

Chapter 11

Semantic and Syntactic Aspects of Remembering Sentences: a Review of Some Recent Continental Research

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The study of sentence memory and retrieval, which had become a dominant issue in the psycholinguistic work of the sixties, underwent a major change at the approach of the seventies. It need not be explained here that the original theorizing was more or less directly derived from normal syntactic notions in linguistics (for a review see Levelt, 1973-1974). The change was induced by renewed attention to semantic and extralinguistic aspects of internal representations. It became doubtful whether an implicit assumption of the earlier work could be maintained, namely the presupposition that what is stored in memory is some sort of linguistic object. And one can now rightly question, as Flores d'Arcais (1974) does in the title of a recent paper, whether there is a memory for sentences at all.

The alternative point of view has been expressed most attractively by Bransford and Franks (1972), and by Barclay (1973). Their position is that a person who reads and tries to memorize a sentence or text does this by building an internal representation of the object, action or situation which is described in the text. In case the text contains more than a single sentence, the person integrates the contents of the different sentences into a 'holistic' semantic representation in which there is no trace of the original syntactic boundaries. The linguistic structure of the stimulus material is normally quickly lost. This can only be prevented by giving the subject the explicit additional task of verbatim reproduction (Fillenbaum, 1966; Sachs, 1967; Flores d'Arcais, 1974).

A seemingly obvious consequence of these developments is a devaluation of the paradigm in which verbatim sentence reproduction is required of the subject. In this way, it is said, the subject is forced to store the linguistic object, namely the sentential form, over and above what he normally extracts from it. Since only the latter process is natural and interesting, the paradigm only diverts attention to an artifact. Such would be the case for Johnson's (1965)

results which seemingly indicate that surface constituent structure is stored into memory, but from which it cannot at all be concluded that normally such storage takes place, let alone that this would be *the* format in which sentential material is recalled. An additional argument for this interpretation might be derived from Johnson's later (1970) work, in which he can correctly predict transitional errors in the recall of nonsense letter strings from the way letters are grouped, just in the same way as he could predict transitional errors in the recall of sentences from the way words are grouped into constituents. Intuitively, however, the memorization of a meaningful sentence is clearly different from the memorization of a nonsense letter string. Johnson's original study might therefore have concerned an artificial grouping effect which had no relation to sentence memory per se, but only to the additional task of verbatim recall.

A similar critique seems applicable to Blumenthal's (1967) work. Though this author suggests that sentences are coded in terms of their deep structures instead of their surface forms, it might again be due to the verbatim recall task that subjects are forced into creating such codes. They may have little relation to what a subject normally abstracts from a sentence. (It should, by the way, be noted that Blumenthal's results could also be an artifact for other, purely experimental reasons. If one repeats his prompted recall paradigm for ambiguous sentences giving rise to the same case shift as in the *John is eager/easy to please* sentence pair, the original effect disappears, as Levelt and Bonarius (1973) have shown for Dutch and *mutatis mutandis* for Finnish.)

Though these arguments unmistakably have some face value, one has to be careful not to throw out the baby with the bath water. The verbatim recall paradigm is not only attractive from the experimental point of view of easy scoreability, but there is also strong evidence that it does not necessarily create the artificialities. On the one hand one can use the paradigm for the analytic study of the role of semantic factors in the recall of sentential or text material. In the next paragraph we will discuss a few, mostly continental, studies along these lines. Some of these studies have up till now only taken the form of unpublished dissertations or reports. On the other hand, we will show that, just in the context of the verbatim recall task, it is probably not the case that subjects base their reproductions on an internal *sentential* representation (surface or phonetic), this in spite of the fact that they do show clear constituent boundary effects. It will be argued, again on the basis of as yet mostly unpublished continental work, that such effects are at least partly due to syntactic retrieval plans, not to syntactic traces in memory. This is done in the second section of the chapter. In a last, concluding section we will try to relate these findings to some diverse non-continental studies; this may be taken as an exercise in bridge building.

Semantic Effects on Verbatim Reproduction of Sentences

One of the first to demonstrate semantic effects in verbatim reproduction of sentences was Rosenberg (1968). He studied the operation of a factor which he

called 'semantic integration' and which is determined by interword associations within the sentence to be remembered. A case of high semantic integration is the sentence *The old king ruled wisely* as opposed to *The poor king dined gravely*, which has little semantic integration. Rosenberg showed that the pattern of transitional errors only reflected constituent boundary effects in the case of weakly integrated sentences, i.e. more transitional errors between than within constituents. For highly integrated sentences, it seemed, subjects were apparently able to construct larger units than (major) constituents.

In a follow up of this finding, Hörmann and Engelkamp started a more analytic approach to this matter. They tried to isolate one factor in semantic integration which they called 'semantic implication' (Hörmann, 1971; Engelkamp, Merdian and Hörmann, 1972). In the latter paper semantic implication is defined as a property of a subject/predicate/object sentence in the following way: semantic implication of such a sentence is high if it is hard to change one of the three constituents given the other two; it is low in the other case. An example of high semantic implication is the sentence *The river erodes the bank*, since there are only few other things than rivers which erode banks, few other things than banks that are eroded by rivers, and few other things than eroding which rivers can do to banks. Low semantic implication, it is remarked, is the case for the sentence *The pupil finds the book*. It will not surprise that the authors are indeed able to show that learnability increases with degree of semantic implication. However, together with this factor Engelkamp *et al.* varied a second factor that might contribute to semantic integration, namely negation. They theorized that semantic implication would only contribute to semantic integration if the implication is not denied. They did an experiment in which the subject had to give verbatim reproduction of the sentence on the occasion of a prompt word from the sentence. Their general finding was that high-implication sentences were reproduced better than low-implication sentences, but only for affirmative sentences. For negative sentences semantic implication showed no effect. It is necessary, however, to make one qualification. The experimental material contained three types of negation: negation of subject, of predicate, or of object. Instances of these are:

Not the river has eroded the bank (subject negation)

The river has not eroded the bank (predicate negation)

The river has eroded not the bank (object negation).

(The latter construction is quite normal and acceptable in German.) It turned out that the interaction of negation and semantic implication only occurred in the latter two cases. Subject negation did not reduce the effect of semantic implication on sentence reproduction. The authors relate this to the relative independence of the subject constituent, even in sentences with high semantic implication (this independence is given credit in linguistics by the classical subject/predicate phrase dichotomy). In our opinion a more obvious explanation should be explored first. It might well be that the finding is due to a

property of the sentential material used in the experiment. It may, furthermore, be the case that the subject can ignore the negative element more easily if it precede (or follow) the rest of the sentence. In the experimental sentences this is only the case for subject negation, but in German this could easily be done for predicate (verb) negation as well:

Der Schüler findet das Buch nicht
(The pupil does not find the book)

In his dissertation Engelkamp (1973) extended the notion of semantic implication to relations between constituents other than subject, predicate and object. In fact he analysed sentences in terms of case relations and expressed semantic implication in terms of case structure. In one of his experiments he used sentences such as (a), (b) and (c):

- (a) *The tradesman with the merchandise hit the boy*
- (b) *The tradesman with the spot hit the boy*
- (c) *The tradesman with the stick hit the boy*

According to Engelkamp's analysis the type (a) sentence contains two relation terms, namely *trade* with arguments (cases) *man* and *merchandise* in subject and object position, and *hit* with *man* and *boy* as arguments:

- (a) *trade (man, merchandise)*
hit (man, boy)

Here, the prepositional phrase *with the merchandise* participates in the *trades* relation. In the type (b) sentences the prepositional phrase expresses an independent relation that we will characterize by the verb *possess*:

- (b) *trade (man)*
possess (man, spot)
hit (man, boy)

In sentences of type (c) it seems that the prepositional phrase relates to the main verb as an instrument:

- (c) *trade (man)*
hit (man, boy, stick)

Engelkamp found in a verbatim recall experiment that transitional errors between *tradesman* and *with*, i.e. within the grammatical subject, were highest for type (b) sentences, in accordance with his analysis. In that sentence type, where the prepositional phrase is neither integrated with *trade*, nor with *hit*, it has low semantic implication.

Studies such as these certainly demonstrate the effect of semantic variables on verbatim sentence recall and give a first theoretical analysis, though a number of new problems arise. Are the semantic effects on reproduction due to the memory code or to some retrieval strategy? Is the degree of semantic implication more than or different from the sum of word association strengths, i.e. is it possible to construct sentences for which the associations between words are controlled and equal and where there is nevertheless a difference in semantic implication? Is semantic implication different from *combinability* of phrases? This latter question needs some explanation which can be done by means of another continental study (Levelt, 1967; Noordman and Levelt, 1970). In this one, Osgood's (1970) 'word intersection' method was used. It consists of having subjects judge the acceptability of word combinations such as verb/adverb (*apologize proudly, kill instantly, etc.*), adjective/noun (*lazy stone, diligent nurse, etc.*) noun/verb (*cars eat, children play, etc.*). The intention is to infer from such judgments something about the feature structure of the words involved. The underlying notion is that acceptability is low in the case of words opposed on some feature. For *lazy stone* the critical feature might be *animateness*. Levelt (1967) studied the combination of interpersonal verbs and adjectives. Noordman and Levelt (1970) analysed verb/noun combinations in the sentence frame 'They *verbed* the *noun* (e.g., *they received the growth*). The study involved 13 verbs and 480 nouns and all combinations were judged. It turned out that a specification on only four features was sufficient to predict nearly all acceptabilities (errors: 3.5 per cent), though these features were not sufficient to predict all non-acceptabilities; in fact, many of them were predicted as acceptable (errors: 24 per cent). The four features were concrete/abstract, living/non-living, human/non-human, and generic/non-generic. Findings of this sort may lead to further analysis of the notion of semantic implication. Can semantic implication be partly or fully expressed in terms of (non-) opposition of certain general semantic features? Does verbatim recall of sentences increase if certain case or modifier relations go with feature similarity between the arguments?

Another approach can be found in Loosen's (1972) dissertation. Returning to the point of departure according to which memorizing sentences is in fact memorizing representations of subjects, situations, events; it is not a big step to assume that in the process of decoding a sentence the first things to be memorized will be the basic structure of such situations, events, etc. More peripheral details will only be added if time and memory load allow. The notion of 'basic' or 'essential' traits, as opposed to peripheral aspects is not well defined in its generality, but within restricted domains of objects it might be possible to give a more stringent definition. For instance, if the described object is a visual pattern one could define a hierarchy of traits in terms of coding systems such as Leeuwenberg's (1971). A more intuitive version of this 'essentials first'-hypothesis is quite old in psychology. In 1894 Binet and Henri presented data from which it appeared that the most important parts of a text were reproduced better than parts of secondary importance. However, in

this and in all later studies no attempt was made to provide an independent estimate of the importance of various words in a sentence, or of passages in a text.

Loosen has filled this gap. He developed an elegant method to extract the 'kernel idea' from a sentence. He presented subjects with written (Dutch) sentences and asked them to underline one to three words that they considered most essential for the meaning of the sentence. Next, he determined over subjects for each pair of words the relative frequency that both words had been underlined together. The resulting symmetric data matrix was then analysed by Johnson's hierarchical cluster analysis (see Levelt, 1970). (This procedure was justified because the matrices turned out to be highly ultrametric, i.e. hierarchical.) The result of such an analysis can be pictured as a tree diagram, an example from Loosen's dissertation is given in Figure 11.1a. It shows the

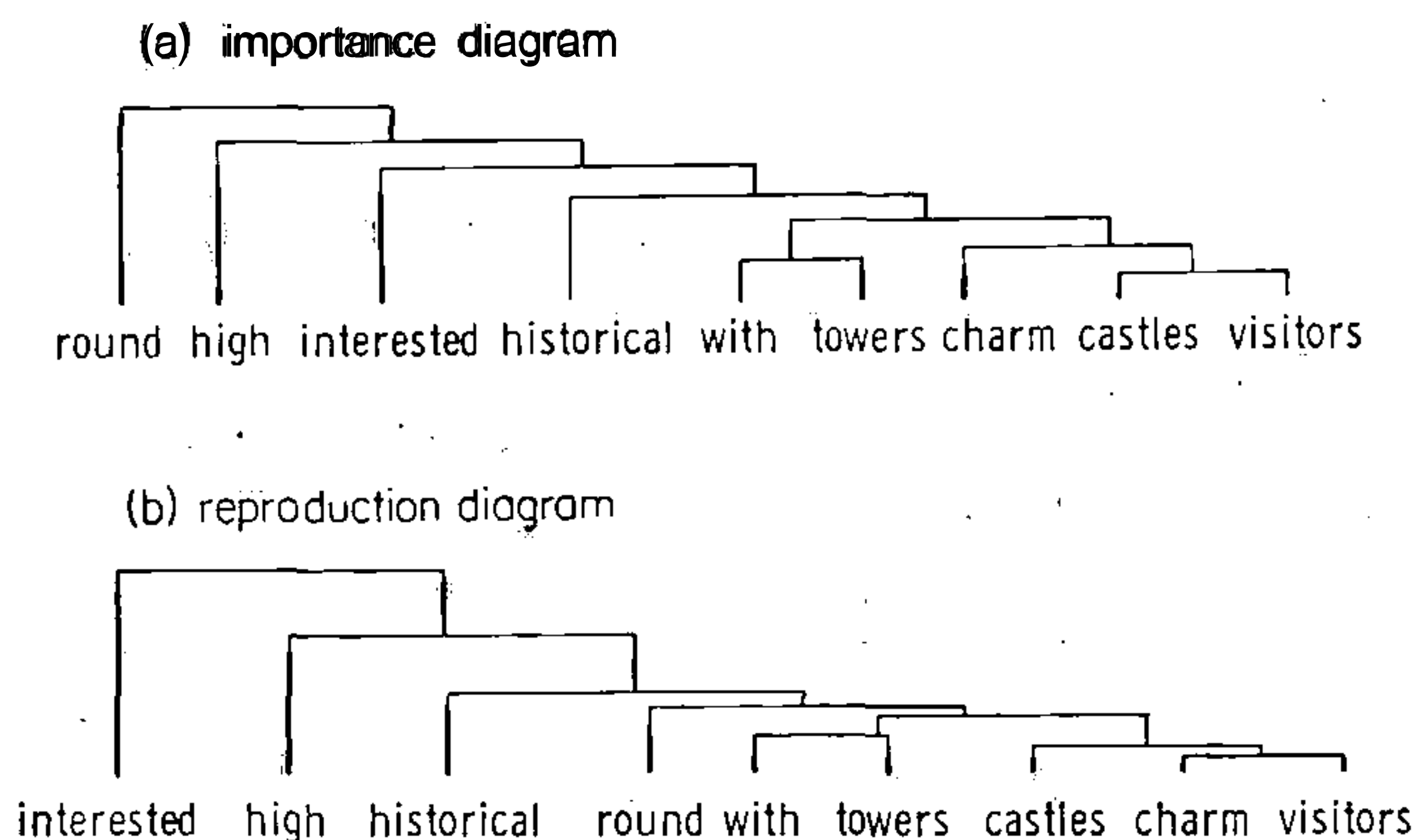


Figure 11.1. Importance and reproduction diagrams for *Historical castles with high round towers charm interested visitors* (after Loosen, 1972)

importance hierarchy for the sentence *Historical castles with high round towers charm interested visitors* (Historische kastelen met hoge ronde torens bekoren belangstellende bezoekers). The lower the node, the higher the relative frequency that words dominated by that node were jointly underlined as most important to the meaning of the sentence. It is clear from the diagram that the kernel idea of the sentence is contained in *castles with towers charm visitors*, or even more strongly: *castles charm visitors*. Other words such as function words and modifiers are more peripheral to the idea expressed by the sentence.

These 'kernel idea' data were now compared with the results of a verbatim recall experiment. In that experiment a different group of subjects performed what was essentially a *continuous memory* task. A long list of sentences was acoustically presented; the subject's task was to listen to each sentence, to judge (by 'yes' or 'no'¹) whether it was plausible (this in order to stimulate real understanding of the sentence), and finally to reproduce verbatim the test

sentence from memory. This was a high-loading task, which resulted in a substantial amount of reproduction errors. The data were analysed in different ways, but the main procedure was to determine for each pair of words from a sentence the relative frequency (over subjects) with which they were *jointly* reproduced. For each sentence the obtained symmetric data matrix was analysed in the same way as the importance data previously referred to.

The main finding of the experiment was that there was a striking similarity between the importance diagrams and the verbatim reproduction diagrams. An example of the latter is given in Figure 11.1b which summarizes the reproduction data for the same sentence as in Figure 11.1a. The correspondence between the diagrams is self-evident. Furthermore, it turned out that, at least for the content words, the chance of being underlined was highly correlated with the chance of being reproduced. For the same sentence this relation is depicted in Figure 11.2. It may be noted in this connection also that Teigeler (1972) found a positive relation between importance and probability of reproduction, but his importance measure is based on purely linguistic considerations. His results are, moreover, rather atypical, as Engelkamp (1973) remarks.

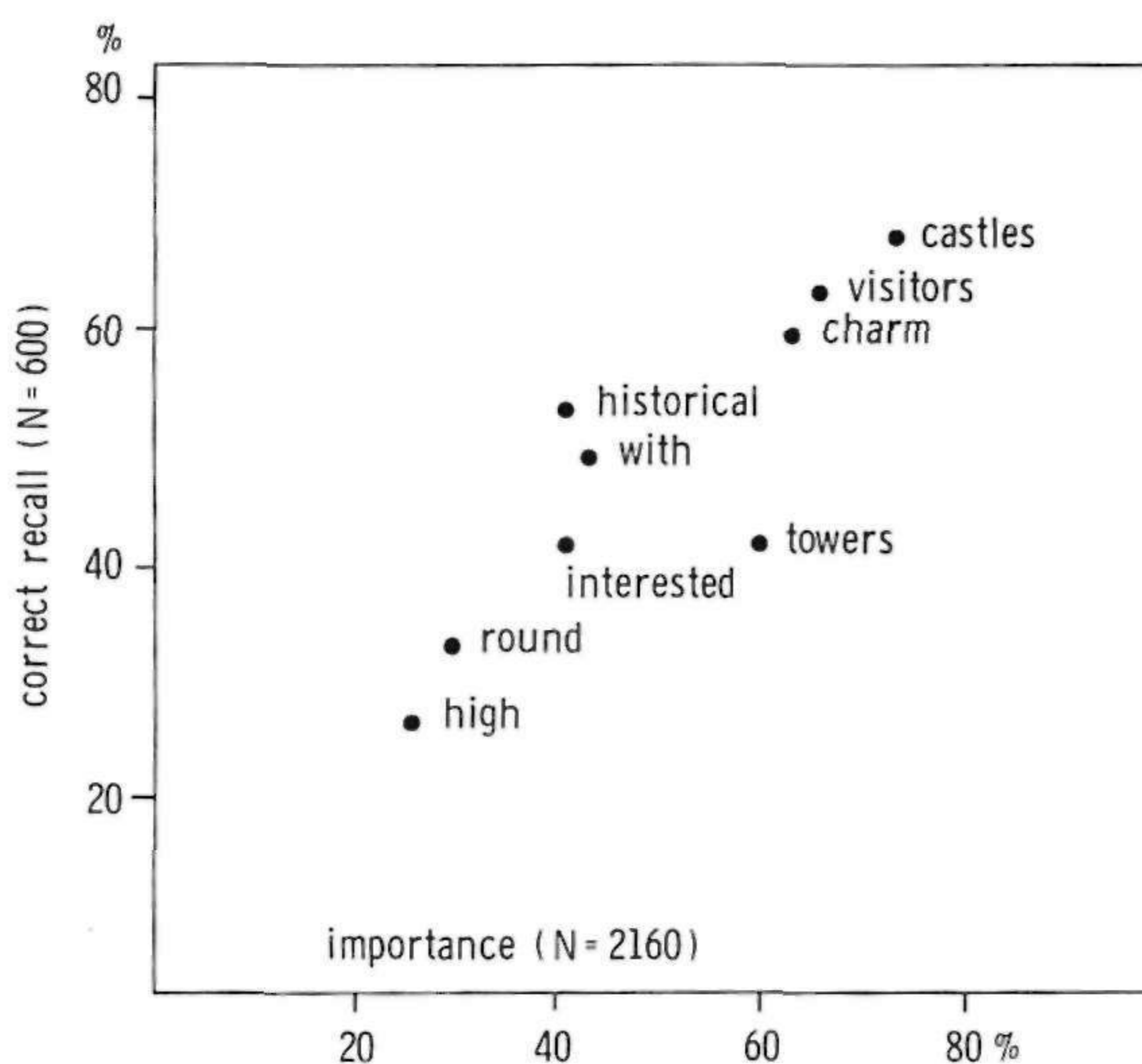


Figure 11.2, Relation between importance and reproducibility for the sentence *Historical castles with high round towers charm interested visitors* (after Loosen, 1972)

As a conclusion to this section we can state that the different studies clearly demonstrate the semantic character of verbatim sentence recall. Even if a subject learns a sentence by heart he does not treat it as a purely syntactic-linguistic object, but tries to create an efficient code from which the sentence may be reconstructed. There is no evidence that the code is

isomorphic to the syntactic structure of the sentence, or stronger, that it is to a substantial degree linguistic in character. This conclusion makes it all the more interesting to study the origin of the syntactic effects that are usually found in verbatim recall experiments. This is the subject of the following section.

The Origin of Syntactic Effects in Verbatim Reproduction of Sentences

Two types of experimental paradigm have been used in order to demonstrate that surface constituent structure is reflected in the pattern of transitional difficulties in sentence recall. The first has been mentioned above: it consists of registering transitional errors during sentence memorization. The other type of procedure consists of measuring reaction times from presentation of a word from the learned sentence to subject's reproduction of the next word in the sentence (probe latencies, or probe reaction times). In both ways it is possible to show constituent boundary effects.

A common element in the different explanations which have been put forward for this phenomenon (*cf.* Johnson 1965, 1970; Wilkes and Kennedy, 1969) is that the cohesion of words within the same constituent results from *learning during the experiment*. One may, of course, differ in opinion about the character of this learning. The sentences may have been stored in LTM in the form of chunks that are more or less related to clauses or constituents. Or sentences are stored in a different format, but during the learning an additional retrieval program is constructed which consists of subroutines that are related to different major parts of the sentence (*cf.* Johnson, 1970). In both cases, however, syntax comes in *during* learning. In this section we will present data which strongly suggest that this assumption is wrong, and, more particularly, that syntactic effects in sentence reproduction are caused by retrieval plans which have a pre-experimental existence, i.e. which are not created during the experiment but which are part of our stock of syntactic skills.

A first indication in this direction was obtained by Loosen (1972). He repeated Levelt's (1970a) experiment with one essential change. In the original experiment subjects had been presented with sentences embedded in noise. Their only task was to write down everything they could reconstruct from what they had heard. The pattern of transitional errors showed not only strong constituent boundary effects, but from computing conditional recall probabilities for all word pairs in a sentence it was possible, moreover, to show that the chunking pattern was highly hierarchical in nature. Levelt explained these findings in terms of perceptual partitioning procedures. Loosen argued that the results could as well be explained by syntactic retrieval procedures, and to show that the actual stimulus was of relatively minor importance and that therefore a perceptual explanation might be less attractive, he repeated the experiment in the following way: instead of presenting whole sentences in noise he presented the words of each sentence in haphazard order (and noise), and instructed the subjects to try to reproduce the list of words as a sentence.

The results were about identical to the original results: they showed the same hierarchical constituent boundary effects in spite of the absence of prosodic information or order information in the stimuli. Also, no particular syntactic frame was given or suggested during the experiment. Apparently, subjects are able to apply syntactic structures of their own making to haphazard word lists, enough to show strong syntactic structuring in their reproduction. This is consonant with the idea that syntax comes in during reproduction and is neither a property of the memory code, nor of a retrieval plan that is learned *during* the experiment. At the same time, however, the experiment does not prove this. It may be the case that the subject listens to the word list, constructs and stores a sentence and finally reproduces the sentence from memory. Stronger results are required apparently.

More definite conclusions can be drawn from a series of experiments by Kempen (1974). It is good practice in memory research to unravel storage and retrieval processes by investigating which aspects of the memorized material can be retrieved in the reproduction phase of the experiment by means of retrieval procedures that are distinct and independent from retrieval procedures which have been learned during the acquisition phase. Kempen applied this method to a number of variations of the probe latency technique which was mentioned above.

In each of his experiments subjects learned a set of four Dutch sentences by heart. The sentences could be qualified as having weak semantic integration; their verbs were 'middle verbs', i.e. they could be used transitively as well as intransitively. Examples are *Those two Finns wrote texts*; *Those three Greeks learned laboriously*. The critical manipulation was the paradigm by which the different transitions were measured. If the usual probing paradigm was used, i.e. presentation of probe words in random order—each probe word followed by the subject quickly mentioning the next word in the sentence—significant constituent boundary effects were obtained. These effects were even stronger if the subject was instructed to react with the *preceding* word in the sentence (backward reactions) instead of the following word. Since in these two paradigms the probe words could be taken from the whole sentence, they are called the 'sentencewise' paradigms ('forward' and 'backward', respectively). The results for these two sentencewise paradigms are summarized in the upper pair of dotted lines of Figure 11.3. It is clear that the transition from subject noun to main verb and inversely (*Finns, wrote*) gives longer probe latencies than the transition from main verb to object noun and inversely (*wrote, texts*). The first transition corresponds to a major constituent break, the second is a within-constituent transition.

However, the profile of probe latencies changes drastically if a different paradigm is used, which Kempen called the 'pairwise' paradigm. In this case, subjects were (after learning) instructed that all probe words would come from one of the two positions around a predetermined syntactic transition, for instance the noun/verb transition, and that if the one word is presented (e.g., the noun) the subject has to reproduce the other (the verb) and conversely.

After this instruction a particular transition was chosen at random and all backward and forward probes were done for all learned sentences. Then the experimenter announced a shift to another transition and again all forward and backward probes were done. This went on systematically until all transitions had been measured. This pairwise paradigm led to a complete disappearance of the constituent boundary effect. This can be seen in Figure 11.3, where the continuous horizontal lines summarize the forward and backward latency data for this paradigm. [A control experiment could successfully eliminate an alternative explanation according to which the subjects engaged in silent rehearsal of the word pairs from which the probes were selected during a given series of pairwise latency measurements. For the details see Kempen (1974).]

Before interpreting this disappearance it is necessary to describe the results of a third experiment. In that experiment Kempen was able to generate a constituent boundary effect by means of the pairwise paradigm. This is important because one might 'accuse' the pairwise paradigm of being insensitive, or at least too insensitive to measure subtle constituent break effects. In order to explain this third experiment a quick course in Dutch is required. The experiment differed from the second one only in terms of its syntactic material. In Dutch the order of the main verb and object is different for a main clause and a subordinate clause. For *Those two Finns wrote texts* the word order in Dutch is the same as in English: the verb precedes the object. However, in the subordinate clause the order inverts in the following way: *Because those two Finns 'texts wrote', they needed some light*. It should be obvious that for Dutch ears these two orders sound equally natural if used in the correct context. The third experiment differed from the second in that the subjects learned a set of subordinate clauses where subject nouns were always followed by object nouns. So a typical stimulus clause was *Because two Finns texts wrote* (there was no main clause added, so the stimuli were incomplete sentences). Here the constituent break is between *Finns* and *texts*, the subject and the object which are juxtaposed in these constructions.

It turned out that this latter transition led to relatively long probe latencies, both forward and backward, whereas the within-constituent transition between *texts* and *wrote* gave short latencies. These results are summarized in Figure 11.3 as the bottom pair of dotted lines.

In order to interpret these data, Kempen reasoned as follows. (For a detailed description of the argument, see Kempen, 1974.) First, it seems clear that the constituent boundary effect depends on the retrieval task which the subjects have to perform, not on what the subjects learned during acquisition. The latter was namely identical for Experiments I and II; these experiments differed only in retrieval task for which instructions were given after learning had been completed. In the first 'sentencewise' paradigm the subject could not know in advance which transition would be probed. At any time he could expect any probe word. In the second 'pairwise' paradigm, however, the subject did know in advance which transition was going to be tested. The second step, then, was to consider what advantage the subject could have from this knowledge. In a

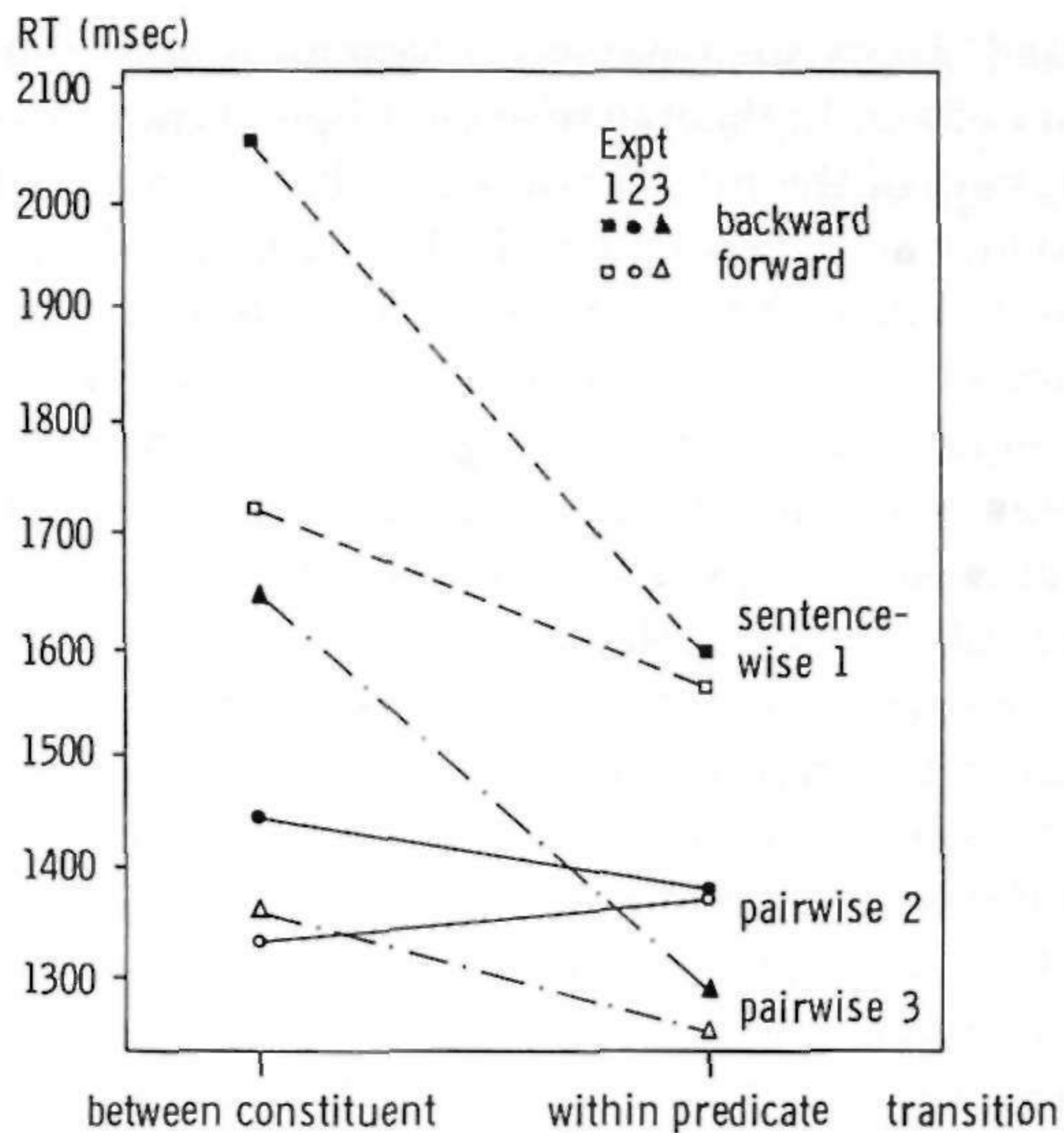


Figure 11.3. Probe reaction times for three experimental conditions (after Kempen, 1974)

first approximation, Kempen hypothesized that in the pairwise paradigm the subject could somehow limit his attention to a subpart of the semantic representation of the sentences, whereas in the first paradigm the whole internal representation had to be kept accessible and retrievable. The pairwise paradigm only required the subject to consider a small (meaningful) part of the internal representation, namely the information that Finns wrote for the first transition, and that it is texts that were written, for the second transition. This explains, to start with, why probe latencies are smaller in the second paradigm. But how to explain the difference in constituent break effect between Experiments II and III? For this Kempen made the additional assumption that the subject, in retrieving such semantic units, makes use of particular syntactic constructions. A syntactic construction is a string of syntactic categories, expressing one or more case or modifier relationships. (In this paper we will refer to specific syntactic constructions by means of labels for the expressed relationships, e.g. S-V, etc., since the intended category sequence is always clear from context.) That is, the subject tries to map a maximally specific syntactic construction on the information to be retrieved. What is the most specific construction that the subject might use in the first 'sentencewise' paradigm? Since in that case the subject does not know which transition is going to be tested there is no other recourse for him than using as a retrieval frame the syntactic construction of the sentence as a whole. The subject first expresses the semantic information in phrases corresponding to the syntactic frame and only then he is able to find the particular transition. The transition,

therefore, is 'read' from such parsed information and thus shows the constituent boundary effect. In the pairwise paradigm, however, the subject knows in advance what part of the information is to be retrieved and can use a much more efficient syntactic construction. In Experiment II the information that Finns wrote can be efficiently captured in the syntactic construction S-V; no other constructions have to be considered. And similarly the information that texts were written is easily caught by using a V-O construction. There is no *a priori* reason to think that one of these is easier to apply than the other so that no differential effect is to be expected, which is in accordance with the data. In other words, the subject can perform his task in Experiment II by applying a completely overlearned syntactic construction, be it S-V or V-O. These constructions can be different from the syntactic structure of the learned sentences, and still be very effective for retrieval purposes. They are pre-experimental in the sense that they are part of the subject's syntactic skills.

Let us now turn to Experiment III and consider why the constituent boundary effect reappears in that case. It should be remembered that the main difference between this and Experiment II is in the order of subject, verb and object, which is not S-V-O any more, but S-O-V (*Because Finns 'texts wrote'*). In this case the smallest meaningful unit related to the pair *Finns, texts* is the information that Finns wrote texts. The sequence S-O does not capture this information, it is moreover not a syntactic construction such as S-V and V-O. For retrieving *texts*, given *Finns*, it is therefore necessary to first use the larger construction S-O-V for retrieving *Finns texts wrote* and then to read off *Finns texts*. The retrieval of *wrote* given *texts* (or inversely) can again be easily done by applying the overlearned O-V construction to the information that texts were written. The pattern of latencies is in correspondence with this analysis.

If this analysis is correct, we are able to reconcile the now popular viewpoint that sentences are memorized in semantic or imagery-type format with the always recurrent finding of syntactic effects on verbatim reproduction. This reconciliation can be made, moreover, without agreeing with the critics who explain these effects by saying that during a verbatim recall experiment the subject not only stores the content of the sentence, but also sets himself the additional and completely artificial task to memorize the syntactic frame, either independently, or as a retrieval plan. Kempen's experiments showed that a syntactic construction used for retrieval is in principle independent of the syntactic structure of the learned sentences. It depends on the experimental task what sort of syntactic construction is going to be used by the subject in order to retrieve (parts of) the stored information. In a verbatim recall experiment the subject may use the construction which he perceived in the learned sentence, but at least for simple sentences such constructions are overlearned already and it should not require much effort to label a particular construction for retrieval purposes; this is quite different from learning a new syntactic construction which would indeed be an artificial task.

As a summary conclusion it can be stated that the data in this section led us to seek the origin of syntactic effects in verbatim sentence recall in the reproduc-

tion phase instead of the storage. They are caused by the use of retrieval programs that correspond to overlearned syntactic constructions and that are applied to read out and verbalize the semantic information in memory.

Discussion

The experiments discussed in the preceding two paragraphs lead to the following global description of what a subject does during verbatim sentence learning. He creates a semantic representation and in some cases an image of the subject, event, etc. of which the sentence is a description. If under memory or time pressure, he tries to store the syntactically parsed string of words, but depending on his expectations with respect to the recall task, he may label a particular syntactic frame as a retrieval program. Only in the case where relatively complex sentences are learned and the subject is anticipating verbatim recall will the storage of the retrieval program involve some syntactic learning. During the reproduction phase, the subject will, dependent on the instructions, choose from his stock of overlearned syntactic frames one which is most specific to retrieving the information required by the task. Only these syntactic frames can cause syntactic recall effects.

At this point we want to make three qualifications. Firstly, it seems unlikely that any frequent syntactic construction can be used as a retrieval program. As we have remarked earlier, the construction should be appropriate to be mapped on some unit of information in memory. Our knowledge of the structure of such units is still very limited but many theories of semantic memory (for a review see Frijda, 1972) represent sentential information in the form of a predication over arguments or cases. If this is correct we would expect that certain syntactic constructions would be particularly suited for retrieval, such as subject-main verb, main verb-object, main verb-prepositional phrase, as well as different types of modifier relations, e.g. verb-adverb, adjective-noun. There may in fact be a close correspondance between effective retrieval programs and the syntactic constructions that figure in Bever's (1970) perceptual strategies. There also the subject tries out syntactic frames which have a high chance of leading him to the most important semantic relations.

Secondly, by promoting syntactic constructions to retrieval programs we do not intend to deny the existence of other means to retrieve sentential information from memory.

Thirdly, we want to be careful in drawing conclusions with respect to spontaneous sentence production. It should be clear from the above that, contrary to the present trend in text memory work, we do not consider syntactic effects in sentence recall as peripheral, artificial, or unnatural phenomena. On the contrary we want to take them as expressions of LTM-operations which are of much more general use, especially in spontaneous speech. Also there the speaker tries to frame information from memory into syntactic construction of his choice. And similarly, a syntactic construction may guide his search for those aspects of the activated information that have to be verbalized at a

particular instant in speech. Care is required, however, because we do not intend to say that in speech the syntactic program precedes the retrieval of information from memory in all cases, nor that it is the only or most important means of retrieval.

To round up this discussion we finally turn to mentioning some non-continental studies which in some form or another have also pointed to syntactic constructions as retrieval plans.

Ervin-Tripp (1961) has suggested that in order to carry out a free association task the subject might use syntactic constructions to find a response word. If he does, the result is a syntagmatic association. Paradigmatic associations can be explained similarly: the stimulus word activates a syntactic frame, the response word can replace the stimulus word in that frame. A possible reason for the availability of replacer sets is their useful function in speech perception: the listener can anticipate the speaker by activating one or more words which would be a likely completion given the syntactic frame under construction.

Miller (1969) proposes that certain asymmetries in the occurrence of word associations be explained in a manner which is quite close to our view. One typical asymmetry is the frequent association from exemplar to category (e.g. *collie-dog*), whereas the converse is rare. Another case is the whole-part association (*hand-finger*) which is more frequent than the converse. According to Miller the subject tries to find an association word by making use of *predicates* like '*... is a...*', or '*... has a...*'.

Polzella and Rohrman (1970) found in an association experiment that transitive verbs as stimuli were more effective in evoking noun reactions than intransitive verbs. They explain this by supposing that in the internal lexicon transitive verbs have a slot for a nominal object constituent. Apparently the subject uses a little V-O construction in order to generate an appropriate response. This construction is not activated in the case of intransitive verbs. Extending this line of thought, Bacharach, Kellas and McFarland (1972) performed a free recall experiment from which it appeared that a pair of intransitive verb and CVC trigram was easier to learn than a pair of transitive verb and CVC trigram, but only in the case where the trigram *precedes* the verb. Apparently, trigrams subsume the role of subject phrase; in the case of a transitive verb the 'sentence' remains incomplete and is therefore harder to learn. The difference disappeared completely, however, in conditions where trigrams *followed* the verbs: there trigrams could either be in the role of object phrase for transitive verbs or of adverb for intransitive verbs, leaving the 'sentence' equally incomplete in the two cases.

Wright (1972) determined error rates for subjects answering questions such as *The doctor helped the nurse. By whom was the nurse helped?* The results led her to suggest that in order to retrieve the answer (e.g. *the doctor*) from LTM it is necessary for the subject to use a mediating sentence context (e.g., *the nurse was helped by . . .*).

Probably closer to our view is a recent paper by James, Thompson and Baldwin (1973). They related retrieval of a sentence from memory to the

constructive process in normal speech production, as we did above. More specifically they select two characteristics of normal free speech for study in a free recall task, namely preference for active constructions over passive, and a tendency to start a sentence with the (semantic) theme. They were able to demonstrate that errors in free recall show the same biases, which is consonant with our view that subjects may use syntactic retrieval plans which are quite different from what they learned during acquisition. It should be added, however, that the authors only mention the reconstructive role of syntax, not its role in memory search.

It is our opinion that both the reported continental studies and the heterogeneous collection of results in this latter section demonstrate the importance of syntactic factors in getting access to non-syntactic information in memory. One would like to see that the presently active study of semantic storage is complemented by an equally active and systematic study of the (partly syntactic) procedures employed in the retrieval and verbal recasting of information from memory.

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