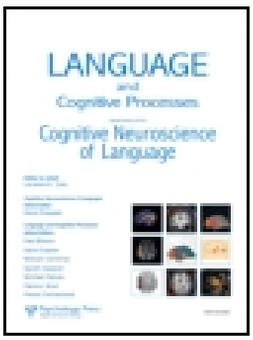

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Hesitations and Sentence Planning

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The study investigated hesitations in the spontaneous speech and story continuations of university students. Hesitations occurred less often before "embedded' clause types than before "combined" clause types in both tasks. This finding suggests that embedded clauses are more likely to be planned ahead during the preceding clause than are combined clauses, which may be planned relatively independently of the prior clause. Also, for each functional clause type, boundaries before non-finite (deep structure) clauses contained hesitations just as often as did full finite (surface structure) clauses. It was concluded that deep structure clauses within surface structure clauses function as speech planning units, just as surface clauses themselves do. An additional experiment examined the pattern of silent pausing when sentences were read aloud. Whereas many silent pauses occurred before finite combined clauses, very few occurred before embedded clauses and non-finite combined clauses. Thus, it is primarily pauses occurring before finite combined clauses in spontaneous speech that have a listener and/or a breathing function.

INTRODUCTION

Explaining how speakers convert thoughts into utterances is a fundamental goal for psycholinguistic research. Central to any but the most behaviouristic approach to this issue is the assumption that speakers plan ahead to some degree before embarking upon speech. Indeed, in the production of

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connected speech, planning presumably occurs at a number of different levels, from extremely global discourse plans through to precise articulatory commands. It is likely that the extent of advance planning will depend on the pragmatic and communicative goals of the interchange, as well as the speaker's prior experience in talking about the topic. Nevertheless, it seems reasonable to assume that any discourse situation will require speakers to decide upon particular ideas, to formulate each idea as a specific proposition or set of propositions, and then to attempt to find suitable linguistic expression for this unit. It is this level of planning and decision making during production on which the present paper focusses.

Converting propositions into an appropriate linguistic format is not always a straightforward or simple process. Speakers' efforts to realise their intentions are seldom completely fluent and error-free. If it is assumed that speakers generally strive for fluency and comprehensibility, then any disruptions and hesitations within the speech flow can be taken to reflect points at which decisions about subsequent output are being made. Based on this premise, studies of the location of hesitations have been used to support claims about units of planning within discourse. Thus, there is some empirical evidence suggesting that sentences are usually distinct planning units in speech. Silent pauses occur more often and are longer before sentences than before words within sentences (Ford, 1982; Goldman-Eisler, 1972). Filled pauses such as *um* and *ah* also occur more often before sentences than at locations within sentences (Ford, 1982). Additional support for the idea that speakers tend to plan sentences independently comes from a study by Ford and Holmes (1978). Using a divided attention task in which subjects were required to press a button whenever they heard a brief tone, they found that processing load, as indexed by tone monitoring times, decreased at the ends of sentences compared with positions during sentences. While there may be occasions on which people can plan the next sentence without hesitating or increasing processing, the studies suggest that speakers usually require time to reflect on what they are going to say before beginning a sentence.

In order to avoid endless repetition of elements, speakers generally link several propositions together within sentences using a variety of different types of clause. Given that most sentences that people typically utter consist of more than one clause, the question arises as to exactly how clausal relations are constructed during the production process. Several studies have shown that clause boundaries contain a higher percentage of silent pauses than do locations within clauses (Beattie, 1980; Goldman-Eisler, 1972; Hawkins, 1971). This suggests that clauses within sentences may be planned relatively independently. Unfortunately, it is far from clear exactly what constituted a clause in these studies, although any examples given suggest a conception of the clause as specified in traditional

grammar (cf. Gleason, 1965). According to this notion, a clause contains a finite verb and, except in the case of ellipsis, an explicit subject and predicate, as exemplified in (1). Such full finite clauses have also been termed surface structure clauses.

1. John ate plums.

One of the major insights of transformational grammar was to draw attention to a "deeper" level of syntactic relations below the surface constituent structure. On this view, the surface structure of a sentence is not always an infallible guide to underlying structure relations. One consequence of this is that surface structure clauses may often be further subdivided into sequences corresponding to units at deep structure level. For example, sentence (2), taken from Gleason (1965), consists of only one surface clause, but contains more than one propositional unit at an underlying level.

2. He decided to begin.

These propositional units are something like *He decided* and *to begin*. In the surface structure, the first deep unit *He decided* contains a finite verb *decided*, and thus is a finite clause, albeit somewhat incomplete when considered without its object, whereas the second deep unit *to begin* lacks an explicit subject and the verb is non-finite in form. For the most part, where a full finite clause contains more than one of these deep structure clauses in English, the boundary between the deep clauses will be before a non-finite clause.

On the basis of the available evidence, Fodor, Bever, and Garrett (1974) proposed that surface clauses are major units of sentence planning. However, Valian (1971) pointed out that deep structure clauses had not been considered in earlier studies on planning units, and suggested that they might be important units within surface clauses. This hypothesis was tested directly by Ford and Holmes (1978), who found that tone monitoring times increased across surface clauses corresponding to only one deep structure clause, and also across deep structure units within surface clauses. Moreover, Ford (1982) showed that speakers hesitated just as often before deep clauses within surface clauses as before surface clauses themselves. In both these studies, there was also no greater complexity before surface clauses containing more than one deep clause compared with surface clauses containing only one, thus providing no evidence that speakers integrate across deep clauses before beginning to utter the surface clause containing them. From these results, Ford (1982) concluded that people plan and output deep clauses within sentences basically one at a time.

Ford's (1982) conclusion implies that deep units such as *He decided* and *to begin* are planned and output independently. But are these superficially incomplete units planned just as independently as the two surface clauses *Sally laughed* and *when I spoke* in sentence (3)?

If this is how Ford's (1982) findings are to be interpreted, then such a conclusion might seem somewhat difficult to accept. Indeed, one reaction to the claim has been to question the generality of the results on which it was based.

3. Sally laughed when I spoke.

For instance, alluding to Goldman-Eisler's (1968) distinction between "hesitant" and "fluent" cycles in speech, Garrett (1982) suggested that the speech in Ford and Holmes' (1978) and Ford's (1982) studies may have been predominantly from fluent cycles. If this were so, then the absence of any higher-order role for surface structure clauses would be attributable to the fact that most integrative planning must have occurred at sentence boundaries. However, the speech produced in these studies did not appear particularly fluent—if anything it appeared somewhat disjointed and non-fluent. This impression led Holmes (1984) to seek an explanation in exactly the opposite terms to Garrett's (1982) suggestion. She tested for evidence of integration of speech into surface units when speech was *more* fluent than that produced in the Ford samples.

In Holmes' (1984) experiment, students gave brief continuations of stories about everyday events, and the speech produced was indeed more fluent than that obtained in the discussion situation previously used. Moreover, the times taken to initiate an utterance suggested that in these circumstances the entire utterance was often being planned in advance, even if it contained more than one sentence. There was also evidence for surface clauses being higher-level units than deep clauses: Initiation times were longer for utterances with more than one surface clause compared with those with one, but the same effect was not observed for deep clauses. In addition, silent pauses occurred more often at surface clause boundaries than at deep boundaries within them. These results suggested that task demands may affect the extent to which speakers pre-plan utterances before beginning to speak.

From the above, it can be seen that how clausal structure is implicated in sentence planning in different speech situations is far from certain. Moreover, there is a problem with the issue as stated so far. It may be misleading to classify *all* surface or full finite clauses together and *all* deep non-finite clauses together. Both finite and non-finite clauses can have different functions, and their particular function may have consequences for how they are planned during speech. In support of this idea, when Ford and

Holmes (1978) and Ford (1982) reclassified clauses as either "non-embedded" or expressing different kinds of subordination, they found that processing load differed as clauses of different types were output, and that pauses occurred with differing probabilities before different clause types. However, in these analyses, the finite or non-finite status of the clause was not differentiated within the different functional types. To clarify the planning roles of deep and surface clauses, it is essential to examine finite and non-finite clauses separately for clauses of different functional types. Even though there may be differences across functional types, it should be that finite and non-finite clauses are planned in the same way for each functional type.

This issue was investigated in the present study in three separate speech situations. First, spontaneous monologues on specific topics were elicited for analysis; secondly, as a control, subjects read aloud sentences selected from the utterances obtained in the spontaneous speech situation; and, thirdly, a replication of Holmes' (1984) story continuation experiment was carried out.

SPONTANEOUS SPEECH

In this part of the study students were asked to talk on two specified topics. One topic was very similar to Ford and Holmes' (1978) and Ford's (1982) issues for discussion. For this evaluation topic, subjects were asked what they liked and disliked about university life. The other topic, the description topic, entailed giving a description of a typical day on which the student went to the university. As in previous research, the assumption was made that units of planning may be inferred from differential rates of producing hesitations at different locations. Thus, following Maclay and Osgood (1959), four different types of hesitation were identified as indices of planning difficulty during speech production.

1. *Silent pauses*. Silent pauses with a duration of 200 msec and over were located in the speech, so that both rate and duration of silent pausing could be estimated. Since silent pauses can occur for reasons other than planning, it was considered imperative to examine vocalised hesitations as well.

2. *Filled pauses*. These were occurrences of *um*, *er* and *ah*. Maclay and Osgood (1959) proposed that filled pauses occur as a reaction to one's own silence, as a way of preventing another speaker from interrupting one's speech, a hypothesis which has received some empirical support (Beattie, 1983). However, filled pauses also occur in monologues (Ford, 1982; Rochester & Gill, 1973), so perhaps they reflect "awareness" of hesitancy even when one is not in danger of being interrupted.

3. *Repetitions*. Sound, word, and phrase repetitions were also examined. As Maclay and Osgood (1959) suggested, these seem like another form of time-filling; they would be unlikely to be produced if the speaker could think of exactly what to say next. This conjecture is supported by a finding of Beattie and Bradbury (1979) that when subjects were forced to avoid silent pauses when speaking, the amount of repetition increased substantially.

4. *False starts*. These are incomplete or self-interrupted units. They represent conscious acknowledgement that an incorrect or unsatisfactory choice has been made. Maclay and Osgood (1959) found that false starts typically involved corrections to individual lexical items. However, it is obvious that false starts can represent recognition of inadequacy at other levels than the lexical, and Levelt (1983) has distinguished several other types. Whatever the particular source of underlying difficulty, false starts provide a plausible index of planning difficulty.

Subjects

A total of 30 graduate and undergraduate students at the University of Melbourne participated in the experiment, of whom 14 were female and 16 were male. Their average age was 21 years and 4 months. They volunteered for an "information processing" experiment, and were paid for their participation. The same subjects participated in the story continuation task.

Procedure

The spontaneous speech was obtained after the subjects had completed the story continuation task. They were told by the assistant that she was collecting information about aspects of current university life. The order in which the two topics were talked about was alternated across subjects. In the introduction to each topic, three general questions were asked about it which were repeated. It was stressed that subjects did not have to confine themselves to those questions alone. Subjects talked on each topic for about 3 minutes. Occasionally, it was necessary for the experimenter to prompt the subject with repetitions of the questions.

Speech Coding

The speech and hesitations were transcribed by a research assistant and each transcript was subsequently checked by the author. Within the speech, meaningless stereotyped expressions such as *well*, *you know*, *I mean*, *and so on*, *sort of*, and *like* were identified and treated as redundant.

These redundant expressions were uttered on average 1.9 times per 100 fluent words. All occurrences of filled pauses, repetitions, and false starts were noted in their exact location in the transcript. Silent pauses of 200 msec and over were measured according to the procedure described by Holmes (1984). Briefly, the speech was digitised by a PDP 11-84 computer system. A higher sampling rate than before was used (8000 Hz), which gives a sample length of 0.125 msec. The speech wave was then represented on a Tektronix 4112 display terminal. Using a Wave Editor program, designated portions of the speech signal could be played back to establish their exact location in the speech. This allowed each silent pause to be determined, measured to the nearest millisecond, and then located in the speech transcript.

The transcribed speech was segmented into sentences, which were defined as independent clauses with any associated subordinate clauses. Redundant linking words introducing sentences (*and*, *but*, *or*, *then*, and *so*) were not counted as true connectives. Clause boundaries were then identified within sentences. Surface clauses were defined as full finite clauses, i.e. units consisting of a subject and a verb phrase whose verbal element was finite. A finite verb was defined as either a modal auxiliary (including *will*) or a verb having past or present tense (Leech & Svartvik, 1975). In (4) there are two surface clauses—*I read the paper* and *while I have some coffee*. The only cases in which finite clauses lacking an explicit subject were considered to be surface clauses were co-ordinate constructions, such as (5). In the co-ordinate clause, *and wander off down to dinner*, the implicit subject *I*, being identical to that in the first clause, has been ellipted:

4. I read the paper while I have some coffee.
5. I don my gown and wander off down to dinner.

Deep clauses within these units were identified primarily by the presence of a non-finite verb, such as an infinitive or a participle. For example, in (6), *You walk around* is a deep clause, as well as being an incomplete finite clause, and *trying to fill in time* is a non-finite deep clause with a further non-finite deep clause *to fill in time* embedded within it. Very occasionally, deep clauses were identified where a verb was implicit, e.g. *then a break* in (7). For simplicity, deep clauses containing a non-finite verb and verbless deep clauses will be called non-finite clauses:

6. You walk around trying to fill in time.
7. I have a Fine Art lecture from ten till eleven then a break.

The boundaries before discontinuous constituents, such as that before

is a very difficult course in (8), were not included in this classification, as they do not bear unambiguously on the question of the advance planning of surface and deep clauses. Only 5% of sentence-internal clause boundaries were before discontinuous constituents:

8. The course I'm doing is a very difficult course.

Each surface and deep clause boundary was coded at the same time for what function the subsequent clause played in the sentence. Examples of each of these functional types are given in Table 1 in both finite and non-finite form where applicable. Two kinds of non-embedded clause were identified: co-ordinate clauses and main clauses following a preposed adverbial clause. Usually, the adverbial was in finite form, but occasionally it was non-finite, as for example in (9). As there were so few of these they were included with the more typical cases. Note that the main clause itself is always finite in both types.

9. After talking to Linda the secretary I go back to my room.

Subordinate clauses were classified into the following standard categories: adverbials, nominal and verbal complements, and non-restrictive

TABLE 1
Examples of Clause Types (the Relevant Clause is in Italics)

Non-embedded clauses
Finite clause (main): As I walk *I usually plan my day at Uni.*
Finite clause (co-ordinate): I get up *and skip for twenty minutes.*
Non-finite clause (co-ordinate): We would be presented with a film *or perhaps read an article.*

Adverbial clauses
Finite clause (preposable): About one o'clock usually I play tennis *if it's fine.*
Finite clause (non-preposable): I learnt that there were some Biology courses I could do *if I took Psychology as a major.*
Non-finite clause: At the end of the day I will usually wander round the Uni *to see which of my friends are left over.*

Relative clauses
Finite clause (non-restrictive): All I can think I dislike actually is Melbourne weather *which is not really the University's fault at all.*
Finite clause (restrictive): You know that there are certain areas *that do require specialisation.*
Non-finite clause (restrictive): I find that a great way *to start the day.*

Complement clauses
Finite clause (nominal): I'm realising *it's okay to flow with your intuitions.*
Non-finite clause (nominal): I really enjoyed *studying Chinese History.*
Non-finite clause (verbal): My course hasn't adequately prepared me *to get a job.*

and restrictive relatives. As there were enough cases to make the distinction, finite adverbials were further classified into those which could be preposed and those which could not be preposed by virtue of their being attached to a lower clause.

Data Analysis

As each subject produced different speech, there were no "items" in this experiment, and so only subject analyses were possible. There were also different numbers of observations for a given category for each subject. The average number of observations on which subjects' data for each category were based is indicated in the tables. When a subject did not produce an example of a particular clause type, the missing score was estimated using Yates' (1933) procedure. The degrees of freedom and error mean square were adjusted accordingly. Cases where missing data occurred are noted. Analyses of variance on both percentage and time measures were performed and, where appropriate, planned orthogonal contrasts were carried out. Where time was the measure, a cut-off procedure was employed, such that any score exceeding two standard deviations from the subject's mean was set at that value. In the analyses on percentages of different linguistic units preceded by a hesitation, it was observed that the standard deviations for the sentence category were more than twice those of the other categories. Analyses were first performed in the usual way including all levels of the factor location. However, as it was important that any small differences between within-sentence categories be detected, a second analysis was performed in which the error term was reduced by excluding the sentence category. Contrasts on within-sentence categories were performed on the basis of the second analysis. All statistical decisions were based on a Type I error rate of $\alpha = 0.05$.

Results and Discussion

For purposes of comparison with the earlier research, the data were first of all summarised ignoring the functional type of the clauses. As stated, discontinuous constituents did not form part of this analysis. The average percentages of different critical locations preceded by a silent pause are shown in Table 2. Overall, the rate at which silent pauses were produced did not differ for the two topics, $F(1,18) = 2.05$. Sentences were preceded by silent pauses more often than were locations within sentences, $F(1,84) = 1288.19$. Clauses in general were preceded by pauses more often than were words within clauses, $F(1,56) = 81.34$, and there was no significant difference between finite and non-finite clauses overall ($F < 1$). There was, however, a significant interaction between topic and location, $F(2,56) =$

TABLE 2
Mean Percentage of Different Linguistic Units Preceded by a Hesitation in Spontaneous Speech[a]

Location	*Silent Pauses*	*Filled Pauses*	*Repetitions*	*False Starts*	
Description topic					
Sentence	69.6	23.4	2.9	5.9	(37)
Finite clause	24.8	3.3	1.8	0.5	(27)
Non-finite clause	19.6	2.9	1.5	0.4	(19)
Within clause	5.6	0.9	0.5	0.7	(384)
Evaluation topic					
Sentence	67.9	24.0	2.9	8.1	(32)
Finite clause	18.1	2.8	2.2	1.8	(30)
Non-finite clause	20.5	3.0	1.4	0.8	(18)
Within clause	7.7	1.3	0.8	0.9	(342)

[a]Average number of observations per subject in parentheses.

4.91. To explore this interaction, contrasts were performed comparing the two clause types for each topic separately. These contrasts showed that for the evaluation topic, the percentages of pauses preceding finite and non-finite clauses were not significantly different, $F(1,56) = 1.28$, whereas for the description topic, finite clauses were preceded by pauses significantly more often than non-finite clauses, $F(1,56) = 5.77$.

The average silent pause lengths are given in Table 3. Five scores had to be estimated for the analysis of these data. The results showed that pauses were longer before sentences than at positions within sentences, $F(1,84) = 294.56$. They were also longer before clauses than before words within clauses, $F(1,84) = 6.12$, but the lengths of pauses before finite and non-finite clauses overall did not differ significantly ($F < 1$). However, there was a significant interaction of topic and location, $F(3,79) = 3.02$. Sub-

TABLE 3
Mean Length of Silent Pauses (200msec or more) Before Different Linguistic Units in Spontaneous Speech[a]

	Topic			
Location	*Description*		*Evaluation*	
Sentence	1144	(25)	1124	(21)
Finite clause	593	(7)	689	(6)
Non-finite clause	676	(4)	651	(4)
Within clause	574	(21)	575	(25)

[a]Average number of observations per subject in parentheses.

sequent contrasts revealed that, while the lengths of pauses before finite and non-finite clauses did not differ significantly in the evaluation topic, $F(1,79) = 1.34$, finite clauses were preceded by *shorter* pauses than were non-finite clauses in the description topic, $F(1,79) = 6.53$. This result is the opposite of what might be expected if before finite clauses speakers integrate across any deep clauses the finite clause might contain. It is noteworthy that Ford (1982) also found shorter pauses before surface clauses than before deep clauses within them, although the difference was not significant.

The silent pause results for the evaluation topic are consistent with Ford's (1982) findings. However, in relation to finite and non-finite clauses, the results for the description topic are more in line with those of Holmes (1984), except that there were no significant differences within pause lengths in her study. Exactly how different topics can produce apparently different results for rate of producing silent pauses will become clear as the rest of the results are presented.

The average percentages of boundaries preceded by filled pauses, repetitions, and false starts can also be seen in Table 2. Although filled pauses were produced much more often than repetitions, the pattern of results for the two hesitation types was highly similar. Both were emitted at the same rate in the two topics (both Fs < 1), and occurred proportionately more often before sentences than before locations within sentences: for filled pauses, $F(1,84) = 225.64$, and for repetitions, $F(1,84) = 11.07$. The percentage of these hesitations before clause boundaries was significantly higher than before words within clauses: for filled pauses, $F(1,56) = 14.11$, and for repetitions, $F(1,56) = 4.82$. They also occurred no more often before finite clauses than before non-finite clauses: for filled pauses, $F < 1$, and for repetitions, $F(1,56) = 1.08$. There was no significant interaction between topic and location for either measure: for filled pauses, $F < 1$, and for repetitions, $F(2,56) = 1.55$. The present findings for filled pauses are very similar to the results Ford (1982) obtained. It is interesting that although the differences were extremely small, essentially the same results were found for repetitions.

The picture for false starts was rather different, however. Unlike the other hestitations, false starts occurred significantly more often in the evaluation than in the description topic, $F(1,28) = 11.13$. This may mean that speakers monitored their speech more carefully for the evaluation topic; or perhaps the difference arose from the increased choice available for this topic compared with the description topic. Despite this overall difference, the same pattern of results as a function of location in the speech was obtained for both topics.

As with the other hesitations, false starts occurred significantly more often before sentences than at locations within sentences, $F(1,84) = 84.20$.

In contrast to the other hesitations, however, they did *not* occur more often before clauses than before words within clauses ($F < 1$). The comparison of finite and non-finite clauses was not significant $F(1,56) = 3.81$, and topic and location did not interact significantly $F(1,56) = 1.96$. Classifying the false starts on the basis of the probable source of difficulty indicated that when speakers changed their mind about what proposition to express, or when to say it, they generally started a new sentence. False starts within sentences were primarily explicable in terms of modifications to lexical items or corrections of pronunciation errors. Thus, when speakers were dissatisfied with choices already made within a sentence, they did not necessarily have to return to a clause boundary to make such lexical alterations.

The results presented so far need to be evaluated in the light of an analysis of the *function* of the clauses produced. Table 4 presents the percentage of silent and filled pauses occurring before clause boundaries classified according to their finite or non-finite status within the major structural types. There were not enough repetitions or false starts before clauses for meaningful analyses on these measures to be performed. Further, owing to the relatively small number of cases, the data had to be

TABLE 4
Mean Percentage of Different Clause Types Preceded by a Silent or a Filled Pause in Spontaneous Speech[a]

	Silent Pauses	*Filled Pauses*	
Non-embedded clauses			
Finite (main):	28.6	6.4	(7)
Finite (co-ordinate):	30.5	4.0	(7)
Non-finite (co-ordinate):	34.1	3.2	(6)
Adverbial clauses			
Finite (preposable):	24.1	4.2	(8)
Finite (non-preposable):	22.8	0.5	(5)
Non-finite (non-finite):	28.1	2.5	(8)
Relative clauses			
Finite (non-restrictive):	48.3	6.7	(4)
Finite (restrictive):	10.4	2.1	(11)
Non-finite (restrictive):	10.4	0.7	(3)
Complement clauses			
Finite (nominal):	12.9	1.9	(13)
Non-finite (nominal):	9.6	2.4	(11)
Non-finite (verbal):	16.6	3.2	(8)

[a]Average number of observations per subject in parentheses.

summarised across the two topics. The data for each functional clause type were analysed separately, and orthogonal contrasts were performed comparing the categories within each type.

For non-embedded clauses, one score had to be estimated in the analyses. The percentage of hesitations before main clauses was not significantly different from that before co-ordinate clauses: for silent pauses, $F < 1$, and for filled pauses, $F(1,55) = 1.90$. Whether co-ordinate clauses were finite or non-finite also made no difference to the probability of prior pausing: for both measures, $F < 1$. Similarly, all contrasts on the adverbial clauses (where three scores were estimated) were non-significant. Comparing finite and non-finite clauses, for both measures, $F < 1$; and comparing preposable with non-preposable finite clauses—for silent pauses, $F < 1$, and for filled pauses, $F(1,53) = 2.66$.

In the analyses of relative clauses, three scores were estimated. The results revealed a marked difference in silent pausing before non-restrictive compared with restrictive relatives, $F(1,53) = 62.81$. Filled pauses also occurred significantly more often before non-restrictive than restrictive relatives, $F(1,53) = 6.07$. These results can be explained by considering the very different function that non-restrictive and restrictive relatives have. As well as containing information already assumed to be known by the interlocutors, restrictive relatives narrow down or specify a particular instance or instances of a concept. By contrast, non-restrictive relatives are used to provide new information, which elaborates on concepts in a preceding nounphrase or entire clause. Thus, the information in non-restrictive relatives is much less closely linked to that in the preceding clause than is the case with restrictive relatives. This conceptual independence would presumably allow for greater independence of planning. Importantly, within restrictive relatives, whether the clause was finite or non-finite was irrelevant. For this contrast, $F < 1$ for both silent and filled pauses.

For complement clauses, there was a tendency for verbal complements to be preceded by silent pauses more often than nominal complements; however, the difference was not significant, $F(1,56) = 3.80$. The percentage of filled pauses before these two types did not differ ($F < 1$). Finite nominals produced no more silent pauses, $F(1,56) = 1.14$, nor filled pauses ($F < 1$), than non-finite nominals.

If we accept that non-restrictive and restrictive relatives are different functional types, then there is no evidence from any of these analyses that *within* a particular structural type hesitations occurred more often before finite than non-finite forms. By contrast, it is clear that differences existed between the functional types themselves. In order to compare the functional types, the data were reclassified disregarding whether the clause was finite or non-finite, a procedure which virtually eliminated the missing

TABLE 5
Mean Percentage of Clauses of Different Functional Types Preceded by a Silent or a Filled Pause in Spontaneous Speech[a]

Clause Type	*Silent Pauses*	*Filled Pauses*	
Non-restrictive relatives	48.3	6.7	(4)
Non-embedded clauses	31.0	4.1	(21)
Adverbials	25.7	2.5	(22)
Restrictive relatives	11.4	1.5	(14)
Complements	12.4	2.3	(32)

[a]Average number of observations per subject in parentheses.

data. (One estimate only remained for the non-restrictive relatives.) The average percentages of filled and silent pauses before the clause types are shown in Table 5.

To analyse the differences, restrictive relatives and complements were grouped together, because they are both cases of clauses being truly embedded within a higher clause. These were compared with the other clause types: non-restrictive relatives, non-embedded clauses, and adverbials. These can be considered as not actually embedded within the preceding clause. Instead, they exemplify various "hypotactic" relations *between* themselves and the prior clause (Halliday, 1985). Following Matthiessen and Thompson (in press), the latter may be termed cases of clause "combining". Both silent pauses and filled pauses occurred more often before combined clauses than before embedded clauses, $F(1,111) = 73.26$ and $F(1,111) = 4.30$, respectively. For both measures, there were no significant differences within the two types of embedded clause (both Fs < 1). Within the combined clauses, non-restrictive relatives were preceded by pauses more often than non-embedded clauses and adverbials: for silent pauses, $F(1,111) = 30.54$, and for filled pauses, $F(1,111) = 4.21$. Adverbials and non-embedded clauses did not differ significantly: for silent pauses, $F(1,111) = 1.64$, and for filled pauses, $F < 1$.

In order to compare the lengths of silent pauses before clauses of different functional types, five subjects who did not make enough pauses were excluded from the analysis. Even so, nine scores had to be estimated. The average lengths are shown in Table 6. The same four contrasts were performed on the means as in the previous analysis. The only contrast for which $F > 1$, was that comparing non-restrictive relatives with non-embedded and adverbial clauses combined, and the result was far from significant, $F(1,87) = 1.48$. Although no effects were observed in these data, this does not mean that a bigger corpus might not detect such differences. Ford

TABLE 6
Mean Length of Silent Pauses (200 msec or more) Before Clauses of Different Functional Types in Spontaneous Speech[a]

Clause Type	*Pause Length*	
Non-restrictive relatives	717	(2)
Non-embedded clauses	643	(6)
Adverbials	654	(6)
Restrictive relatives	644	(2)
Complements	656	(5)

[a]Average number of observations per subject in parentheses, based on 25 subjects.

(1982), for example, found that non-embedded clauses were preceded by longer pauses than other clause types.

The final analysis examined hesitations at one particular location once a clause had been commenced. It has been suggested that people might hesitate after the first word of a clause, especially if it is a conjunction or other linking word (Boomer, 1965; Fodor et al., 1974). Ford (1982) found more silent and filled pauses at these positions than before other words within clauses. It might be expected that the extent to which hesitations occur after a clause connective would depend on the function of that word itself in the clause about to be produced. The more integral a part of the clause is the connective, the less likely might a speaker be to hesitate after it. To examine this possibility, all clauses that were introduced by a connective were selected, and the percentage of silent and filled pauses occurring after the connective was calculated for each major functional clause type. Since main clauses were almost never introduced by connectives, they were not included in the analysis.

The data, for which two scores had to be estimated, are shown in Table 7. The role of relative pronouns (e.g. *who*, *which*) in relative clauses is particularly crucial, as they serve primarily as subjects or objects within the clause. Accordingly, they were followed by pauses less often than were connectives in the other clause types. This effect was significant for silent pauses, $F(1,110) = 33.32$, and for filled pauses, $F(1,110) = 12.74$. Non-restrictive relatives were no different from restrictive relatives in this regard ($F < 1$ for both measures). It was thought that, owing to their greater semantic value, the conjunctions introducing adverbials (e.g. *when*, *because*, *if*) might be more fundamental words in their clauses than the complementisers (e.g. *that*, *to*) introducing complements and the conjunctions (e.g. *and*) introducing co-ordinates. However, neither this

TABLE 7
Mean Percentage of Connectives in Clauses of Different Functional Types Followed by a Silent or a Filled Pause in Spontaneous Speech[a]

Clause Type	*Silent Pauses*	*Filled Pauses*	
Non-restrictive relatives	3.5	0.0	(4)
Co-ordinate clauses	16.3	4.1	(10)
Adverbials	10.8	2.8	(17)
Restrictive relatives	4.0	0.7	(11)
Complements	12.2	2.4	(23)

[a]Average number of observations per subject in parentheses.

contrast nor one comparing complements and co-ordinates approached significance for both measures. Nonetheless, it is clear that for co-ordinates, adverbials, and complements, the position after the connective is an important one for hesitations. A comparison of Tables 5 and 7 indicates that for complements, people hesitated just as often after the complementiser as before the whole clause. For co-ordinates and adverbials, filled pauses occurred just as often and silent pauses occurred about half as often after the conjunction as before the clause.

The results of the analyses involving clause function can be summarised in the following way. While people paused with differing probabilities before clauses of different functional types, whether the clause to be produced was finite or non-finite, made no difference to this probability. Relating this conclusion to the results of the initial analyses, however, reveals an inconsistency. Although the results for the evaluation topic mesh with it exactly, those for the description topic are at odds with it in relation to silent pauses. For the description topic, finite clauses overall were preceded by silent pauses significantly more often than non-finite clauses. Why would the two topics produce apparently different results for silent pausing? The following argument provides one plausible account: Given that silent pause rates differed before clauses of different functional types, such a discrepancy could arise if there were differences in the rates at which finite and non-finite forms *of the clause types themselves* were produced. If a particular speech sample contained many finite clauses of the type which is frequently preceded by pauses, but few non-finite clauses of this type, then pausing rate calculated for all finite clauses pooled would be higher than it would be for all non-finite clauses pooled. In other words, the comparison of pausing rates for finite and non-finite clauses across all functional types would only be unambiguously interpretable if finite and non-finite forms of a given functional type were produced at the same rate. It is therefore critical to determine exactly what was the distribution of

TABLE 8
Percentage of Different Clause Types Produced on Each Topic in Spontaneous Speech

Topic	*Clause Type*	*Finite*	*Non-finite*
Description	Non-restrictive relatives	5.4	0.0
	Non-embedded clauses	21.3	9.2
	Adverbials	12.4	10.8
	Restrictive relatives	9.1	2.9
	Complements	10.1	18.7
Evaluation	Non-restrictive relatives	3.5	0.0
	Non-embedded clauses	4.8	5.3
	Adverbials	15.8	7.2
	Restrictive relatives	14.6	3.4
	Complements	23.1	22.2

finite and non-finite structures of the functional types in the present corpus.

The percentage distribution of clause types produced within each topic, presented in Table 8, shows clearly that an assumption of equal rates of producing finite and non-finite forms may be wrong. As noted earlier, non-restrictive relatives were not produced as non-finite structures, but even as finite structures they were not produced very often for either topic. Within the description topic, while adverbials and restrictive relatives were produced as finite and non-finite clauses about equally often, non-embedded clauses were produced far more often in finite than non-finite form, whereas for complements the reverse was true. Because non-embedded clauses were preceded by silent pauses very frequently, but complements were not, this is just the pattern which would result in the overall pause rate being higher before finite than non-finite clauses. A different distribution was obtained for the evaluation topic. Although non-embedded clauses and complements were produced about the same amount of time in finite and non-finite form, there were more finite than non-finite adverbials. As adverbials are clauses which were often preceded by silent pauses, this would increase the overall probability of pausing before finite clauses. But there were also more finite than non-finite restrictive relatives, which, being seldom preceded by pauses, would act to reduce this value. Thus, the distribution is entirely consistent with the finding that the average probability of pausing before finite clauses was no different from that before non-finite clauses.

The results presented here have indicated that speakers paused with differing probability before clauses of different functional types. People hesitated less frequently before clauses which were embedded within the preceding clause than before clauses which were additions to, or elaborations of, some aspect of the clause they followed. However, within a given

functional type, non-finite clauses were produced just as independently of the prior clause as were finite clauses. The overall higher rate of silent pauses before finite than non-finite clauses for the description topic can be seen to be a result of the unequal rate at which finite and non-finite forms of particular functional types were produced for this topic. Silent pause durations also offered no comfort for the view that finite clauses should be preceded by longer pauses than non-finite clauses, as for the description topic pauses were actually shorter before finite clauses. Note that the results for silent pause *durations* before clauses should be treated with some caution, as they were based on relatively few observations per subject. In order to draw firm conclusions about pause durations, it would be desirable to gain more reliable data from a larger speech sample.

READING SENTENCES ALOUD

This experiment sought to evaluate the extent to which silent pauses in spontaneous speech reflect true hesitation. To this end, students were asked to read aloud representative sentences that had been produced in the spontaneous speaking situation. In reading aloud, the printed text determines the content and structure of the sentence, and hence, any silent pauses would be expected to occur only for phonological and prosodic decision making. Henderson, Goldman-Eisler, and Skarbek (1965) compared rates of producing silent pauses in the two situations and, not surprisingly, found more silent pausing in spontaneous speech than in reading aloud. This indicates that at least some pauses in spontaneous speech may be for planning subsequent semantic and syntactic content.

There is evidence suggesting that when people pause during reading they do so prior to sentences and before "important" surface boundaries within sentences (Grosjean & Collins, 1979; Grosjean, Grosjean, & Lane, 1979). However, the studies do not provide sufficient information for a comparison to be made with the results of the first experiment reported here. Data on probability of pausing were not supplied, and the range of structures studied was very limited. In the present experiment, subjects were asked to read aloud individual sentences containing all the types of clause boundaries that were examined in the preceding experiment. The pattern of results could thus be compared across experiments, so that a statement could be made about which of the pauses in the spontaneous speech were likely to reflect planning activity and which were not.

At this point, some comment should be made about the role of breathing in causing people to pause when speaking. Henderson et al. (1965) found that breaths occurred at "grammatical junctures"; exclusively so for reading, and over two-thirds of the time in spontaneous speech. Grosjean and Deschamps (1975) similarly found that in English spontaneous speech

75% of pauses that were *en fin de phrase* contained breaths. Unfortunately, neither study indicates unambiguously whether breathing occurs more often before sentences than before clauses. In Grosjean and Collins' (1979) reading experiment, however, where these two types of boundary were distinguished, it was found that about 90% of pauses at sentence boundaries contained breaths. By contrast, less than 50% of pauses before finite co-ordinate clauses contained breaths, and there were virtually no breaths at other locations within sentences. Thus, it seems that in reading aloud, people almost always pause to breathe before sentences, presumably while they read the text silently and make prosodic and phonological decisions about how to utter it. It therefore seemed justifiable to have sentences read individually in the present experiment. Nevertheless, because it was important to avoid the criticism that sentences were too short for any pauses to occur naturally, fairly long sentences were used, to increase the chances of breath pauses occurring.

Subjects

A sample of 45 undergraduate students at the University of Melbourne acted as subjects. There were 25 females and 20 males in the sample, and their average age was 21 years and 1 month. Three additional subjects were run, but their data were not included, as they were unable to read more than 50% of the sentences without making some kind of error. Subjects received a very small remuneration for their participation.

Method and Procedure

From the spontaneous speech already gathered, sentences were selected which contained typical examples of all the different clause types as set out in Table 1. Discontinuous clauses were not included. As mentioned, the sentences were longer than the average of 13 words for the spontaneous speech, being either 16, 17, or 18 words in length. Each sentence was chosen to exemplify one of the 12 clause types. The relevant clause boundary occurred either early, after the fourth, fifth, or sixth word of the sentence, or late, after the eleventh, twelfth, or thirteenth word of the sentence. Three sentences were selected for each clause type at each clause position.

Three lists were drawn up containing one example from each of the 24 conditions. The sentences were randomly ordered and interspersed with nine filler sentences. Sentences were typed across a page using only one line, with no internal punctuation and with triple spacing between items. Four warm-up items were used. Each list was given to a separate group of 15 subjects. Giving subjects only a third rather than all of the sentences to

read was to avoid their becoming bored with the task and possibly starting to read in an unnatural way. Further, as a way of obscuring the aim of the experiment, subjects were asked to rate each sentence after they had read it for the plausibility of its meaning. Included in the instructions was the request for subjects to read the sentence in their head first, and then to read it out loud as fluently and clearly as possible, so as to convey its meaning clearly.

The tape-recorded sentences were examined for silent pauses of 200 msec or more by means of the same procedure as in the first study. In addition, any errors or changes to the original sentence were noted and classified as belonging to one of the following categories: wrong word, omission, addition, order error, mispronunciation, and repetition. In analysing the percentages of occasions on which the critical clause boundaries were preceded by a pause, subject analyses of variance could not be performed, because a given subject read only one example from each condition. Percentages were calculated over subjects for each sentence, and the analyses that were carried out were *item* analyses. As there were only three items per condition, rather than analysing each major structural type separately, an increase in power was obtained by performing just two analyses, one for combined clauses and one for embedded clauses. As before, combined clauses were the first seven types exemplified in Table 1, and embedded clauses were the last five types. In the analyses, differences within the main effect of functional type were examined by means of orthogonal contrasts. They were also used to examine whether there was a different effect of clause position for finite and non-finite clauses.

Results and Discussion

Before turning to the results for silent pauses, it is of interest to note that the subjects often made errors when reading the sentences. It appeared that they were probably unused to reading sentences out loud in a clear manner. Across subjects, the average rate of making some kind of error was 1.4 errors per 100 words. The most common error type was reading wrong, though usually highly similar, words (24.1% of all errors). Omitting words represented 23.7% and adding a word or words represented 16.8% of errors. In the latter two cases, the words involved were usually short function words. Order errors occurred only occasionally (5.4%), and no filled pauses were produced. The only errors which resembled those made in spontaneous speech were mispronunciations (16.4%) and repetitions (13.6%).

It would seem that errors were caused either by not reading the text carefully enough in the first place, or from breakdowns in carrying out articulatory commands. In 55% of cases, subjects noticed their error and

corrected it by re-reading the relevant word or words. Errors occurred at the critical clause boundaries only 2.8% of the time, and the distribution of these errors was totally unsystematic with respect to either clause position or clause type. These trials were excluded from the subsequent analyses.

As the subjects in this experiment knew what to say before speaking, the silent pauses they inserted should have been largely for aiming at clear communication for a listener, or for breathing. That some pauses did occur at clause boundaries in reading aloud is indicated by the non-zero values in Table 9, which gives the average percentages of times that clauses were preceded by a silent pause of 200 msec or more. It is evident that such pauses were produced much less often in reading than in spontaneous speech. In addition, their average length, 389 msec, was considerably shorter than that of 656 msec for analogous pauses in the spontaneous speech. It is also apparent that people treated combined and embedded clauses differently, in that there were many more pauses before combined than before embedded clause types.

The analysis of combined clauses will be considered first. Clearly, there were differences in rate of pausing before the various structural types within this general class. First, significantly more pauses occurred before

TABLE 9
Mean Percentage of Different Clause Types Preceded by a Silent Pause (200 msec or more) in Reading Aloud

	Clause Position		
	Early	*Late*	*Mean*
Non-embedded clauses			
Finite (main):	23.0	37.8	30.4
Finite (co-ordinate):	17.8	31.3	24.6
Non-finite (co-ordinate):	2.8	6.8	4.8
Adverbial clauses			
Finite (preposable):	9.0	22.7	15.9
Finite (non-preposable):	4.4	23.3	13.9
Non-finite (non-preposable):	4.4	14.1	9.3
Relative clauses			
Finite (non-restrictive):	9.4	20.0	14.7
Finite (restrictive):	4.4	0.0	2.2
Non-finite (restrictive):	2.2	0.0	1.1
Complement clauses			
Finite (nominal):	0.0	4.4	2.2
Non-finite (nominal):	2.2	0.0	1.1
Non-finite (verbal):	0.0	0.0	0.0

finite than non-finite boundaries, $F(1,28) = 7.07$. Secondly, within finite clauses, there were significantly more pauses before non-embedded clauses than adverbials and non-restrictive relatives, $F(1,28) = 5.76$. The remaining contrasts that were tested within structural type were as follows. One contrast compared the two non-finite types, co-ordinates and adverbials; the others were within the finite clauses. Within finite non-embedded clauses, co-ordinates were compared with main clauses, finite adverbials were compared with non-restrictive relatives, and preposed finite adverbials were compared with non-preposed finite adverbials. None of these contrasts was significant (all Fs < 1).

A third positive finding was that there were more pauses late rather than early in the sentence, but this was significant only for finite clauses, $F(1,28) = 7.34$, and not for non-finite clauses ($F < 1$). The increase in pausing before late compared with early clauses may possibly have resulted from an increased need to breathe as the sentence proceeded. If this is so, then people evidently chose to breathe primarily at finite rather than non-finite clauses. A residual contrast taking up the rest of the sums of squares for clause position and the interaction of position and structural type was not significant ($F < 1$).

From the data presented in Table 9, it can be seen that very few pauses were made before embedded clauses. Even so, it was the case that significantly more pauses occurred before finite than non-finite clauses, $F(1,20) = 5.53$. Note that the magnitude of this average percentage difference was extremely small (1.8). The other contrasts that were tested within structural type compared non-finite restrictive relatives with non-finite complements, non-finite nominal with non-finite verbal complements, and finite restrictive relatives with finite nominal complements. These tests produced no significant differences (all Fs < 1). There was no significant difference in amount of pausing at early and late positions, either for finite clauses overall or non-finite clauses overall (both Fs < 1). This suggests that, even if people did need to breathe more often later in a sentence, they did *not* do so before embedded clauses, whether finite or non-finite.

The residual taking up the rest of the sums of squares for clause position and the interaction of position and structural type was significant, $F(3,20) = 14.45$. In other words, there was an interaction between clause position and structural type, but it was unrelated to whether the clause boundary was finite or non-finite. It seemed to occur largely because the only pauses that occurred before finite clauses were at the early position for relatives and the late position for nominals. This interaction pattern has no ready interpretation, and given the very small values concerned, it did not seem worthwhile giving it prolonged attention.

It is of interest to compare the mean percentages over clause position in

Table 9 with the mean percentages of silent pausing in spontaneous speech shown in Table 4. Considering first the combined clauses, it can be seen that people paused before finite non-embedded clauses just as often in reading as they did when speaking spontaneously. For finite adverbials, they paused somewhat less often in reading, the rate being about two-thirds that of spontaneous speech. However, for non-restrictive relatives, people paused three times less often in reading than in spontaneous speech. Importantly, the rate of pausing before non-finite clauses was markedly different in the two speaking tasks. Non-finite co-ordinates were preceded by pauses seven times less often in reading than in spontaneous speech, and for non-finite adverbials pausing was three times less frequent in reading. Turning to the embedded clauses, it is clear that, even though relatively few of these were preceded by pauses in spontaneous speech, there were even fewer pauses before them in reading. Finite embedded clauses were preceded by pauses 5 times less often in reading than in spontaneous speech, and non-finite embedded clauses occasioned pauses over 16 times less often.

The results of this experiment are consistent with the findings cited above, that people often pause at clause boundaries when reading aloud. Their value lies in showing exactly what kinds of clauses are considered to be realistic locations for pausing. It was found that subjects were sensitive to the degree of linkage a clause had with the one preceding it. They scarcely paused at all before embedded clauses, such as restrictive relatives and complements, apparently realising that pausing before these clauses might impede communication. This finding allows the inference that the pauses occurring before embedded clauses in spontaneous speech are *not* listener-oriented. Rather, the vast majority of such pauses must presumably represent true hesitations.

By contrast, readers did pause quite frequently before clauses having a less intimate connection with the prior clause, namely combined clauses such as non-embedded clauses, adverbials, and non-restrictive relatives. From these data it is not possible to distinguish between their role as actually helpful to the listener or merely as being less detrimental to communication than at other locations. Nevertheless, of particular importance in the present context is the further finding that readers differentiated finite from non-finite clause boundaries as locations for silent pausing. In reading aloud, silent pauses occurred more often at finite than non-finite boundaries. Whereas this difference was only small for the embedded clauses, it was quite substantial for the combined clauses. This is a crucial difference between the results for reading aloud and spontaneous speech, where probability of silent pausing was no higher for finite than non-finite clauses when clause function was taken into account. It implies that, while many silent pauses in spontaneous speech before *finite* combined clauses

cannot be given an unambiguous interpretation, those occurring before *non-finite* clauses of this type are hardly likely to be motivated by concern for a listener. They are presumably only there because the subsequent clause has not yet been fully assembled for output.

The present results, then, only constrain the interpretation of silent pauses in spontaneous speech when these pauses occur before finite combined clauses. Thus, the results provide support for the conclusion already drawn, that non-finite clauses are planned as distinct units within finite clauses during spontaneous speech.

STORY CONTINUATIONS

The aim of this part of the study was to clarify processes involved in producing short continuations to stories; in particular, to see how the results obtained for speech in this task might be reconciled with those obtained in the spontaneous speech situation. Recall that Holmes (1984) found that the probability of making a silent pause was higher before surface than before deep clauses in the story continuation task. In conjunction with the results of the times taken to initiate the utterances, this finding was taken to mean that deep clauses were not separable units within surface clauses. But we have already seen that an overall result of more frequent silent pausing before surface clauses than before deep clauses within them may be obtained in spontaneous speech as well. This occurred where, because of the topic being talked about, clauses that were often preceded by silent pauses were produced more often in finite than in non-finite form. Thus, the question arises as to whether the story continuation result may be explained by a similar imbalance of finite and non-finite forms across functional clause types. The present experiment attempted to determine whether this was the case.

Three things are necessary to establish the validity of this account. First, it has to be determined whether clauses of different functional types evoke different amounts of prior pausing in this task. Secondly, if this is so, it has to be seen whether this is true for both finite and non-finite forms of each functional type. Thirdly, the distribution of functional clause types has to be examined, to find out whether there are more finite than non-finite clauses of the type often preceded by pauses.

Subjects

The 30 subjects for this experiment were those who participated in the first part of the study. Both parts were conducted in the one experimental session. An additional four subjects were run, but their data were subsequently rejected on the basis of their performance in the story continuation

task. One subject did not conform to the constraints of brevity, while the other three had extremely variable voice initiation times.

Method and Procedure

A set of 40 simple stories was composed based on everyday stereotypical events, such as sitting for an exam, visiting someone in a hospital, going on a picnic, cooking a meal, etc. Each story was either two or three sentences long. An additional 32 filler items composed of either a single sentence or four sentences were randomly interspersed among the test stories.

The stories were presented to subjects according to exactly the same procedure as that described by Holmes (1984). Sentences appeared on the screen of a microprocessor system one at a time at a rate controlled by the subject by pressing a button. The subjects were instructed to read the sentences of the story without spending too much time on them. The last button press introduced a signal (a line of dots), which was the cue to make up and say a single sentence that continued the story sensibly. The subject could not tell until the line of dots appeared exactly when the story was going to end. Thus, even if some very general planning of content was taking place while the sentences were being read, the time between the signal and vocalisation should represent time needed for planning enough details of the utterance for vocalisation to begin.

Subjects' utterances were spoken into a microphone attached to headphones they were wearing, and were recorded on one channel of a tape-recorder. The subject's voice activated a voice-key which sent a signal to the computer and a tone on to the other channel of the tape-recorder. The voice-key was also set to detect any pauses longer than 6 seconds once the utterance had begun. When a pause of this duration occurred, the computer was instructed to commence the next trial. Voice initiation times were measured by the computer from the onset of the dots signal until the activation of the voice-key. However, it was necessary to check all these responses and to adjust for any occasions when the voice-key was activated prior to or after the first speech sound. This was done subsequently by listening to the speech and the tone via the Wave Editor system already described. Silent pauses of 200 msec or more within the utterance were also measured using this procedure.

On 1.7% of test trials data were lost because subjects made no response within 6 seconds or the voice-key did not go off. A further 0.8% of test trials were discarded because subjects' utterances did not appear to be continuations of the story they had just read. There was an average of 39 test utterances remaining for each subject. The utterances were transcribed and treated in the same way as the spontaneous speech in the first part of

the study. Filled pauses, repetitions, and false starts were also identified. These occurred comparatively rarely. Filled pauses never occurred before utterances, and within utterances they occurred on average 0.2 times per 100 words. Repetitions and false starts occurred before 1.5 and 0.8% of trials respectively, and within utterances they occurred on average 0.4 and 0.9 times per 100 words respectively. Thus, these hesitations did not yield enough data for meaningful analyses of them to be conducted.

Sentence and clause boundaries were determined. As before, the functional type of the clause and its finite or non-finite status was noted. The 2.8% of clause boundaries before discontinuous constituents were not included in the pause analyses. In addition, each utterance was classified according to whether it contained one sentence or more than one sentence. A two-sentence utterance is exemplified in (10):

10. She asked for permission to go and get her glasses. [But] it was refused.

Single-sentence utterances were then classified according to whether they contained one or more than one finite clause. The additional finite clauses could be of any functional type. A single-sentence utterance containing two finite clauses is shown in (11):

11. He then decided he wouldn't make the breakfast after all.

Sentences containing only one finite clause were then divided into those containing at least one non-finite clause, as in (12), compared with those containing only a finite clause, as in (13):

12. One of the party went out to get some more wine at the nearby pub.
13. They couldn't find much in the way of Chinese ingredients at the supermarket.

After the syntactic coding was complete, silent pauses were located on the transcripts.

Results and Discussion

The voice time results will be discussed after an examination of the results for silent pauses. Table 10 presents data on the percentages of sentences, finite and non-finite clauses, and words within clauses, that were preceded by a silent pause. Sentences were preceded by silent pauses significantly more often than were locations within sentences, $F(1,84) = 86.06$, and clauses were preceded significantly more often by silent pauses than were

TABLE 10
Mean Percentage of Different Linguistic Units Preceded by a Silent Pause (200 msec or more) and Mean Silent Pause Length in Story Continuations[a]

Location	*Pauses (%)*		*Pause Length*[b]	
Sentence	33.7	(10)	536	(5)
Finite clause	17.5	(33)	539	(7)
Non-finite clause	10.7	(22)	565	(3)
Within clause	4.1	(435)	466	(21)

[a]Average number of observations per subject in parentheses.
[b]Based on 23 subjects.

words within clauses, $F(1,84) = 14.49$. Finite clauses were preceded by silent pauses significantly more often than non-finite clauses, $F(1,84) = 5.09$. The average length of pauses of 200 msec or more for these locations was calculated for 23 subjects for whom there were enough data. Three scores were estimated in these data, which are also given in Table 10. None of the contrasts on these values approached significance. Comparing sentences with the other locations and comparing finite and non-finite clause boundaries led to $F < 1$, and for the comparison of clause boundaries and words within clauses, $F(1,63) = 2.78$. The pattern of results for silent pauses once the person started speaking is highly compatible with that obtained by Holmes (1984).

The percentages of clauses of different functional types that were preceded by silent pauses are shown in Table 11. Non-restrictive relatives were not included, as they were not produced frequently enough in this task. Three missing values were estimated for the analysis. Combined clauses (non-embedded clauses and adverbials) were preceded by pauses significantly more often than embedded clauses (complements and restrictive relatives), $F(1,81) = 45.18$. Non-embedded clauses were preceded by pauses significantly more often than adverbials, $F(1,81) = 8.83$, but the difference between complements and restrictive relatives was not significant, $F(1,81) = 1.35$. These results are quite consistent with those reported above for the spontaneous speech. The major difference was the significantly higher rate of pausing before non-embedded than adverbial clauses in this task, although there was a non-significant difference in this direction in the spontaneous speech. There were not enough data to perform reliable analyses on the lengths of pauses before clauses of different functional types.

To see whether silent pausing rate varied according to whether the clauses were finite or non-finite, the clauses were subdivided according to

TABLE 11
Mean Percentage of Clauses of Different Functional Types Preceded by a Silent Pause in Story Continuations[a]

Clause Type	*Pauses (%)*
Non-embedded clauses	29.4 (12)
Adverbials	19.0 (14)
Restrictive relatives	9.7 (5)
Complements	5.6 (23)

[a]Average number of observations per subject in parentheses.

this feature. Not enough non-finite restrictive relatives were produced for restrictive relatives to be included in the analysis, and six scores had to be estimated. The mean percentages of clauses preceded by silent pauses of 200 msec or more can be seen in Table 12. Comparing finite and non-finite clauses within each functional type produced non-significant results: for non-embedded clauses, $F(1,50) = 2.60$; for adverbials, $F < 1$; and for complements, $F(1,50) = 1.04$. Just as in the spontaneous speech, there was no evidence that silent pauses occurred more often before finite than non-finite clauses for a given functional clause type.

The percentage of times that people paused after a connective introducing a clause was again calculated for each functional clause type. The means over subjects are shown in Table 13. When the same contrasts as were tested in the spontaneous speech were performed, no significant effects were obtained: for the contrast comparing restrictive relatives with the remaining types, $F < 1$; for the contrast comparing adverbials with complements and co-ordinates, $F(1,79) = 1.25$; and for the contrast between complements and co-ordinates, $F < 1$. The average of the values (4.5) was scarcely higher than the percentage of times that words in general within clauses were preceded by pauses (4.1). Thus, it would seem that for

TABLE 12
Mean Percentage of Different Clause Types Preceded by a Silent Pause in Story Continuations[a]

Clause Type	*Finite*		*Non-finite*	
Non-embedded clauses	30.4	(10)	23.2	(2)
Adverbial clauses	16.5	(8)	18.2	(6)
Complement clauses	8.0	(11)	3.4	(12)

[a]Averge number of observations per subject in parentheses.

TABLE 13
Mean Percentage of Connectives in Different Clause Types Followed by a Silent Pause in Story Continuations[a]

Clause Type	*Pauses (%)*
Co-ordinates	5.5 (8)
Adverbials	3.6 (12)
Restrictive relatives	3.4 (3)
Complements	5.4 (17)

[a]Average number of observations per subject in parentheses.

no structural type in this task was the position after a clause connective, if there was one, a privileged location for pausing. This result differs from that obtained in the spontaneous speech, where, for all clause types except relatives, this position did contain hesitations more often than did other words within clauses. Apparently, subjects in the story continuation task were fairly certain what they wanted to say once they began a clause; any silent pauses occurring within a clause would presumably have resulted from problems in locating appropriate lexical items.

The next step in analysing the data was to determine how often finite and non-finite structures were produced for each functional clause type. The percentage distribution of finite and non-finite clauses is shown in Table 14. Comparing the values with those given in Table 8 indicates that the distribution was not exactly the same as either topic in the spontaneous speech. Nevertheless, in one critical respect it was more similar to that obtained for the description than the evaluation topic. Whereas other clause types were produced about equally often in finite and non-finite form, there were many more finite than non-finite non-embedded clauses.

TABLE 14
Percentage of Different Clause Types Produced in Story Continuations

Clause Type	*Finite*	*Non-finite*
Non-restrictive relatives	1.6	0.0
Non-embedded clauses	18.0	4.1
Adverbials	14.7	9.7
Restrictive relatives	6.1	2.6
Complements	20.4	22.8

Because non-embedded clauses were the clause type before which silent pauses occurred the most frequently, this difference in their distribution invites the same conclusion as was drawn for the spontaneous speech, i.e. the overall result of more silent pausing before finite than non-finite clause boundaries should again not be taken at face value. In this case, it is merely a consequence of the disproportionate representation of non-embedded structures among the finite clauses compared with the non-finite clauses. If this argument is correct, then it is only from the analysis of separate functional clause types that an accurate picture of the data is to be gained. This analysis revealed that probability of pausing was *not* significantly higher before finite than non-finite clauses for each functional type.

In sum, the results so far have indicated that the speech produced in this task was different in some ways from that produced in the spontaneous speech situation. The speech was markedly more fluent, containing very few filled pauses and exhibiting a much lower rate of producing repetitions and false starts. Silent pauses of 200 msec or more occurred much less often than in the spontaneous speech, particularly before sentences. When silent pauses did occur, they were on average much shorter at all locations. In addition, silent pauses did not occur after clausal connectives any more than at other positions within a clause. Given the relative simplicity of content and the constraint on utterance length, the greater fluency of the story continuations is not surprising. These features were also true of the speech obtained by Holmes (1984); they suggest that subjects may have pre-planned their utterances in considerable detail before speaking. What is important is that the *pattern* of silent pausing in the story continuation task turned out to be the same as that in the spontaneous speech. Silent pausing before embedded clauses occurred less often than pausing before combined clauses, and whether the clause was finite or non-finite within a functional type did not influence pausing rate. The overall higher amount of pausing before finite than before non-finite clauses could thus be explained by the preponderance of non-embedded clauses that were finite, just as in the description topic in the spontaneous speech.

It remains to examine the results for the time taken to initiate the speech. The average voice initiation times for utterances in the four syntactically defined categories are shown in Table 15. In the analysis, one category for one subject contained no observations, and so this score was estimated. It is apparent from the results that subjects paused for longer before starting to utter more than one sentence than before commencing just one. This comparison was significant, $F(1,86) = 6.24$, and is in agreement with Holmes' (1984) finding. However, in contrast to the results of that study, uttering more than one surface clause took no more planning time than uttering only one surface clause, $F(1,86) = 1.26$. Finally, as Holmes (1984) found, within utterances of only one surface clause, being

TABLE 15
Mean Voice Initiation Times (msec) and Mean Utterance Length (Words) for Different Utterance Types in Story Continuations[a]

"Linguistic Level" of Utterance	*Voice Time*	*Utterance Length*	
More than one sentence	1643	17.3	(9)
One sentence: more than one surface clause	1557	14.8	(18)
One sentence: one surface clause with more than one deep clause	1479	12.2	(5)
One sentence: one surface and only one deep clause	1516	8.3	(7)

[a]Average number of observations per subject in parentheses.

about to utter more than one deep clause made no difference to planning time ($F < 1$).

The failure to find an effect of number of surface clauses on voice times is a fundamental difference between the present results and those of the earlier story continuation study. One possible reason for the discrepancy is that any significant differences among linguistic categories could merely reflect the fact that subjects need to plan for longer before producing a longer utterance, regardless of the number of sentences or clauses that it contains. Holmes (1984) found an increase in utterance length as "linguistic level" of the utterance increased. Perhaps the present data differed from this, such that multi-sentence utterances were longer than single-sentence utterances, which were all the same length. However, the average lengths in words of the utterances that the present subjects output, which are also shown in Table 15, show that this was not the case. Since the length differences within single-sentence utterances were just as great as the difference in length between single-sentence and multi-sentence utterances, the failure to find voice time differences within single-sentence utterances cannot be explained in this way.

An alternative is to suppose that subject differences may have contributed to the different pattern of results observed in the two experiments. Despite the fact that the utterances were extremely similar in terms of the types of meanings conveyed and the range of structures used, subjects' speed of performing all aspects of the task was markedly faster in the present experiment compared with the earlier one. Perhaps the present subjects were in some way able to plan their outputs more rapidly and efficiently than the earlier subjects. Even if this were so, the fact that they paused for longer before multi-sentence than before single-sentence utterances would still have to be explained. It may be that when subjects replied with more than one sentence, this was because they could not find a ready

way to continue the story in just one sentence, as the instructions requested. In other words, the longer times in this experiment for that one condition may have come about as a result of hesitation due to task-related thinking rather than linguistic planning.

It is evident that no really satisfactory explanation of the difference in patterns of voice times across the two studies is at hand. Whatever this account turns out to be, the present voice time data taken on their own are entirely consistent with the preceding interpretation of the silent pause data. There was no evidence that, if integration over deep clauses within surface clauses occurred before the person started speaking, this integration took any extra time. There were also no grounds for concluding that more planning time was necessary if more than one surface clause was about to be uttered. Within each functional type, deep clauses appear to be planned in the same way as surface clauses.

GENERAL DISCUSSION

The research reported here has shown that people hesitate as often before non-finite as before finite forms of a given functional clause type. Because the boundaries before non-finite clauses correspond to deep structure clause boundaries, the findings provide additional support for the proposal of Ford and Holmes (1978) and Ford (1982) that deep structure clauses are fundamental speech planning units within surface structure clauses. The plausibility of the claim may have been obscured in earlier discussions because the concept of the deep structure clause was not made very explicit, typically involving examples of non-finite complement clauses embedded within full finite clauses. Perhaps if deep structure clauses had been exemplified by non-finite co-ordinate or adverbial clauses attached to relatively complete finite clauses, the proposal would have been better understood.

Another outcome of the experiments presented here is the unification of the results for producing brief story continuations and those for spontaneous speech. It is clear that the story continuation task allows more advance planning of the entire utterance than does spontaneous speech. But the present results have indicated that this did not lead to surface clauses contributing more to pre-utterance pause time than deep clauses, nor did finite and non-finite clauses differ in terms of segregation in the speech output once clause function was considered. It can be concluded that the finding of more silent pausing overall before finite than non-finite clauses in this task was caused by the differential rates of producing finite and non-finite forms of particular functional types, as it was in the description topic in the spontaneous speech. The results, then, indicate that speakers plan deep clauses in the story continuation task just as they do in more naturalistic situations.

It might be wondered why clause types would differ in frequency depending on the topic being talked about. The reason for this is that there is a correspondence between classes of meanings and the structures which convey them the most simply. For example, when describing a typical day, subjects used five times as many finite non-embedded clauses as when evaluating university life. This difference was largely due to the more frequent use of finite co-ordinate clauses in describing sequences of events, as in (14):

14. I usually sneak in and sit down at the back.

These constructions also occurred frequently in the story continuations for the same reason. The evaluation topic, on the other hand, evoked more than twice as many finite complement clauses as did the description topic. This was in order to state personal opinions, as in (15), sometimes simply by prefacing remarks with the phrase *I think*, as in (16):

15. I find that it's a very rewarding experience.
16. I think it's not as relevant as psychology.

Complements in general were the most frequently used of the structures in the story continuation task, usually to express the thoughts and reactions of the characters, as in (17):

17. The baby hated having baths.

Clearly, it is necessary to be aware of how the syntactic structures produced in any given speech situation may vary depending on particular discourse, pragmatic and semantic requirements.

The present study, by examining silent pauses when people read aloud representative sentences from the spontaneous speech task, has also permitted some conclusions to be drawn about the extent to which silent pauses represent forward planning of speech. For many pauses before combined clauses, if they are finite, there is no way of knowing whether the pauses are for planning ahead, reflecting on the previous speech, demarcating units for the listener, or breathing. However, the reading results have shown that we can be confident that pauses before *non-finite* forms of these clauses are not generally inserted for communicative reasons. Similarly, the virtual absence of pauses before embedded clauses when sentences are read aloud guarantees that such pauses in spontaneous speech are not listener-oriented. It is highly probable, then, that many of these pauses in spontaneous speech represent genuine hesitations, whether or not they allow some other function such as breathing or monitoring earlier

speech as well. Thus, the results of the reading aloud experiment leave intact the interpretation of the silent pause data of the spontaneous speech study as demonstrating the importance of the deep structure clause in sentence planning.

It is worth noting that the major claims being made here in relation to spontaneous speech could in fact be substantiated without reference to silent pauses at all. Apart from the finding of more silent pauses before finite than before non-finite clauses overall in the description topic, which in any case has been seen to be ambiguous, every result which was significant for rate of producing silent pauses was also significant for rate of emitting filled pauses. It would be difficult to imagine why filled pauses would occur unless speakers were unable to continue an utterance they had started or were unable to begin an utterance to their satisfaction. Repetitions must surely serve a similar time-filling function. Although they were produced much less frequently than filled pauses, they also occurred just as often before non-finite as before finite clauses. Thus, all three hesitation types provide a consistent picture of difficulties encountered in sentence planning.

False starts also had the same rate of occurrence before finite and non-finite clauses. However, they differed from the other hesitations in occurring no more often before clause boundaries than before words within clauses. Inspection of the false starts revealed that when speakers changed their mind about which idea to express, they almost always started the whole sentence again. But for lexical or pronunciation changes, people did not need to return to clause boundaries any more than to word or phrase boundaries. False starts can be seen as occurring for somewhat different reasons from filled pauses and repetitions. Rather than arising from difficulty in deciding on or formulating what one is *about* to say, they demonstrate dissatisfaction with a linguistic choice that has already been made and that has received partial or complete physical expression.

The conclusion that has been drawn so far is that deep clauses serve as planning units within surface clauses in both speech situations considered here. But it does not follow from this that every deep clause is planned as independently as every surface clause. A critical finding of the present study is that embedded clauses (restrictive relatives and complements) are produced with fewer prior hesitations than combined clauses (non-restrictive relatives, non-embedded clauses, and adverbials). The equivalence of hesitation rates before finite and non-finite clauses occurs only within a given functional clause type. The fact that clauses with different functions are produced with different amounts of prior hesitation suggests that speakers decide first on the clausal function that satisfactorily expresses the relation between the propositions to be conveyed. Only then do they decide on the particular phrasal groupings to express each proposition,

and whether a finite or non-finite form is finally chosen to represent the proposition is of no consequence. This is not to deny that the exact form in which the clause is couched may not be important for *listeners*, as Ford and Holmes (1978) point out. It may well be that clauses which are superficially complete are more comprehensible to listeners. But the fact that a unit may be superficially incomplete is not a problem for speakers, because speakers themselves know ultimately what they want to say.

The finding that embedded clauses are preceded by hesitations less often than combined clauses demonstrates that embedded clauses must frequently be planned further ahead than combined clauses. This seems entirely plausible, as the functions which restrictive relatives and nominal and verbal complements serve are fundamental to the higher clauses within which they are embedded, whereas combined clauses have a much more optional role. To know exactly which types of decisions are obligatory and which types of decisions can be delayed before different clause types are uttered is of fundamental importance to models of the speech production process. Unfortunately, on the basis of hesitation data alone, the types of decisions that are made prior to any clause being uttered cannot be specified.

What hesitations can reveal about sentence planning is also limited by the fact that planning for what one is about to say next does not *require* any sort of hesitation, at least within sentences, and may to some degree proceed while the person is uttering previously planned speech. It was the attempt to examine production processes without relying on hesitations that prompted Ford and Holmes (1978) to use a divided attention task, where reaction times to intermittently occurring clicks served as an index of processing load. Recently, Power (1986) has reported the use of a motor tracking task which may be even better, as it allows a continuous measure of processing load during speech output. However, even these techniques cannot provide information as to what is *causing* any fluctuations in processing load as a sentence is uttered. Processing load may be high because subsequent speech is being planned ahead or because local difficulties in lexical choice or syntactic construction are being encountered. It might be fruitful to study hesitations and processing load at the same time, to see whether units that are preceded by hesitations have different patterns of processing load from units that are produced without prior hesitation. For example, it may be that if speakers hesitate before a sentence, processing load within the sentence is lower, reflecting only residual lower-level decisions. Such possibilities could be further elaborated and tested.

Some insight into the nature of the different kinds of decisions that speakers have to make has been obtained from the study of errors that occur naturally in spontaneous speech. On the basis of such errors, Garrett

(1976, 1980, 1982) has argued that planning for functional relations of clauses can be distinguished from planning for superficial details. According to his model, planning at the functional level involves choosing an abstract semantic specification for each of the concepts of the non-linguistic message, and determining the basic functional relations between them. Mistakes can occur during the planning of this level, resulting in word exchange errors, such as that in (18):

18. Is there a cigarette building in this machine?

Garrett (1980) has noted that, while errors like this may occur across different phrases, they are usually within the same surface clause. However, they can cross surface clause boundaries, doing so 20% of the time, with the maximum span being two surface clauses.

At the subsequent "positional" level, a planning frame for the sentence is computed, in which the serial position of the concepts is fixed, and the corresponding lexical items and their phonological forms are identified. This information in turn must be converted into phonetic, prosodic, and respiratory specifications for the articulatory system. Mistakes can also arise at the positional level, and are exemplified by "stranding" errors, such as that in (19), or sound exchanges (Spoonerisms), such as that in (20):

19. Fancy getting your model renosed.
20. Bill snovels show.

Garrett (1980) reported that these errors not only usually occur within the same surface clause, but also generally within the same phrase. In fact, a large percentage (41%) of sound exchanges is restricted to adjacent words.

If Garrett's notion of a surface clause corresponds to the one being assumed here, then it follows from the finding that word exchanges *can* occur in separate surface clauses, that functional planning is not always limited to an individual surface clause. What the present research suggests is that the extent to which such advance planning occurs should depend on the clause's functional type. Clause-crossing of word exchanges would be expected to be much more likely for embedded than combined clauses. A stranding error recently uttered by a colleague, given in (21), attests to the fact that clause-crossing can certainly occur for restrictive relatives:

21. The chair that I just papered wasn't on Psychology.

On the other hand, Garrett's (1980) examples of cross-clause word exchanges were all non-embedded clauses. Garrett argued that there may be

something special about the occasions on which this kind of long-distance planning occurs. Apparently, the cases involved sentences where virtually the same structure was used for each clause, as in (22), or where a meaning opposition was intended, as in (23):

22. I read the newspaper, watch the radio and listen to TV.
23. Once I stop, I can't start.

Nevertheless, these error data indicate that functional planning of combined clauses may sometimes be going on well before the actual utterance of the clause. Even non-restrictive relatives, which often seem to be parenthetical remarks or complete afterthoughts, may be anticipated at a functional level during the preceding clause. A speech error made by another colleague, given in (24), although not completed by the speaker as in Garrett's examples, provides evidence of such anticipation:

24. He worked all night and all morning, which he called bizarre, I mean, which he called being a night-owl, but which I call bizarre.

Not just functional organisation, but also superficial details, should be more likely to be planned ahead for embedded than for combined clauses. Indeed, embedded clauses may sometimes be completely pre-planned before the speaker begins to utter the clause containing them. Some data consistent with this possibility have been reported by Garrett (1980). He noted that sound exchanges, presumed to arise during positional-level planning, may cross surface clause boundaries. Of the four examples that he gave, two are not relevant to the present argument, as the other "clause" was either a one-word vocative (a person's name) or a one-word stock expression (*Help*). But the other two examples were nominal complements (25 and 26):

25. I bess I getter go.
26. I never know you nuticed.

It would be interesting to know whether these examples are representative of the occasions on which sound exchanges cross surface clauses. On the basis of the claim being made here, it would be expected that the phenomenon would also occur for restrictive relatives, but would be unlikely for combined clauses.

In conclusion, the research reported here has shown that the probability of hesitating before a clause is differentially determined by its functional role, embedded clauses being produced with fewer prior hesitations than combined clauses. This suggests that embedded clauses are more likely to

be planned ahead than are combined clauses. The present study has also demonstrated that, for each functional clause type, speakers were no more hesitant before finite than non-finite clauses. The results have therefore confirmed our earlier conclusion that deep clauses, in spite of their superficial degradation, function as planning units within surface clauses. Precisely how decision making proceeds within clausal and sentential units cannot be answered on the basis of the present data. However, one way of making some progress towards a model of the speaker might be to apply the distinctions between clause types that have been utilised here in an analysis of speech errors.

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REFERENCES

Beattie, G. W. (1980). The role of language production processes in the organization of behaviour in face-to-face interaction. In B. Butterworth (Ed.), *Language production, Vol. 1: Speech and talk*, pp. 69–107. London and San Diego: Academic Press.

Beattie, G. W. (1983). *Talk*. Milton Keynes: Open University Press.

Beattie, G. W. & Bradbury, R. J. (1979). An experimental investigation of the modifiability of the temporal structure of spontaneous speech. *Journal of Psycholinguistic Research, 8*, 225–248.

Boomer, D. S. (1965). Hesitation and grammatical encoding. *Language and Speech, 8*, 148–158.

Fodor, J. A., Bever, T. G., & Garrett, M. F. (1974). *The psychology of language*. New York: McGraw-Hill.

Ford, M. (1982). Sentence planning units: Implications for the speaker's representation of meaningful relations underlying sentences. In J. Bresnan (Ed.), *The mental representation of grammatical relations*, pp. 797–827. Cambridge, Mass.: MIT Press.

Ford, M. & Holmes, V. M. (1978). Planning units and syntax in sentence production. *Cognition, 6*, 35–53.

Garrett, M. F. (1976). Syntactic processes in sentence production. In R. J. Wales & E. C. T. Walker (Eds), *New approaches to language mechanisms*. Amsterdam: North-Holland.

Garrett, M. F. (1980). Levels of processing in sentence production. In B. Butterworth (Ed.), *Language production, Vol. 1: Speech and talk*, pp. 177–220. London and San Diego: Academic Press.

Garrett, M. F. (1982). Production of speech: Observations from normal and pathological use. In A. Ellis (Ed.), *Normality and pathology in cognitive functions*, pp. 19–76. London and San Diego: Academic Press.

Gleason, H. A., Jr (1965). *Linguistics and English grammar*. New York: Holt, Rinehart & Winston.

Goldman-Eisler, F. (1968). *Psycholinguistics: Experiments in spontaneous speech*. London and San Diego: Academic Press.

Goldman-Eisler, F. (1972). Pauses, clauses, sentences. *Language and Speech, 15*, 103–113.

Grosjean, F. & Collins, M. (1979). Breathing, pausing and reading. *Phonetica, 36*, 98–114.

Grosjean, F. & Deschamps, A. (1975). Analyse contrastive des variables temporelles de l'anglais et de français: Vitesse de parole et variables composantes, phénomènes d'hésitation. *Phonetica*, *31*, 144–184.

Grosjean, F., Grosjean, L., & Lane, H. (1979). The patterns of silence: Performance structures in sentence production. *Cognitive Psychology*, *11*, 58–81.

Halliday, M. A. K. (1985). *An introduction to functional grammar*. London: Edward Arnold.

Hawkins, P. R. (1971). The syntactic location of hesitation pauses. *Language and Speech*, *14*, 277–288.

Henderson, A., Goldman-Eisler, F., & Skarbek, A. (1965). Temporal patterns of cognitive activity and breath control in speech. *Language and Speech*, *8*, 236–242.

Holmes, V. M. (1984). Sentence planning in a story continuation task. *Language and Speech*, *27*, 115–134.

Leech, G. & Svartvik, J. (1975). *A communicative grammar of English*. London: Longman.

Levelt, W. J. M. (1983). Monitoring and self-repair in speech. *Cognition*, *14*, 41–104.

Maclay, H. & Osgood, C. E. (1959). Hesitation phenomena in spontaneous English speech. *Word*, *15*, 19–44.

Matthiessen, C. & Thompson, S. A. (in press). The structure of discourse and "subordination". In J. Haiman and S. A. Thompson (Eds), *Clause combining in discourse and grammar*.

Power, M. J. (1986). A technique for measuring processing load during speech production. *Journal of Psycholinguistic Research*, *15*, 371–382.

Rochester, S. R. & Gill, J. (1973). Production of complex sentences in monologues and dialogues. *Journal of Verbal Learning and Verbal Behavior*, *12*, 203–210.

Valian, V. V. (1971). *Talking, listening and linguistic structure*. Unpublished doctoral dissertation. Northeastern University, Boston.

Yates, F. (1933). The analysis of replicated experiments when field results are incomplete. *Empire Journal of Experimental Agriculture*, *1*, 129–142.