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Conceptualizing and Formulating in Sentence Production

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The study of the psychological process of generating acoustic language utterances has to cover three aspects. First, there is the problem of content selection: how does the speaker decide which conceptual structures (thoughts, perceived events) he will convert into natural language utterances? Goldman (1974) calls this the what-to-say problem. The second aspect is syntactic form selection: mapping a conceptual structure into a string of morphemes or, rather, morphs. Actually, two issues are at stake here. One is form determination: which procedure carries out the conversion of conceptual structures into morpheme strings? The other is paraphrase selection. A conceptual structure usually can be phrased many ways; this raises the question of how the speaker chooses between alternative paraphrases. Third, morpheme strings are phonetically realized as sound sequences. These three aspects I will call the processes of conceptualizing, formulating, and speaking, respectively.

This paper concentrates on conceptualization and formulation. It is commonly presupposed that they are processes which take place in temporal succession, without overlap in time. Put differently, the content of an utterance is thought to have been selected before the formulation process starts. I will present evidence that runs counter to this assumption and exposes the conceptualization process as being strongly dependent upon the formulation process. Furthermore, I will put forward an idea that might contribute to the solution of both the content and paraphrase selection problems. The key notions I will use here are syntactic constructions (Kempen, in press) and scripts (Schank & Abelson, 1975).

The experimental part of the paper deals with tasks where subjects had to memorize and reproduce sentences. If certain precautions are exercised, sentence reproduction may be considered a genuine form of sentence production that is experimentally very tractable. I will report an experiment that puts to test a prediction from the syntactic construction concept. Finally, in reviewing a line of experimentation that focused on the lexical structure of verbs, I will show that syntactic constructions provide a better explanation of the published data than lexical structures do.

I. OBSERVATIONS ON THE DEPENDENCE OF CONCEPTUALIZATION ON FORMULATION

That we must assume some sort of dependence of content selection upon formulation is indicated by a variety of linguistic and psychological observations. Here, I list four of them.

1. *Content revision.* Every skilled speaker of a language will have had experiences of the following kind. While in the middle of planning or pronouncing a sentence he notices that the syntax of the utterance built thus far does not allow him to express the content he intended for the remainder of the utterance. The mismatch between conceptual intentions and syntactic possibilities that arises here is resolvable in two ways: either by revising the content selection for the remaining utterance part, or by abandoning the attempted fragment and making a restart. The former choice implies that syntactic decisions are given priority over conceptual ones.

2. *Syntactic morphology.* Languages differ considerably with respect to the elaborateness of their syntactic morphology. As examples I take tense, number, and addressing systems. Japanese does not distinguish between singular and plural as does English, Dutch, etc. Nouns of Bahasa Indonesia have an unmarked form that may serve both singular and plural function, and a special form marked as plural. Thus, speakers of Dutch or English who wish to use a count noun always have to think about the number of objects this noun refers to: one or more; unlike speakers of Japanese or Bahasa Indonesia who need not worry about this. Analogous contrasts exist between the way a language keeps track of the social relation between speaker and addressee. English only has the second personal pronoun *you,* Dutch distinguishes between *je/jij* and the polite form *U*; Japanese has a complicated system. In the area of verb tenses languages vary widely, too. Compare English and Dutch, which differentiate between past (perfect, imperfect), present, and future, with Bahasa Indonesia. This language has no tense system at all and marks tense (by special words) only if the situation asks for it.

Often it is assumed that conceptual structures ("deep structures") underlying sentences are universal, that is, invariant over languages. This would imply, for example, that the conceptual structures underlying Japanese, Indonesian, and English sentences contain information about number, tense, and speaker/addressee relationship respectively. All this information would be thrown away during the formulation processes in the respective languages. More economical and efficient seems the assumption that the syntactic morphology determines which of the conceptual dimensions (numbers, temporal and social relations) make part of the "deep structures" in these languages.

3. *Lexicon.* Most systems that have been proposed for representing word and sentence meanings posit a distinction between words and concepts. More specifically, the meaning of a single word is often represented by a structure of several concepts. For example, Schank (1972) proposes that one sense of the verb *throw* is represented by a conceptual structure where, among other things, the primitive acts PTRANS, PROPEL, and GRASP have their place. PTRANS indicates change of location of the thrown object; PROPEL and GRASP have to do with the way the location change is effected. If the conceptualization process generates a conception that contains these three concepts, the formulation process will consult the lexicon and find the word *throw* to be applicable. But suppose the formulation process starts with a conceptual structure that only contains the primitive acts PTRANS and PROPEL. The verb *throw* is too specific now. In English, the transitive *move* would do, but Dutch does not have a verb which is neither too specific nor too general (Kempen, 1975). A speaker of Dutch would have to make a choice here. Either he resorts to a long and cumbersome circumscription (something like "to propel NP so that NP moves to . . .") or he revises the selection of primitive acts in such a way that a more specific or a more general Dutch verb fits. The latter choice implies that the lexicon, the list of (frequent) words of the language, becomes one of the determinants of the conceptualization process.

To this I may add a suggestion put forward by Goldman (1974). Perhaps, the formulation process always tries to be maximally specific. For instance, if the conceptual acts that together correspond to the English verb *give* are offered to the formulation process, then the lexicon might suggest *return* as a more specific alternative. This might initiate a search within the memory: did the receiver own the given object at some earlier time? If so, then this information is added to the current conceptual structure.

4. *Syntactic constructions.* Often the speaker need not plan all the details of the sentence that is going to express the intended content. He may use prefabricated sentence frames or phrases that he knows will accommodate his intentions. An important aspect of such phraseology is that it partly takes over the content selection job. If I reserve the term *theme* for the general topic the speaker wishes to communicate to his audience (e.g., the event he perceives, an idea that occurred to him), then the sentence frames determine which parts of the theme will be overtly expressed. On the one hand, only a limited range of aspects fits into a selected frame, while on the other, for each slot in the selected frame the speaker is forced to find an appropriate filling.

The first to notice that sentence frames are able to support the conceptualization process was Selz (1922). His example is the phraseology of definition sentences. He observed that subjects who attempted to define difficult words utilized sentence frames such as *An X is a Y that . . .* or *An X is a . . . Y* to guide the process of retrieving the logically required memory information.

In the next section I will introduce the notion of a *syntactic construction* which, as defined there, is more adequate than sentence frame or phrase. I will argue that the utilization of syntactic constructions for guiding the conceptualization process is a widespread phenomenon, one calling for a special type of sentence production mechanism.

II. SYNTACTIC CONSTRUCTIONS

The arguments reviewed in Section I suggest the following general design of the human sentence production mechanism (cf. Fig. 1). From the theme the speaker wishes to communicate to his audience, the Conceptualizer selects a part as the content of the next sentence to be uttered (Arrow 1). The selected conceptual structure is input to the Formulator (Arrow 2) that fabricates a syntactically organized word string. The syntactic decisions taken during the formulation process may call for a revision of the initial conception offered to the Formulator (Arrow 3). The end result is a sequence of words generated from left to right (cf. Observation 1 of Section I).

In what way can such a sentence production mechanism incorporate the sentence frame phenomena of the previous section? Let me first define the notion of a syntactic construction. A syntactic construction is a pair consisting of (a) a conceptual pattern and (b) a syntactic frame. Borrowing from Schank's (1972) conceptual dependency theory I define a conceptual pattern as a combination of conceptual relations (actor, object, instrument, etc.) and, possibly, concepts. A syntactic frame is a sequence of word categories or words. Word categories may be defined in syntactic terms (e.g., parts of speech, such as noun, intransitive verb, preposition) or in terms of meaning (e.g., words denoting a time interval). The concrete words may be function words (e.g., *by* in the passive construction) as well as content words (e.g., *is a* or *consists of* in definition sentences; cf. Section I).

The syntactic frame of a syntactic construction is said to *express* the conceptual pattern. In English, for example, the syntactic frame N1VN2 (noun + finite

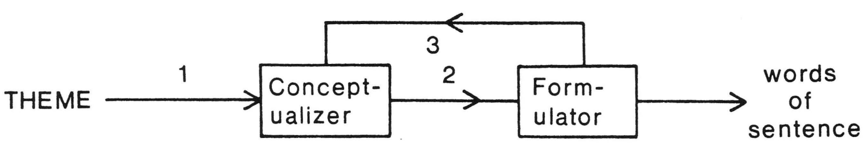


FIG. 1 Global design of the human sentence production mechanism according to the present theory. For explanation see text.

verb + noun) expresses the conceptual pattern "actor ⇔ primitive act ← object." Thus, *John threw stones* and John⇐actor⇒PTRANS←object–stones are concrete embodiments of, respectively, the syntactic frame and the conceptual pattern of this construction. A syntactic frame may belong to more than one syntactic construction, and so can a conceptual pattern.

I will assume that, associated with each frequently occurring syntactic construction, speakers of a language have available a program which does the following two things:

1. It searches through the conceptual network that previously has been designated as the theme, looking for an instance of the conceptual pattern.
2. It casts the retrieved conceptual information in the form of the syntactic frame.

These programs I will call Search-and-Formulate programs.

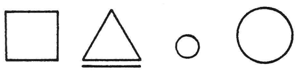
Under circumstances that I will describe in Section III, the formulating process starts with two types of input: not only a conception but also a syntactic construction. The associated Search-and-Formulate program is called, then, and maps the conception, or a revision of it, into a word sequence embodying that syntactic construction.

III. WHERE DO SYNTACTIC CONSTRUCTIONS COME FROM?

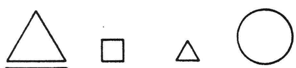
How does the speaker find a syntactic construction that guarantees a quick and successful wording of his communicative intentions? As yet, I have identified two probable sources of syntactic constructions.

First there are numerous instances of what I will call repetitive speech situations. The radio reporter who reads out a series of sporting results might use the same syntactic construction for each match. In situations like these, both the content and a suitable sentence frame are known to the speaker before he initiates his next utterance.

That the conceptualization process can be affected by such prevailing syntactic constructions is easy to demonstrate. Suppose a person is presented with cards depicting geometrical figures such as squares, circles, triangles. On each card, one figure has been underlined. The person has to indicate the identity of the underlined figure to a second person who cannot see the drawings on the card, in as few words as possible. Looking at a card containing the figures



the person might say "the triangle." But if the same triangle is underlined in



a longer phrase would be called for, for example, "the big triangle." In the latter case, size as well as form have to be considered. Making the appropriate selections is a task of the conceptualization process. Under normal circumstances, people are very efficient in building a description sentence which contains just enough information to single out the underlined figure (cf. Osgood, 1971). Now prepare a deck of, say, 20 cards in such a way that the first 15 of them require the longer construction. But from the 16th card onward the shorter construction (without adjective) will suffice. Will the subjects, after 15 repetitions of the longer construction, immediately switch over to the shorter construction? It is my experience that many subjects, adults as well as children, are fooled and persevere in the long construction for one or more cards. In the opposite condition, too, subjects make errors or hesitate: after 15 short-construction cards they often fail to mention the adjective required by the 16th card. Thus, the prevailing syntactic construction seems capable of guiding the conceptualization process.

The second source of syntactic constructions, I hypothesize, is linked to nonrepetitive but nevertheless standard situations. Schank and Abelson (1975) introduce the notion of a *situational script,* a "predetermined and stereotyped sequence of actions that define a well-known situation [p. 3]." The sequence can often be divided into *scenes,* and each scene contains certain *players* who take specific *roles.* Schank and Abelson's example is the restaurant script with its entering, ordering, eating, and exiting scenes, and with roles played by the customer, waiter, and cashier. From the customer's point of view the ordering scene looks as follows.

ATRANS–customer receives menu
MTRANS–customer reads menu
MBUILD–customer decides what he wants
MTRANS–customer gives his order to waiter

Knowledge of situational scripts helps a person to plan his own behavior as well as to understand (texts describing) other people's actions.

The aspect of scripts which is of interest here in the MTRANSes where players talk to each other (e.g., customer delivering his order to waiter). I put forward the idea that, within a person's knowledge base, such MTRANSes may have a syntactic construction associated with them. If somebody finds himself playing a role in a situational script, these constructions help him to shape the utterances he is going to produce. The constructions need not have interindividual generality: different persons may have different constructions for a given speak–MTRANS. And the same person may even have different preferred constructions in different periods of time. The important point is that the association between a speak–MTRANS in a situational script and a syntactic construction resides in the speaker's memory for some period, and is activated during each staging of the script within that period.

I do not know of any published empirical data that support or undermine this idea. So I decided to obtain some—rather informal—observations on spontaneous speech during a standard situation. A Dutch speaking girl of 3 years and 8 months, my daughter Jessica, played an assembly game on five consecutive days, together with her mother. Each day the game—making a little doll out of Lego pieces—was repeated twice. Thus, I collected 10 samples of tape-recorded speech of about 10 minutes each. The game always began with the Lego pieces (not only blocks but also heads, arms, wigs, etc.) lying on a table. Jessica chose one of the models (a boy, a girl, a grandma) as the doll she wanted to make. Then she started constructing the doll—always in the same fashion, from the feet upward to the wig. Jessica's mother was around for giving help, answering questions, redirecting her to the game after interruptions, distractions, etc.

Without going so far as to write a complete script for the game, I looked for "scenes" that satisfied the following three conditions:

1. Jessica often produced an utterance during the scene.
2. The scene occurred in most repetitions of the game.
3. The scene is easy to identify. I selected these: "Choosing the model," "Doll finished," and "Which wig?" (Jessica found it difficult to tell apart the various wigs.)

Table 1 gives the utterances recorded during these scenes. It also presents the sentence frame that seems to have been active during each scene. Since only a small proportion of the utterances does not fit into those frames, I take these observations as, at least, an encouragement to pursue further the idea of syntactic constructions hooked up with scripts. Indeed, apart from trivial cases such as the phraseology of buying train tickets, this or a similar principle seems necessary for explaining such remarkable feats of sentence production as are displayed by, for instance, radio reporters doing running commentaries of soccer matches or horse races.

A second aspect of the doll-assembly observations is worth stressing, too. Only a minority of Jessica's utterances were directly instrumental to attaining her goal. For instance, the "Which wig?" questions were likely to elicit help in overcoming an obstacle to finishing off the doll. But the purpose of both other utterance groups in Table 1 is much less clear. Nonetheless, they had a stable position in the doll-assembly script. On the other hand, MTRANSes that would have been judged perfectly relevant just never occurred. For instance, Jessica never commented on how she liked the doll she had made. Generalizing away from these observations, scripts might contain speak–MTRANSes at fixed places. Some of them bear no direct relationship to the goal of the script or are even adverse to it. Such "superfluous" speak–MTRANSes together with the "essential" ones described by Schank and Abelson become important determinants of the conceptualization process in that they control when and about what kind of things persons talk in script-like situations.

TABLE 1

Utterances and Sentence Frames for Three Scenes of the Doll-Assembly Game Described in Section 3[a]

Utterances	Sentence frames
Scene 1: Choosing the model	
3 Ik ga oma maken	
4 En nou ga ik 't jongetje maken	
5 En nou maak ik deze	(en) nou ga ik (DET) N maken
6 Dit meisje	
7 Nou ga ik dit meisje maken	
8 En nou ga ik dit meisje maken	
9 En nou oma	
10 Nou ga ik dit meisje maken	
Scene 2: Which wig?	
1 Welke moet ie dan op?	
5 Welke muts moet ie dan op?	
6 Welk mutsje moet ie hebben?	welke (N) moet ie (ADV) V
8 Welke moet ie nou op?	
9 Welke moet ie op?	
Scene 3: Doll finished	
1 Nou is 't meisje klaar	
2 Klaar	
3 Daar is oma	
4 Nou is 't meisje klaar	(zo) nou is (DET) N klaar
5 Nou is dit klaar	
7 Zo, nou is ie klaar	
8 Zo, nou is ie klaar	
9 Nou is oma klaar	
10 Zo	

Vocabulary

daar = there	klaar = finished
dan = then	maken = make
deze = this	moet = have to
dit = this	muts(je) = cap (here also: wig)
en = and	nou = now
ga = go	oma = grandma
hebben = have	op = (put) on
ie = he (here also: she)	't = the
ik = I	welk(e) = which (one)
is = is	zo = so
jongetje = boy	

[a]Numbers refer to repetitions of the game.

A final remark. Throughout this section I have emphasized the stereotyped sides of human sentence production. Of course, there is more to it; see Section VI.

IV. AN EXPERIMENT ON PARAPHRASTIC REPRODUCTION OF SENTENCES

The first experimental support for the idea of Search-and-Formulate programs associated with syntactic constructions was obtained by means of the paraphrastic reproduction method (Kempen, 1973, in press; Levelt & Kempen, 1975). Contrary to what is often thought, literal reproduction of a memorized sentence does not imply that the subject has stored it in a literal format. It is possible for literal reproduction to start from a genuine conceptual representation of the meaning of the sentence, provided the subject knows the syntactic construction of the memorized sentence. The Search-and-Formulate program belonging to that construction will then take care of the exact wording. An accurate memory for the individual words (irrespective of order) does not seem necessary for this to be possible. The subject only needs to remember words if, for some slot in the syntactic frame, the language offers a set of synonyms that would all be fitting. It seems justified to consider sentence reproduction a special case of sentence production, as long as this description is valid.

The experiment to be reported here applies the paraphrastic reproduction method. After having memorized a number of sentences the subject has to recall them not only literally but also in the form of a paraphrase prescribed by the experimenter. If the reproduction sentence (or phrase) contains the total content of the memorized sentence, then it is called a full paraphrase. It is a partial paraphrase if it expresses only part of the memorized sentence. By way of example, (1) and (2) are full paraphrases, (3) is a partial paraphrase of (1) and (2):

		notation
(1)	. . . omdat die waakse honden fietsers bijten	S2
	(. . . because those watchful dogs bite cyclists)	
(2)	. . . want die waakse honden bijten fietsers	M2
	(. . . for those watchful dogs bite cyclists)	
(3)	. . . want die waakse honden bijten	M1
	(. . . for those watchful dogs bite)	
(4)	. . . omdat die waakse honden fietsers	S1
	(. . . because those watchful dogs cyclists)	

Notice the word order reversal within the predicates of the Dutch sentences. Coordinate clauses like (2) have the order verb–object; in subordinate clauses such as (1) the obligatory order is object–verb. Now also consider (4) which is a truncation of (1). Unlike (3) which, in a sense, is a truncation of (2), (4) is ungrammatical. Quartets such as (1) through (4) provide the opportunity to test a prediction from the Search-and-Formulate programs proposed in Section II.

As for notation, clauses (1) through (3) consist of a conjunction, a subject phrase, and a predicate phrase. In (1) and (2), the predicate phrase contains two words; in (3) only one word. Since the predicate phrases of (2) and (3) have the word order of a main clause, I will refer to the constructions they instantiate by M2 and M1, respectively. The word order of the two-word predicate of (1) is that of a subordinate clause: S2. Although (4) does not contain a full predicate, I will refer to sentences of this type by S1.

The Search-and-Formulate programs associated with predicate phrases M1, M2, and S2 may be expected to take different execution times. The M1 program can presumably be executed faster than the M2 and S2 programs, for the latter have to engage in a more extensive search through the theme and in more complex response planning. Since no Search-and-Formulate program is available for ungrammatical "predicate phrases" of type S1, the subjects have to follow a different course. They might first execute the S2 program. Then, since this program delivers a word pair as a result, they curtail this result in such a way that only the first word is actually uttered. The latter operation requires extra time. Taken together, the execution times are expected to assume the rank order M1 < (M2, S2) < S1. At the end of this section I will explain why this prediction is, indeed, crucial.

In order to obtain data that reflect the execution times of the programs I devised a special probe latency procedure. Each subject first learned 12 sentences which all embodied the same syntactic construction. The stimuli to be presented during probe latency measurement were assembled this way. The first word was a conjunction (*want* or *omdat*). Then followed the subject phrase of one of the memorized sentences. Latencies (reaction times) were measured under four conditions: M1, M2, S1, and S2. In condition M1, the subjects had to pronounce as soon as possible the first word of the predicate, that is, the verb. The other word of the predicate was to be produced in condition S1. In conditions M2 and S2 the required response was both words of the predicate in the order of a main and a subordinate clause, respectively. Thus, the conditions are named after the sentence type the participants had to complete.

Most important is that the subjects produced many successive responses within the same condition. Once they had got accustomed to a new condition—during a few preliminary trials—they were sure to receive 24 stimuli of the same sort: each sentence twice. Only after that a switch to another condition would be announced. This blockwise presentation enabled the subjects to activate the appropriate Search-and-Formulate program and to execute it on each successive trial.

The tasks were made clear to the subjects by first calling their attention to the word order ordained by the conjunction in an example sentence. In conditions M2 and S2 they were asked to pronounce the two predicate words in that order, whether or not it was the memorized word order. In the M1 and S1 conditions they were told that the word which, in the demanded order, occupied the first predicate position, would count as the correct response; pronouncing both words would be considered erroneous.

A few further details. Each subject participated in all four conditions, which were counterbalanced so as to exclude effects of practice or fatigue. The stimuli appeared on a CRT-screen connected to a PDP-11/45 computer that also controlled reaction time measurement. The experimenter's task was limited to explaining the instructions and checking correctness of responses. Reaction time (latency) was defined as the interval between start of stimulus presentation and onset of the spoken response word or word pair. A pilot study had shown that in the M2 and S2 conditions subjects do not hesitate or pause between words. They output the predicate as a single unit, even if the word order differs from the memorized order. In many respects (treatment of erroneous responses; a filler task between successive stimuli; interstimulus interval) the present experimental procedure is similar to the one described in Kempen (in press).

A total of 32 subjects (Dutch speaking university students) participated in the experiment. Half of them memorized M2 sentences (with conjunction *want*), the other half S2 sentences (with *omdat*). The groups of 16 were again split up into two groups of 8. The first of these received sentences of type (1) or (2), that is, having an object noun in their predicate phrases. For the second group, the object noun had been replaced by an adjective which served as an adverbial modifier to the verb, for example, *bite badly* instead of *bite cyclists*. Efforts were made to avoid adjectives that could also be taken as modifiers of the subject nouns.

I introduced this complication because the object nouns are likely to be more concrete than the verbs. Recalling abstract words has often been found more difficult than recalling concrete words. This factor might affect response latencies, too, and counteract the hypothesis under study. For instance, I predict that M1 responses will have shorter latencies than S1 responses. But the M1 responses are more abstract (verbs) than the S1 responses (nouns). I judged that adjectives on the average are less concrete than nouns.

Results. The hypothesis was nicely confirmed. The average reaction times (arithmetic means) for conditions M1, M2, S2, and S1 were 1279, 1317, 1315, and 1352 msec, respectively, in remarkably good agreement with the predicted pattern. The interaction between clause type (M versus S) and response length (1 versus 2 words) was statistically significant; $F(1, 28) = 5.82$, $p = .02$. Furthermore, the most important parts of the hypothesis, namely, that M1 $<$ M2 and S1 $>$ S2, are both true. This pattern is indeed generated by three out of the four participating groups of subjects (cf. Table 2).

Even so, this cannot be the whole story. Table 2 shows that word order of the memorized sentences exerted a considerable influence: if the subjects had to reverse this order, the reaction times increased. This indicates that they did not

TABLE 2
Average Reaction Times (Milliseconds)
for Main Conditions of the Experiment of Section IV[a]

Clause types	M				S			
Condition	M1	M2	S1	S2	M1	M2	S1	S2
Object noun	1207	1151	1228	1238	1242	1342	1284	1210
Adjective	1196	1253	1488	1472	1471	1525	1409	1341
Total	1202		1357		1395		1311	

[a]Each mean (not including the totals) represents about 175 observations.

always reproduce the predicate phrase from a representation of its meaning; apparently, they sometimes had a quicker access to the literal form of the predicate. And, of course, the hypothesis under study does not apply if subjects use this strategy.

Second, the subjects had more difficulty in switching from main to subordinate clause word order than the other way around: see the line labeled "total" in Table 2. The corresponding interaction is very significant: $F(1, 28) = 39.19, p < .00002$. This finding might open speculations about the psychological status of these two word orders within the predicate (not only in Dutch but also in German; needless to say that although the subordinate clause order is very difficult to learn for native speakers of English or French, Dutch and German speakers do not find it less normal and easy than the main clause order). Third, although the pertinent interaction is not nearly significant, the sentences with adverbial modifiers seem to give better results than the object noun sentences. This might be related to the abstractness factor discussed above.

Before turning to other data I have to point out that the predicted and obtained pattern of latencies, M1 < (M2, S2) < S1, does not follow from other leading theories on memory for sentences. Although Johnson (1970) does not consider within-sentence reaction time data, his model seems to predict that single word responses (M1 and S1) can be produced quicker than double word responses (M2 and S2). The opposite prediction, (M2, S2) < (M1, S1) is defendable too. During the memorization stage of the experiment, the predicates evolve into integrated memory units. Conditions M1 and S1 not only ask for their being retrieved but also broken apart. The latter process might increase the latencies of overt response production. Finally, one might try to interpret the results in terms of search through memory. Most theories on how to represent sentence meanings in conceptual or semantic networks would predict that, given an actor, it is easier to find the action than the object; or even that the object can only be found after first having retrieved the action. Theories like these lead to the predictions M1 < (M2, S2) and M1 < S1. But S1 > S2 does not naturally follow (see, also, Kempen, in press, footnote 2).

V. SYNTACTIC CONSTRUCTIONS AND LEXICAL STRUCTURES: FURTHER EXPERIMENTAL EVIDENCE

The notion of a syntactic construction as defined in Section II is related to what is known as the lexical structure of words. For instance, to say of a given word that it is a transitive verb is not only a statement about one aspect of its lexical structure but also about a certain class of syntactic constructions the word may appear in (predicate phrases, say, having a noun phrase which expresses the conceptual object). Because of this relationship, experimental data on the psychological effects of lexical structures are relevant here.

In the pertinent experiments the subject had to carry out memory tasks with transitive, intransitive, or middle verbs. (Middle verbs can be used both transitively and intransitively.) Polzella and Rohrman (1970) found that transitive verbs elicited a larger proportion of free associates belonging to the noun category than intransitive verbs did. They attributed this effect to the lexical structure of verbs in these categories. The lexicon specifies an object slot for transitive but not for intransitive verbs; nouns or noun phrases fit into that slot. Bacharach, Kellas, and McFarland (1972) pursued this idea in a free recall learning experiment. Subjects memorized pairs consisting of a consonant–vowel–consonant (CVC) trigram and a verb. The verbs were either transitive or intransitive; the CVCs either preceded or followed the verb. Each subject participated in only one of these four conditions (blockwise presentation; cf. Section IV). CVC–intransitive verb pairs, it was found, were easier to learn than CVC–transitive verb pairs if the trigram preceded the verb. No such difference between transitive and intransitive verbs obtained in the order verb–CVC.

The explanation went like this. In the conditions where trigrams came first, they took the role of subject phrase for the subsequent verb. If that verb was intransitive the CVC–verb pair made up a complete sentence. But not so if the pair contained a transitive verb; then, the object slot remained empty which presumably made such a pair more difficult to remember. In the order verb–CVC the transitive verbs were no longer at a disadvantage since their object slots were filled by the trigrams (Bacharach, Kellas, & McFarland, 1972).

But one aspect of the data is difficult to explain on the lexical structure hypothesis. Because transitive as well as intransitive verbs demand a subject phrase, one could argue that in the verb–CVC order both verb categories had slots left open. Whereas in the CVC–verb order one category (the intransitive verbs) had their environment completely filled in. Consequently, one would expect the order verb–CVC to produce, on the whole, slower learning than the CVC–verb order. But this difference does not show up.

The syntactic construction notion does not run into this problem. It considers verb–object sequences (without subject phrases) complete syntactic constructions, just as it does subject–intransitive verb sequences. The participants who tried to recall the verb–trigram pairs could make use of the Search-and-Formulate programs associated with these constructions. In the condition CVC–

transitive verb (in that order), the appropriate syntactic frame was made up of a verb and two nouns, one for the subject and one for the object. The latter noun, of course, did not figure in the syntactic frame for the CVC–intransitive verb condition. This length difference between the two frames provides a sufficient explanation for the recall difference observed in these conditions. Possibly, the open object slot interpretation is true at the same time. The Search-and-Formulate program running in the CVC–transitive verb condition had to work in a context of insufficient information.

A major weakness of the lexical structure notion has been uncovered by Kail and collaborators (Kail & Bleirad, in press; Kail & Segui, 1974; Segui & Kail, 1972). She pointed out that the lexical structure hypothesis makes wrong predictions for middle verbs. As indicated by their name, middle verbs take a position intermediate between transitive and intransitive verbs on the lexical complexity scale.

In a series of experiments, Kail had subjects memorize lists of transitive, middle, or intransitive verbs. Sometimes the verbs were presented in isolation, in other conditions they were embedded in sentences with one (subject) or two (subject and object) noun phrases. The results may be summed up as follows. The recall scores for middle verbs were never in between the scores for intransitive and transitive verbs. Instead, the middle verbs behaved either as transitive or as intransitive verbs, depending on whether or not they were followed by a noun phrase that could take the role of object.

One experimental condition deserves special attention. Subject–verb pairs–the verbs could be transitive, middle, or intransitive–were followed by a noun phrase printed on the next page of the booklet that contained the learning material. The noun phrases could be meaningfully interpreted as objects for the transitive and the middle verbs. By "integrating" these noun phrases into the preceding sentence fragment, the subjects could substantially reduce the memory load required by the learning material. In the case of an intransitive verb, they had to resort to the less efficient "segregation" strategy of memorizing the noun phrases as independent items. From a variety of recall measures Kail and Bleirad concluded that middle verbs gave rise to the integration strategy as readily as transitive verbs. But if middle verbs are inserted in a context of intransitive verbs, they behave as intransitive verbs and induce the segregation strategy. Unlike middle verbs, transitives and intransitives are not subject to context influences.

Kail and her co-workers explain these results by postulating a double-faced lexical structure for middle verbs. They are basically transitive verbs and in the absence of context influence they expect an object noun phrase. But in a context with mainly intransitive verbs, their intransitive side is activated.

Although I have no arguments which disprove this type of account, syntactic constructions probably provide a simpler explanation of Kail's data. I do need a context mechanism–compare the repetitive situations discussed in Section III;

the blockwise presentation needed in Section IV—but the special assumption that middle verbs are "basically" transitive verbs is superfluous. If middle verbs are regularly followed by noun phrases, then the participants mobilize the corresponding Search-and-Formulate program. If not, then they activate the "intransitive" Search-and-Formulate program which does not look for an object.

Thus, the appropriate level of explanation seems to be that of syntactic constructions, not of individual words. The lexical structure of a word influences recall performance only indirectly, namely, if it dictates what kind of Search-and-Formulate program the subjects execute.

VI. THEORETICAL OVERVIEW

After this long survey of experimental work, which appears to support the main theoretical notions of syntactic constructions and Search-and-Formulate programs, it is useful to summarize the human sentence production system outlined in this paper.

The sentence production system does not work according to the schedule: conceptualization first, then formulation. Instead, selection of conceptual content and determination of sentence form are heavily interdependent. Often, the speaker has available a syntactic construction that he knows will allow him to express what is on his mind, at the same time or even before he has definitely decided on the content of the sentence. This syntactic construction, then, shapes the content selection process. The interaction between conceptualization and formulation is made possible by Search-and-Formulate programs, of which I have sketched a few outlines.

How does the speaker know that a certain syntactic construction will fit in with what he wants to say? I mentioned two possibilities (but there must be more of them): repetitive situations where many messages of the same type of content have to be worded in succession, and scripts which specify both when the speaker will engage in speaking and which syntactic construction he can use. This idea of hooking up syntactic constructions with speech scenes in scripts is important because it contributes to the what-to-say and the how-to-say-it problems at the same time.

The syntactic formulation process does not always start with a full-fledged conceptual structure built by the Conceptualizer. What often seems to be the input to the Formulator is (a) a rudimentary conceptual structure only containing the core of the to-be-expressed content, and (b) some advice on which type of syntactic construction to use. The formulator must be able to search through memory for further content details. Finally, what has to happen if the syntactic advice turns out to be wrong? In order to do justice to the great flexibility the human language generation system obviously has, it seems obligatory to endow it with some sort of problem-solving mechanism that is able to reason about the applicability of the syntactic constructions it has in store. But writing about this topic requires many what-to-say and how-to-say-it problems solved first.

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