X. LINGUISTICS*

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A. SOME OBSERVATIONS ON LANGUAGE ACQUISITION: THE DEVELOPMENT OF WORDS

1. Research into language acquisition has focussed on phonological development, aspects of vocabulary growth, and syntactic development. Relatively little attention has been given to the psychological processes underlying a child's ability to formulate approximations to words in his parents' speech – an ability that manifests itself roughly between the tenth (0:10) and twenty-second (1:10) months. How, for example, does the child select a particular segment of his parents' speech to approximate? Typically the child does not encounter words in isolation but rather as part of a sentence with no obvious segmentation. Nor does the child imitate a segment of the signal more or less at random, homing in on the target word in successive approximations. Whatever is involved here, some ability to segment the acoustic signal is a prerequisite to the development of words.

Presumably relevant to this issue are the well-known studies by Leopold,[1] and Velten,[2] and several papers by Roman Jakobson, among others, that concern the development of phonemic contrasts. Many of the issues raised in these papers remain

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unresolved, however; in large part this is due to the often deplored diversity of children's behavior during language acquisition. For example, recent observations that I have made of one child throughout this period show a number of differences from previous reports. With a few reduplicative exceptions, e.g., baby, mommy, all word approximations are of consonant-vowel (CV) form. In approximations to multisyllable forms, only the initial CV is kept. This is true except in those cases where it is unstressed; e.g., tomato [me$_{\text{ɪ}}$], outside [sa$_{\text{ɪ}}$]. Here the stressed CV is kept, and the unstressed initial CV is dropped.

Even up to 1:10 there are no final consonants. The vowel, however, may be lengthened, diphthongized, or have a final [r], e.g., more [mɔr]. Indeed, contrary to rumor, [r] appeared early (about 1:4) in excellent approximations to adult forms; e.g., door [dɔr], car [kar], radio [re$_{\text{ɪ}}$]. About 1:7, a few forms like paper, water pick up an additional syllable, [be$_{\text{ɪ}}$ər], [wɔər] with medial consonants omitted.

In contrast to the Leopold, and especially, the Velten reports, there are few consonant substitutions found in initial C position: these, for the most part, are apparent interactions with the resonants, /n/, /m/, and /l/. Thus, a noninitial nasal in the adult word, if not ignored, appears initially; e.g., open [mo$_{\text{ɪ}}$/mu$_{\text{ɪ}}$], on [$\tilde{\text{ɔ}}$], down [nau]. The effects of /l/ are varied. In shell and silly, for example, /l/ is replaced by a kind of pharyngealized rounding, [ɻ], perceptually similar to a lip-rounding [w] (unless one is looking at the lips). In stop contexts; e.g., airplane, Cleve the cluster is replaced, roughly, by a [d] made with the mid-tongue (blade), [de$_{\text{ɪ}}$], [di], respectively. Not unexpectedly, initial /s/ in stair and Snoopy is dropped, and the b/p, d/t, and g/k contrasts are not always made clearly. Initial /s̬, s, f/ are quite clearly distinguished; e.g., shoe [s̬u], Sue [su], foot [fʊ].

2. A simple hypothesis concerning this child's word development suggests itself – take the last relatively stressed syllable of a parent's sentence as a segment corresponding to a possible word nucleus. This hypothesis has several things going for it. (i). It is well known that human short-term memory is excellent for the last two or three items of an unstructured list. Immediate repetition (rehearsal) of an item serves to increase its memory strength. Children at this age are often inveterate echoers. The child described above was capable at 1:5 of repeating two syllables, e.g., da di each varying in pitch (high-low, low-high), maintaining both order and content information without error. Leopold[1] comments that his child's lack of echolalia may have hindered her development. (ii). The English utterances typically directed to children of this age, questions and emphatics, often have emphasis on the last word. Acoustic and physiological correlates of this prominence are reported by Ladefoged[3] and Lieberman.[4] Lieberman[4] points out that rising pitch, usually at the end of a sentence, is characteristic of questions for many languages in addition to English. This convergence of

psychological and linguistic mechanisms with regard to prominence along with the informal observations described here hardly seem coincidental. Continuing research along these lines is expected to demonstrate that such connections are important in the child's segmentation of speech during word learning.

J. E. Limber

References

1. W. Leopold, Speech Development of A Bilingual Child, Vol. I (Northwestern University Press, Evanston, Ill., 1939).
2. H. V. Velten, "The Growth of Phonemic and Lexical Patterns in Infant Language," Language 19, 281-292 (1943).
3. P. Ladefoged, "Some Physiological Parameters in Speech," Language and Speech 6, 109-119 (1963).
4. P. Lieberman, Intonation, Perception and Language (The M.I.T. Press, Cambridge, Mass., 1967).

B. TESTS FOR ECHOIC STORAGE EFFECTS

Work by Treisman,[1] Crowder,[2-4] and Crowder and Morton[5] indicates that the presence of a second unattended signal in the same voice as the signal to which subjects are expected to listen affects subjects' ability to respond in a variety of tasks. Moreover, this research indicates that if the unattended signal is not in the voice of the speaker of the attended signal, then the ability of the subjects to respond, while not as good as when there is no competing signal, is significantly better than when the unattended signal is in the same voice as the attended signal. The conclusion that Crowder and Morton have drawn from their results is that "acoustic storage" is one aspect of auditory perception and affects processing of auditory material for a short time (approximately 1.5 sec) after the acoustic stimulus has been presented. This "iconic" or "echoic" storage of an acoustic stimulus may affect the processing of sentential material. The present report tests the hypothesis that a second attended signal in the same voice as an initial attended signal will be easier to process and to match with the initial attended signal than when the two are in different voices, and that this effect will be observed with sentential material.

If subjects are presented with one-word probes following a sentence and asked to respond to the question, "Was the probe word in the sentence or not?", then for those probed words occurring in the last second or so of the sentence subjects may have longer reaction times when the probe is in the opposite voice (male if the sentence was spoken by a female and vice versa) than when the probe word and the sentence are in the same voice. We therefore designed an experiment in which the independent variables were the voice (M or F) of the sentence, the voice (M or F) of the probe, and the position of

the probed word in the sentence. Each subject was presented with 16 sentences in which probed words appeared 14, 12, 10, 8, 6, 4, 2, 1 and 0 syllables before the end of the sentence (each sentence was presented only once), and with 10 sentences in which the probe word did not appear in the sentence. Thus each subject heard 26 sentences, each followed immediately by a probe word. Each sentence and probe was presented in every voice condition (MM, MF, FF, MF) – one voice condition of each sentence per subject. Sixteen tapes were made so that the sequence of voice conditions for sentences with IN probes were controlled. No effort was made to control either materials effects or effects of serial position of sentences in the list. A millisecond timer was activated by a high-frequency noise burst placed temporally with the onset of the probe word on a second tape channel that was inaudible to the subject. The subject was instructed to indicate whether the probe was IN or OUT of the sentence by pushing a button that stopped the timer. Reaction times and responses – the dependent variables – were noted. Thirty-two subjects took part.

The results of intersubject comparisons show that for probed words 2 and 4 syllables from the end of the sentence, reaction time is greater when the voice changes than when the voice remains the same. For probed words farther back than 4 syllables from the end of the sentence, there is no appreciable difference between these two conditions. When the probed word was the last word in the sentence, however, the reaction times were substantially shorter when the voices changed. A possible explanation of this unexpected result is that subjects may not have realized that the sentence was over when the probe word was in the same voice as the sentence. Thus they were able to begin a search immediately when the voice changed and only after a short time when the voice remained the same. Provided that searching for the last word in the sentence takes very little time relative to that required for other words, the difference in starting a search may have distorted results for final position. Several subjects spontaneously remarked that this was the case.

To test for this possibility, we re-ran the experiment with 32 other subjects, after having spliced 150 ms of leader tape between the end of the sentence and the probe. The motivation for this change was to introduce a short silence between the sentence and the probe in order to allow the subjects to recognize the end of the sentence. The results were the same as in the first experiment for probed words 2 and 4 syllables from the end of the sentence, but no difference between the voice conditions appeared in sentence-final probed words, which was an improvement according to our hypotheses. The desired effect also showed up 6 syllables from the end of the sentence. Farther than 6 syllables from the end of the sentence, results were nil, with respect to the variables of voice.

The results were consistent with the hypothesis that an echoic memory is operative for sentences for about 1 to 1.5 sec after presentation of a sentence. In work that is

now being designed, we shall test possible interaction of this echoic memory with syntactic structures and form-classes of words.

D. Caplan

References

1. A. Treisman, "Monitoring and Storage of Irrelevant Messages in Selective Attention," J. Verb. Learn. Verb. Behav. 3, 449-459 (1964).
2. R. G. Crowder, "Improved Recall for Digits with Delayed Recall Cues," J. Exptl. Psychol. 82, 258-262 (1969).
3. R. G. Crowder, "An Auditory Subsystem in Human Memory," address to the A.A.A.S., Boston, Mass., December 30, 1969.
4. R. G. Crowder, "The Role of One's Own Voice in Immediate Memory" (to appear in J. Cognitive Psychol).
5. R. G. Crowder and J. Morton, "Precategorial Acoustic Storage," Percept. Psychophys. 5 (1969).

C. COMPREHENSION OF PASSIVE WITH REDUCED SYNTACTIC CUES

It has been demonstrated[1] that agentless passive sentences such as (1) and (2) are learned more easily by English-speaking children than the corresponding standard passive sentences (3) and (4), even though this order of ease of acquisition flies in the face, both of the adult linguistic rules relating to these sentences and of the simplest and most elegant theories of language acquisition based upon such rules.

(1) The boy got hit.
(2) The boy was hit.
(3) The boy got hit by the girl.
(4) The boy was hit by the girl.

Two factors have been proposed there to account for these facts: First, that the absence of a noun immediately following the transitive verb (here, hit) facilitates the learning of the passive function of the markers get and be; and second, that the learning of the markers themselves facilitates the learning of the agentive passives (3) and (4).

In the studies reported briefly here, two further experiments were conducted in which the learning of the truncated, or agentless, passives was studied more closely. In the first experiment, the hypothesis was tested that the mere presence of a syllable (whether word or nonsense) where the be or get normally occurs is sufficient to facilitate a passive interpretation of the string. Four examples each of the string types (5-9) were read aloud to fifty 3-year old children, the last two being the critical ones.

(5) The girl hit the boy.
(6) The boy got hit by the girl.
(7) The boy was hit.
(8) The boy blue hit.
(9) The boy off hit.

Their task was to choose which of a pair of pictures represented best the sentence they had just heard. In each case, one picture represented the boy as actor and the girl as object, and the other the converse.

Analysis of variance indicated that the active and normal truncated be passive ((5) and (7), respectively) were understood more easily than the other three types, $F(4, 160) = 49.79$, $p < .001$. Neither the strings (5) and (7), nor the types (6), (8), and (9) differed among themselves. X^2 tests indicated, however, that the children understood the critical strings (8) and (9) far more often as passives than should have occurred by chance, $p < .01$ in each case. The results thus supported the hypothesis that at some stage of acquisition the content of the marker is less important than its mere occurrence.

A second experiment tested the further hypothesis that the position of such a marker (whether correct in content or not) is critical in facilitating the passive interpretation of the string. Fifty 3-year old children were presented with 4 examples of the strings (10)-(14) and again asked to choose the correct one of a pair of pictures.

(10) The girl hit the boy.
(11) The boy got hit by the girl.
(12) The chook boy hit.
(13) The boy chook hit.
(14) The boy hit chook.

Analysis of variance showed that the critical sentence types (12-14) did indeed differ significantly from one another in their facilitation of a passive interpretation, (14) being least often understood as passive, and (12) most often, $F(4,160) = 19.98$, $p < .01$. (The fact that (13) facilitates a passive interpretation more readily than (14) but less so than (12) is consistent with the earlier results which suggested that the absence of a noun immediately following a transitive verb independently facilitates a passive interpretation.)

The combined results of the two experiments reported here offer strong support for the hypothesis that the presence of some sort of marker between the noun and the transitive verb, regardless of its specific content or form, strongly facilitates the interpretation of the string as passive.

R. Reed Bates

References

1. Reed Bates, "A Study in the Acquisition of Language" (in preparation for publication).

D. EFFECT OF VERBS IN A DIFFICULT COMPLETION TASK

Each verb has idiosyncratic constraints on the types of construction that can follow it. As a result verbs determine decisively the structure of the sentences in which they occur. The psychological importance of these strict subcategorization rules[1] shows up (a) in the fact that it is easier to give a left-completion of a sentence fragment in which the verb allows complements than one in which it does not;[2] and (b) in that the number of possible constructions that a verb can take appears to be a metric for the complexity of the sentences in which it occurs.[3]

One of the aims of the present experiment was to clarify the nature of the information that is intrinsic to verbs of different types, in a task that approximates ordinary listening conditions.

Subjects were asked to complete sentences of the following form:

(1) The secret agents {inform / expell / tempt / remember} ed the senators that the president was likely to ...

Two types of completion are possible.

Type C (complement): .... disregard them. (e.g., a transitive verb and its object, or an intransitive verb).

Type OR (object relative): .... disregard. (e.g., a transitive verb whose object is senators).

Sentences in which the main clause verb is like inform (see class 1 in Table X-1), that is, those that take an NP-that-S complement allow either the type C or the type OR completions. All other verbs (see e.g., classes 2, 3, and 4) allow only completions of type OR.

Confusion frequently occurred, however, when object relatives were required, and in this experiment a very high rate of type C completions were found in which the main verb made such completions ungrammatical. For example:

(2) The secret agents rescued the senators that the president was likely to be killed by an assassin.

More important, even among the classes of verb for which such type C completions are ungrammatical, the class of verb had a strong effect on the frequency of this error.

Table X-1. Classes of verbs.

1	2	3	4
inform	expel	tempt	understand
advise	rescue	encourage	remember
warn	meet	deter	watch
reassure	remove	coerce	hear

Although class 1 verbs can take either completion, none of type OR were given. This suggests that subjects had either a very strong bias toward complements or some difficulty with object relatives. The results for other classes show, I think, both tendencies. Class 2 verbs differ from all the rest, in that they permit no complement constructions at all. In spite of this, there were no more than 16/32 type OR responses. Since type C responses can be assigned no interpretation here (see sentence 2), one could conclude that these errors are purely a result of a difficulty with object relatives. For class 3 there were only 4/32 type OR completions; these verbs all undergo Equi-NP deletion and can take either NP-for-to-S or NP-Preposition-S complements. For example:

(3) She tempted him to eat.

(4) He coerced her into agreeing.

The still higher error rate here may mean that, as well as the difficulty of object relatives, sentences with these verbs are being assigned a reading of some kind in a complement structure for which the main verbs are not subcategorized.

Class 4 turns out to be heterogeneous. Remember and understand had 1/16 correct, OR, completions; they both permit that-S or NP-for-to-S constructions, the latter being quite unlike the tempt case, in that it is the result of subject raising not Equi-NP deletion.[4] On the other hand, watch and hear behaved more like class 2 with 7/16 correct, OR, completions. These last two verbs differ from the others in taking a progressive construction.[5] For example:

(5) He watched the world go mad.

The excessively high error rate on some verbs suggests some property that encourages them to be taken as NP-that-S complement verbs. The present data could be interpreted as showing that any complement verb has this property, as long as it is assumed that the poorly understood progressive does not count as a complement (which is not unreasonable). Under this theory one would probably try to explain the results in terms of confusion among different complement constructions in verbs subcategorized as [+complement]. This move would be extremely unsatisfactory because our present definition of the notion of complement is merely operational.

Further research will be directed toward two problems. First, it is hoped that semantically motivated distinctions can be drawn which will explain the verb results. Second, other syntactic variables that affect the error rate must be isolated before we are to have a clear idea of the nature and timing of the decision processes involved in understanding this difficult construction.

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References

1. N. Chomsky, Aspects of the Theory of Syntax (The M. I. T. Press, Cambridge, Mass., 1965).

2. J. A. Fodor and M. F. Garrett (unpublished research, M. I. T., 1969).

3. J. A. Fodor, M. F. Garrett, and T. G. Bever, Percept. Psychophys. 3, 453-461 (1968).

4. J. R. Ross, Class Notes, M. I. T., 1969 (unpublished).

5. P. S. Rosenbaum, The Grammar of English Predicate Complement Constructions (The M. I. T. Press, Cambridge, Mass., 1967).