864, as amended. This research report is one of several which have been submitted to the Office of Education as Studies in Language and Language Behavior, Progress Report No. VII, September 1, 1968.

The authors express appreciation to Mrs. June England, Project Director, Wayne County Intermediate School District.

References

Chomsky, N. Aspects of the theory of syntax. Cambridge, Mass.: M.I.T. Press, 1965.

Denny, M. R. Research in learning and performance. In H. A. Stevens & R. Heber (Eds.), Mental retardation. Chicago: Univ. of Chicago Press, 1964. Pp. 100-142.

Gough, P. B. Grammatical transformations and speed of understanding. Journal of Verbal Learning and Verbal Behavior, 1965, 4, 107-111.

Gough, P. B. The verification of sentences: The effects of delay of evidence and sentence length. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 492-496.

Hays, W. L. Statistics for psychologists. New York: Holt, Rhinehart, & Winston, 1963.

Lenneberg, E. H., Nichols, I. A., & Rosenberger, E. F. Primitive stages of language development in mongolism. Disorders of communication, Vol. XLII: Research publications, A.R.N.M.D. Baltimore: Williams & Wilkins, 1964.

Semmel, M. I. Arousal theory and vigilance behavior of educable mentally retarded and average children. American Journal of Mental Deficiency, 1965, 70, 38-47.

Semmel, M. I., & Greenough, D. E. Immediate memory span of mongoloid children for verbal material as a function of semantic and syntactic bonds between words. Unpublished.

Siegel, G. M. Language behavior of adults and children in interpersonal assemblies. Journal of Speech and Hearing Disorders, 1963 (Monogr. Suppl. 10), 32-53.

Siegel, S. S. Nonparametric statistics for the behavioral sciences. New York: McGraw-Hill, 1956.

Slobin, D. I. Grammatical transformations and sentence comprehension in childhood and adulthood. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 219-227.

Templin, M. Certain language skills in children. Minneapolis: University of Minnesota Institute on Child Welfare Monograph No. 26, Univ. of Minnesota Press, 1957.

Zeaman, D., & House, B. J. The role of attention in retardate discrimination learning. In N. R. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963. Pp. 159-223.

Table 1

Sentence Stimuli for the Comprehension Task

A. 1. The dog is being chased (by the cat). *
2. The dog is not chasing the cat.
3. The dog is chasing the cat.
4. The cat is being chased (by the dog).
5. The dog is not being chased (by the cat).
6. The cat is not chasing the dog.
7. The cat is not being chased (by the dog).
8. The cat is chasing the dog.

B. 1. The ball is not being hit (by the clown).
2. The ball is not hitting the clown.
3. The ball is hitting the clown.
4. The clown is hitting the ball.
5. The ball is being hit (by the clown).
6. The clown is hitting the ball.
7. The clown is not being hit (by the ball).
8. The clown is being hit (by the ball).

C. 1. The ball is not hitting the flowers.
2. The ball is not being hit (by the flowers).
3. The flowers are being hit (by the ball).
4. The flowers are not hitting the ball.
5. The ball is hitting the flowers.
6. The flowers are not being hit (by the ball).
7. The ball is being hit (by the flowers).
8. The flowers are hitting the ball.

D. 1. The girl is being kicked (by the boy).
2. The girl is kicking the boy.
3. The boy is not being kicked (by the girl).
4. The boy is being kicked (by the girl).
5. The boy is kicking the girl.
6. The girl is not being kicked (by the boy).
7. The girl is not kicking the boy.
8. The boy is not kicking the girl.

*Expressions in parentheses were deleted in the imitation task (Study II).

Table 2

Summary of Orthogonal Comparisons of Relationship Between Level of Grammatical Complexity and Imitation Scores

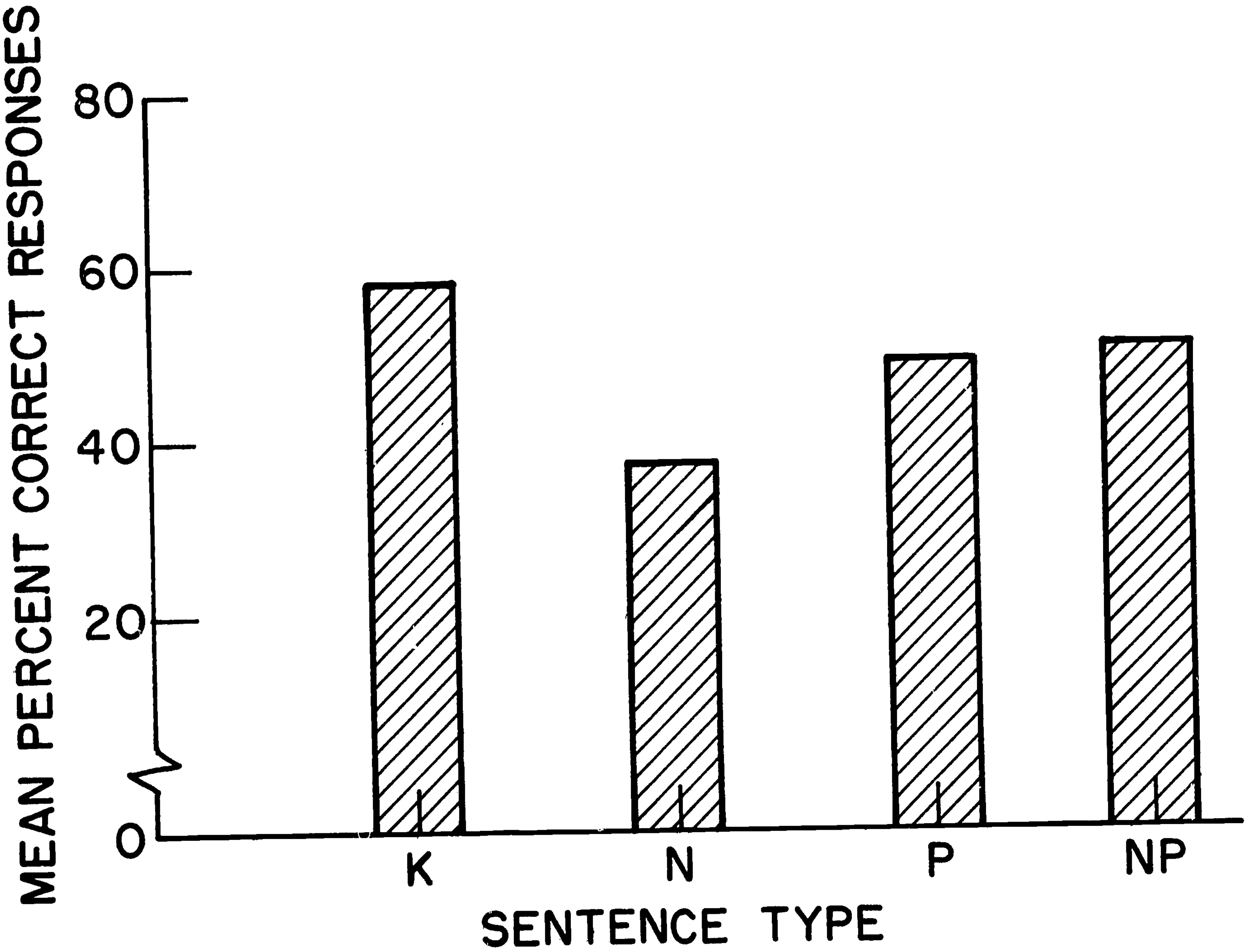
	Orthogonal Comparisons		
Hypotheses:	Obligatory Transformations vs. Optional Transformations	One Transformation vs. Two Transformations	Syntactic Transformation vs. Semantic Transformation
$\hat{\Psi}$	9.37	5.3	2.4
Est. Var. $(\hat{\Psi})$	26.54	29.87	39.82
t	1.82*	0.97	0.38

*$p < .05$

Figure Captions

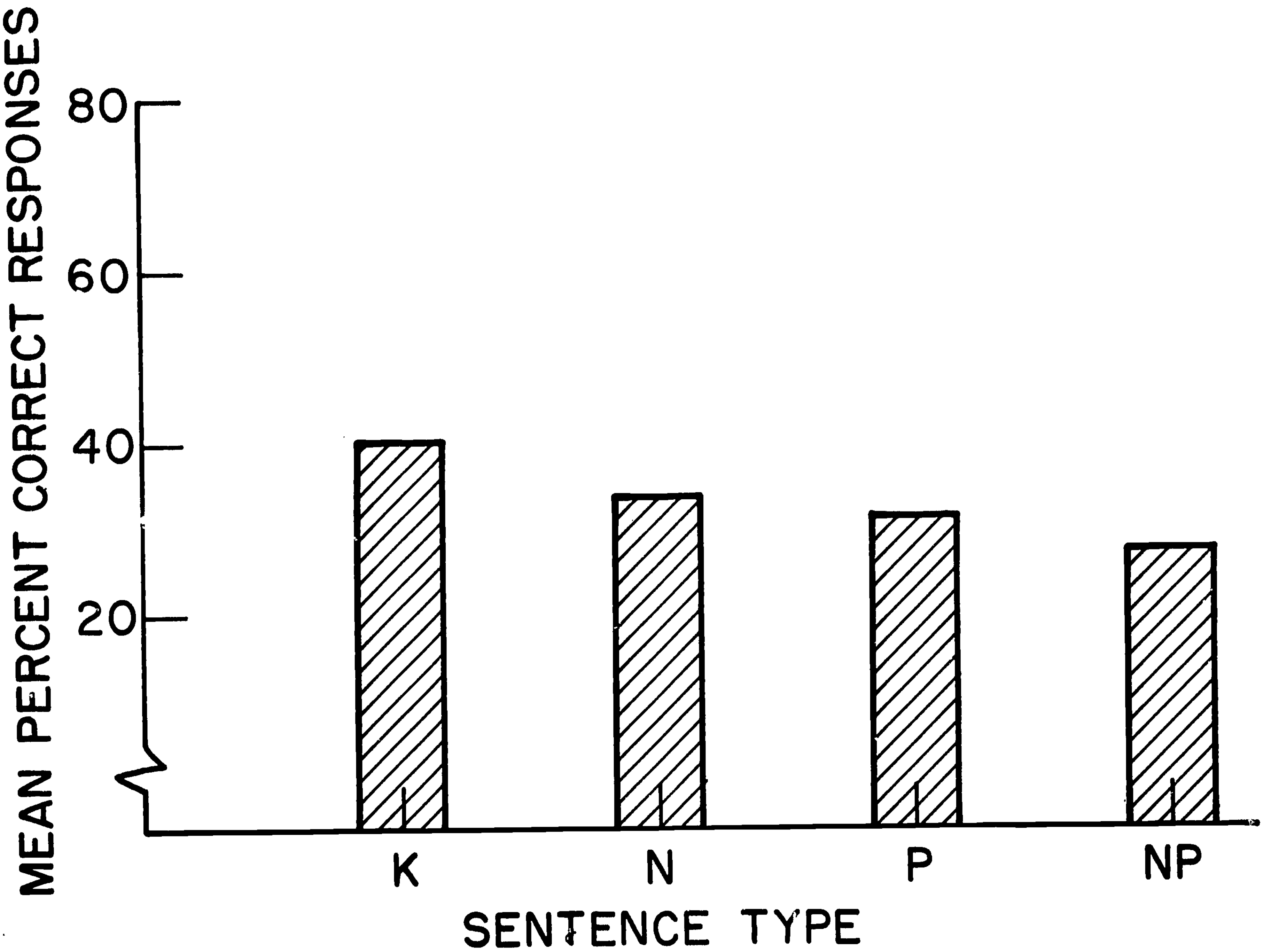
Fig. 1. Mean percentage of correct comprehension responses as a function of sentence type.

Fig. 2. Mean percentage of correct imitation responses as a function of sentence type.



COMPREHENSION TASK

Figure 1



IMITATION TASK

Figure 2