The Effect Of Syntactic Word Variations On The Predictability Of Sentence Content In Speechreading

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There is little information available regarding the linguistic structure of our language as it relates to speechreading ability. A report by the Subcommittee on Human Communication and Its Disorders (1969) has emphasized the need for research into the effect of language structure on the reception of speech by the hard of hearing. The above report further states that "the application of modern linguistic approaches to auditory training or speechreading instruction should be stressed if we are to effectively teach the deaf and hard of hearing to utilize language most effectively."

From an investigative and aural rehabilitative standpoint, Lloyd (1964), Lowell (as cited in Vernon, 1968), Jerger (1968), O'Neill (1968), Woodword and Barber (1960), Lowell (1969) and others, have recognized and stressed the importance of obtaining knowledge regarding the structure of language as it relates to the visual reception of speech. Clinically, information regarding the structure of language as it affects the visual reception of speech would seem to be a vital link in our knowledge of the processes involved in the speechreading of sentence material. If there are structural elements within our language that either enhance or impede the visual and/or auditory reception of speech, then this information should be utilized when attempting to teach the hearing impaired individual to perceive verbal informational content through speechreading. The present study, therefore, was designed as an attempt to obtain information regarding the effect of language syntax on the reception of speech among normally hearing subjects under the experimental conditions of (1) visual-alone, (2) auditory-alone, and (3) intact visual presentations combined with systematic additions of auditory word cues.

In an effort to determine the possible effect of language syntax on

the reception of speech, the following primary research questions were experimentally tested:

1. What effect will six systematic variations in the presentation of parts of speech have on the identification of sentences under the condition of visual-alone at the thought and verbatim levels?
2. What effect will six systematic variations in the presentation of parts of speech have on the identification of sentences under the condition of auditory-alone at the thought and verbatim levels?
3. What effect will six systematic variations in the presentation of parts of speech have on the identification of sentences at the thought and/or verbatim levels of prediction when systematic additions of auditory word cues are combined with intact visual presentation of the stimulus materials?

PROCEDURES

The procedure designed to answer these questions was a video taped modification of the CLOZE procedure (Fillenbaum, et al., 1963). Modifications of the CLOZE procedure included the following:

1. Rather than attempt to measure the predictability of speech in written form as was accomplished by Taylor (1953), and Odom, Blanton and Nunnally (1967), this procedure was modified so that the effect of variations in the presentation of syntactic cues on the identification of sentences when presented auditorially and/or visually could be determined. This was accomplished by modifying the method of presenting stimulus materials. These modifications included:

a. *Mode of stimulus presentation.* Instead of presentation of written transcripts of oral speech as in previous research utilizing the *CLOZE* procedure, video-taped presentation of oral running speech was utilized.

b. *Stimulus conditions.* Most investigations utilizing the *CLOZE* procedure have compared different groups of subjects in their ability to incorporate the principles of language under one written condition of stimulus presentation. The present investigation had as its purpose the comparison of the effects of variations of syntax presentation on experimental stimulus conditions of auditory-alone, visual-alone, and a combined auditory-visual condition.

c. *Syntactic word cues.* The systematic variations of syntactic cues were determined by three groupings of eleven categories of parts of speech as described by Fillenbaum et al., (1963)*. Parts of speech were

* The eleven categories utilized by Fillenbaum, et al., (1963) included the following: nouns, verbs, pronouns, adjectives, adverbs, relatives, articles, auxiliary verbs, quantifiers, prepositions, and conjunctions.

grouped as follows: (1) semantic or principle words (nouns, pronouns and direct objects), (2) supportive words (verbs, adverbs and adjectives), and (3) function words or connectives (articles, prepositions, conjunctions and quantifiers). For purposes of establishing the basic information proposed for this investigation, it was felt that the above three group classifications would provide sufficient data for this initial study regarding the effects of language syntax on visual-auditory speech reception.

d. *Rate of word deletion.* Rather than presentation of deletions of every second or every third word within an otherwise complete text as was utilized in earlier *CLOZE* procedure studies, sentences were treated so that all words were systematically deleted in every sentence. Words were dubbed onto video tape, one at a time, in predetermined order until all words were presented as a complete sentence. The purpose of this procedural change was to determine which words, under which syntactic combinations, were essential before subjects could predict the content of individual sentences.

e. *Levels of prediction.* Levels of word prediction utilized by Fillenbaum, et al., (1963) were as follows: (1) Form Class prediction which was defined as the prediction of the correct part of speech of words without predicting the exact word, and (2) verbatim prediction, defined as the prediction of the exact words missing within a given sentence. Instead of using the level of "form class" prediction, which did not lend itself well to the present study because this investigation had proposed to determine the predictability of thought content, the following levels of sentence prediction were defined:

Verbatim Predictability. The extent to which subjects were able to predict exact word-for-word content of stimulus sentences.

Correct Thought Prediction. The extent to which subjects were able to predict the correct thought of sentences presented as stimulus items when all auditory or visual verbal information was not available.

This modified *CLOZE* procedure was then utilized in the present experimental design.

In order that the same subjects could be utilized for all experimental conditions, three separate lists of twelve stimulus sentences each were developed by this investigator and equated in terms of auditory and visual intelligibility. The sentences were developed according to the following criteria:

a. An equal number of interrogative and declarative sentences.
b. All sentences contained an equal number of words (eight).
c. All words within each sentence were taken from the Jones and Wepman (1966) list of 1,000 most commonly spoken words.
d. Parts of speech within each sentence were varied as much as possi-

ble in terms of position so identifying cues could not be obtained from word position.

e. Percentage of words among parts of speech was based on norms established by Templin (1967) regarding the structure of the English language.
f. No common phrases such as "good morning," "in the U.S.," or "how are you" were used in the sentence developed.
g. No contractions that might be confusing in terms of completing written answers were included.
h. No bisyllabic proper nouns were included that might have confused subjects in terms of written responses.
i. No highly visible words that could influence the visual intelligibility of sentences were included (Fisher, 1968).

To determine those parts of speech which would appear to enhance the predictability of sentences presented auditorially and visually, all words were systematically deleted from prepared sentences. An electronic switch (Mark VI Special Effects Generator and Sarkes-Targain Switch) was utilized for these deletions in regard to either the audio or video word portions of the video tapes. Words from the stimulus sentences were dubbed onto the video tape, one at a time, for separate presentations in predetermined syntactic order until all words could be seen or heard as a complete sentence. The syntactic combinations, abbreviated *P* for principle words, *V* for verbs and modifiers, and *C* for connectives or function words (prepositions, conjunctions, articles, etc.), were systematically varied six ways in terms of their presentation to subjects. For example, the syntactic combination of PVC would indicate that the principle words were presented first in random order, the verbs and modifiers second, and the connectives last. The syntactic word cues under combinations of CPV, VCP, PCV, VPC, and CVP were presented in those orders. The subjects' task was to attempt to predict sentence content when words within the sentences were missing. By utilizing the dubbing technique, individual words could be deleted from the taped sentences for the experimental conditions described below.

1. *Auditory-Alone:* This experimental condition consisted of an ordered selection and presentation of one of three lists of equated sentences with syntactic word cues presented auditorially via video tape. Words within each sentence were added one at a time in varied syntactic orders until all words were heard by the subjects. Each additional word was presented until the subject was able to predict the content of the sentence. The counterbalanced additions of syntactic word cues were the same as those in all other experimental conditions. An example of the script utilized for the video taping of word additions

for one sentence is shown in Table 1 where verbs and modifiers were presented first, connectives second, and principle words last.

Table 1. Representative Script for Syntactic Word Presentations and Variations Utilized for Video Tape Dubbing Procedure

	Word-order of presentation for the V-C-P syntactic word order under the A-V mode							
	V	V	AV	V	V	V	V	V
1.	____	____	is	____	____	____	____	____
	V	V	AV	V	V	V	V	AV
2.	____	____	is	____	____	____	____	again.
	V	V	AV	AV	V	V	V	AV
3.	____	____	is	blowing	____	____	____	again.
	V	V	AV	AV	V	AV	V	AV
4.	____	____	is	blowing	____	the	____	again.
	V	V	AV	AV	AV	AV	V	AV
5.	____	____	is	blowing	from	the	____	again.
	AV	V	AV	AV	AV	AV	V	AV
6.	The	____	is	blowing	from	the	____	again.
	AV	V	AV	AV	AV	AV	AV	AV
7.	The	____	is	blowing	from	the	northeast	again.
	AV	AV	AV	AV	AV	AV	AV	AV
	The	wind	is	blowing	from	the	northeast	again.

2. *Visual-Alone:* This experimental condition included selection and presentation of the equated sentences to the same subject utilized in all three stimulus conditions. For all sentence presentations under this category, the sentences were not seen intact until the final sentence presentation. For example, the subject would see the speaker utter one word of the eight from the sentence during the first presentation. During each of the remaining seven presentations, the subject viewed the speaker as he uttered an additional word until the sentence was finally viewed in its entirety. The time factor relative to complete sentence utterance remained the same for each sentence.

3. *Visual-Auditory:* In addition to the above two experimental conditions, the effect of language syntax on a specific combination of visual-auditory stimuli was also investigated. The video tapes for this stimulus condition were produced from the same master list of equated sentences as the experimental conditions of auditory-alone and visual-

alone, and included the same systematic additions of syntactic word cues as under the condition of auditory-alone that were again presented auditorially. As each auditory word cue was presented, the sentence could be viewed in its entirety (See Table I for one example of presentation order). The subjects' task once again was to attempt to predict sentence content after each additional auditory word cue was presented.

The purpose of this aspect of the present investigation, then, was to determine if various syntactic word combinations presented auditorially would affect the prediction of sentences when subjects were also allowed to speechread those sentences in their entirety.

The specific procedure used in preparation of stimulus materials and conducting this investigation are described below.

It was the subjects task to attempt to predict sentence content as each syntactic word cue was added under each stimulus condition. Subjects' responses were graded in terms of (1) the number and syntactic class of words presented before each sentence could be predicted at the level of thought prediction and (2) the additional number and type of words necessary for verbatim prediction within each of the six combinations of syntactic word cue presentations. All statistical analyses were conducted within stimulus conditions to determine the effect of the presentation of words among the six syntactic combinations on sentence predictability.

RESULTS

The results of this investigation are discussed in terms of the effect of sentence identification under the six combinations of syntactic word cues on the identification of sentences within each of the three separate stimulus conditions. Statistical analyses of data are presented for subject responses within each of the two experimental conditions of (1) auditory-alone and (2) intact visual presentation with systematic additions of auditory word cues. The visual-alone condition appeared so difficult that only a few sentences were identified at even the thought level. For this reason, the results of this stimulus mode were not treated statistically. Results of the visual-alone condition are descriptively analyzed in terms of the number of words correctly speechread within individual sentences.

The major findings are summarized below for the three stimulus modes:

Visual-Alone. The poorest mean subject scores for all syntactic combinations were obtained under this stimulus condition. No syntactic combination seemed to facilitate sentence prediction under the visual-

alone presentation mode. From the results of this study and previous investigations, it was postulated that the low subject scores were not the result of the various syntax combinations, but of the difficult task of attempting to predict sentence content by the use of visual clues only. These results are presented in Table 2 and Figure I.

Table 2. Combined Mean Subject Responses and Standard Deviations for the Six Variations of Syntax Presentation Under the Visual-Alone Presentation for Both the Thought and Verbatim Levels of Prediction for Three Lists of Equated Sentences.

Prediction Level	Syntax Combinations											
	PVC		PCV		VPC		VCP		CPV		CVP	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Thought	8.70	0.83	8.72	0.08	8.78	0.20	8.81	0.31	8.86	0.45	8.88	0.95
Verbatim	9.00	0.00	9.00	0.00	9.00	0.00	9.00	0.00	8.97	0.11	9.00	0.00

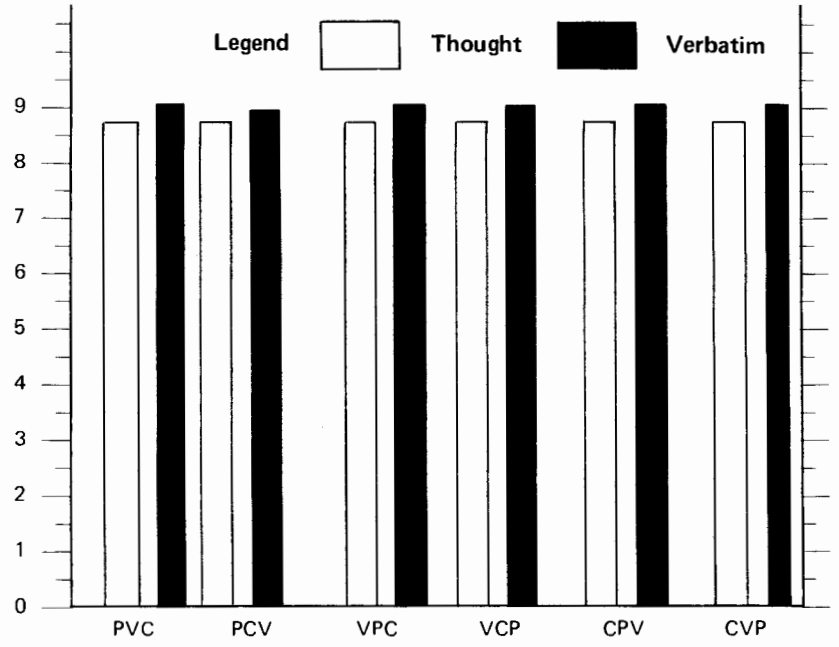

Figure 1. Mean Number of Words Required for Sentence Identification for Six Syntactic Combinations Under the Stimulus Condition of VISUAL-ALONE.

Auditory-Alone. The stimulus condition of auditory-alone also demonstrated relatively poor subject scores for all syntax combinations at both levels of sentence prediction. As can be seen in Table 3 and Figure 2, no syntax combination seemed to facilitate sentence prediction under this stimulus mode. The reason for the relatively low subject

Table 3. Combined Mean Subject Responses and Standard Deviations for the Six Variations of Syntax Presentation Under the Auditory-Alone Presentation Mode for Both the Thought and Verbatim Levels of Prediction for Three Lists of Equated Sentences.

Prediction Level	Syntax Combinations											
	PVC		PCV		VPC		VCP		CPV		CVP	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Thought	5.65	0.57	5.71	0.12	6.11	0.06	6.36	0.14	6.92	0.12	7.34	0.34
Verbatim	7.16	0.42	7.10	0.17	7.38	0.07	7.77	0.25	7.63	0.25	7.86	0.48

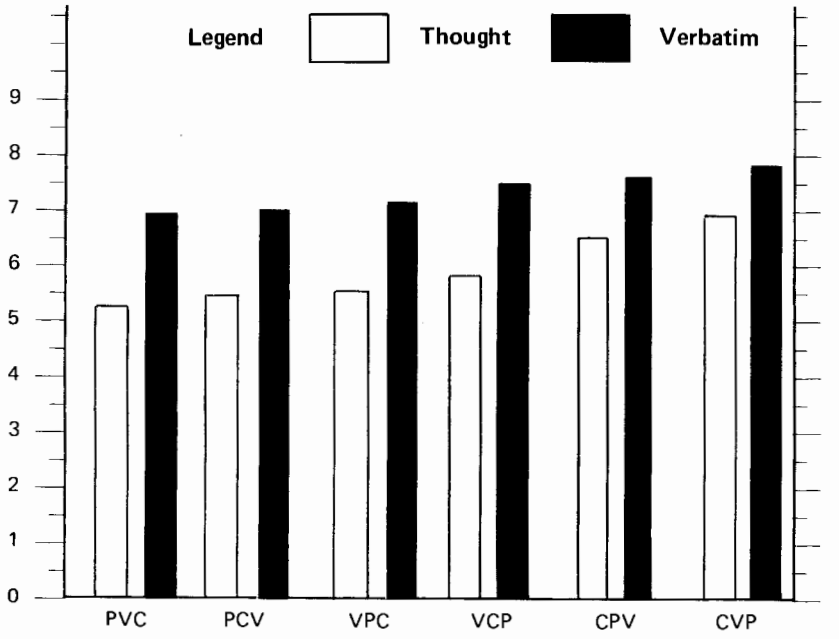

Figure 2. Mean Number of Words Required for Sentence Identification for Six Syntactic Combinations Under the Stimulus Condition of AUDITORY-ALONE.

scores for this condition was postulated as being the very wide range of word choices from which the subject is required to select. When only one or two words, for example, are presented auditorially to subjects, the probability of predicting the remainder of the sentence seemed relatively low, especially when only "supportive" words and connectives were presented. The wide choice of principle words made the task of prediction difficult even for subjects with normal language function. From these results, a primarily aural approach for rehabilitation of hearing impaired individuals appeared questionable.

No statistical significance was apparent for the auditory-alone condition at either level of sentence prediction.

Visual-Auditory. The results of this condition are presented in Table 4 and Figure 3. Sentence prediction scores, especially at the thought level, were better under the stimulus mode of intact visual presentation combined with certain additions of auditory cues. A mean of only 2.1 auditorially presented words were required for thought prediction of sentences under the syntax combination of (PVC) when subjects were allowed to also speechread the entire sentence. Statistical analyses of these results showed that a significant difference did exist between various syntactic combinations for thought prediction, but did not exist at the verbatim level. In discussing the results for this stimulus condition, it is postulated that the high prediction scores were not only the result of the compliment of audition to vision, but also the position of the auditory presentation of principle words. The relative ease of sentence prediction for the syntax combinations of (PCV) was thus also suggested.

Table 4. Combined Mean Subject Responses and Standard Deviations for the Six Variations of Syntax Presentation under the Visual-Auditory Presentation Mode for Both the Thought and Verbatim Levels of Prediction for Three Lists of Equated Sentences.

Prediction Level	Syntax Combinations											
	PVC		PCV		VPC		VCP		CPV		CVP	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Thought	2.13	0.57	3.10	0.12	3.76	0.06	5.01	0.14	4.04	0.12	5.96	0.50
Verbatim	5.00	0.42	5.00	0.14	5.63	0.07	6.85	0.17	6.83	0.29	7.28	0.49

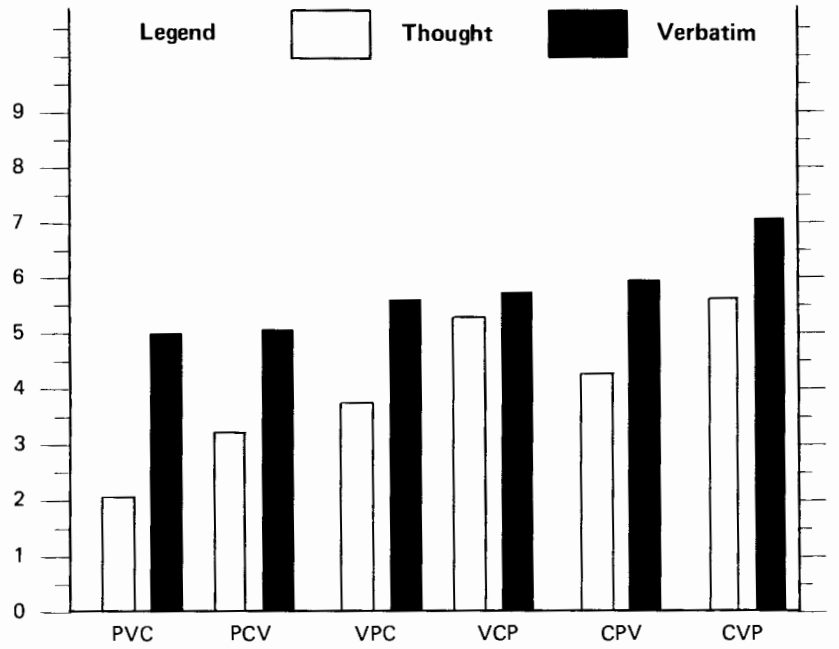

Figure 3. Mean Number of Words Required for Sentence Identification for Six Syntactic Combinations Under the Stimulus Condition of AUDITORY-VISUAL.

CONCLUSIONS

From the results of this study, several conclusions seem reasonable:

1. That no syntactic combination appeared to influence sentence prediction under the stimulus condition of visual-alone.
2. That no syntactic combination seemed to facilitate prediction of sentence content under the auditory-alone stimulus mode.
3. That intact visual presentation of sentences when combined with selected auditory word cues, appeared to facilitate prediction of sentence content, especially at the thought level.
4. That the auditory perception of principle words, under syntactic combinations of PVC and PCV, while the remaining portion of the sentence is presented visually, seemed to be an important factor in correctly identifying the content of sentence materials.

DISCUSSION AND THERAPEUTIC IMPLICATIONS

The difficulties of attempting to predict sentence content visually-alone, and the compliment of vision to audition in relation to speech-

reading instruction seem apparent. It is proposed that those engaged in speechreading instruction might stress the complimentary patterns of our language in relation to use of both intact vision and residual hearing for thought prediction of sentence content rather than the traditional remediation attempt at the verbatim identification of verbal material presented only visually.

The results of this investigation appear to lend support to a bisensory approach for speechreading instruction. The traditional instructional technique of teaching speechreading from a visual-alone standpoint would appear not to be a worthwhile approach neither in terms of its feasibility nor in terms of the frustration that it causes on the part of clients and the instructor. This investigation and the studies by O'Neill (1954) and Binnie (1970) suggest the difficulties involved in attempting speechreading continuous discourse by the unisensory mode of visual-alone. For too long, speechreading and auditory training have been separated. Speechreading of digits, phonemes, words and sentences by vision-alone has been stressed by hearing clinicians who question whether their clients are indeed becoming better speechreaders. Auditory training is often conducted by another clinician or in many cases not utilized at all.

It is contended that a bisensory approach to speechreading instruction should be stressed. While stressing the importance of utilization of visual cues in communication, an attempt should be made to train hearing impaired clients to make the most efficient use of all residual hearing that they possess. Since it would be unrealistic to require that hearing impaired individuals make use of all auditory cues in the communication environment, he should be trained to become an efficiently selective listener.

The present investigation suggests that there is a compliment between the linguistic patterns of our language and the auditory and visual reception of sentences. Principle words such as nouns and pronouns appeared to be difficult to speechread, while verbs and modifiers were more often perceived visually. Connectives such as articles, prepositions and conjunctions seemed to be highly predictable, but difficult to speechread. Principle words appear least predictable, but carry important content information. With all factors above working together, there appears to be facilitating characteristics between audition, vision, and prediction in terms of the reception of continuous discourse. This interaction is demonstrated in the present investigation. With, for example, only 2.13 of the more highly information carrying words presented auditorially in context while subjects were allowed to speechread entire sentences, predictability of content was enhanced.

Therapeutically it is speculated that hearing impaired individuals could be trained to be selective listeners, selective enough to be able to "pick out" the more highly information-carrying words within individual sentences and conversational speech. While watching the speaker, they could acquire the capability of "piecing" together messages when they cannot hear every word, resulting in improved communicative function.

SUMMARY

The present study was designed in an attempt to obtain information regarding the possible effect of language syntax on the reception of sentence materials among normally hearing subjects under experimental conditions of (1) visual-alone, (2) auditory-alone, and (3) intact visual presentation combined with systematic additions of auditory word cues.

The procedure designed to answer these questions was a video taped modification of the CLOZE procedure. Systematic additions of syntactic word cues from stimulus sentences were individually presented to subjects in a predetermined order until the words formed complete sentences.

The poorest mean subject scores for all syntactic combinations were obtained under the *visual-alone* stimulus condition. No syntactic combination seemed to facilitate sentence prediction under this presentation mode. The stimulus condition of *auditory-alone* also demonstrated relatively poor subject scores for all syntax combinations at both levels of sentence prediction. As in the visual-alone condition, no syntax combination seemed to facilitate sentence prediction under this stimulus mode. From these results, a primary aural approach for rehabilitation of the hearing impaired individual did not appear practical. Sentence prediction scores, especially at the thought level, were better under the stimulus mode of intact *visual* presentation *combined with* certain additions of *auditory* word cues. A mean of only 2.13 auditorially presented principle words were required for thought prediction of sentences when subjects were allowed to also speech read the entire sentence.

The apparent difficulties of attempting to predict sentence content visually-alone, and the compliment of vision to audition in relation to speechreading instruction were discussed. It was proposed that those engaged in speechreading instruction might stress the complimentary patterns of our language in relation to use of both intact vision and residual hearing for thought prediction of sentence content rather than the traditional attempt at the verbatim identification of verbal material by vision-alone.

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