Observations with self-embedded sentences[1]

ARTHUR L. BLUMENTHAL
HARVARD CENTER FOR COGNITIVE STUDIES

The Miller-Isard hypothesis that people attempt to process multiply self-embedded sentences as recursively interrupted sub-routines was critically examined. Results of a sentence comprehension test showed that Ss perceive such sentences as ungrammatical approximations to sentences with one embedding rather than as multiply embedded structures. The Miller-Isard hypothesis appeared irrelevant to the actual processing performance of the naive Ss.

Psycholinguists have devoted considerable attention to self-embedded (SE) sentences because by known rules of grammar these forms are grammatical, yet when multiple self-embeddings occur the sentence is incomprehensible (Yngve, 1960; Miller & Chomsky, 1963; Miller & Isard, 1964). We have an SE sentence when a phrase is placed totally within another phrase of a similar type, e.g., (1) *The nurse that the cook saw heard the butler.* A multiple SE sentence has a phrase within a phrase which is in another phrase, e.g., (2) *The nurse that the cook that the maid met saw heard the butler.* The latter example is definitely unacceptable to speakers of English. People have difficulty in pairing the verbs with their subject nouns, if indeed they even get as far as recognizing that the words comprise a sentence.

SE sentence studies are interesting to psychologists for they seem relevant to investigations that deal with recursive interruptions in human performance. Several psycholinguists propose that the inability to process SE sentences is caused by limitations on short-term memory. Miller and Isard presented the following "subroutine" hypothesis based on analogy with computers: In attempting to process the multiple SE sentence, people enter the same subroutine again (a relative clause in the above example sentence) and thereby they erase the "re-entry address" for that structure, i.e., the point where one clause ends and another continues.

The present investigation was an analysis of errors and introspective data from Ss who attempted to comprehend multiple SE sentences. The purpose was to show how people actually interpret them.

Method

Ten Harvard-Radcliffe undergraduates were shown 10 multiple SE sentences, one at a time, each with three embeddings (see appendix for test sentences). The Ss task was to re-write each sentence to render it more acceptable or understandable. The Ss could add punctuation and change or add words if necessary, but they were not to change the meaning of any sentence. A correct re-write of the SE sentence, (3) *The manager whom the designer whom the typist whom the recep-* tionist encourages interests consults phoned the producer, would be the corresponding right-branching sentence, (4) *The receptionist encourages the typist who interests the designer who consults the manager who phoned the producer.*

Results

Scoring was based on the "entry address" of each multiply embedded relative clause, i.e., the grammatical subject of one clause had to be interpreted as object of its embedded clause to be correct. The two inner-most clauses were scored separately, giving a score of two correct for a sentence with the clauses correctly related to each other. Two Ss failed to follow instructions and wrote completely new and unrelated sentences; their data was discarded. With eight Ss and 10 sentences, each with two multiply embedded clauses, there were 160 observations. Only 41 of these were instances where grammatical relations were correctly assigned according to the embedded structure. Of these 41, only 24 contained the correct verb for the clause.

There was a rather consistent pattern in the remaining 119 observations. All relative pronouns in a given sentence were interpreted as referring back to the initial subject-noun rather than to each immediately preceding noun, e.g., either (5) *The manager that the designer encourages, that the typist interests, and that the receptionist consults, phoned the producer,* or (6) *The manager that the designer, the typist, and the receptionist encourage, interest, and consult, phoned the producer.* In these cases Ss either interpreted the sentences as having one relative clause containing a compound subject and a compound verb, or they perceived three successive relative clauses, all referring to the initial noun.

After the test session Ss were asked what was wrong with the original sentences. When explanations were given, the sentences were described as lacking certain coordinating conjunctions and punctuation which made it especially difficult to interpret the string of words. All Ss described the sentences as ungrammatical. Generally, Ss did not attempt to consider the sentences as multiply self-embedded. In effect, the successive "that the ..." phrases were not interrupting each other as subroutines but were merely being compounded.

Discussion

The following generalization describes the results: Typically, when people encounter successive relative-plus-noun phrases these are all referred back to the initial noun-subject, rather than to each preceding noun. Perhaps this may be considered a rule of psycholinguistic performance. The difficulty in multiple SE sentences is that of assigning grammatical relations

("subject-of-X," "object-of-X") to sentence constituents. However, one may conclude that in psycholinguistic experiments multiple SE sentences are in fact ungrammatical for Ss who characteristically perceive them as approximations to sentences containing one compounded clause. Thus the proposed difficulty of interrupted subroutines and of retaining re-entry addresses in memory would be irrelevant to the processing performance that actually occurs.

Appendix-Test Sentences

(1) The businessmen whom Fred whom Bill whom Pete trusts follows obeys warned the engineer.

(2) The florist that the watchmaker that the jeweller that the photographers assist trains entertains invited the electrician.

(3) The visitors that the soldier that the girl that the general sees impresses directs saluted the troops.

(4) The playwrights that the editors that the novelist that the poet advises summons bother feared the audience.

(5) The delegates whom John whom Jim whom George knows calls leads described the committee.

(6) The deans that the specialists that the instructor that the professor helps needs like recognized the student.

(7) The actors that the dancers that the drummer that the conductor dislikes ignores watch pleased the director.

(8) The manager whom the designer whom the typist whom the receptionist encourages interests consults phoned the producer.

(9) The librarians that the teachers that the secretary that the principal annoys discourages dismiss met the trustee.

(10) The sculptor that the draftsman that the architect that the designer interrupts questions praises fired the agent.

References

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Note