Syntactic Effects of Information Availability in Sentence Production

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Two experiments investigated sentence production processes underlying the tendency for given information to precede new information in a sentence. The factors hypothesized to contribute to this effect were referential availability and lexical availability. Experiment 1 found that information coreferential with an antecedent referring expression tended to occur earlier in produced sentences than new information. This effect was more pronounced when the information was lexically identical to its antecedent. Experiment 2 found lexical availability effects when referential functions were minimized. These results may be accounted for by assuming that both referential availability and lexical availability contribute to the speed of lexicalization processes in sentence production, and that the order in which constituents become available after lexicalization influences surface syntactic organization processes.

This paper is concerned with the relationship between the retrieval and assembly of information in sentence production and the ordering of given and new information in the sentences produced. A traditional linguistic hypothesis about given information is that it tends to precede new information (Quirk, Greenbaum, Leech, & Svartvik, 1972); this regularity may in fact be a linguistic universal (Clark & Clark, 1978). While some support for the given–new ordering hypothesis has been found in experimental studies of production

and recall of sentences (Bock, 1977; Perfetti & Goldman, 1975; Tannenbaum & Williams, 1968), a general processing account of the phenomenon remains to be worked out.

The conditions for discourse givenness have not been precisely defined. However, standard descriptions of the information structure of sentences (Chafe, 1970; Halliday, 1967) generally regard given information as information with a readily recoverable antecedent; that is, information that has been mentioned earlier, and probably recently, in the discourse. In terms of this description, a definite referring expression or a proper name with a coreferential antecedent in an immediately preceding sentence is an uncontroversial example of given information. It is this type of givenness with which this paper is primarily concerned.

The early positioning of given information may be explained in several ways within a model of sentence production. The cognitive component of such a model can be roughly broken down into two sets of

processes (Chafe, 1977; Clark & Clark, 1977; Fodor, Bever, & Garrett, 1974; Schlesinger, 1977; Osgood, Note 1): (a) conceptualization processes, which are responsible for assembling underlying referents—situations, events, ideas—into potentially expressible units (e.g., propositions); and (b) surface structure assembly processes, which map the underlying propositions provided by the conceptualization processes into a syntactically structured array of lexical items. The conceptualization level thus provides the intended referents with access to the linguistic system, while the assembly level retrieves and arranges the lexical items chosen to convey the intended referents within the context of the discourse.

At both of these levels, using information that requires little processing may facilitate sentence production. Information previously formulated for inclusion in a sentence, or readily retrieved from memory for the preceding discourse, may be more available for production than new information. If this readily available information is prepared for production earlier than other information, given—new ordering may be explained as the result of either availability at the conceptualization level or availability at the assembly level.

The claim that given—new ordering may result from the availability of either ideas—intended referents—or words is consistent with the results of a number of different investigations of sentence memory and production. Availability for conceptualization may result within a discourse from thematization, so that a particular referent maintains a privileged position in memory (Kintsch & van Dijk, 1978; Perfetti & Lesgold, 1977). Referent availability might also result from a particular focus of attention (Carpenter & Just, 1977; Hornby, 1974). Experiments on alternative syntactic orderings have been consistent with this type of conceptual-level explanation, since both thematized or given information from discourse contexts (Bock, 1977; Perfetti &

Goldman, 1975) and focused information from perceptual contexts (Clark & Chase, 1974; Flores d'Arcais, 1979; Prentice, 1967; Turner & Rommetveit, 1967, 1968) tend to occur early in sentences.

Although referent availability may account substantially for the given—new ordering effect, it is reasonable to suppose that surface structure assembly processes contribute to it as well. Speech disfluencies (Goldman-Eisler, 1958; Maclay & Osgood, 1959), speech errors (Fay & Cutler, 1977), and tip-of-the-tongue phenomena (Brown & McNeill, 1966) all indicate the difficulty of lexical retrieval in production. One way in which speakers might alleviate this difficulty is to use easily retrieved lexical items early in the production of a sentence; this might free resources which could then be allocated to the retrieval and arrangement of less well-formulated parts of the sentence. Easily retrieved lexical items might include any which occurred recently in the discourse, close associates of recent items, and pronouns, which are high-frequency, closed-class items. Some effects on sentence order attributable to lexical availability were reported by Prentice (1966), who found that sentences containing primary associates of prompt words tended to be recalled with the primary associate in surface subject position.

In most experiments on the effects of discourse context on syntax in sentence production and reproduction, referent availability and lexical availability are confounded: both an underlying referent and an appropriate lexical realization are made more available for one sentence constituent than for another. The effects observed may thus be due to either or both types of availability. However, a study by Perfetti and Goldman (1975) provides some evidence that both referential availability and lexical availability have effects on syntactic structure. Participants in the experiment read passages whose theme (established by repetition) served as the surface subject or object of the last sentence in the passage.

This concluding sentence could be in either the active or passive voice. Recall of these sentences was later prompted with either the subject or the object of the sentence. Although Perfetti and Goldman were principally concerned with the amount of meaning-preserving recall produced by the various thematization and prompting conditions, they also examined a syntactic effect of their manipulations—changes in recall from the passive to the active voice. Shifts from passive to active sentences were most likely to occur when the word which prompted recall of the sentence was the agent, which serves as the subject of active sentences. If the agent had also been the theme of the passage for which the to-be-recalled sentence served as a conclusion, it was even more likely to be the subject. Under the assumptions that thematization produces primarily referent availability, and prompting primarily lexical availability, these findings suggest independent contributions of these factors to sentence syntax.

The experiments reported below were specifically concerned with the effects of referent and lexical availability on the syntactic structure of sentences. The first experiment varied the givenness and lexical identity of referring expressions in questions and sentences which answered the questions. If mention of a particular referent in a question makes that referent more available, and referential availability affects constituent order in sentences in the manner hypothesized, information that is defined as given by virtue of the presence of an antecedent in the question should tend to precede new information in the answer to the question. If the availability of words for lexicalizing a constituent affects constituent order, a more readily lexicalized constituent should tend to occur early in a sentence more often than a less readily lexicalized constituent. Therefore, identical expressions should occur early in sentences more often than different expressions, so that the given—new ordering effect should be stronger when the lexical realizations for

coreferential expressions are identical than when they are different.

The first experiment used a procedure for manipulating givenness that follows from suggestions by Chomsky (1971) and van Dijk (1977). What is given information in a sentence can be established by using prior wh- questions: for a sentence like *Alfred sold his neighbor the lawnmower,* a prior question like *What did Alfred sell to his neighbor?* establishes the proposition that "Alfred sold something to his neighbor" as given information, and *the lawnmower* as new information. Alternative questions can be used to change the given or new status of other sentence constituents: for example, *What did Alfred do with his lawnmower?* This technique was used successfully by Bock (1977) to manipulate the given–new structure of sentences. In the paradigm employed, subjects hear a list of questions, followed by a list of sentences which can serve as answers to the questions. The question list is then read a second time, and subjects are asked to respond to each question with an answer based on one of the sentences read earlier. Performing this task requires both remembering the answers and linking each answer to the correct question.

EXPERIMENT 1

Method

Subjects. The subjects were 128 undergraduates at Michigan State University, who received extra credit in an introductory psychology course or $2.00 for participating.

Materials. The materials consisted of four question lists and two answer lists. The answer lists were constructed from a pool of 80 sentences consisting of four pairs of sentences from each of 10 different syntactic types: Adverb Preposing, Cleft, Conjunct Movement, Dative, Equative, Particle Movement, Active/Passive, Phrasal Conjunct Reversal, Pseudocleft, and Subject/Object Reversal. The two sentences in each pair were semantically similar but differed

in syntactic structure; for example, *The eye doctor examined the sailor* versus *The sailor was examined by the eye doctor*. All pairs of the same syntactic type were related by the same transformation. For example, all Dative pairs were related by the interchanging of the direct and indirect object, as in *The doctor offered some candy to the child*, versus *The doctor offered the child some candy*. All transformations involved the movement or inversion of one or two target noun phrases. These target noun phrases were always preceded by a definite article, unless they were proper nouns. Examples of sentences of all types employed may be found in Bock (1977).

Forty sentences were assigned to each of the two answer lists. Each of the 10 syntactic types was represented by four sentences on each list, with the alternative syntactic structures for each type represented an equal number of times. The two sentences from each pair were assigned to different lists. List order was constant, so that sentences from the same pair appeared in the same serial position on both lists. Sentences of the same syntactic type did not appear consecutively. With these constraints, order was random.

The question lists were composed of questions written to manipulate the given– new structure of each of the 80 answers. Each question contained a declarative sentence designed to establish a context, followed by a *wh-* interrogative sentence; for example, *When the doctor gave the child a penicillin shot, the child began to cry. What did the doctor do?* Four questions were written for each sentence pair. In general, two of the four questions mentioned one of the target noun phrases in the sentence pair, but not the other, while the remaining two questions mentioned the other target. Thus, each question established one of the targets as given information, and the other target as new information.

This general pattern differed for questions written for Conjunct Movement and Particle Movement sentences, since these sentences contain only one target noun phrase (e.g., *The doctor plays poker with the lawyer* versus *The doctor and the lawyer play poker,* and *Mr. Hansen picked up the doll* versus *Mr. Hansen picked the doll up*). In these cases, two of the four questions mentioned the target noun phrase, while two did not. Thus, the target was given when paired with two of the questions, and new when paired with the other two.

The two questions mentioning the same target constituent differed only with respect to the lexical relationship between the target constituent in the question and the target constituent in the answer. For one question, the target constituent mentioned in the question was lexically identical to and coreferential with the target noun in the answer, while for the other question the target constituent mentioned in the question was coreferential, but lexically different. This condition of coreference with lexical difference was achieved by employing terms that stood in one of several semantic or general knowledge relationships to each other. These included the lexically cohesive relationships (Halliday & Hasan, 1976) of synonymy (e.g., *woman/lady*), near–synonymy (generally consisting of cohyponyms which seemed unlikely to be rigidly distinguished, e.g., *monkey/chimp*), and superordination (e.g., *poodle/dog*). General knowledge relationships employed were name/definite description (*Gone with the Wind/famous novel about the Civil War*), and whole/part (*train/locomotive*).

An example of a question–answer set is given in Table 1, showing an answer pair and the questions written for each answer. Note that either answer can be used with any of the four questions. When a question was used with the answer containing the mentioned target constituent in its earliest position (i.e., given information preceding new) it defined one of two Appropriate conditions, Appropriate/Identical if the target was coreferential and lexically iden-

TABLE 1

A DATIVE QUESTION–ANSWER SET FROM EXPERIMENT 1 IN FOUR APPROPRIATENESS/IDENTITY CONDITIONS

Q_1 A rancher received an inquiry from a cowboy about something he needed for his act. What did the rancher do?

       A_1 The rancher sold the cowboy the horse. (Appropriate/Identical)

       A_2 The rancher sold the horse to the cowboy. (Inappropriate/Identical)

Q_2 A rancher received an inquiry from Roy Rogers about something he needed for his act. What did the rancher do?

       A_1 The rancher sold the cowboy the horse. (Appropriate/Related)

       A_2 The rancher sold the horse to the cowboy. (Inappropriate/Related)

Q_3 A rancher had a horse who kept running away. What did the rancher do?

       A_2 The rancher sold the horse to the cowboy. (Appropriate/Identical)

       A_1 The rancher sold the cowboy the horse. (Inappropriate/Identical)

Q_4 A rancher had a stallion who kept running away. What did the rancher do?

       A_2 The rancher sold the horse to the cowboy. (Appropriate/Related)

       A_1 The rancher sold the cowboy the horse. (Inappropriate/Related)

tical in question and answer, and Appropriate/Related if the target was coreferential but lexically different. When a question was used with an answer in which the mentioned target constituent was in its latest position (new information preceding given) the relationship was Inappropriate. For Particle Movement and Conjunct Movement sentence types, the Appropriate condition was defined by the use of a target-mentioning question with those answers containing the target in its earliest position, and the use of questions not mentioning the target with answers containing the target in its latest position. The Inappropriate condition reversed the target-mentioning and non-target-mentioning questions. Cleft sentences in written text place new information before given, and mark the given–new distinction by means of their distinctive syntax (e.g., *It was the telephone that Alexander Graham Bell invented*). Questions used with Cleft sentences thus mentioned the later target constituent (the relative clause noun phrase) in the Appropriate condition and the earlier target constituent (the noun phrase following *It was*) in the Inappropriate condition.

Each of the four questions related to an answer pair was assigned to a different question list. Questions were assigned to lists so that, when combined with either of the answer lists, an equal number of question–answer combinations appeared in the conditions Appropriate/Identical, Appropriate/Related, Inappropriate/Identical, and Inappropriate/Related. The four sentences of each syntactic type on an answer list each occurred in one of the four conditions in a particular answer list/question list combination, and across all list combinations, each sentence appeared in every condition.

Question list order was random, with the constraint that questions written for the same types of sentences could not appear consecutively in a list. Order across lists was constant, so that questions related to the same answer pair appeared in the same serial position on each list. Question list order did not correspond to answer list order.

Design

The four question lists were used with both of the answer lists, with 16 subjects assigned to each list combination. Each subject thus contributed data to every cell of a 2 × 2 factorial design, with factors of Appropriate/Inappropriate, and Identical/Related. Each item (a sentence pair constituted a single item) also appeared in

every cell of the design. Form within syntactic type was treated as a replication factor.

Procedure

The question and answer lists were read by the experimenter. An effort was made to employ the same relatively neutral, natural intonation contour across all readings of answers. A moderate reading rate was used, allowing roughly 3 seconds between list items. Subjects heard the entire 40-item question list first, followed immediately by the 40-item answer list. The question list was then read again, with subjects responding with a written answer to each question immediately after it was read. Enough time was allowed so that after most questions all subjects finished writing their answers before the next question was read. Approximately 5 minutes elapsed between the first presentation of a sentence and writing the sentence in response to a question. Subjects were instructed that they were to use the sentences from the answer list as answers, and that their answers should be as close to the wording of the original as possible. They were specifically instructed not to substitute pronouns in their answers for nouns contained in the original. Warm-up lists containing four questions and answers similar to those from the experimental lists were presented to familiarize subjects with the procedure.

Subjects recorded each answer on a blank page of a booklet. Two orders of items (1−40 and 21−40, 1−20) were used for each question and answer list, with equal numbers of subjects receiving each order. Subjects participated in small groups.

Scoring

Four major scoring categories were defined: correct, shift, substitution correct, and substitution shift. An answer was scored correct if it was identical to the input sentence, with the following deviations allowed: (1) changes in number (singular/ plural); (2) changes in article definiteness (several experiments (Bock, 1977; Grieve, 1973; Harris, 1974; Osgood, 1971) suggest that such changes should be quite systematic, although these effects will not be examined in the present study); (3) lexically synonymous single-word substitutions not affecting target constituents; (4) context-supplied deletions of adjectives not otherwise affecting syntactic structure, for example, *little doll,* mentioned in the question, contracted to *doll* in the answer; and (5) context-supplied insertions which did not change the basic syntactic structure of the sentence, for example, *pie* in a sentence expanded to *pie for the fair* in the answer, where the phrase *pie for the fair* was used in the question.

An answer was scored as a shift if the input sentence was produced in the alternate syntactic structure for its syntactic type. Deviations equivalent to those enumerated for the correct category were permitted.

Substitution corrects met all the criteria for corrects except that the coreferential target expression from the question was substituted in the answer for the original constituent in the sentence. Substitution shifts met all the criteria for shifts except for this substitution. These categories applied only in the Related conditions.

An omit was scored if no answer was given. All other responses were scored as errors.

Results

Analyses of variance on the arcsine transformed percentages treated both subjects and items as random effects (Clark, 1973; Coleman, 1979). Unless otherwise indicated, effects discussed were significant at or beyond the .05 level. The percentages of corrects and shifts in each condition are shown in Figure 1. Sentences in the Appropriate condition were more often correct than sentences in the Inappropriate condition (33 versus 22%), $F_1(1,127) = 70.7$,
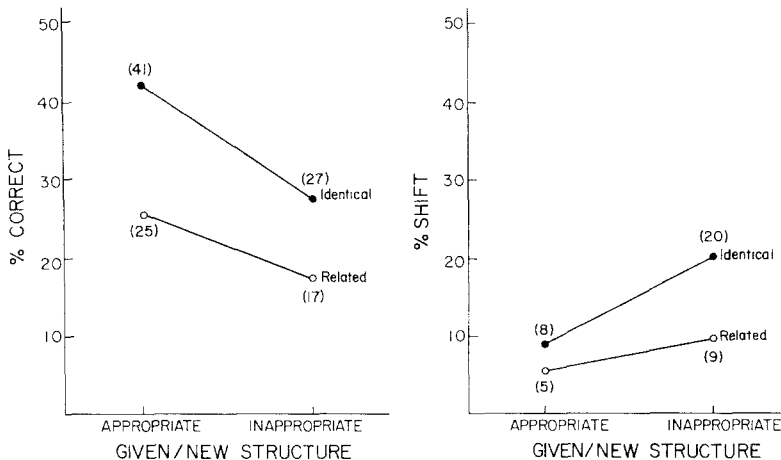
FIG. 1. Mean percentages of correct and shift responses in Experiment 1.

$F_2(1,39) = 41.4$, min $F'(1,89) = 26.1$. More sentences in the Identical condition were correct than in the Related condition (34 versus 22%), $F_1(1,127) = 111.9$, $F_2(1,39) = 37.4$, min $F'(1,67) = 28.0$. The interaction of Appropriateness and Identity was significant in both the subjects and items analyses, $F_1(1,127) = 14.4$, $F_2(1,39) = 4.51$, though marginal overall, min $F'(1,65) = 3.4$, $p < .07$. Simple effects tests showed that there were significantly more Appropriate Identical corrects than Inappropriate Identical corrects, $F_1(1,127) = 67.5$, $F_2(1,39) = 30.3$, min $F'(1,77) = 20.9$, and more Appropriate Related than Inappropriate Related corrects, $F_1(1,127) = 23.6$, $F_2(1,39) = 17.6$, min $F'(1,102) = 10.1$. This difference was, however, larger in the Identical than in the Related condition.

Sentences in the Inappropriate condition shifted more frequently than sentences in the Appropriate condition (15 versus 7%), $F_1(1,127) = 71.3$, $F_2(1,39) = 23.4$, min $F'(1,67) = 17.6$, and there were more shifts in the Identical condition than in the Related condition (14 versus 7%), $F_1(1,127) = 58.9$, $F_2(1,39) = 35.0$, min $F'(1,89) = 22.0$. The Appropriateness/Identity interaction for shifts was significant, $F_1(1,127) = 18.8$, $F_2(1,39) = 8.3$, min $F'(1,77) = 5.8$. Tests of simple effects showed that there were more Inappropriate than Appropriate shifts in

both the Identical, $F_1(1,127) = 56.8$, $F_2(1,39) = 22.9$, min $F'(1,73) = 16.3$, and Related, $F_1(1,127) = 17.7$, $F_2(1,39) = 8.9$, min $F'(1,82) = 5.9$, conditions. However, this difference was again larger in the Identical than in the Related condition.

The analyses of corrects and shifts thus reveal a given–new order effect in both Identical and Related conditions. The interaction shows that this effect is stronger in the Identical than in the Related condition. While a possible floor effect in the shift data may be a component of this interaction, the fact that the interaction also appears for corrects suggests that lexical identity does contribute to the order effect, and lends support to the argument that such an effect is also present for shifts.

A different pattern of results appears when the correct and substitution correct categories are merged, and the shift and substitution shift categories are similarly combined, to serve as the data from the Related condition. These combined categories represent the data appropriate for an analysis of syntax-preserving gist recall. Figure 2 displays these data, along with the original data from the Identical condition. If the interactions found in the analyses of corrects and shifts were in some way due to greater difficulty in recalling the gist of answers in the Appropriate Related con-
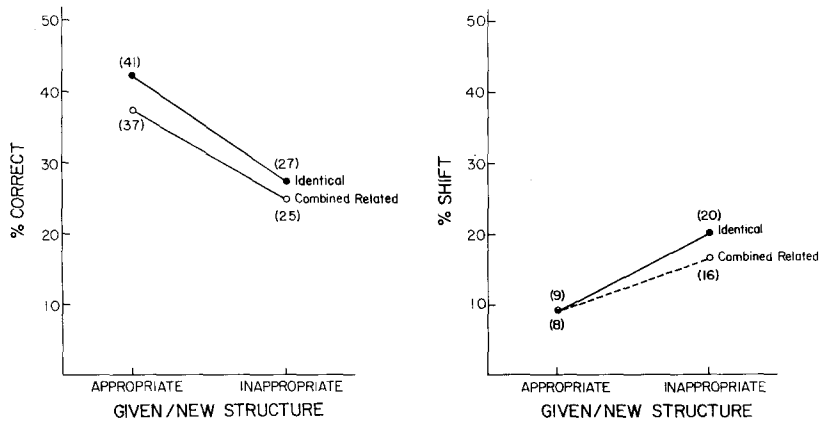
FIG. 2. Mean percentages of Identity corrects and shifts compared to Related combined corrects and combined shifts in Experiment 1.

dition, these interactions should also be present in analyses of the combined data. Analyses showed that the interaction was reliable only for subjects in the shift analysis, $F_1(1,127) = 5.4$. It was not reliable for corrects, $F_1(1,127) = 2.5$, $F_2(1,39) = 1.2$, or overall for shifts, $F_2(1,39) = 4.0$, min $F'(1,102) = 2.3$, $p = .13$. The main effect of Appropriateness was significant for both corrects and shifts. There were more Appropriate than Inappropriate corrects (39 versus 26%), $F_1(1,127) = 79.5$, $F_2(1,39) = 35.5$, min $F'(1,77) = 24.6$, and fewer Appropriate than Inappropriate shifts (9 versus 18%), $F_1(1,127) = 72.8$, $F_2(1,39) = 22.1$, min $F'(1,64) = 16.9$. The Identity variable was marginally significant overall in the analysis of corrects, $F_1(1,127) = 7.8$, $F_2(1,39) = 7.4$, min $F'(1,116) = 3.8$, $p = .053$, with more Identical than Related corrects (34 versus 31%), but not in the shift analysis (14 versus 12%), $F_1(1,127) = 2.9$, $F_2(1,39) = 4.8$, min $F'(1,149) = 1.8$, $p = .18$.

Analyses of omissions showed no effect of Appropriateness (11.0% Appropriate versus 11.5% Inappropriate, all Fs less than 1), but a marginal effect of Identity, $F_1(1,127) = 8.2$, $F_2(1,39) = 5.6$, min $F'(1,97) = 3.3$, $p = .07$, due to a greater number of omissions in the Related than in the Identity condition (12.4 versus 10.1%).

The interaction was not significant, all Fs less than 1.

Data in each condition for individual sentence types are presented in Table 2. Type was not included as a factor in the analyses because each subject received only one item of each type in each cell of the design. Inspection of Table 2 shows, however, that the Appropriateness effect (generally, given information occurring earlier in sentences than new information) was numerically present for 36 of the 40 contrasts presented: there were more Appropriate than Inappropriate corrects (except for sentences of the Dative and Adverb Preposing types in the Related condition in which there were equal numbers), and fewer Appropriate than Inappropriate shifts (except, again, Adverb Preposing in the Identical condition, and Pseudoclefts, for which there were no Related responses). There were thus no cases in which the effect was opposite to that predicted. The interaction between Appropriateness and Identity, such that the given–new effect was more pronounced in the Identical than in the Related condition, was numerically present in 13 of the 20 contrasts. The exceptions were sentences of the Active/Passive, Particle Movement, Equative, and Pseudocleft types in the correct category,

TABLE 2
MEAN PERCENTAGES OF CORRECTS AND SHIFTS BY SYNTACTIC TYPE: EXPERIMENT 1

| Type | Appropriateness condition | Scoring category | | | |
| | | Correct | | Shift | |
		Identical	Related	Identical	Related
Dative	Appropriate	61	19	5	4
	Inappropriate	20	19	36	6
Active/Passive	Appropriate	41	34	17	8
	Inappropriate	36	20	20	18
Conjunct Movement	Appropriate	60	26	7	7
	Inappropriate	41	19	27	13
Subject/Object Reversal	Appropriate	54	27	6	2
	Inappropriate	31	24	15	5
Phrasal Conjunct Reversal	Appropriate	42	20	10	8
	Inappropriate	29	12	36	10
Particle Movement	Appropriate	40	34	17	11
	Inappropriate	25	19	31	23
Adverb Preposing	Appropriate	38	16	6	1
	Inappropriate	24	16	6	3
Cleft	Appropriate	16	12	2	0
	Inappropriate	9	9	3	6
Equative	Appropriate	61	54	19	15
	Inappropriate	53	37	23	16
Pseudocleft	Appropriate	8	13	0	0
	Inappropriate	6	2	3	0

and Active/Passive, Adverb Preposing, and Cleft for shifts.

Discussion

The results of Experiment 1 suggest that both referent availability and lexical availability contribute to the given−new ordering effect. Subjects' answers to questions tended to place expressions coreferential with antecedent expressions from the questions earlier than expressions with no coreferential antecedent. This was reflected in the fact that there were more Appropriate corrects and Inappropriate shifts, both of which result from a tendency to place given information early in sentences. Thus, referent information that was presumably more available to conceptualization processes in sentence production appeared earlier in sentences than information that had not been previously introduced, and should have been less available. This effect held both when the content words of

coreferential referring expressions were lexically different, so that available lexical information was minimized, as well as when the expressions contained the same content words. These findings replicate previous experiments demonstrating a given−new ordering effect using question-answering techniques (Bock, 1977; Carroll, 1958) and extend the evidence for the effect to cases in which given information is expressed in a form that is lexically different from its antecedent.

Evidence for the effect of lexical availability on given−new ordering was found in the interaction between given−new ordering (Appropriateness) and relatedness of coreferential expressions (Identical versus Related). Given information was significantly more likely to be placed earlier than new information when it was lexically identical to its antecedent than when it was different. Thus, the availability of lexical information appears to contribute to early

production within a sentence, over and above the contribution made by referential availability.

The fact that there were more responses in the Identical condition than in the Related condition can be explained in terms of the memory storage and retrieval demands of the task. Such demands might also be called upon to explain why the likelihood of producing sentences in given–new order was greater when the expressions in the question and answer were identical, revealed in the interaction between Appropriateness and Identity. However, these demands seem unable to account for this interaction, since it was not significant for omissions or combined scores. This suggests that the preponderance of responses in given–new order (Appropriate corrects and Inappropriate shifts) in the Identical condition, relative to the Related condition, was due to something more than better gist memory for those items. Specifically, the way in which the data were arrayed in the various conditions, beyond the main effect of Identity apparent in the analysis of omissions, appears to be due primarily to response processes—that is, to sentence production mechanisms.

The analyses which included the combined scores are also consistent with the argument that lexical availability contributes to given–new ordering. Since the substitution responses employed lexically available expressions from the question rather than the less available target constituent, there should be proportionally more corrects, and proportionally fewer shifts, in the Appropriate condition than in the Inappropriate condition, relative to the original Related condition. Such effects are implied by the reduction of the interaction between Appropriateness and Identity in the analyses using combined scores, compared to the original analyses.

EXPERIMENT 2

Experiment 2 was designed to further investigate the hypothesis that lexical availability contributes to the syntactic order of a to-be-produced sentence. The results of the first experiment suggested that given–new ordering is influenced by both lexical availability and referent availability. The effect of lexical availability was to increase the likelihood of given–new ordering when both lexical and referent information was readily available, relative to a condition in which only referent information was readily available.

If lexical availability by itself influences sentence syntax, it should be possible to demonstrate such effects in the absence of referent availability. But because the relationships between words and potential referents are complex—certain words and phrases (most obviously proper names) may uniquely denote some individual, and certain referents may have easier access to a particular label than to other eligible labels (Brown, 1958; Rosch, 1978)—it is impossible to create conditions under which it can be argued that a particular word has no conceptual referent.

Words presented in isolation, however, carry minimal referential import (Lyons, 1977, p. 208). Thus, single words presented as prompts for sentences to be produced or recalled should provide primarily lexical information (a phonological representation plus "dictionary meaning") without implying a particular referent. The lexical availability hypothesis predicts that such prompt words should tend to be placed earlier in the sentences produced.

There is evidence from studies of prompted recall that single words and primary associates of words presented as prompts tend to occur early in recalled sentences (Perfetti & Goldman, 1975; Prentice, 1966). These studies contrasted only active and passive sentences, however. Experiment 2 employed the prompting technique on a sample of sentences of the same syntactic types as those employed in Experiment 1. If lexical availability has an effect on the syntax of such sentences in production, sentences should tend to be recalled more

frequently with the prompt word early in the sentence than with the prompt word late in the sentence.

The naturalness of the syntactic form of a sentence has a strong influence on its recall probability, so that the more natural-sounding member of a syntactic paraphrase pair tends to be recalled more often than the less natural-sounding member (Bock & Brewer, 1974; James, Thompson, & Baldwin, 1973; Levelt & Kempen, 1975). These stylistic preferences, as determined from ratings of the sentence pairs employed, should also be related to performance in the present experiment, with preferred sentences being recalled more frequently than nonpreferred sentences.

Method

Subjects. The subjects were 80 undergraduates at the University of Oregon who participated for extra credit in a lower-level psychology course.

Materials. The sentence pairs employed were different examples of the same 10 syntactic types used in Experiment 1, drawn from Bock (1977). There were again four pairs of each of the 10 types.

The sentences from each pair were assigned to two lists using the procedure described in Experiment 1 for answer lists. Within lists, sentences were assigned to one of five blocks of eight sentences each so that within each block no more than one sentence of each syntactic type occurred. In order to minimize primacy and recency effects, each block of sentences was buffered with three distractor sentences, one at the beginning and two at the end of each block. The distractors were syntactically similar to the experimental sentences.

Two prompt lists were developed using the target constituents from each sentence. For all sentence types except Particle Movement and Conjunct Movement there were two prompts corresponding to the two target constituents. For example, the prompts for the sentence *The falling tree crushed the lumberjack* were *tree* and *lum-*

berjack. Each of the prompts for a sentence was assigned to a different prompt list.

Since Conjunct Movement and Particle Movement sentences contained only one target constituent, a neutral prompt, the head noun of the first noun phrase of sentences of these types, was used as the second prompt. This noun phrase was never the target constituent. The two prompts for the Particle Movement sentence *The husband refused to take out the garbage* were thus *husband* and *garbage.*

Prompts were assigned to prompt lists so that half of the sentences of each type within a list were prompted with head nouns of target constituents which occurred in a late position (relative to the other target) within a sentence, and the other half occurred in early positions. For Conjunct Movement and Particle Movement sentences, half the sentences within a list were prompted with the head noun of the target constituent, and half with the neutral prompt.

By using both prompt lists with each sentence list, it was possible to cue each sentence in a pair with both of the prompts. Thus, the two prompts occurred in contrasting positions (early versus late) in the alternate sentences of a pair, and these sentences were both prompted with both targets. Individual subjects, however, received only one combination of prompt list with sentence list.

Prompts within a list were arranged in blocks corresponding to the sentence blocks. The prompts were in random order with respect to the sentences in the same block. Only the experimental sentences were prompted.

Each of the two sentences in the 40 sentence pairs employed was given a stylistic preference designation of preferred or nonpreferred on the basis of ratings of these sentences collected by Bock (1977). Half of the sentences of each type within each sentence list were preferred, and half were nonpreferred.

Procedure

In order to make the procedure as analogous to the question-answering paradigm as possible, the list of prompts in a block was read first, followed by the list of sentences, followed by a second reading of the prompt list. After the second reading of the prompt, subjects wrote down the corresponding sentence from the list. This procedure was repeated for each of the five blocks.

Three different random orders of the blocks within a list were used. Each order was used for roughly equal numbers of subjects in each cell of the design.

Subjects were instructed that they would hear 11 sentences in each block, but that recall would be required for only 8 of the 11. They were also told that the wording of their sentences did not have to correspond exactly to the wording of the presented sentences. A four-item warm-up list of sentences comparable to the experimental sentences was presented to familiarize subjects with the task.

Design

Each subject contributed data to the cells of a 2 × 2 factorial design, with factors of Preference (Preferred versus Nonpreferred) and Location of prompt in the to-be-recalled sentence (Early versus Late). Each

item (with an item defined as a sentence pair) was also tested in each cell of this design.

Scoring

The scoring criteria were comparable to those used for corrects and shifts in Experiment 1, except with respect to context intrusions. An omission was scored if the subject made no response to a prompt, or simply wrote down the prompt. All other responses were scored as errors.

Results

Figure 3 presents the percentages of corrects and shifts in each condition. Analyses of variance on the data for corrects, treating both subjects and items as random effects, showed the effect of preference to be significant, with more preferred sentences recalled then nonpreferred (59 versus 48%), $F_1(1,79) = 27.9$, $F_2(1,39) = 12.8$, min $F'(1,75) = 8.8$, $p < .01$. The effect of prompt location and its interaction with preference was not significant for corrects in any analysis, all Fs < 1.

For shifts, both the effect of preference and of prompt location within the sentence were significant. Preferred sentences were less likely to shift than nonpreferred sentences (6 versus 17%), $F_1(1,79) = 141.7$, $F_2(1,39) = 12.7$, min $F'(1,46) = 11.6$, $p <$
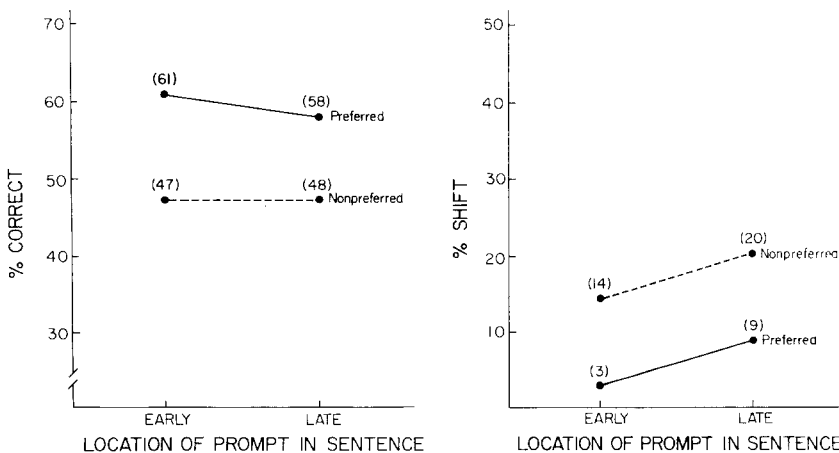

FIG. 3. Mean percentages of correct and shift recalls in Experiment 2.

TABLE 3
MEAN PERCENTAGES OF CORRECTS AND SHIFTS BY SYNTACTIC TYPE: EXPERIMENT 2

Type	Prompt condition	Scoring category	
		Correct	Shift
Dative	Early	43	18
	Late	58	14
Active/Passive	Early	72	6
	Late	65	15
Conjunct Movement	Early	72	14
	Late	60	18
Subject/Object Reversal	Early	60	2
	Late	58	14
Phrasal Conjunct Reversal	Early	71	8
	Late	56	29
Particle Movement	Early	33	17
	Late	46	20
Adverb Preposing	Early	61	13
	Late	68	15
Cleft	Early	24	6
	Late	30	5
Equative	Early	82	6
	Late	72	18
Pseudocleft	Early	21	0
	Late	16	0

.01. Sentences with a late prompt were more likely to shift than sentences with an early prompt (14 versus 8%), $F_1(1,79) = 23.8$, $F_2(1,39) = 13.3$, $min F'(1,82) = 8.5$, $p < .01$. Thus, sentences were most likely to shift when changing the syntactic form allowed the prompt word to be placed early in the recalled sentence. The interaction did not approach significance in any of the analyses.

Analyses of omissions revealed a main effect of prompt location with late prompt sentences (10% omissions) less likely to be omitted than early prompt sentences (13% omissions), $F_1(1,79) = 10.1$, $F_2(1,39) = 10.1$, $min F'(1,104) = 5.04$, $p < .05$. The effect of preference and the interaction between prompt location and preference were not significant in the omissions analysis.

The percentages of corrects and shifts for individual sentence types, collapsed over preference categories, are presented in Table 3. This breakdown reveals a general tendency in both corrects and shifts for the prompt to occur early in those single-clause sentence types in which the prompt had the option of occurring in sentence-initial position as the surface subject: Active/Passive, Subject/Object Reversal, Phrasal Conjunct Reversal, and Equative.

Discussion

These results suggest that lexical availability does influence the syntactic structure of sentences, although the effect was found in only the shift category. Since specific referent availability was minimized by using the prompting technique, it appears that the presence of relatively superficial word information may have some influence on assembly processes in sentence production.

The fact that this effect was present only when subjects recalled sentences in the opposite form from the one heard implies that when a sentence was recalled correctly, subjects were likely to have a more complete verbatim representation of the sentence available than they did when a sen-

tence shifted in recall. To the degree that a verbatim sentence representation is available in memory, it is unnecessary to engage the cognitive component of sentence production. A prompt may effectively retrieve this entire representation without further influencing recall of the sentence, in these cases. When a less complete representation is available, however, higher level sentence production processes may be employed in reconstructing the sentence. If lexical availability affects these processes, its influence should be observed only when reconstructive operations are required. Since shifts almost by necessity reflect reconstructive processes, lexical availability affected both Preferred and Nonpreferred responses.

A methodological assumption of this and the preceding experiment is that when memory is reconstructive, and verbal output is required, an important part of the reconstruction involves sentence production processes. There are certainly ways of remembering and recalling sentences that can reveal very little about sentence production. Recalling the preamble to the Constitution (cf. Rubin, 1977), for example, seems to have little more in common with "ordinary" sentence production than the motor component. In general, though, memory for sentences and prose does not have this character. Some evidence for the involvement of sentence production processes in reconstructive memory comes from studies of sentence memory which indicate that the syntactic biases of normal speech are observed in recall (Binet & Henri, 1894; Bock & Brewer, 1974; James et al., 1973), even when these biases were not present in the material that was studied. At higher levels, the structure of recalled prose descriptions of events bears a striking relationship to the structure of verbal descriptions produced from memories of the actual events (Bower, Black, & Turner, 1979; Lichtenstein & Brewer, in press). It should therefore be possible to use reconstructive recall paradigms to study sentence

production processes, as long as the memory component of the task employed makes no interesting contribution to performance. The memory task may be viewed simply as an effective way of controlling the conceptual input to the sentence production process.

GENERAL DISCUSSION

In planning and producing sentences, it is necessary to organize the underlying ideas into linguistically expressible propositions, and assemble these propositions into lexical items in a surface syntactic structure. The preceding experiments suggest that both referent availability and word availability affect the development of the syntactic structure for a sentence.

The introduction of a referent into a discourse should make that referent more available to both the speaker and the hearer, whether through activation within a knowledge network (Lesgold, Roth, & Curtis, 1979) or maintenance in a short-term memory buffer (Kintsch & van Dijk, 1978). A number of studies of discourse comprehension are consistent with the claim that introducing a particular referent into a discourse facilitates processing of subsequent coreferential information. In sentence comprehension tasks (Chang, 1980; Clark & Sengul, 1979; Garrod & Sanford, 1977; Haviland & Clark, 1974) subjects take less time to indicate that they have understood a sentence when a coreferential antecedent has been established for referring expressions in the sentences read, than when no antecedent is available. In these types of tasks, the facilitation observed does not depend on lexical identity between the coreferential expressions (Yekovich & Walker, 1978).

However, the lexical activation which results from simply hearing, reading, or saying a particular lexical item should have the effect of making the activated item more retrievable than items that are not activated (Collins & Quillian, 1970; Warren, 1972). Experiments which have examined the pro-

cessing of individual words in reading and listening show substantial persisting effects of the presentation of one lexical item on the processing of subsequent identical (Forbach, Stanners, & Hochhaus, 1974; Warren, 1977; Jakimik & Cole, Note 2) or closely associated (Meyer & Schvaneveldt, 1971; Neely, 1976) lexical items. Many of these effects may be present whether a word is presented in isolation or in a sentential context (Davidson, Note 3; Irwin, Stanovich, & Bock, Note 4).

In Experiment 1, it was possible to observe the effects on sentence production both of having a particular referent activated, and of having a particular word primed for retrieval. Both types of processes appeared to influence sentence production; specifically, they appeared to have an effect on the surface syntactic structure of the sentence produced. Thus, syntactic structures which allowed placing available referents early in sentences were more likely to be produced than structures which resulted in later placement, and when the available referents could be instantiated with available words, structures allowing early placement were even more likely to be used. Experiment 2 showed that lexical availability by itself may lead to the use of structures allowing early placement.

The fact that these effects were observed in the syntax of sentences may be explained by the processing demands of manipulating the multiple hierarchical and serial components of a sentence in production. If these demands tax the processing system (Yngve, 1960, 1961), it should be expected that languages would provide, and speakers would employ, devices that allow them to reduce the amount of information that must be manipulated. One way of achieving this reduction involves the idea that the searches for all of the words necessary to lexicalize a single underlying proposition may proceed in parallel, but with some of the searches being completed before others. The assumption that lexicalization of an underlying proposition is a parallel process is based

on evidence from speech errors which suggests that the elements of a single clause are simultaneously active (cf. Boomer & Laver, 1968; Garrett, 1975). However, parallel processing does not rule out the possibility that some words or constituents finish the lexicalization process before others.

Each of the two factors investigated in the present experiments might affect search time in lexicalization. If the propositional elements corresponding to more activated referents tend to finish lexicalization before those related to less activated referents, referent availability should result in lexicalization of one constituent of an incipient sentence earlier than other constituents. Alternatively, if all elements of a proposition are equally available, but appropriate lexical information is more available for some elements than for others, the constituent that finishes the lexicalization process first should be the one which requires the least retrieval effort. If the formulation of the surface syntactic structure can be permitted to proceed on the basis of partial information—that is, if lexical information that becomes available early can also be positioned early in the incipient sentence—those processing resources that might otherwise have to be allocated to the maintenance of information in memory may be used for processing the rest of the sentence. One area in which there is some flexibility in the assignment of surface syntactic structure in English is in the surface syntactic role of particular noun phrase constituents. If the case role of the constituent to be produced is known, and enough has been determined about the verb of the sentence (Lindsley, 1975) to evaluate the surface structure options it permits (Bresnan, 1978; Dowty, 1978; Kempen, 1978), the strategy of beginning a sentence with the first available noun phrase might be frequently employed to reduce memory load during sentence production.

The process of formulating the surface syntax of a sentence is to a large degree under the control of the speaker: we may

revise or decide not to say anything at all after a sentence has been completely formulated. Revisions may be initiated for a variety of reasons, ranging from fundamental grammatical motives to more esoteric stylistic and rhetorical aspirations. Such editing processes may be responsible for the preference effects observed in the second experiment, though the source of these rather strong editorial biases is unknown. Because of these editing processes, however, it need not always be the case that what is conceptually or lexically most available occurs first. There are a variety of functions which surface subjects may be called upon to perform (cf. MacWhinney, 1977); while some of these functions may reflect further factors which underlie conceptual availability, they may (alternatively or additionally) reflect the exercise of editorial options. If these options have a high value in the discourse context, and the resources are available to exercise them, the effects of availability could be easily overridden.

In summary, these experiments suggest that the availability or activation of both lexical and referential information contributes to the syntax of a sentence in production. The first experiment showed that an available referent tends to occur early in a produced sentence (the familiar given-precedes-new principle) regardless of whether the referring expression was the same as or different from the antecedent. When referent availability was supplemented by lexical availability, however, there was increased incidence of given—new ordering. Experiment 2 provided further evidence that lexical availability alone may influence sentence syntax: words used to prompt sentences for recall tended to appear early in those sentences that were recalled in the form opposite to the one presented. These findings are consistent with the assumption that the time course of lexicalization processes influences construction of the surface syntax of sentences.

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