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THE COMPREHENSION OF SENTENCES

CONTAINING TEMPORAL CONNECTIVES

MARION ENGLAND

1990

A thesis submitted for the degree of Doctor of Philosophy
in the Faculty of Science, University of Durham

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28 AUG 1991

ABSTRACT

This thesis brings together ideas from psychology (particularly the work of Bever and Townsend 1979) and from linguistics (particularly the work of Partee, 1983 and Moens and Steedman 1986) about the nature of temporal representation, especially with regard to the effect of different temporal connectives on language processing.

Experiments in the second chapter looked at memory for temporal information and order and results indicated that information about temporal order is less well remembered that information about spatial order.

The third chapter examines the role of before as introducing sentences that can be either factive or non-factive and concluded that there is no clear divide between these two types of sentence, the difference depends on knowledge of regularities in the world, and it is only with clearly non-factive before sentences that readers have definite expectations about factivity.

This theme is continued in the fourth chapter which looks at SALIENCE, by examining continuations from sentences with temporal connectives and notes that a tendency to continue text from the main clause is modified by an effect of continuing from the last occurring event, irrespective of order in the text.

The fifth chapter examines the effect of context for sentence processing and concludes that context consistent with the main clause of a sentence is preferred. It also shows that similar processes are involved in building up a model containing temporal information to those involved in building a model of a spatial array. The last experiment demonstrates that lack of a clear temporal referent disrupts language processing in the same way as lack of a clear antecedent for a pronoun does.

The results are discussed in terms of a possible model for representation which would include events being represented in a form similar to a "nucleus".

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CHAPTER I -INTRODUCTION

1.1 Delineating a Problem

This thesis began with a very broad remit - I wished to find out more about how temporal information from text (written or spoken) is represented in the mind. The first step was to see how language conveys temporal information - the second was to decide there were so many ways this is done by language that this was too broad a subject and I would have to restrict my interest to temporal connectives and ignore tense and aspect.

The most simple way in which temporal information is conveyed by language is that events in sentences following each other are assumed under normal discourse conditions to follow each other temporally. When the time of an utterance is taken from previous text this is known as "temporal anaphora", e.g. We had a party. Carol got drunk. "The party" sets up a "reference time" in relation to which the next sentence is understood. (It also sets up a "reference location").

The time an event takes place is related to the moment of speech by means of tense. As Comrie (1985) points out, tense is a rather vague temporal indicator so 75% of tenses are found combined with temporal adverbs of some kind (Crystal 1966).

Within each sentence syntactic factors play a part, two clauses conjoined by "and" acting in the same way as two successive sentences but the temporal relationship between two clauses varies with different

connectives and it is possible the order in which clauses occur makes a difference to the ease with which temporal order of events is understood.

Semantics and pragmatics are also vital. One problem I have considered is how much about connectives can be explained in semantic terms. According to Leech (1970) this means factors that are principled (rule governed). Semantic explanations of these factors have been made in terms of logical semantics and where these have failed discourse representation theories have stepped in to provide an answer in terms of "discourse models".

I will assume that discourse representation theories bridge the divide between semantics and pragmatics. A discourse representation (e.g. a mental model; Johnson-Laird, 1983) is derived from a linguistic representation and from inferences based on general knowledge and it is only with the application of real world knowledge that we can explain how the listener obtains meaning from the temporal expressions in language.

1.2 Syntax

We need some kind of syntactic component in order to comprehend sentences such as "There was calm before the storm" where it is word order (syntax) that indicates which event occurs before which.

Languages such as English allow either real world congruent or real world non-congruent ordering of sentence clauses. Two events may be

described in the order in which they are expected to occur. "The girl jumped before she ate her tea." or in the opposite order "The girl ate her tea after she jumped". The difference between real world congruent and real world non-congruent ordering of events in language appears to have implications for the processing of sentences. But the two sentences given above differ not only in whether they are real world congruent or real world non-congruent but also in which event is described by the main and which by the subordinate clause.

This may be important because whether an event forms a main or subordinate clause may be a result of the salience of that event to the discourse as a whole.

The main clause dominates the subordinate clause in the structural description of the sentence. If sentence comprehension involved reconstruction of the surface tree from the top down and from left to right comprehension would be quicker for clauses higher and to the left. In this case there would be no effect of real world congruence or clausal order within sentences. It seems more likely that a purely syntactic representation is not constructed - see Section 1.5 for a description of an alternative view - that meaning is assigned constituent by constituent.

Bever and Townsend (1979) report considerable evidence that adults and children have better access to the meaning of a main clause, but better access to the verbatim form of a subordinate clause immediately or shortly after hearing a sentence (e.g. Amidon & Carey, 1972; Flores d'Arcais, 1978; Harris, 1976; Shedletsky, 1974; Singer, 1976;

Singer & Rosenberg, 1973; Smith & McMahon, 1970 in two of three experiments; Townsend, 1974; Townsend & Erb, 1975). In addition several previous studies show that perception, comprehension and long-term retention are easier with sentences with main-subordinate order. (Foss & Lynch, 1969; Holmes, 1973; Hoosain, 1974). All these findings are consistent with the view that a dominant strategy in sentence comprehension is an initially deeper interpretation of a main clause.

However, such a syntactic explanation of how processing proceeds needs the addition of a semantic, and often a pragmatic component, to explain the vagaries of certain connectives which behave differently in different circumstances, for example, while, if, before and when.

Townsend (1983) suggests that sentences joined by while are understood differently depending on clausal order. For example if the while clause is in initial position in the sentences is more likely to be interpreted as having what he calls a "causal" component than if the while clause is second, as the following examples show:

While Harry took the arsenic, he didn't die.
Harry didn't die while he took the arsenic.

Townsend's claim that the first while is causal rests on there being an expected causal link between "taking the arsenic" and "dying", which while in initial position has the effect of denying. In the second position while seems much more temporal, the only reason we might possibly get a causal reading (in the sense of denying an expected

link) is because we expect arsenic to cause death. If we substitute "medicine" for "arsenic" I think it becomes unequivocally temporal.

Bever and Townsend (1979) produce evidence to support this. Subjects listened to two-clause sentences but were interrupted either before the last word of the first clause or the last word of the second clause. At the interruption point, they read and classified a verb-object phrase as being consistent or inconsistent with the meaning of what they had just heard. Their response was timed. The interrupted clause was either a main or subordinate clause, if a subordinate clause it began with either though, while, when, since and if.

Response (and therefore "on-line accessibility to meaning") was faster to main clauses than to subordinate clauses, but there was considerable variation among the conjunctions. The score for each conjunction was achieved by taking the response time for the subordinate minus the response time for the main clause. One of these differences was that the on-line propositional processing of initial while is like that of initial though, but that of final while is like final when.

1.3 Semantics

Syntax is never enough however, to enable us to derive meaning from text. For example, in the sentence "We had a party. Carol got drunk." The event Carol got drunk is understood as occurring at the party although syntax alone does not tell us this. This is the phenomena that Partee (1983) refers to as "temporal anaphora", which is analagous to

nominal anaphora, as for example, in the text "A man came in. He was very wet." where He is normally taken to refer to the man.

This assignment is done by means of semantic knowledge - something akin to a model of the situation described by the two sentences - which enables the pronoun he to be assigned to the antecedent a man. Stevenson (1989) describes the process thus; "on encountering the words a man we can set up an entity to stand for the man in a discourse model. Then, on encountering the pronoun, this acts as an instruction to look for an entity in the model which agrees with the pronoun in number and gender. In this example, there is only one entity in the model (the man) so the pronoun can be assigned to that entity."

With my previous example of temporal anaphora - We had a party sets up an event in the discourse model in which the next mentioned event, Carol getting drunk is understood to occur. This provides what is known as the reference time. This is referred to in more detail in Section 1.8 and experiment 17 examines similarities between nominal and temporal anaphora.

Theories of what I shall term "discourse model" semantics have advantages over truth functional semantics which had problems explaining some facets of language, for example, some connectives. Johnson-Laird (1977) points out that in fact not all connectives are truth-functional. For example, the truth of

Edward insulted Maggie and Maggie ignored Edward

does not mean either

Edward insulted Maggie because Maggie ignored Edward

or Maggie ignored Edward because Edward insulted Maggie

This requires that one event is the cause of the other but their co-occurrence does not in itself establish the required relation between them. (However, as we shall see later, cause is often inferred when reading because of two principles, (i) we understand two clauses as occurring immediately after one another, (Kamp 1971) and (ii) we infer cause from the juxtaposition of two events if at all possible (Heinamaki 1974).

Johnson-Laird points out that a similar principle applies to the connective if which provides problems for traditional semantics. The antecedent always states conditions whereas the consequent can serve a variety of functions so an account of the meaning of if is required that will accommodate statements, questions and requests in the consequent clause.

We also need to explain the unacceptability of the transitive inference from:

If you need any money there's a pound in your wallet.
and If there's a pound in your wallet you don't need any money.
to If you need any money you don't need any money.

The answer, Johnson-Laird says is that instead of a single uniform logic we need a single semantics from which the logical vagaries of if arise. He rejects analysis in terms of possible worlds in favour of one in terms of mental models.

He points out that a sentence defines its own context, because listeners generally do not know before they hear an utterance what knowledge will be relevant to its interpretation, so an antecedent will produce a mental model - e.g. the antecedent

If Russia invades West Berlin

will elicit a mental model that will represent certain protagonists and it is in respect to these protagonists that the consequent will be understood.

Conditional sentences are not "creatures of a constant hue" (Wason & Johnson-Laird, 1972) - their logical properties are determined in part by the nature of the propositions that they interrelate. He concludes not that <u>if</u> is ambiguous but that it has a single unequivocal semantics that leaves a role to be played by the interpretation of the clauses that it connects.

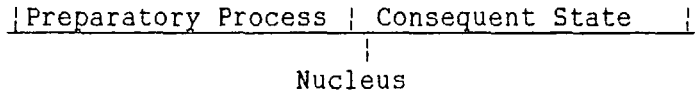
A similar point is made by Moens & Steedman (1986) about the connective <u>when</u> which they say "seems to escape uniform semantic descripiton". Consider for example, the sentence below:

When the terrorists blew up the bank they phoned a warning
they destroyed the whole building
they escaped in a van
they were caught by the police

If we give these sentences the general structure <u>when A, B</u>, then the possible temporal relation between the events described in the subordinate clause (A) and those in the main clause (B) apparently ranges from A happened before B through A coincided with B to A happened after B. Instead of concluding that <u>when</u> allows events to be

temporally connected in totally unpredictable ways they claim that vagaries of tense, aspect and related systems disappear if a specific ontology for the model of temporal semantics is assumed by giving an appropriate account of the nature of the temporal referent.

This should be envisaged as a "nucleus" which is a complex entity consisting of a preparatory process, which leads up to (but does not necessarily reach) a culmination point, and this in turn has certain consequences attached to it. Moens and Steedman depict this as under:



They say "The nature of the temporal and aspectual information conveyed by a verbal expression is closely related to the concept of a nucleus. Depending on its position in the diagram, an expression describes different parts of the nucleus, or describes those parts from a different perspective."

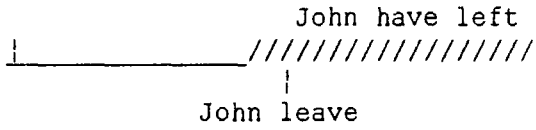
They revise Vendler (1967)'s taxonomy of verbs to produce the following five categories:

events	(culmination	e.g. recognise
	(culminated process	e.g. build a house
	(point	e.g. hiccough
	(process	e.g. run
state	state	e.g. know

These categories can they be fitted neatly into the nucleus above, "If the expression belongs to the culminated process category, it describes the whole nucleus, i.e. the core event with the preparation as well as its consequences; if it is a process expression, it only describes the

(preparatory) process; culmination expressions focus on the culmination point and its consequences; points only describe the culmination without considering the consequences; and expressions belonging to the category of consequent states describe exactly that part of a nucleus."

For example, the statement "John has left" fits into the "consequences" part of the nucleus around the core event "John leave" and refers to any time after that core event has occurred.



Given this ontology, they say, many anomalies can be removed and many ambiguities resolved. Temporal categories and propositions refer to a mental representation of events to which the notion of a nucleus is central.

However, the need for world knowledge is still strong. For example, as Moens and Steedman themselves point out the difference between

John played the sonata for a few minutes and

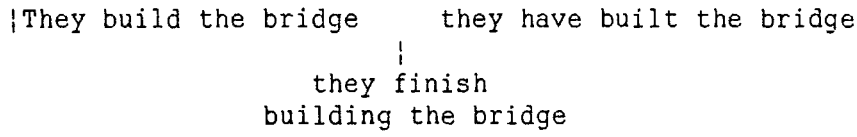
John played the sonata for about eight hours

is that "our knowledge about sonatas and how long they typically last" allows us to assume the second sentence is an iteration of points, at each of which John finishes playing the sonata.

Moens and Steedman suggest that we need world knowledge for <u>when</u> clauses as well, because when confronted by one, the hearer will try to interpret this <u>when</u> clause as describing a complete nucleus This

then functions as the temporal referent relative to which the main clause has to be evaluated. It means the main clause is to be situated somewhere within the nucleus described by the when clause.

For example the clause "When they built the 39th Street bridge ..." appears as the nucleus



The main clause event can be situated anywhere in this nucleus

...they used the best materials.
...a local architect drew up the plans.
...the president came to open it.
...they solved most of their traffic problems.

However, although the referent of a when clause is the whole nucleus it is world knowledge which allows us to decide where to situate the main clause in the nucleus. Even given knowledge of "how things happen in the world", sometimes it is still not clear, for example, in the sentence "When Nikki Lauder won the race, the best technicians worked on his car" intuitions vary as to whether "the best technicians worked on his car" was one of the facts that enabled him to win the race or whether it follows it as one of the consequences.

Moens and Steedman claim the idea of a nucleus as a temporal reference provides an answer to the linguistic and philosophic problem of the "imperfective paradox" (Dowty 1979) which concerns how a progressive is related to the meaning of the corresponding non-progressive sentence. "John was drawing a circle" does not imply that at some future point it

will be true that "John has drawn a circle".

Using the concept of a nucleus the referent in "John was drawing a circle" is given natural expression in the concept of a process which is associated with, and identified by a culmination point irrespective of whether that culmination point is actually reached.

In a similar way the concept of nucleus as referent allows us to suggest its representation in a model might already include its likely consequence(s). For some events their consequences will be negative, in that they prevent something else happening and in these cases a non-factive consequence will be understood naturally.

In Section 1.10 I describe of the work of Keenan (1968) which supports the idea of more and less anticipated consequences arising from reading a sentence describing an event.

The concept of a nucleus adds a degree of sophistication to the problem of the temporal referent and suggests that temporal representation should not be thought of as representation of a series of points but as a series of events. It is at the stage of the combination of the linguistic description of the event with representation of discourse already processed and general knowledge at the level of a discourse model that theories of scripts, schemas, scenarios, etc become relevant - they are a stereotyped image of the event described.

The idea of a nucleus leads me to question the work of Partee (1984) (see section 1.8) when she suggests the 'unmarked' value of a discourse

structure is "simple linear progression" and the event clause moves the narrative forward by bringing in a new reference time "just after" the given event, so that a (preposed) when clause in a linear narrative triggers the introduction of a new reference time located just after the event described in the when clause. Moens and Steedman's idea would mean the new reference time could be anywhere on the nucleus, so that, with a text such as "When the terrorists blew up the bank they phoned a warning. The police made frantic efforts to clear the building but forgot to check the strong rooms", the second sentence falls quite naturally into the time behind the explosion and the event that forms the main clause will be the centre of focus for the processing of the next sentence.

One way the idea of an 'unmarked' or 'natural' ordering understood from syntactic and semantic factors could be tested is from RT experiments to see if this order speeds RT. If Moens and Steedman's notion of a 'nucleus' has psychological reality, reading times would presumably not differ wherever on the nucleus the when clause is located.

I would suggest that the concept of a nucleus, as presented by Moens and Steedman may well be useful in describing how we understand and represent a large number of connectives, other than when, whose meaning can vary depending on the semantics of the clauses they connect.

1.4 Pragmatics

So, as we have seen, sometimes neither syntax nor semantics is enough to enable complete understanding. Stevenson (1989) gives the example "Jane

was late for her appointment with Sue and she hurried to get a taxi." Because the pronoun is contained in a separate clause both potential antecedents (Jane and Sue) are available on syntactic grounds. A semantic analysis will not help as the pronoun she is compatible in both number and gender with either of the two antecedents.

Pragmatics however means that this sentence is not truly ambiguous because we can make inferences from general knowledge about the likely consequences of someone being late for an appointment to infer that she in fact refers to Jane. Much of the discussion in the "semantics" section regarding when clauses could equally well appear under the heading pragmatics. Discourse model theories tend to blur the distinction between semantics and pragmatics and spelling out the relationship between the two is a matter of current debate.

My first indication that general knowledge of world order could be of an importance even overriding that of syntax and semantics, was from French and Brown (1976) and Trosberg (1981) who reported that children performed better with before and after on sentences describing events in "logical" rather than "arbitary" order. Fillenbaum (1974) reports that people often take no notice of the connective when events are described in "contra-logical order".

The fact that pragmatics is given the deciding place by Moens and Steedman in their discussion of when sentences supports evidence from Heinamaki's work on temporal connectives which suggests that, especially with before but also with many other connectives, there is no simple semantics - these connectives only achieve stable meaning when context

is there to aid evaluation (and sometimes not even them) as with the Nikki Lauder sentence above).

Heinamaki (1974) discusses what makes some before clauses non-factive and reaches similar conclusions to Johnson-Laird, above, that it is the meaning of the two clauses and the relationship between them that determines whether the before clause is interpreted factively or non-factively.

With a sentence "Max died before he saw his grandchildren" - the inference from the main clause, together with some assumed facts (the belief the dead cannot see) semantically entails that the "before" clause cannot be true. This does not however, explain the difference between the two following:

Ted put money in the parking meter before a policeman gave him a ticket.
Ted blew his nose before a policeman gave him a ticket.
With the first sentence there is a belief of the form - "If Ted had not put money in the parking meter, it is expected that a policeman would have given him a ticket later on". The non-factive interpretation of the second sentence is ruled out because the counter-factual to it, "If Ted had not blown his nose, it is expected that later a policeman would have given him a ticket" is not plausible.

This is why "Max died before he saw his grandchildren" is reasonable (it commits readers to the counterfactual conditional "If he had not died it is expected that later he would have seen his grandchildren"), whereas "Max died before he became the King of England" is odd because

it commits the reader and speaker to the counterfactual "If Max had not died it is expected that later he would have become the King of England".

With a non-factive before sentence the main clause expresses an event that prevents the before clause from coming true. The event described by the main clause is both a sufficient and necessary condition to prevent the event described by the subordinate clause. There is no way this can be determined from the syntax of the sentence - it relies on both semantics and general knowledge of the world.

Heinamäki admits it is not as simple as this. There are sentences that can be interpreted either way.

Sue left the party before she punched anyone.
Mary left John's apartment before he managed to seduce her.
Rush the victim to hospital before he dies!

In these sentences the conditions that the non-factive reading requires hold with respect to some situations and not with others. These three sentences can appear both where conditions for non-factive before clause are met and where they are not. The second one can have the non-factive reading if the only place for seduction is John's apartment, but if John could have seduced Mary elsewhere the before clause can be factual.

Often quite complicated assumptions are required for the counterfactual conditional. The following sentence is an example

The police saw her before she hid in the alley.

For a non-factive reading we need to assume that the police stopped her,

presumably because she was a criminal (else why would she hide).

From our examination of when and before we can conclude that connectives do not have simple invariant meanings that can be applied uniformly across different contexts irrespective of the meaning of the individual clauses which they connect.

Another strange factor in our comprehension is the tendency to attribute cause when two sentences are joined by a temporal connective. In most cases the temporal clause is taken to be the cause or reason for the state of affairs described in the main clause e.g. "The room was cold when the heater broke down", the cause of the room being cold is the heater breaking down. However as Heinamaki points out, if we change the main clause into a when-clause "When the room was cold, the heater broke down", if we get a causal implication at all, then the fact that the room is cold is taken to be the cause for the heater's breaking down. As long as and while act in the same way.

With after and since it is again the temporal clause that gives the cause,
"John was depressed after he got ill" (his illness made him depressed)
"John was ill after he got depressed" (his depression made him ill)

There are cases where before and until clauses are understood to be the causes:

"Roses bloomed before the cold front arrived" (where cold front put an end to roses blooming) but also cases where the main clause is the cause

"We fixed the pipe before the kitchen was flooded".

Heinamaki comments that this has been observed before, but not explained. Some events related by temporal connectives also have other connections than the temporal one, and these connections do not have to be causal.

"Bruce brushed his teeth before the comet appeared." sounds odd, because of something loosely called "lack of relevance", whereas with "Bruce became a pilot before the energy crisis started" it is possible to think of several ways in which the temporal clause is relevant to the main clause. Although the first could be made relevant given a context, the very fact that a context is needed shows that some kind of relevance is necessary. We can have pure temporal relation only with a date, for example "John arrived in 1973 after 6 o'clock" because a date has no other ties to context.

This leads Heinamaki to state "Some kind of other connections in addition to the temporal one is the rule not the exception and these connections are manifestations of the relevance principle." Causality links two events in a relevant way.

We cannot have a causal relation unless there is a certain kind of temporal relation between the events too, the cause temporally precedes the effect. With after and since this is as expected, with before and until the subordinate clause cannot express the cause that brings about the event mentioned in the main clause but they can express a factor that brings about the end of the state of affairs

described in the main clause. With co-temporal clauses the situation is more complex, but cause is evident here as well,

We felt homesick when we were eating blueberry pie.
Chico helped us when we asked him to.
We were happy when Chris came back.

I would suggest that in these cases it is the description of the clauses as co-temporal which is wrong. In all of them we understand the when clause to at least begin prior to the main clause and cause the event/state in the main clause. In terms of Moens and Steedman's (1986) concept of a nucleus, "when we were eating blueberry pie" can have certain possible consequences, for instance it can cause satiation, indigestion or in certain circumstances homesickness.

1.5 Weakly Interactive Processing Model

Having defined the levels of syntax, semantics and pragmatics as necessary in processing language, we are faced with the problem of providing a satisfactory account of how these three interact.

For the purpose of this thesis the model proposed by Stevenson (in preparation) provides a theoretical base to which the experiments which follow can be related. This model is a development of the weakly interactive model of Crain and Steedman (1985) and Altman and Steedman (1988), which was built to explain why some sentences with local ambiguities lead us "up the garden path". All potential analyses are constructed in parallel and the processor chooses one of them, rather than only computing one and backtracking if it turns out to be wrong; incremental processing is fine-grained, which means that

meaning is assigned as early as possible, probably constituent by constituent rather than at the end of a sentence and there is a weak interaction between syntax and semantics - semantic information rules out potential syntactic analyses but does not affect the choice of which analyses to construct.

This notion of a fine-grained incrementalism suggests that an independent syntactic representation (such as that described in Section 1.2) is not constructed beyond the level of a constituent, since a meaning is assigned to each constituent as it is parsed. The output of the parser is an interpreted string which Stevenson calls a propositional representation (see Johnson-Laird 1983) This propositional representation contains the syntactic information but it also contains the meaning associated with each constituent.

Crain and Steedman examine the way a weakly interactive model explains the problem of local ambiguities which can give rise to garden path effects: e.g. "The horse raced past the barn fell", and show that these garden path effects can be due to the nature of the processes within the syntactic component and also that, on some occasions (i.e. given the correct context), these syntactic ambiguities can be resolved by reference to the semantic component, allowing the syntactic component to yield a unique syntactic interpretation. Instead of trying to resolve local ambiguities structurally they suggest recourse to a system of immediate, almost word by word interaction with semantics and reference to context.

They examine certain varieties of definite and indefinite referring

expressions and their presuppositions and suggest a way this reference might interact with the parsing processes. Their argument is that the null or neutral context used in many experiments is far from neutral with respect to the parsing processes, instead, as Heinamaki pointed out (p.148) "When the hearer encounters [a sentence] (s)he recognises what its presuppositions are and consequently what the context has to be for [the sentence] to be proper".

Crain and Steedman then show how the garden path effect of sentences such as "The horse raced past the barn fell." can be explained by reference to the context, requiring the satisfaction of any presuppositions.

It is important to note that there is no reason to assume the null context, in which no horses whatsoever have been mentioned, will be neutral with respect to the above sentence. The two readings of this sentence may, because of the differential number of presuppositions that they invoke, differ in the ease with which the hearer can set up referents.

The restrictive reading of this sentence "The horse (which was) raced..." is more propositionally complex because it involves several horses rather than one, and a number of further facts about the way these can be distinguished.

"The horse which was raced past the barn fell." involves (1) that a set of individuals indentified by the head nominal (a set of horses) is already represented in the hearers model (2) that it is already given or

implicit that the relative clause applies to some individual in that set (3) the whole expression identifies a single individual. If this was not the case the speaker would have said "The horse fell", or "A horse fell".

Crain and Steedman tested this by providing alternative contexts for sentences that had previously caused subjects to "garden path" and asked subjects to press a response key if the target sentence was ungrammatical. Reports of ungrammaticality were much reduced when context agreed with interpretation of target sentence required. For example

a. Complement-inducing context
A psychologist was counselling a married couple.
One member of the pair was fighting with him but the other one was nice to him.

b. Relative-inducing context
A psychologist was counselling two married couples.
One of the couples was fighting with him but the other one was nice to him.

c. Complement target sentence
The psychologist told the wife that he was having trouble with her husband.

d. Relative target sentence
The psychologist told the wife that he was having trouble with to leave her husband.

The conclude that contextual clues seem to be used during the first pass through the sentence, i.e., the knowledge that the presuppositions of a relative clause have or have not been established appears to be used during sentence comprehension. This contradicts accounts of comprehension which claim division of a sentence into given and new information occurs only after its syntactic and semantic interpretation is completed (e.g. Clark and Haviland 1974).

The argument is thus that interpretation is facilitated by the context sentence which enables a unique syntactic interpretation to be given to the target sentence.

Stevenson and Pickering (in preparation) point out that full interpretation requires more than this however, each noun phrase in a sentence must be assigned to a unique individual so that a complete interpretation is provided. Assigning individuals to each noun phrase is carried out by the semantic component and the pragmatic component can rule out competing referential assignments.

e.g. Two women lived next door to each other.
One woman died and the other woman went to the funeral.
Target 1 The clergyman told the woman (that survived) that death comes upon us all.
Target 2 The clergyman told the woman that death comes upon us all.

Pragmatic plausibility tells us us which of the two women the clergyman must be talking to even in Target 2 where there is no relative clause, and this enables the semantic component to produce a unique referential interpretation for the sentence.

This model has three major components, a syntactic component, a semantic component and a pragmatic component. Stevenson and Pickering propose that information from the semantic component may be used to rule out competing syntactic analyses but pragmatic information cannot directly influence the syntactic component. However, the pragmatic component does have a direct influence on the semantic component. This model is awaiting confirmation from experiments.

1.6 Memory for temporal order

Ideally, any work that looks at temporal connectives from a language processing point of view, should be able to explain how we would represent such a passage as the following, taken from Hirst (1978), with ^ indicating a point where the direction of time flow changes.

> "Slowly, hesitantly, Ross approached Nadia. ^ He had waited for this moment for many days. ^ Now he was going to say the words ^ which he had agonised over ^ and in that very room ^ he had often dreamed about. ^ He gazed lovingly at her soft green eyes."

How much of this do we remember? Does only what we remember go into a model (which would make it synonymous with gist) or does the whole lot? If not, do we only remember time flow changes - or temporal order - where they have some importance (relevance), possibly causal, possibly because the two things happen together in some particular order - brush her teeth before she goes to bed - as a matter of custom. Fillenbaum (1974) points out in this case we don't even notice often if we hear "she goes to bed before she brushes her teeth".

Perhaps it is a good idea to see first what we do remember from stories. Most work on memory for detail from short stories dates back to the 1930s. Bartlett (1932) found (1) omission of detail and parts of story that did not fit in, (2) rationalisation to explain incongruous factors, (3) a dominant detail often became an anchor point, (4) words and names changed to become more familiar, (5) transformation of order, especially in descriptive as opposed to narrative passages.

In a fascinating (but extremely dated) book, Sturt (1925) gives the

results of an experiment where two stories were read to subjects who were asked to reproduce them. She counted how many items containing time and place information were remembered compared to other items and concluded that details of time and place are poorly remembered, they "form a sediment at the bottom of the list". Of the two, time holds a lower place than place. Her subjects were 11-yr olds and adults (she chose 11 year old children because in previous experiments found that children's appreciation of temporal factors improved up to that age and then stabilized). Percentages of people remembering the different types of items were:

		Time	Space	Other
Stories 1 & 2	Children	29.25	37.9	44.4
Stories 1 & 2	Adults	33.5	38.2	54.9

I would interpret Sturt's findings as support for a view which took time and place details as basic and often therefore less important details of a model - the context in which the story can unfold. It may however, be necessary to distinguish between temporal items such as Sturt was monitoring (in 1943, after 3 days, etc) and temporal order that is often necessitated by the normal causal patterning of events in the world.

Trosberg (1981) studying before and after sentences found that children were able to perform better on tasks, at a younger age, when the sentence referred to items in "logical" rather than arbitrary order, i.e. where a character has a bath before bedtime. In many experimental tasks this element is excluded by deliberately choosing arbitary events to combine into sentences - see for example how much care is taken by Gernsbacher, Hargreaves and Beeman (1989) to ensure there is no "preferred" order of two events in a sentence.

There is an obvious similarity between sentences describing events in an arbitary temporal order (e.g. she ran past the shop, then she ran past the church then she ran past the school) and sentences describing locations of objects (e.g. There was a shop, next to that was a church, and next to that a school).

Experimental work (Barclay 1973, Ehrlich & Johnson-Laird, 1982) shows that factors such as continuity influence memory for descriptive passages of text. Can we see the same factors at work in passages describing events which are temporally related?

Barclay used one-dimensional arrays with five members, such as:

lion bear moose giraffe cow

with the relation between the members being "on the right (left) of". He presented sentences describing such arrays, and asked half of his subjects to memorise the sentences, and half to try and figure out the array. Later all subjects were given an unexpected recognition test. Subjects who were asked to memorise the sentences performed fairly well at recognising the actual sentences heard, whereas those told to figure out the array tended to sort the sentences into those that were true of the array and those that were false, regardless of which sentences they had heard. The subjects who had to extract the content of the sentences had derived a representation that was compatible with any true description of the array but which did not contain information about how the array was originally described. Barclay's results can be explained by assuming that people who are told to figure out the array construct a representation analogous to the array - a mental model of it.

In a similar experiment, Potts (1972) showed that subjects were faster to verify sentences decribing relations between objects far apart in an array than those describing objects close together.

Other work on the representation of spatial relations (Ehrlich & Johnson-Laird, 1982; Mani and Johnson-Laird, 1982) suggest more complex arrays are not always constructed, for example, when there is a referential discontinuity as there is between the first and second sentences below. (Ehrlich & Johnson-Laird, 1982)

The knife is in front of the pot.
The glass is behind the dish.
The pot is to the left of the glass.

Model building is also more difficult if the relations are indeterminate, so that two different arrays are consistent with the description, (Mani & Johnson-Laird, 1982)

They tested the idea that subjects would tend to form a mental model of a spatially determinate description but would not do so for an indeterminate description consistent with more than one spatial layout - especially if their task was to check whether the description corresponded to a diagram. They might easily form the "wrong" model, that is, one that did not match the diagram, though it was equally consistent with the indeterminate description.

The subjects heard a series of spatial descriptions, such as:

The spoon is to the left of the knife.
The plate is to the right of the knife.
The fork is in front of the spoon.
The cup is in front of the knife.

After each description they were shown a diagram such as:

spoon knife plate
fork cup

and they had to decide whether the diagram was consistent or inconsistent with the description. Half the descriptions that the subjects received were determinate as in this case and half were spatially indeterminate. The indeterminate descriptions were constructed merely by changing the last word in the second sentence:

The spoon is to the left of the knife.
The plate is to the right of the spoon.
The fork is in front of the spoon.
The cup is in front of the knife.

This description is consistent with two radically different diagrams:

spoon knife plate
fork cup

spoon plate knife
fork cup

After the subjects had judged the descriptions and diagrams, they were given an unexpected test of their memory for the descriptions. On each trial they had to rank four alternatives in terms of their resemblance to the original description: the original description; an inferrable description, and two 'foils' with a different meaning. The inferrable description for the example contained the sentence:

The fork is to the left of the cup.

in place of the sentence interrelating the spoon and the knife. The description is therefore not a paraphrase of the original, but it can be inferred from the layout corresponding to the original description in the case of both the determinate and the indeterminate descriptions. This inference is only likely to be made if the subjects construct mental models, and, moreover, ones that are symmetrical. If they were

to construct an asymmetrical model of, say, the determinate description above:

spoon knife plate
fork

cup

then they might well fail to consider that the fork is to the left of the cup.

The subjects remembered the gist of the determinate descriptions better than the indeterminate descriptions. The original and inferrable descriptions were ranked higher than the confusion items 88% of the time for the determinate descriptions but only 58% of the time for indeterminate descriptions. The original was ranked higher than the inferrable more often on the indeterminate descriptions than the determinate ones, showing subjects tend to remember the gist of determinate descriptions better than that on indeterminate descriptions and the verbatim detail of indeterminate ones better than of determinate.

Johnson-Laird explains this by suggesting that subjects construct a mental model of the determinate descriptions but abandon such a representation in favour of a superficial propositional one as soon as they encounter an indeterminacy in a description. It is reasonable to suppose the same factors will affect the build-up of a model of events in temporal order.

Likewise, if the results of the Potts study (quoted above) apply equally

well to events in temporal order, we should find that events close together in time are more easily confused in memory than those far apart. Similar confusions with non-temporal text are shown by Garnham (1981) who demonstrated that people confuse sentences that are semantically, as well as syntactically, different. Two sentences differ semantically if the range of situations that they could describe are distinct. Such sentences may be mistaken for one another if, in the context of a passage, they describe the same event, i.e. have the same referent. For example, in a passage that starts:

By the window was a man with a martini.

The noun phrases the man by the window and the man with the martini are co-referential, though in other passages they are unlikely to be. Subjects who heard a passage beginning with the sentence above could not remember whether they had later heard:

The man with the martini waved to the hostess.

OR The man by the window waved to the hostess.

Thus people remember neither the syntax now the semantics of what they hear but rather its referential content. They produce a representation of what the world would be like if the passage were true - a representation that is not closely related to any linguistic description of the text and which should not be called a semantic representation. This is what Garnham calls a "mental model" of a situation in the real or imaginary world.

The above review of memory for temporal information makes it clear that there is still a vast amount of work which needs to be done. This thesis aims to answer a number of the questions raised in this chapter, and

these are listed below:

Can I confirm Sturt's findings that temporal and locative information are remembered to a similar extent?

Is there a difference between memory for order between what Trosberg calls logical and arbitrary order?

Do we form a representation of temporal events analagous to the sort of representation shown by Barclay, Ehrlich & Johnson-Laird, Mani & Johnson-Laird for location of objects? Are the same factors (continuity and determinacy) important?

Are we more likely to confuse two events occurring close together in time more than two events far apart?

1.7 Given-New Strategy

Bever and Townsend (1979) attempt to simplify a complicated field by collating various labels for what they see as a "de-emphasised/ emphasised" distinction in language. As they see it, given information, old information, presuppposition, presumption, background, topic, psychological subject, theme, have all been used to refer to the de-emphasised portion of speech while new information, focus, assertion, foreground, comment, psychological predicate and theme have all been used to refer to the emphasised portion.

For the purpose of this thesis I wish to separate out three of these terms for especial comment.

1) "Focus" is given a section to itself later in the chapter.

2) "Presuppositions" are closely linked to "semantic entailments" and can be tested for by applying the "negation test". For example, putting "It is not the case that..." before the sentence "Harry got sick when he ate the apple" does not negate the underlined portion of the text, which is the presupposition. As Heinamaki (1974) points out, a sentence in isolation presupposes the existence of the entities in the subordinate temporal clause.

This suggests that temporal expresions might be understood more quickly in a context that provides the presuppositions. As mentioned in section 1.5, Altman and Steedman show that, where syntax allows two possible sets of presuppositions, providing a context for one of those sets resolved local ambiguities in text with relative clauses.

3) The given-new dimension was first investigated by Haviland and Clark (1974) who proposed that the presupposed information in a sentence coincides with given information or "what the listener already knows", while the asserted information coincides with new information, with which the listener is unfamiliar. They measured the time that subjects spent reading targe sentences such as:

The beer was warm.

in two different contexts. The fact that a definite noun phrase was used presupposes the reader already knows about the existence of some beer. In one context beer was explicitly mentioned in the preceding sentences:

We got some beer out of the trunk.

In the other an inference was required to establish that beer was among the picnic supplies:

We checked the picnic supplies.

This inference is plausible because picnic supplies often include beer. The sentence "The beer was warm." was read more slowly in the second of these contexts suggesting that computation of the inference took time. This result could not be explained by the fact that the beer was repeated in the other passage. A non-specific mention of beer did not help. Subjects spent a comparatively long time reading "the beer was warm" after:

Andrew was especially fond of beer.

The context should establish the reference time, just as Haviland and Clark's context sentences established a reference for the beer, although often this is done unobtrusively (e.g. the above sentences establish that the beer was warm at the time they got it out of the trunk, but this is unlikely to be especially noticed.)

Smith (1978) examines how reference time for one sentence can be established by a prior one (considering that sentences without a time adverbial are vague or incomplete) Sentences (b) below require (a) to give complete temporal reference

(a) I talked to Mary last night. (b)She was happy.

(a) I talked to Mary on Friday (b) She was leaving in 3 days

(a) John arrived at noon. (b) Mary came later.

Others can be understood with temporal reference in a prior sentence or alone e.g. (b) can be understood alone or in conjunction with (a):

(a) Next Sunday we're flying to Amsterdam

(b) We visit friends on Monday

Others cannot be understood in a temporal context established earlier

(a) Robert talked to Bonnie at noon

(b) He (Robert) arrived 3 hours ago

Yekovich, Walker and Blackman (1979) suggest sentences are easier to understand when given information occurs at beginning of one sentence and picks up a new reference made at the end of the previous sentence. In terms of the two-clause sentence connected by before or after this would suggest that subordinate-main sentences are optimal. To see this clearly, imagine a two-sentence fragment of text; new information from the previous sentence would provide the given information at the beginning of the second sentence. This would need the reference time in the subordinate clause to be established in the previous context - just as Yekovich et al's analysis needs the 'given' entity to be introduced in the prior context with an indefinite noun phrase.

Ehrlich and Johnson-Laird (1982) found no support for this however. On the contrary, in two of their experiments the task was easier when a reference was made at the start of the first sentence to the item to be referred to in the second sentence, and they also report that the effects of referential continuity need not be restricted to second sentences.

Theories about prominence in text and thus organizing reference assignment (which has relevance for temporal reference) fall into two broad schools. Yekovich et al's work forms part of a body of thought which assumes readers represent explicit information about the text, including surface information such as order of mention. According to this theory reference asignment becomes more difficult the further away referents are located in the text. This ignores the issue of different prominence that different items might have in a text, which is one of the hurdles that discourse model theories attempt to surmount by suggesting that once a model is constructed the part that is currently relevant for interpretation will be in working memory.

Yekovich et al are dealing with purely syntactic factors whereas my view would be that semantic and pragmatic factors are more likely to determine continuations.

Partee argues that two factors may be involved
(a) main clause continuation is 'unmarked' ("preferred") (i.e. a syntactic view) and
(b) latest event in time continuation is 'unmarked' (i.e. a semantic view)

Bever and Townsend point out that because of the correlation of the given-new dimension with the main-subordinate structural distinction, (subordinate clause contains given) the studies that suggest main clauses are more deeply encoded can be taken as support for the claim that new clauses are more deeply encoded. It is difficult to

know how these two factors could be teased apart.

There are a number of questions raised by the foregoing discussion about the way in which preceding context facilitates sentence comprehension. In particular as far as this thesis is concerned I would wish to discover whether reading time of a target sentence is affected by a prior context for main clause or subordinate clause.

Yekovich et al would argue that subordinate clause followed by a sentence in subordinate-main clause order is optimal, because it is the subordinate clause which picks up a new reference from the previous sentence. By contrast, Johnson-Laird would argue that whether context was for subordinate or main clause would not affect reading time as both clauses would be in the mental model available for easy reference.

The other point which seems to be important at this stage is confirming that the easy identification of a temporal referent is important for language understanding in the same way as the easy identification of a referent for a pronoun.

1.8 Linguistic Models

In the area in semantics I have characterised as discourse model semantics, Kamp (1981) has taken the lead in explaining how the temporal order of events conveyed by language might be represented. He begins from the failure of traditional model-theoretic semantics to take account of the fact that discourse conveys a definite temporal order among the events it represents and proposes a discourse

representation theory where one of the rules of discourse representation construction is that a sentence in passe simple introduces a new event which follows the last event already introduced. This means that the temporal relations in the representation become an integral part of truth conditions of the discourse.

This is a useful idea, and accords with my intuitions, and it is supported by the results of an experiment by Townsend (1983) who showed that people remembered more of a discourse when sentences were presented in the order in which the events described occurred, indicating that temporal order aids comprehension (see section 1.10 for more detail).

It may be that it is too simplistic in some respects, because not all language is in (even the English equivalent of, passe simple) and it needs adapting to explain how we cope with texts such as the one, quoted above but repeated below for easy reference, taken from Hirst (1978), with ^ indicating a point where the direction of time flow changes.

> "Slowly, hesitantly, Ross approached Nadia. ^ He had waited for this moment for many days. ^ Now he was going to say the words ^ which he had agonised over ^ and in that very room ^ he had often dreamed about. ^ He gazed lovingly at her soft green eyes."

In this passage the second sentence has to fit into the time before the first, the passage then returns to the time of the first sentence but only for one phrase "Now he was going to say the words" and then it reverts to the past again. The text flows back and forth between the present and the past without undue contrivance and indicates that if we do adopt Kamp's rule of discourse construction, for passe simple

sentences, we are still able to understand text which doesn't follow a smooth time line.

This is the case with an after clause continuing from the subordinate clause of a previous sentence, as in the following example

After Mary had left we realised she had forgotten her umbrella.
She had gone out of the back door so she could see the garden.

here "She had gone out of the back door" refers to the time "Mary had left" which is before "we realised she had forgotten her umbrella", yet we have no difficulty relating the second sentence to the relevant part of the first one.

A similar case arises with a before clause continuing from the main clause previous sentence.

Before Peter shouted "bingo" Marylou jumped up and waved her card.
She thought she'd got a full house and sat down sheepishly when she realised her mistake.

Here the second sentence refers to the earlier of the two events mentioned in the first sentence, rather than the last occuring of the two events.

This rule of discourse model construction may have originated simply because this is the direction in which we most often use language to describe things and the way in which we tend to think of things happening.

Kamp's argument allows him to claim that when is not necessary as the

same temporal relations are expressed by two sentences and this allows Kamp to provide rules for construction of discourse representation structure that handle the occurrence of tense forms in complex sentences in much the same way as they are handled in a sequence of sentences.

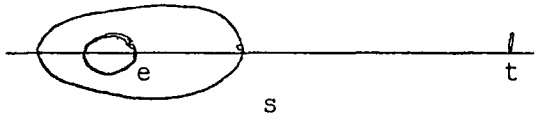
The discourse representation has another advantage however, as it allows for the representation of the difference in French between passe simple and imparfait, and the equivalent different between "Bill worked" or "Bill was working" in English be tackled. The choice of tense form depends on the function of the sentence in which it occurs in a text, so

i) Imparfait sentence introduces new discourse state "s"

ii) This state "s" lies before speech point

iii) Contains last event'e' (introduced by passe simple)

Kamp and Rohrer (1972) depict this schematically as:



Kamp then tries to precisely formulate rules from the stage the representation has reached for the rules to be applied. In order to do this he adapts the ideas of Reichenbach (1947) who distinguished three underlying times in his account of the relation of past and perfect. The speech time S and the event time E are self-explanatory. A third time, the reference time R corresponds to the notion of the time that is being talked about. In the case of the simple past R is coincident with the past event time, but in the case of the present perfect it is coincident with the time of utterance. This is shown below with a sort of time line diagram:

Simple past (John left)

E,R	S

Present Perfect (John has left)

E	R,S

For Kamp at each such stage a particular time or event in the DRS is marked as reference point. This reference point gets transferred to the next event that gets to be introduced into the representation by a passe simple sentence. Kamp says reference points are established by context - often relevant contextual factors are contained in the antecedent discourse. Moens and Steedman's concept of nucleus can be claimed to be an improvement on this, using "reference event" instead of "reference point" while allowing the rest of Kamp's ideas to stand.

As mentioned in section 1.3, Partee likewise uses Reichenbach's notion of reference time as extended by Hinrichs (1981) and combines it with Kamp's theory of discourse representation (but says file-card semantics as developed by Heim (1982) would do equally well) to cover cases of temporal quantification and temporal analogs of donkey pronouns.

Partee considers the interaction of temporal adverbs and tense and makes some claims which, although at first glance appear to be necessary to explain the construction of a discourse model, contradict the psychological work produced so far. As already stated, Bever and Townsend (1979) report considerable evidence that adults and children have better access to the meaning of a main clause, but better access to the verbatim form of a subordinate clause immediately or shortly after hearing a sentence (e.g. Amidon & Carey, 1972; Flores d'Arcais, 1978;

Harris, 1976; Shedletsky, 1974; Singer, 1976; Singer & Rosenberg, 1973; Smith & McMahon, 1970 in two of three experiments; Townsend, 1974; Townsend & Erb, 1975). In addition several previous studies show that perception, comprehension and long-term retention are easier with sentences with main-subordinate order. (Foss & Lynch, 1969; Holmes, 1973; Hoosain, 1974). All these findings are consistent with the view that a dominant strategy in sentence comprehension is an initially deeper interpretation of a main clause.

Partee, however, claims that the main clause is interpreted with respect to a reference time descriptively characterised by the subordinate clause. This necessitates prior processing of the subordinate clause, presumably to a fairly deep level. Her rules for DR construction, then state, if the main clause is an event clause, the last step in the processing is the resetting of the reference time to a time "just after" the main clause event.

This means that the reference time in effect after the sentence depends on which clause was the main clause. This corresponds with her informal observation that it is the main clause that carries the main story line along. Suppose we are interpreting a simple past tense narrative, our most recently established past reference time is r and the next sentence begins with a <u>when</u> clause. The <u>when</u> clause triggers the updating of the reference time to a new value (r2) and the content of the <u>when</u> clause puts conditions on r2. The main clause is then interpreted with respect to r2. (In the following example, "r" indicates reference time and "e" indicates an event.)

Mary turned the corner. When John saw her she crossed the street.
r0 e1 r1 r2 e2 e3 r3

Partee adds some ideas from her notion of linear narrative.

1. She treats successively introduced reference times as strictly following one another (but she only manages this by putting before clauses outside linear narrative - does she not have to do this with other connectives, certainly at least until as well?)
2. When clauses usually indicate simple linear progression, as do concatations of sentences (similar to Kamp). So that just as an event clause moves narrative forward by bringing in a new reference time just after the given event, so does a when clause. A (preposed) when clause in a linear narrative triggers the introduction of a new reference time located just after the event described in the when clause.

She says the function of a when clause in simple linear narrative is to provide a new reference time for the associated main clause. The event in the when clause differs from one in a simple sentence in that it is not constrained in the then current reference time, but rather serves to provide a descriptive anchor for the next introduced reference time.

This is shown in

"People began to leave. When the room was empty the janitors came in.

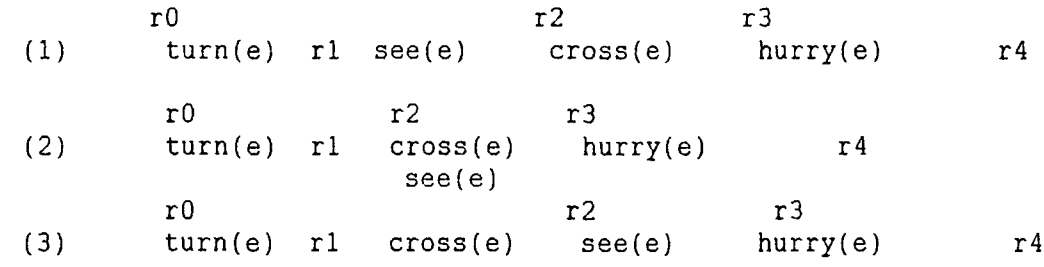
Which is an interesting example because it suggests when can act like after, functioning to close off previous discourse.

Partee interprets the contents of subordinate clauses as events rather than states or processes so doesn't put the subordinate clause event within any reference time of its own and she continues in the belief that subordinate clauses are always processed before main clauses and introduce the reference time with respect to which the main clause is interpreted. (It should be noted that she restricts this claim to preposed subordinate clauses, and makes no predictions about the effects of postposed subordinate clauses.) After and before function asymetrically in establishing reference time.

Mary turned the corner. When John saw her she crossed the road. She hurried into a store. (1)

Mary turned the corner. Before John saw her she crossed the road. She hurried into a store. (2)

Mary turned the corner. After John saw her she crossed the road. She hurried into a store. (3)



The reference time (at which the main clause occurs) is introduced by the subordinate clause and comes after the previous reference time (r1) regardless of which subordinate conjunction begins the clause.

She claims the event in the before clause does not end up in the linear order at all; it merely helps to describe the temporal location of r2, but it is not otherwise connected. This accords well with the ease with which we construe events as not part of the real event structure at all.

The conflict between the ideas of Partee and the findings of Bever and Townsend illustrate a divide which is not that easy to overcome. Partee's theories, like those of Kamp, are semantic theories, which set out possible ways in which temporal factors might be obtained from presented language and assigned truth conditions. If these are wrong we need another semantic framework which accounts for the findings of people such as Bever and Townsend. It is worth noting again that Partee does not claim the same processes occur with postposed subordinate clauses Evidence from Bever and Townsend about while (in Section 1.2) shows there might indeed be a difference in the way subordinate clauses in first or second positions are understood and their other work shows that syntax (in the form of clause order) does affect processing.

Pragmatics also affects processing. We can see this most clearly with non-factive befores, where the processing of the main clause sets up a number of possible consequences, one of which may be to prevent the occurrence of the subordinate clause.

Some of the contradictions set up would be adequately dealt with by a complex model of representation in which different depths of processing of different parts of speech for syntactic, semantic and pragmatic reasons. This could be combined with a weekly interactive model of language processing such as that put forward by Altman and Steedman so that syntax and semantics interact at a more surface level, and at the resolution of which, the pragmatic factors begin to play a part, in the form of the event described together with ideas of its possible consequences.

A number of questions are raised by the foregoing discussion, the main ones being:

Partee's idea that the subordinate clause is processed first to form a basis for main clause is contradicted by evidence showing that the meaning of the main clause is available first, and that sentences in main-subordinate order are faster to read. If my results confirm previous evidence that meaning of the main clause is available first can I provide an alternative to Partee's account?

The part of a sentence which serves as a basis for the continuation can be claimed the most salient (Sandford, Moxley and Barton 1990) and it could be argued that if the only purpose of the subordinate clause is to provide the reference time for the main clause it will always be less salient. One way of establishing what is the most salient entity in a discourse model, is to find out how people would continue a discourse. Do people, in fact, always continue from the main clause, thus supporting Partee's argument?

The idea that before does not end up in linear order is a useful way of dealing with the frequent non-factivity of before clauses but is counter-intuitive in some cases where the before clause would appear to provide the basis of the story line in the next sentence. Does the relative number of continuations from before clauses compared to after and when clauses provide any support for the idea that before clauses fall outside the main story line?

1.9 Processing Models

The work of Bever and Townsend (1979) follows much of the work in adult psycholinguistics by examining the processes the listener conducts while hearing a single sentence with minimal contextual cues. Bever and Townsend assume that (1) The listener determines the location of major surface structure breaks during listening; (2) The listener applies perceptual mapping rules to assign the words of a clause to their semantic roles; (3) as the listener determines a set of underlying logical relations within a clause and an interpretation for the clause, the exact word order of the clause fades. The process of deciding about an underlying structure for a clause and removal of exact wording from immediate memory has typically been assumed to occur at the clause boundary (Jarvella 1979).

Bever and Townsend suggest that the fact that the propositions in complex sentences are related to one another in a variety of ways may mean that clausal processing is modified if listeners are concerned with obtaining these higher order semantic relations. Although the nature of the semantic relation between clauses depends on the individual meanings of the clauses being related, regularity does exist, cued by different conjunctions. A partial list of possible relations includes: cause, + prior in time, simultaneous in time, - prior in time, effect and adversive.

Bever amd Townsend speculate that a strategy exists that emphasises early interpretation of underlying causes or potential causes. So a clause marked by a conjunction that signals a causal connection to

another clause is more deeply processed during listening and is more basic to listener's post-sentence organisation. They rank conjunctions according to clausal efficiency as follows "because, if, for, since, after, when, and, while, until, before, so, although, but".

They claim support for the use of the causal-temporal dimension in organisation and memory in the data from many of the following studies; before and after sentences are easier to remember and act out when they present events in the actual order of occurrence (Clark & Clark 1968, Smith & McMahon, 1970, Barrie-Blackley, 1973, Clark, 1971; Johnson, 1975) and such sentences appear relatively early in the child's speech (Clark 1970, Osgood, 1971); the question "What happened first?" following a before or after sentence is answered more quickly than "What happened second?" (Smith & McMahon, 1970, Townsend & Ravelo, 1978), the relative difficulty of although with respect to because and the preference for ordering events as "cause, effect" (Katz & Brent 1968). They say their study is unique in examining on-line processing of clauses with a wide range of conjunctions. (In fact they examine only five and do not say why they have selected those five).

Bever and Townsend's first experiment presented 16 affirmative two-clause sentences to subjects which were interrupted either before the last word of the first clause or the last word of the second clause. 4 sentences contained while and three contained if, since when and though. At the interruption point, subjects read and classified a verb-object phrase as being consistent or inconsistent with the meaning of what they had just heard. The interrupted clause

in either position was either main or subordinate (introduced by if, since, when, while or though). For the experimental sentence "There is little danger of a major depression though good jobs are (now) quite scarce (now) in most large towns" the consistent phrase was "finding employment" and the inconsistent phrase one judged by other students to be totally unrelated.

Experiment 2 presented the same sentences but subjects were asked whether the probe word (in the above sentence it is "now") had ocurred in the fragment. The critical variable was whether it occurred early or late in the phrase. They also presented results from 12 negative sentences but I am not concerned with those results here.

Overall results from experiment 1 showed response times were shorter when main clauses were interrupted; i.e. subjects had greater access to the meaning of main clauses. Response times for subordinate clauses varied with conjunctions. The way this is reported is slightly unusual however, as the times we are given are "(Response time for subordinate) minus (Response time for main)". If and though clauses showed opposite effects. Initial if clauses were 136ms faster than main clause and initial though clauses 340ms slower, with since when and while fragments falling in between. On final clause fragements response times were 295ms slower on if clauses than on corresponding main clauses and response times for though clauses was reduced to only 21ms slower than main clauses.

Experiment 2 looked at response time to a word which could be in two positions in either the main or subordinate clause (in the above

sentence it was "now"). Results are presented with effects of target position in subordinate clauses relative to effects in the corresponding main clauses. They calculated the difference for the subordinate clause (mean response time to word in late position minus mean response time to word in early position) and subtracted from that the main clause difference (mean response time to word in late position minus mean response time to word in early position). This rather complicated calculation produced results showing in initial-clause position the relative primacy effects were strongest in <u>though</u> clauses and became weaker as subordinate clause became more causal. In final clause position, although they report a "roughly" opposite effect to that of initial clause. I feel they do not produce strong corroborative evidence for a difference depending on strength of the causal link. This is because the two closest reading times in final clause position are <u>since</u>, the only causal connective, and <u>though</u> the adversive one. Their results are reproduced below:

	Initial Clause	Final Clause
If	-159	+86
Since	-106	-329
When	-67	-125
While	+77	-34
Though	+399	-267

Table 6.7 from Bever and Townsend's Experiment 2
Effects of Clause Type on Word Recognition in
Sentences with Various Conjunctions

Bever and Townsend were looking for the answer to the question "Are listeners sensitve to the differences in causal-temporal meanings between the conjunctions used during immediate processing?", and their

conclusion was that despite the generally faster on-line accessibility to meaning in main than subordinate clauses the considerable variation in size and even direction of subordinate-main differences with different conjunctions supported an explanation in terms of the different causal temporal meanings of those conjunctions.

Initial clauses that were more explicitly marked as stating a cause for the event in the following clause (i.e. beginning with if or since) were more directly interpreted and initial though clauses, which explicitly stated that the event in the initial clause is not a cause for the following event, were less directly interpreted. The initial though clause may be held in superficial form so that it can be interpreted in light of the meaning of the following main clause. The relative effects of if and though clauses in final clause position however, were reversed.

As an aside, it seems to me that though is almost negative in its effect on a mental model. "Although you can smell hotdogs, we're having beefburgers" is similar to "Its not hotdogs, its beefburgers". It seems likely that in a gist representation the mention of hotdogs would not appear. There is a similarity between these and a non-factive before clause, for example, "She drank the poison before I could stop her" in that it sets up a possible event or object which is to be represented but ultimately it is not that object or event that happened, but something else.

In experiment 2 Bever and Townsend had target words which could either appear early or late in either clause. Target position effects were

much smaller in initial main clauses than in other types of clauses, suggesting that literal form of an initial main clause is more quickly lost in immediate processing. Target position effects were also influenced by conjunction - in initial clauses primacy effects in subordinate clauses were weakest in if clauses but stronger through since, when, while and though clauses.

Bever and Townsend conclude that listeners are sensitive to possible semantic relations between clauses that are cued by conjunctions while they hear a two-clause sentence and modify their comprehension processes in terms of these semantic relations. However, I feel their conclusions are weakened in various ways, not least by the absence of because as one of their connectives. Also, as previously stated, the results for 2nd position sentences reproduced in Table 6.7 do not mirror the results from initial clause which would be necessary for their argument to be upheld. Their work supports the argument that cause is one relevant relationship but it is not enough to support their very specific proposition.

1.10 Processing Models (part 2 - Townsend)

Townsend (1983) builds on the work of Bever and Townsend (1979) to suggest that language processing consists of two partially separated processes.

(1) propositional processing which obtains the literal meaning of clauses by applying lexical and syntactic knowledge to the words in the clause. Propositional processing retains hypotheses about syntactic structure and literal meaning until the proposition has been integrated

with the preceding text.

(2) thematic processing "determines the relation of incoming propositions to previously processed ones by applying the meanings of connectives, by applying patterns that had been established earlier in the text and in similar texts etc. Thematic processing integrates just apprehended propositions into a thematic representation of the text for example, in the case of narratives it determines the causal/temporal relations of incoming propositions to previously processed propositions." The product of this processing, the "thematic representation" could be compared to a discourse model containing the text already processed and providing a context for incoming discourse. When processing text, problems arise with flashbacks or when there is a denial that some expected event occurred (e.g. although denies an expected cause-effect relation). Since thematic processing cannot determine the thematic relevance of the although clause on the basis of the propositional evidence contained in it, superficial information is retained until further information is obtained that allows it to be thematically integrated.

Experiment 1 in Townsend (1983) presented seven test sentences, four of which contained while and three of which contained since. Subjects heard only a fragment of a sentence, ending before either the last word of the initial subordinate clause or an entire sentence that completed the fragment. There were two types of data: (1) After hearing a fragment or sentence, the subject determined whether a visually presented verb-object phrase was consistent in meaning with what she had heard. The verb-object phrase paraphrased the verb-object

phrase of the initial clause of the fragment or sentence. Townsend reasoned that if the on-line representation of an initial noncausal (while) clause is not fully semantic, response times for synonomy judgement will be faster after the whole sentence has been heard than they are while hearing the clause; if the on-line representation of an initial causal (since) clause is fully semantic, there will be no difference in response times near the end of the clause and after the whole sentence has been heard. (2) Subjects determined whether a probe word had occurred in the fragment. Townsend assumed that the more subjects retained a superficial representation of the clausal fragment including word-order information, the faster response times will be to targets that had occurred earlier in the fragment. If the on-line representation of an initial while clause is more likely to contain syntactic information, word recognition times should be faster for targets occurring earlier in the fragment.

Subjects in the sentence fragment tasks heard all but the last word of the clause, those in the sentence task heard all the sentence. At the end of the fragment, a tone was presented, then, one-third of a second later, subjects either heard a word about which they had to decide whether it was in the fragment or saw a slide containing a 2-4 word predicate phrase which they had to classify as being either consistent or inconsistent with the meaning of any part of the fragment or sentence they had heard.

Subjects were able to recognise whether a phrase was consistent with one in the target for an initial while clause 220ms faster after the whole sentence was heard than they were during listening to the while

clause, but for a since clause the difference was 28ms. This indicated to Townsend that the on-line representation of an initial while clause is not fully semantic. This is supported by the word recognition task, where recognition times were slower for late targets than for early targets in initial while clauses, suggesting representation of the fragment one word at a time whereas the opposite was found in since clauses suggesting a more semantic representation had been constructed.

Townsend suggests the text processor retains the superficial form of the initial while clause and hypotheses about its meaning until the unexpected effect stated in the final clause allows it to determine what effect the speaker had expected to occur based on the event in the while clause. The thematic meaning of an initial since clause, on the other hand, does not depend on information in the final clause, so there is no need for easy access to its superficial representation.

This experiment allowed Townsend to conclude that "in the processing of an isolated sentence, the presentation of the events of a sentence out of cause-effect (or first event-second event) order disrupts the comprehension of the sentence: it produces relative in-accessibility on-line to the meaning of the disruptive clause and the retention of a relatively superficial representation of it." Whilst this finding might accord with our intuitions, it seems a rather impressive conclusion from a study which only compared two conjunctions - since and while. He used since as the causal connective, though it has both a temporal and a causal meaning and while as a non-causal one though it is not semantically simple either. Using 7 sentences is very minimal material

and leaves open the possibility that the particular sentences used may have been atypical in some respect, a suspicion not allayed by the fact the results were only marginally significant ($P<0.1$) for both parts of the experiment.

Experiment 2 presented subjects with 8 two-clause sentences, four containing initial clauses introduced by since and four containing initial clauses introduced by though. The final main clauses were either active or passive non-reversible clauses. Wright (1972) showed that under normal processing conditions questions about active final main clauses will be answered more quickly than passive main clauses. Townsend argued that this would only be the case if thematic meaning of an initial clause has no effect on within-clause processing but if a thematically incomplete clause affects processing of the next clause this effect of syntactic form would not be obtained in the next clause.

Results were that response times were faster for active than for passive final main clauses preceded by a since clause but not for those preceded by a though clause. Townsend argued these results show that propositional processing of a final clause preceded by an adversive clause occurs (e.g. though) quickly in order to obtain information that can be used to thematically integrate the adversive clause.

Again, only a small number of sentences was used, and differences in reading time were small as can be seen from Table 2 below. Townsend fails to explain why the "relatively rapid" propositional processing which he assumes occurs after an initial though clause actually slows down answering a question about an active final main clause.

Context	Active Final Main	Passive Final Main
Since	1417	1561
Though	1615	1427

Table 2 (Table 6 from Townsend. Mean response times (Msec) to questions about active versus passive clauses depending on the context clause)

Experiment 3 was based on a word-naming task (Tyler and Marslen-Wilsen 1977) in which subjects heard an ambiguous phrase of the form verb+ing noun which could either be a progressive adjectival (..dying flowers..) or a gerund (..watering flowers..). In Tyler and Marslen-Wilson the context clause was consistent with the adjectival (Although dead ones are ugly, growing flowers..) or the gerund (Although looking after plants is easy, growing flowers..) After the critical phrase in Tyler and Marlsen-Wilson's experiment, a slide containing is or are appeared and the subject was timed reading the word on the slide. Reading times were faster for continuations that were appropriate for the meaning of the context clause, which was interepreted to show that people use contextual semantic information to make on-line decision about the structure of an ambiguous phrase.

Townsend suggests that instead listeners may have been using the superficial cues (e.g. is versus are) which were present in 92% of their material and says that experiment 1 has already shown that such superficial cues are more available for adversive clauses (like (while and although) than for causal clauses (like since and if) (though experiment 1 only used since and while).

In Experiment 3 there were three trial types:

- initial subordinate clauses ending with unambiguous clauses e.g. If riding subways...
- initial subordinate clause, followed by main clause ending with unambiguous clause e.g. If the boxer wants to avoid injury, dodging punches...
- initial subordinate clause, followed by main clause ending with ambiguous clause e.g. If the pit crew works efficiently, racing cars...

Subjects heard the target sentence, then were required to say as quickly as possible afterwards whether a word presented on a slide was an appropriate or inappropriate continuation. For ambiguous fragments target words were either is or are, for unambiguous ones some were either is or are but predominantly they were some other verb.

Results are presented as a function of the connective introducing the initial clause (if or though) and whether the number information on the target was expected based on local structural information. For ambiguous fragments response times for

semantic expectations (whether the number attached to the target matched the semantic bias of the context)

verb number expectations (whether the number attached to the target matched the number attached to the verb in the context)

lexical expectations (whether the target was identical to a word appearing in the context)

For example, context clauses containing is/are would be as follows:

Singular Semantic Bias
a) singular verb number bias: If the pilot is required to attend flight school, landing planes...
b) plural verb number bias: If the pilots are required to attend flight school, landing planes...
Plural Semantic Bias
a) singular verb number bias: If the airline's ground crew is on the runway, landing planes...
b) plural verb number bias: If ground crews are very often on the runway, landing planes...

The results suggest that context effects on the syntactic processing of a final main clause occur only when the context has not been thematically integrated and hence when lexical and syntactic information from the context are easily accessible. An initial if clause is a complete processing unit in that its propositional meaning is stored in a thematically integrated form at the clause boundary and does not affect the processing of the next clause. An initial though clause, however, is an incomplete processing unit. At a though clause boundary the processor retains a mixture of superficial and propositional information, awaiting full thematic closure; of these representations, specific lexical items, like is/are exert the strongest effect on structural hypotheses in the next clause. The results indicate that a critical factor in the phenomenon of "propositional closure" is thematic integration of the proposition.

In this experiment Townsend used if and though to demonstrate that on-line accessibility to syntactic hypotheses in a clause depends on an interaction of the causal meaning of the introductory connective and the position of the clause in the sentence.

Experiment 4 used six connectives, because, after, when, and, before, and although. Two stories were presented to subjects on

slides and just after a two clause sentence in a story the subject would be asked whether a 2-4 word verb-object phrase was similar in meaning to any part of the sentence most recently read. In each story six test sentences were used in different forms so that (a) the final clause was introduced by because, after, when, and, before, and although, (b) the initial clause was modified in order to make the resulting sentence meaningful as a whole, and (c) the final clauses were identical except for the connectives introducing them. Subjects thus saw two sentences with each connective (one in each story).

Results showed that the response time the to propositional meaning of the final clause after reading the sentence was very similar for because, after, when, and and, increased slightly for before, and increased more for although. i.e. slowest for clauses which explicitly signal a non-causal event. Townsend argues this provides support for his model because if the reader organised the propositions of a just-comprehended complex sentence in a causal or temporal pattern, accessibility to propositional meaning would be faster for causal clauses than for noncausal clauses.

Experiment 5 used because, since, after, when, while, or before, in a replication of Clark and Clark (1968) which required subjects to recall test material verbatim. Where verbatim recall is tested I would question whether a "model" is constructed (or in Townsend's terminology, whether thematic processing is being used). Johnson-Laird and Stevenson (1970) showed that subject's performance was different (i.e. verbatim recall was better), when they knew a memory task was involved, and I would suggest that stressing verbatim recall

either discourages the formation of a model or encourages retention of a propositional representation as well.

Main-subordinate order and subordinate main order interacted with connective, and Townsend presents experiment 5 results in terms of the relative superiority of initial main recall over initial subordinate recall for each connective. Using this method of scoring, results did indicate some effect of cause-effect and first event-second event organisation.

He reports "three connectives which are explicit in signalling a non-causal relationship (while, before) or inexplicit in signalling a causal and temporal relationship (when) were much easier to recall with initial main clause. At the other extreme, the connectives which explicitly signal a causal or prior relationship (because, after) show a slight superiority in recall with initial subordinate clauses. The co-incidence between his model and the results of this experiment is exaggerated by his not mentioning the results for since which previously he has used as a causal connective, but the results for which are halfway between those for (when/while/before) and (because/after).

Experiment 6 presented six stories containing 10-20 sentences where event in sentence n logically occurred prior to the event in sentence n+1 but no temporal connectives were used. They were presented in (a) normal order (a, b, c, d, e, f), (b) with sentence pairs in reversed order (b, a, d, c, f, e), (c) with sentences presented backward, (f, e, d, c, b, a). Subjects were asked to recall

the whole story from memory.

Propositional recall was highest for sentences in a story presented in normal order, next when sentence-pairs were reversed and lowest for backward versions.

Experiment 7 presented two-sentence texts, where the second sentence was introduced by therefore, afterward, no connective, meanwhile, previously, or however, and asked the subjects to construct a continuation sentence. Subjects saw three sentences with each introductory word. Subjects were asked to read each sentence and construct a sentence that would be a reasonable continuation of the story. When the subject had constructed a continuation sentence, she pressed the button on the computer keyboard. This recorded the time spent viewing the sentence and displayed the next sentence. However when the text ended the instruction "Write a continuation sentence" appeared on the screen instead of another sentence of the text.

Continuation time varied for second sentences that were introduced in different ways, being faster the more causal the connective. Townsend concluded integrating the propositions of successive sentences becomes easier as the connective in the second sentence signals more explicitly that the propositions appear in the expected causal/temporal pattern.

Experiment 8 is interesting because it manipulates linguistic context. Subjects read a context sentence that paraphrased either clearly or vaguely the main or subordinate clause of a target sentence containing because, while or although. After reading the target their task

was to press a button when they had constructed a sentence that appropriately continued the text. There were eight forms in which a connective could appear. Subject saw one sentence with each connective in each form. Forms were main-subordinate/ subordinate-main, given information first/new information first, direct versus indirect paraphrase in context.

Previous experiments suggest that thematic integration will be easier for although sentences when the "unexpected effect" (i.e. main clause) appears earlier in the sentence. Experiment 8 shows that response time is faster even if this unexpected event occurs in the previous sentence, indicating similar processes at work for both inter- and intra- sentence processing.

Whether context provides the cause or effect, although sentences are read faster in main-subordinate order and because sentences in sub-main order. This provides support for the idea that we need to hear causes before effects.

While is peculiar because if a while sentence is in subordinate-main order "While Harry took the arsenic, he didn't die." the meaning is more likely to be adversive, than in main-subordinate order "Harry didn't die while he took the arsenic." This experiment confirmed that while behaves like although when the context provides the cause (subordinate clause) but it behaves like because when the context provides the effect. Where the context provides the cause it is faster in main-subordinate order, where the context provides the effect it is faster in subordinate-main order.

Although Townsend's results are very interesting, I have some methodological reservations for example, in experiment 7, - asking people to compose a continuation gives a response time for "reading + composing" so processes other than reading and understanding are timed. The other main problem which I have already mentioned is a somewhat undisciplined choice of connectives for the different experiments, and the small number of examples of each connective in each experiment.

Although Townsend's work supports his theory, its strength is diminished by the fact that he uses different connectives in different experiments. While I presume this is intended to show the applicability of his theory over all temporal and causal complex sentences, in fact it weakens his claim. If we take the most obvious example, in Experiments 2 and 3 since is used as a causal connective (he does not mention that it is ambiguous in having a possible temporal meaning) whereas in experiment 5 the results for since are halfway between those connectives explicitly signalling a causal relation because/after and those signalling a non-causal relation when/while/before. In neither of the experiments using only two connectives to contrast a purely causal connective with either a non-causal one or one signalling an unexpected effect, does he use because. This is a peculiar omission in view of the unique position of because as being unambiguously causal and one which he does not explain.

Because of the different meanings that connectives can have perhaps larger numbers of sentences containing each connective could have been

given to subjects and copies of the materials used presented in his report. The wide variety of experimental methods used, in addition to the different connectives, again makes comparison across experiments impossible.

The work of Bever and Townsend (1978) quoted in the previous section and of Townsend (1983) quoted here has led me to wonder how the "causal processing strategy" affects my concern with temporal connectives. As mentioned earlier (Section 1.4) a causal relation depends on certain temporal relation (cause before effect) and often a sentence on the surface conveying a temporal relationship in fact conveys a causal one as well (for example "She felt sick after she ate the pork pie" implies strongly that the pork pie is responsible for her nausea).

A "cause and first-event strategy" such as that suggested here would mean that before sentences in main-subordinate order and after sentences in subordinate-main order would facilitate language processing more than their reverse and this is difficult to reconcile with Partee's idea that subordinate clause is always processed first. Do reading time experiments using different connectives and clausal orders provide clear evidence either in favour or against such a strategy?

The work of Bever and Townsend also raises questions about differences between sentences with causal or temporal subordinate clauses and this thesis intends to see whether there are such clear differences, bearing in mind the caveat expressed above about the difficulty of distinguishing between the two.

1.11 Focus

That which is readily available and accessible in a mental representation may be said to be in focus. "Focus" is a term coined by Grosz (1977) to help us understand how we derive a referent for an anaphoric mention. It provides a retrieval domain which incorporates the information most pertinent to our understanding at any one time. It is now used not only in computational linguistics the field in which Grosz was working but also in the psychology of discourse (e.g. Sanford and Garrod 1981).

Sanford and Garrod use the idea of focus in combination with that of a scenario - scenarios shift in and out of attentional focus given the appropriate language input. A scenario is "an information network called from long-term memory by a particular linguistic input" and may vary in complexity. They also argue that focus consists of the representation of things mentioned in the discourse - these they call tokens.

The nature of scenarios and tokens must be an important question for any theory of discourse representation to tackle, because it concerns the nature of the information that is called from general knowledge by the linguistic input, to form the discourse representation. I would suggest that the problem bears a resemblance to that generated in the 1970s as to the form of semantic information that is stored with a word - semantic component theories ran aground because they could not state which properties of an object were essential and which peripheral - the discussion led to the work by Rosch (1967) on prototypes. Rosch showed

that a word conjured up a prototypical member of the species denoted by that word, e.g. bird would be more likely to bring to mind a robin than a penguin. Her work has never been developed and linked into other cognitive work, and this may have been because of the essential vagueness of the concepts she was working with at a time when the development of artificial intelligence and computational linguistics meant that being able to specify exactness was a prime virtue.

It now seems that it may be possible to describe the "token" of Sanford and Garrod as a prototype, whose properties can be specified more exactly if necessary by adding extra information. In the same way a "scenario" is a prototype situation which can be altered in the representation by the addition of more linguistic information. It may be possible to combine the idea of a scenario with Moens and Steedman's (1986) idea of the representation of an event nucleus having a (preparatory) process, an event, and a consequence.

"When she went to the bakers" conjures up a scenario, it also forms the nucleus of the event. The scenario that is conjured up also has consequences associated with it. Some consequences are more likely than others - "she bought a loaf of bread" is more likely than "she took back her library books". If the scenario evokes the consequences then one would expect the first alternative to be read more quickly than the second.

Janice Keenan (1978) investigated this. She measured the reading time of a target sentence after four different first sentences, which differed in their likelihood of their consequence being the target

sentence. I give the material below:

Joey's big brother punched him again and again.
The next day his body was covered in bruises.

Racing down the hill Joey fell off his bike.
The next day his body was covered in bruises.

Joey's crazy mother became furiously angry with him.
The next day his body was covered in bruises.

Joey went to a neighbour's house to play.
The next day his body was covered in bruises.

She found that reading time decreased monotonically with the assesed level of their relatedness to the antecedent. This indicates that consequences are in some way part of the scenario/nucleus event. At the end of a scenario the focus may change and this may be indicated by a time change.

Anderson, Garrod & Sanford (1983) carried out a reading experiment to investigate the way in which time changes alter the availability of both principal actors and scenario-dependent characters for subsequent anaphoric reference. They needed to estimate normal lengths of times of various events, such as having a hair-cut, watching a film, then provided a story, for example

The birthday party
The children were all enjoying the party
There was an entertainer to amuse them.
No expense was spared to make the party a success.

One)
) hour(s) later energies flagged. TIME CHANGE
Five)

Scenario-dependent Topic
Organising the games had exhausted him.
Playing the games had exhausted them.

Subjects were presented with passages such as the above with one of

the two time interval (e.g. One hour later..) and one of the two possible final sentences. Reading times were measured for the final sentences, which were both read more quickly with the shorter time interval - one that was consistent with the length of the episode. However there was also a difference between the scenario dependent character and the topic character. Topic characters were read more quickly within range and this difference increased when a longer time interval was used. The scenario dependent character has gone out of focus.

Grosz was concerned with ways of ascertaining that focus shift has occurred. It seems from Sanford, Garrod and Anderson's work quoted above that time (and intuitively place as well) may be two of the factors that contribute to this focus shift.

Morrow (1985) agrees with this view and tests it in his experiments on story understanding but uses the terms from Hopper (1979) of Foreground and Background rather than describing text as in or out of focus. Foreground consists of a sequence of completed events that defines the plot and narrative time line whereas Background introduces, comments on or concludes the plot. Morrow suggests that the temporal relations among events (indicated by tense/aspect markers and conjunctions) help indicate which parts of the model are most prominent or active in working memory.

Morrow pays particular attention to the role of after because, he says, it introduces a sharper foreground/background distinction. Both after and while mark a subordinate event as a landmark for locating

the two time interval (e.g. One hour later..) and one of the two possible final sentences. Reading times were measured for the final sentences, which were both read more quickly with the shorter time interval - one that was consistent with the length of the episode. However there was also a difference between the scenario dependent character and the topic character. Topic characters were read more quickly within range and this difference increased when a longer time interval was used. The scenario dependent character has gone out of focus.

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Morrow pays particular attention to the role of <u>after</u> because, he says, it introduces a sharper foreground/background distinction. Both <u>after</u> and <u>while</u> mark a subordinate event as a landmark for locating

a role in assigning events to their place in the discourse model so here we have another link between linguistic theory and psycholinguistic research.

The points raised in this section raise questions which need to be tested experimentally. The suggestion that after clauses indicate a shift to a new focus may be supported by evidence from continuation experiments. If there are fewer continuations from subordinate clauses begun by after than by other connectives it may indicate that they are less salient because the event they describe is out of focus. Can I show this evidence from continuation studies?

CHAPTER II - MEMORY FOR TEMPORAL INFORMATION

GENERAL INTRODUCTION

Previous experiments for memory of explicitly temporal information were not easy to find and, in their absence, experiments in this chapter focus around three main areas.

1. How is non-factive information remembered?

2. When 2 events occur at the same time does the representation distinguish clearly between the one (usually described first) for which the reference time is provided and the co-occurring event.

3. Is there a similarity between the way we represent temporal order and the way we represent a spatial array? More work has been done on memory for spatial information, (e.g. Barclay 1973, Bransford, Barclay and Franks 1972, Ehrlich and Johnson-Laird 1982 and Mani and Johnson-Laird 1982)

I wanted to shed more light on the process of representation of a complete text in the form of a short story. Experiments 1 and 2 (1 on children, 2 on adults) tested the findings of both Bartlett and Sturt about memory for temporal items, especially temporal order in a story, in the light of the points made by Trosberg (1981) that logical ordering of events was easier for children than arbitrary ordering. Often events have a "prototypical order".

Trosberg presented children with sentences containing before and after and asked them to tell the experimenter which event took place first. When children had difficulty with before and after they would use knowledge of the world to say which event usually happened first. The same strategy would allow adult subjects to make informed guesses about order of events and should mean events forming part of the structure of a story are remembered in order.

The importance of sentence order in text understanding was also examined by Townsend (1983) when subjects were asked to remember stories (a) with sentences in correct order, (b) with consecutive sentence pairs reversed and (c) with all sentences in the story in reversed order. Townsend's subjects remembered (a) better than (b) better than (c). This confirms the ease with which continuous sentences were understood over discontinuous sentences in Ehrlich and Johnson-Laird (1982). These suggest that where event order is the same as sentence order comprehension is easier.

Mani and Johnson Laird (1982) showed that determinate descriptions of objects were remembered better than indeterminate descriptions, and one possible temporal equivalent of this is the occurrence of events in "non-factive" before clauses, i.e. where the event is prevented by the pragmatic and semantic consequences of the main clause event. Experiments 1 and 2 try to probe this further.

Once the mental model has been built the linguistic form in which the text is presented is forgotten quickly. I am assuming that events that are temporally close to each other are close together in the model

and both experiment 1 and 2 have parts designed to look at this aspect. Experiment 3 looks at whether different instructions to subjects will influence sentence recognition. When 2 events occurring at the same time are presented in different sentences are they confused so the event in the second sentence is wrongly remembered as occurring in the first?

Attempts were made to answer questions raised in Section 1.6 of the introduction. Can I confirm Sturt's findings that temporal and locative information are remembered to a similar extent? Experiments 4 and 5 compare spatial and temporal representation. Do the many similarities in our language for spatial and our language for temporal information reflect similarities in our representations of the two dimensions? One way to check this out was to try to ensure (by giving appropriate instructions) that a mental model is constructed, and to see whether details of spatial and details of temporal information are recalled in a similar manner, i.e. if mistakes fall into a regular pattern (such as the "temporal confusions" in experiment 3) which reveal the nature of the representation.

EXPERIMENT 1

INTRODUCTION

This study on 12-year olds was a preliminary investigation of the importance of various factors involved in memory for temporal information.

The experiment was to test four hypotheses:

1. Events in a story occur in a definite temporal order. Order of events would be remembered better when they form a logical rather than an arbitrary order. "Logical" referred to items in an expected or usual order whereas "arbitary" items had no preferred order.

2. Events and temporal items (times, days, etc) can fall inside or outside the main story line. Memory would be better for those events and temporal items that form part of the main story.

3. An event in a non-factive before clause does not happen. However, because it is mentioned in text it should form part of any model. If it appears in some form in the model there may be some doubt expressed about whether it occurred. So subjects would sometimes mistakenly claim the event in the non-factive clause occurred especially if nothing else happens to the event in the non-factive clause.

4. When two events occur at the same time but are described in two different, consecutive sentences, the discourse model, which is an integrated version of the story, will not record their linguistic form i.e. in two sentences. Subjects should identify one sentences which combines the time given in the first sentence and the event in the second sentence which happens at that time.

METHOD

Subjects

Subjects for this experiment were twenty-six pupils from a Hartlepool Comprehensive School, aged 12-13 years. There were approximately equal numbers of males and females.

Materials

Materials were prepared by first composing four stories of approx 600 words in length. An example is given below:

STORY 1

The two kids were happy. It was Saturday. On Wednesday Uncle Eric had given them 50p each. On the same day they'd earned a pound from Auntie Joan. Now they had their pocket money as well and were going to the shops to buy a new football. Joy of joys, the sun was shining. They brushed their teeth and washed their faces with the scantest of attention - the regulation three shredded wheat were wolfed down with no regard for their digestive systems and they were off to the town, running down the pavements.

Gary kicked an empty pepsi can in an absent-minded sort of way - Peter intercepted it before it flew into someone's garden and immediately they were taking part in the FA Cup Final - they weaved in and out of the other pedestrians who'd been lured into the open by the sunlight and ignored the occasional worried toot from a driver imaging a squashed boy under the wheels. The pace was hot and frantic until the inevitable happened and a too-enthusiastic kick from Peter sent the can flying high into the road.

A still moment, until they remembered the nature of their errand and headed for the shops again. They tried Woolworths first - it had a good toy section. Walking past the school equipment Gary saw a rubber shaped like a hedgehog. He paused for a moment, reached out to touch it - was it really all rubber? He felt a heavy hand on his collar "Come on you - out of here - no messing around - and your mate too". Gary instinctively tried to shrug off the offending hand. It gripped tighter, hurting him as the fingers dug in, he wriggled more, trying to lessen the pain. "Quit that or I'll get the cops" the gravelly voice

spoke again.

Gary gave in and was still. The fingers still hurt. His face was red, he was gasping for breath, trying not to cry from the pain and the shame as other shoppers began to look round interestedly watching the scene. He kicked the guard in the shin. "Bloody hell" the man said. His grip loosened for a moment as he almost gave in to the impulse to rub his leg.

Peter had been frozen in shock for a moment. He had been ahead of Gary and turned round when the man spoke. He couldn't believe what he saw. His big brother held prisoner by a uniformed stranger. He flew at the man, just as his grip on Gary's shoulder was loosened and knocked him off balance.

The guard tried to get the same grip on Peter as he had on Gary, at the same time holding them as far away as possible from his body to avoid the punishing kicks which they were both now inflicting on him. One of the spectators laughed. No-one else moved.

The guard tried to change his grip on the lads to pinion their arms to their side. He yelled "Sid" and then he yelled "ouch" immediately after - he had inadvertently let his wrist stray within biting distance of Peter's mouth and Peter had taken full advantage of the opportunity.

As he dug his teeth in deeper, all the guard's faculties became focused on removing his arm from danger. He let go of Gary and used his free had to push Peter away, releasing his grip on him at the same time.

The boys took a frantic look around them, saw the guard let go of his wrist ready to reach for them again, saw another burly uniform approaching from the back of the shop and fled in the opposite direction, pushing through the knot of bystanders who had gathered.

They were out of the shop and along the High Street as if pursued by devils - outside Littlewoods Peter looked back and saw no pursuers, but it was only when they got to Boots they both slowed their pace and of one accord, went down the alley beside the petshop.

A door was open into an empty back yard. Gary pulled Peter in after him and they sat down, gasping for breath. As his breathing slowed down, Gary thought of their happiness as they came into town and how quickly things had gone wrong. Peter burst into tears suddenly and Gary put his arm round him.

Story 1 - Questions

1. Can you remember what was happening when one of the spectators laughed?
2. Put these events in order:
   - the guards grip loosened
   - the car tooted
   - they ran past Littlewoods
   - they brushed their teeth

Peter burst into tears
they got out of bed
Peter flew at guard

3. What shops did they run past?
4. At what point did the guard swear?
5. What did Gary touch that started all the trouble?
6. (a) Was it morning or afternoon?
   (b) How do you know?
7. What made Peter turn round and see the guard holding Gary?
8. What was the name of the second security guard?
9. What did they have for breakfast?
10. (a) What day was it?
    (b) How do you know?
11. Where did the pepsi can end up?
12. Was this sentence in the story?
    "Last Wednesday they earned a pound from Auntie Joan."

For each story 12 questions were composed some of which were fillers and others which were intended to throw light on the following temporally related phenomena:

1. Was there a difference between subject's memory for order of events when these formed a logical order and when they were in arbitrary order? Logical order was the order in which they occurred in the text and the order in which it was assumed these events must occur if the story is to remain as it is. Events in arbitary order could occur in any order without affecting the story. Examples from Story 1 are questions 2 and 3 (above). Subjects were scored either correct or incorrect on the whole order.

   Logical order:
   Put these events in order:
   the guards grip loosened,
   the car tooted,
   they ran past Littlewoods,
   they brushed their teeth,
   Peter burst into tears,
   they got out of bed,
   Peter flew at guard.

Arbitrary order: In what order did they run past the shops?

2. Was there a difference between subject's memory for order of events and temporal items in and out of the main story line? Questions about temporal order or sequence of events (e.g. what was happening at the same time as....? were originally scored separately from questions about temporal items, (for example "How long ago had Sue agreed to help?")but because there were few items in both categories and because both were differentiated with respect to whether they were in or out of main story line it was decided to combine the two types of temporal information. Subjects were scored either correct or incorrect. Examples of all four types are:

An event in the main story line:
What made Peter turn round and see the guard holding Gary?

An event out of the main story line:
Can you remember what was happening when one of the spectators laughed?

A temporal item in the main story line: (from Story 3)
What time did the first guest arrive?

A temporal item out of the main story line (from Story 2)
How long had the house been on the market?

3. Sentences with non-factive before clauses were present in each story; in two stories these were continued with positive alternative endings to the event in the "before" clause. In two there was no re-iteration of the non-factivity. The two conditions were compared. The sentences and quetions were as under:

Story 1
Peter intercepted it [the pepsi-can] before it flew into someone's garden.
(Positive alternative ending - the pepsi-can later meets its end under the wheels of a car)

Question - "Where did the pepsi-can end up?"

Story 2
Margo dived for him [Freddie] before he did his circus trick.
(Positive alternative ending) - Freddie is put in his basket.
Question - "Did Freddie have the chance to leap on Margo's shoulders?"

Story 3
Before Mary's dad could make any rude comments the doorbell rang again.
(No positive alternative ending given)
Question - What did her father say about Samantha's outfit?"

Story 4
Before Kevin could start washing up Mary bundled him out of the house.
(No positive alternative ending given)
Question - "Did Kevin wash up before they left the house?"

4. Was one sentence containing an anchor time and an event confused with another sentence containing a second event happening at the same time but described in another sentence?

Story 1
"On Wednesday Uncle Eric had given them 50p each. On the same day they'd earned a pound from Auntie Joan."
Questioned as to whether "On Wednesday they'd earned a pound from Auntie Joan." appeared in the story.

Story 2
"At 7.30 Jan packed the last of the bedding. At the same time Margo made some breakfast."
Questioned as to whether "At 7.30 Margo made some breakfast" appeared in the story.

Story 3
"Once she was in bed her mother began baking fairy cakes. At the same time her father began wrapping presents for "pass the parcel".
Questioned as to whether "Once she was in bed her father began wrapping presents for "pass the parcel" appeared in the story.

Story 4
"Immediately the doorbell rang, Sam the dog began to bark furiously. At the same time Jenny appeared at the door."
Questioned as to whether "Immediately the doorbell rang, Jenny appeared at the door." appeared in the story.

Because these stories were intended to be as natural as possible it was impossible to select questions in the categories logical/arbitary order and inside/outside main story line from each story. In logical

arbitary order there were 6 questions made up of 2 from stories 1 and 2 and one from stories 3 and 4. In inside/outside main story line there were 14 questions, 2 from story 1, 3 from story 2, 4 from story 3, 5 from story 4. In the other 2 categories of question there was one question from each story.

The complete set of stories and questions is given in Appendix 1(a).

Design and Procedure

The experiment took the place of an English lesson. Subjects sat in their classroom and were handed a piece of paper containing the story they were to read. As there were 26 subjects and 4 stories, stories 1 and 4 were read by 6 subjects each and stories 2 and 3 by 7 subjects each.

Subjects were told "You will be given a story which you should read carefully, when you have done this they will be collected and you will be given some questions to answer." When subjects had finished reading the story, it was removed and they were given the set of questions pertaining to the story they had read.

The whole procedure including handing out stories and questions, and collecting completed questionnaries took about 20-25 minutes.

The answers provided were examined for the above temporally related phenomena. The number of correct answers was out of 6 for two stories and out of 7 for the other two, so answers are given as "percentage

correct" to compensate for this inequality.

RESULTS

F1 analysis was not possible because subjects saw only one story and not all categories of question appeared in each story. Results are given below for the four factors:

1. Logical v arbitrary temporal order
2. Temporal Order and items inside/outside main story line
3. Non-factive before clauses
4. "Temporal confusions"

No of correct answers for all the above factors are shown in Appendix 1(b) and details of analyses in Appendix 1(c).

1. Temporal Order (Logical v Arbitrary)

Logical Order % correct	Arbitrary Order % correct
62	40

Table 1.1: Mean percentage correct from questions relating to logical/arbitary temporal order

Subjects were asked the correct order of a sequence of events and were scored "correct" if they were able to recall the correct sequence. Percentages of correct answers are shown in Table 1.1. A Mann-Whitney test showed no significant difference between subjects memory for events in stories which formed logical or arbitrary order.

2. Events and Temporal Items (Inside v Outside Main Story Line)

	Main Story Line % correct	Out of Story Line % correct
Order of Events	52	10
Temporal Items	84	58
Total	68	34

Table 1.2: Mean percentage correct from questions relating to temporal order in/out of story line

As explained above (in "Method") order of events and temporal items were combined to give an overall measure of how much temporal information is recalled from the inside the main story line as opposed to outside the main story line. From Table 1.2 it can be seen there was a significant difference between memory for items in an out of main story line ($F2=12.49$, $df=1,6$, $P<0.05$).

3. Non-Factive Before clauses

Positive alternative % correct	No Positive alternative % correct	Overall % correct
77	55	66

Table 1.3: Percentage correct from questions relating to non-factive before clauses with/without positive alternatives

For this item, subjects were asked whether the event in the before clause occurred were required to respond that it had not, or what had happened instead. Table 1.3 shows that the difference between the answers from the two types of non-factive before clauses (those with a positive alternative ending and those without). Using a Mann-Whitney test the difference was significant ($P<0.05$).

4. "Temporal Confusions"

Story	% correct
1	50
2	43
3	14
4	33
	35

Table 1.4 : No of subjects correctly rejecting "temporal confusions"

From Table 1.4 it can be seen that over the four stories 65% incorrectly accepted false "integrated" sentence where one sentence containing an anchor time and an event was confused with another sentence containing a second event happening at the same time.

DISCUSSION

The difference between memory for order of events in logical and arbitrary order was in the predicted direction although it did not reach significance. There is evidence that order of events and temporal items in main story line are remembered better than those not in main story line. Overall 66% subjects were correct in remembering that an event in a non-factive clause didn't happen but this varied depending on whether the story provided an alternative ending to the non-factive event. 65% of people accepted the "temporal confusion" sentence made up of time and a different event to that presented in the story.

Because the number of subjects was small and each subject only saw one

story, I can only draw tentative conclusions from this experiment and these conclusions will be subject to further examination in the next experiment.

These results suggest the following; First, that the main story line forms an important basis for the discourse model, with items within it remembered more clearly than those on the boundaries, and the events within it which form a clear, logical order tend to be remembered better than arbitarily ordered events.

Second non-factive clauses are not definitely excluded from the representation of the text. An alternative ending seems to provide a further indication that the event in the non-factive clause had not occurred and reduced the number of incorrect responses significantly.

Third, two events occurring at the same time are represented together and subsequently the exact linguistic form in which the occurrence of these two events was described cannot be recovered.

EXPERIMENT 2

INTRODUCTION

This experiment builds on the results from the previous experiment, looking at the same and additional factors.

Are subjects better at remembering details of the temporal order of

events or details of their location? Memory for the order of events in logical order within the sentence appeared fairly accurate and in this experiment I compared this with location of events to examine Sturt's (1925) finding that temporal details were remembered slightly less well than locative ones. I expected there to be little difference between the extent that locative and temporal detail, both of which give "contextual" detail, are remembered.

What factors might lead subjects to incorrectly remember that the event in non-factive before clauses happened? Having shown in experiment 1 that providing a definite alternative ending for the event in the before clause increases the likelihood of subjects correctly remembering the non-factivity in the clause, in this experiment instead of the before clauses being given positive alternative endings, the questions were varied, so that in three stories the event in the clause would be queried directly, in the other three indirectly. I would expect a direct enquiry about the event would increase the likelihood of subjects correctly remembering that it did not occur.

Is there more likelihood of subjects confusing two sentences describing two events occurring close together temporally than two far apart in time? In experiment No 1 subjects frequently misrecognised "temporal confusions", in this experiment these were compared for events occurring at the same time and for two events occurring at two separate times. The prediction was that if the mental representation of a text groups events together because of the time at which an event occurs in relation to other events, then sentences describing events should be less easily confused if the two events occur at different times rather than at the

same time.

Previous work (Johnson-Laird & Stevenson 1970) has shown that when subjects were aware that a memory test was to follow their reading a passage of text subjects recognition of verbatim sentences was better (i.e. they were less likely to mistakenly recognise a sentence which was different but meant the same). This might affect the recognition of temporal confusions so in this experiment there was one question for each story where subjects were given a paraphrase of a sentence that occurred in the story and asked if it had occurred. This was compared with the number of times subjects recognised a sentence that actually had been present in the story. If subjects were affected by the knowledge that a memory test was to follow it was expected they would retain a more linguistic representation of the text and hence be able to clearly distinguish between the actual sentence given in the text and a paraphrase.

METHOD

Subjects

Subjects for this experiment were fourteen first-year Psychology students from Durham University. Ages ranged between 18 and 24 years and there was an approximately equal number of males and females.

Materials

Materials were prepared by first composing six stories of about 500

words each. An example is as follows:

Story 1 - A Walk in the Country

Tina and Chris walked along silently. The path was rising slightly. To the left the ground sloped away to a rushing stream, to the right there was a wooded hillside where they could hear the birds singing. Last time they were here Chris spotted a woodpecker. This time Tina pointed out a robin, sitting on a low branch of a young beech tree, and they stopped and watched as it flew down to within a few feet of them, and began scratching in the fallen leaves.

Chris couldn't believe that in half an hour they would have to get back in their car and drive back to the big city. Tomorrow at 8.30 they would both be at work at their desks, in stuffy rooms and the memory of this walk would fade, just as the sunlight was already beginning to dwindle in the evening air.

She sighed deeply and the noise was enough to startle the robin who flew back to the safety of his beech sapling. Tina looked sympathetically at Chris, as if sharing her thoughts and then decided to shake her out of her dreary mood. "Come on, I'll race you," she said suddenly and the two of them tore up the narrow track, laughing as a nervous squirrel hurried out of their way, and then, when it was sitting in a holly bush, gave them a scandalised look. Such goings on indeed!

Before they got to the large oak tree they were gasping for breath. They stopped and grinned at each other and, as of one accord, started down a small diversion from their path, which led down towards the rushing water. There were small gorse bushes on either side and, when her foot slipped because the path was quite steep and very muddy, Tina grabbed onto one for support. She let go again quickly because it was prickly and stood for a moment regaining her balance.

They picked their way carefully down the last few yards to the side of the stream. The ground sloped steeply just beyond where they were standing and the stream went over a little waterfall. As they reached the top, Chris bent down to pick up a small rounded pebble. At the same moment Tina stopped, entranced with the moving water. Chris, too, was fascinated by the ever-moving, ever-changing flow for a while. She lost interest fairly quickly however and looked over to the other bank where there were some orchids the last time they were here.

Tina was taking no notice of anything but the water, she was always almost hypnotised by waterfalls, or waves, and Chris waited patiently for a full five minutes, keeping a hopeful eye out for the otter they'd seen months ago, until Tina sighed and turned away from the stream. They turned homeward and began the ascent.

Questions for Story 1

1 How wide was the stream?
2 Was this sentence in the story?

"Chris found it incredible that in thirty minutes
they would have to drive back into town."

3 Which side of the path were the prickly bushes on?
4 Was this sentence in the story?
"She lost interest fairly quickly however and looked over
to the other bank where there were some orchids."
5 What caused Tina to slip?
6 What type of bush did Tina grab for support?
7 What time did they start work?
8 Where did the steep path lead?
9 In what order were these events suppposed to have happened?
Tina saying "Come on, I'll race you"
Heard birds singing
They startled a squirrel
They saw an otter
10 What sort of work did they do?
11 What startled the robin?
12 When did they see a woodpecker?
13 Where was the robin sitting?
14 Did they pass a large oak tree?
15 Was this sentence in the story?
"Chris slipped right over and Tina helped her to her feet."
16 What sort of bush did the squirrel retreat to?
17 Was this sentence in the story?
"She let go again quickly because it was prickly and stood for a
moment regaining her balance."
18 As the story starts, on which side of them was the wooded hillside?
19 Was this sentence in the story?
"As they reached the top Tina stopped, entranced
with the moving water."
20 How close to them did the robin come?

For each story 20 questions were constructed, 8 of which were fillers, and the others which were intended to investigate the following phenomena

1. Memory for temporal order compared to memory for details of location
There were four questions about the location of objects and events in the story (subjects were asked "Where did .... happen?) and the results of these questions were compared (as described in Results section) with the answer to question about temporal order which consisted of a list of 4 events mentioned in the story which subjects were asked to put in order of occurrence.

2 Non-factive before sentences- there was one sentence with a non-factive before clause in each story. For three stories a question asked directly whether the before clause happened, (e.g. "Did they pass a large oak tree? - Story 1) for three a question asked indirectly about the before clause (e.g. Story 3 says "She poured herself a large whisky but put it down before she could take a sip" and subjects were asked "How much whisky did she drink?).

3. Temporal confusion - Two adjoining sentences (or occasionally a two clause sentence) were combined to give the recognition test sentence. There were two types of combination.

A. Temporal confusion - As in experiment 1, one sentence contained time and event and a second sentence a co-occurring event. The combined sentence contained time and co-occurring event. e.g. As they reached the top, Chris bent down to pick up a small rounded pebble. At the same moment Tina stopped, entranced with the moving water. Recognition - As they reached the top, Tina stopped, entranced with the moving water.

B. Close together in text - Two events that happened at different times are described either in one sentence or in two adjoining sentences. The recognition sentence describes the second event happening at the time of the first event. e.g. She lost interest fairly quickly however and looked over to the other bank where there were some orchids the last time they were here. Recognition She lost interest fairly quickly however

and looked over to the other bank where there were some orchids.

4 Verbatim vs Paraphrase sentence - One question involved subjects being asked to recognise a verbatim sentence and another to recognise a paraphrase sentence to investigate what sort of representation was being constructed.

A full set of materials is attached as Appendix 2(a).

Design and Procedure

The subjects were tested in the first-year psychology laboratory and were split into 6 groups (4 of 2 and 2 of 3). Each member of group 1 was presented with a copy of story 1, each member of group 2 a copy of story 2, etc. Subjects were told "You will be given six stories in all. When you are given each one you should read it carefully and hand it back to the experimenter when you have finished, and you will be handed the questions appertaining to that story." When they had completed all the questions they handed the questionnaire to the experimenter and were presented with the next story. This procedure was continued until all groups had read and answered questions on all stories, with order counterbalanced so as to even out effects of practice, expectation and fatigue. Time taken for the subjects to complete all six sets of stories and questions varied between 25 minutes and 45 minutes.

The answers to each question were recorded and subjected to statistical

analysis.

RESULTS

F1 and F2 analyses were carried out on the four factors already listed. These are

1. Temporal Factors
   (a) Temporal order vs location
   (b) Direct vs Indirect querying of non-factive befores
   (c) Temporal confusions with items close together in time vs far apart in time
2. Verbatim sentences vs paraphrases

Raw data for all these factors appears in Appendix 2(b) with details of analyses in Appendix 2(c).

Temporal Factors

1. Memory for Temporal Order compared with Memory for Location

Temporal order	Location
3.79 (63%)	4.04 (76%)

Table 2.1: Subject means for no of items recalled correctly

Table 2.1 shows the means for the two types of information. The difference was not significant (F1<1, F2=2).

2. Non-factive before sentences

Direct Question	Indirect Question
2.4 (80%)	1.8 (60%)

Table 2.2: Mean no of non-factive clauses recalled correctly as not having occurred depending on type of question asked.

Table 2.2 shows the results from this factor. The difference was marginally significant on F2, but not significant on F1 (F1=3.24, df=1,13; F2=15, df=1,2, P=0.06).

3. Temporal Confusions

Events close together (correctly rejected)	Events far apart (correctly rejected)
3.34 (58%)	3.85 (64%)

Table 2.3: Mean no of responses correctly rejected for items close together and far apart

Table 2.3 shows the subject means for recognition of sentences where two close together events are confused and two far-apart ones are confused. This was not significant (F1=2.33, df=1,5; F2=1.6, df=1,13).

Verbatim sentences v paraphrases

Verbatim sent recognised	Same Meaning sent recognised
4.5 (75%)	1.8 (30%)

Table 2.4: Subject means for number of sentences recognised verbatim v same meaning only

From Table 2.4 it can be seen that subjects were surprisingly good at recognising whether sentences had been in the stories or not. Both by subject and by-story there was a significant difference between recognition of those sentence which had actually occurred and those which merely paraphrased an occurring sentence ($F1=58$, $df=1,13$, $P<0.01$: $F2=8.06$ $df=1,5$, $P=0.05$).

DISCUSSION

The results showed that temporal and location information was remembered to a very similar extent. As predicted, it was more likely that the event in the non-factive before clause would be correctly remembered as not having occurred when its occurrence was directly queried rather than when a question was asked which to some extent took the occurrence of the event in the non-factive before clause for granted.

There was no difference for recognition of sentences where two items far apart were combined or two items close together. This is a surprising finding, but can perhaps be explained with the help of the results of the recognition test for sentences with same meaning but different words where subjects were surprisingly good at distinguishing sentences that had occurred from those that hadn't. As subjects were expecting a memory test they may have formed a model of the text, but they also retained more detail of the actual surface form of the text than they would have done if no memory test was expected (Johnson-Laird & Stevenson 1970; Stevenson, 1988).

These results support the idea that locative and temporal information

(whether explicit or relational) are of equal (although perhaps not of major) importance in forming a representation of a text. The fact that non-factive before sentences are not always correctly remembered indicates that their occurrence or non-occurrence is not treated as of vital importance in the representation of the complete text.

The results from the "temporal confusions" suggest that two items occurring close together in the world described are not represented close together. This is such a surprising finding that instead it is more likely that even if a discourse model was constructed for these sentences, subjects made a conscious effort to retain details of linguistic form, because they were expecting a memory test.

It is also possible that because material was produced in written form there is also some memory trace of the actual appearance of the sentences on the page, which would not occur with aural presentation.

EXPERIMENT 3

INTRODUCTION

This experiment was conducted to examine further similarities between representation of temporal and locative information.

With temporal information, Bransford, Barclay and Franks (1972) found that sentence memory representations can embody more than the sentences contained. So, for example, subjects hearing "The woman stood on the stool and the mouse sat on the floor beneath it" could not remember

whether they had heard that sentence or "The woman stood on the stool and the mouse sat on the floor beneath her" which is implied by the first sentence. Barclay (1973) assumed that most communication situations require the listener to construct semantic representations (or possibly discourse models) of objects, relations between objects, events, states of affairs and the like rather than representations of sentences per se. However certain tasks, primarily memorisation, do require sentences be treated as objects rather than sources of information about other aspects of the world.

As described in the introduction, he presented acquisition sentences containing the expressions to the left of and to the right of describing an array of five animals standing in a row:

LION BEAR MOOSE GIRAFFE COW

to two groups of subjects; one of whom had to figure out the linear order of the animals while the other attempted to memorise the acquisition set.

Subjects were presented with a recognition task, 5 sentences were old, i.e. had been presented in the acquisition set, 5 reversed subject and object in these sentences, 5 changed the relation in these sentences, 5 were equivalent, i.e, changed subject, object and relation. There were also 4 new true sentences and 4 new false sentences.

Subjects were asked to indicate confidence of "new" or "old" on a 5-point scale, and these were scored with + indicating old and - indicating new. Barclays results are displayed in Table 1:

Group	Old	Equiva-lent	True New Pair	Relation Reversal	Subject Object Reversal	False New Pair
Imagers	3.35	2.91	3.03	- 3.81	- 4.09	- 4.23
Memorisers	1.04	0.74	0.19	0.56	0.83	- 0.92

Table 3.1: Mean recognition scores for sentence categories (Barclay 1973)

Results showed that "imagers" treated all true sentences and no false ones as acquisition sentences, whereas "memorisers" results were less clear but rated false new sentences below all others and showed an almost significant difference between old sentences and true new acquisition sentences.

In order to further investigate the extent of similarities between representation of locative and temporal information it was decided to carry out an analog of this experiment.

METHOD

Subjects

40 First year undergraduate psychology students acted as subjects in this experiment. There were approximately equal numbers of males and females, and ages ranged from 18 to 35 years. 20 subjects took part in the "Imagers" condition and 20 in the "Memorisers".

Material

The acquisition sentences referred to a series of 5 events in the following order:

the cat meowed
the mouse ran
the dog barked
the boy yelled
the hen clucked

Before and After were used instead of to the left of and to the right of, and this generated the following frame:

the cat meowed)		(the cat meowed
the mouse ran)	before	(the mouse ran
the dog barked)		(the dog barked
the boy yelled)	after	(the boy yelled
the hen clucked)		(the hen clucked

The acquisition set is given in Table 1 below. Three orders of the 11 acquisition sentences were arranged consecutively for the total set. Orders were random except for the constraint that no consecutive sentences among the 33 refer to the same pair of events.

The cat meowed before the mouse ran
The cat meowed before the boy yelled
The mouse ran before the dog barked
The mouse ran after the cat meowed
The dog barked before the boy yelled
The dog barked after the cat meowed
The boy yelled before the hen clucked
The boy yelled after the dog barked
The hen clucked after the boy yelled
The hen clucked after the mouse ran
The hen clucked after the cat meowed

Table 3.2 - Acquisition set

The recognition set consisted of six categories which are described and illustrated in Table 2. Five of the acquisition sentences were used to

derive OLDs, SUBJECT-OBJECT REVERSALs RELATION REVERSALs and EQUIVALENTs. The remaining acquisition sentences and their derivatives were not used because each qualified for two recognition categories. TRUE NEW PAIR and FALSE NEW PAIR categories each contained four sentences and the rest each contained five. Thus the recognition set contained 14 true and 14 false sentences, 23 of which were new. The full set of 28 sentences can be found in Appendix 14. The recognition list contained two consecutive randomisations of the 28 sentences, again with the constraint that no adjacent sentences among the 56 refer to the same pair of events.

Category sentences	Example	Rule for producing
OLD	The cat meowed before the boy yelled	(From acquisition list)
SUBJECT-OBJECT REVERSAL*	The boy yelled before the cat meowed	1. Interchange the subject and object of an OLD
RELATION REVERSAL*	The cat meowed after the boy yelled	2. Change relational term of an OLD to its opposite
EQUIVALENT (to OLD)	The boy yelled after the cat meowed	3. Apply rules 1 and 2
TRUE NEW PAIR	The boy yelled after the mouse ran	4. Correctly describerelation between two events which did not occur together in any acquisition sentence
FALSE NEW PAIR*	The cat meowed after the dog barked	5. Incorrectly describe relation between two events which did not occur together in any acquisition sentence

*Note that these are false with respect to the original order.

Table 3.3 : Recognition List Categories.

Design and Procedure

Subjects were divided into two groups and instructions were read out as

under:

Imagers This experiment is to investigate the communicative properties of language. I'm going to read you a list of sentences and you should use the sentences to form a picture of these events in the order they occur.

For instance, I may read "The girl stood on her head before the woman screamed", then "The car drove away after the woman screamed." You should form an image of these events in their correct order. However, when you hear one event occurred before another, or after another, it does not necessarily mean it happened immediately before or after it, another event, or possibly 2 or 3 events might occur between them.

You will later be asked to write down the order in which these events occurred. Some of the sentences may be repeated.

Memorisers I want you to memorise the sentences I'm going to read to you for an experiment on memory. When they have been read to you you will be given a recognition test containing the sentences you have heard and very similar new ones and will be asked to say whether or not you have heard the sentences before. Some of the sentences may be repeated.

The experimenter read sentences with normal intonation, pausing 3 seconds after each.

The recognition task began 2 min after the final acquisition sentence was read. Subjects were instructed "Please indicate on the piece of paper before you whether the sentences you hear are old or new and rate your confidence in your judgement on the 5 point scale provided from 1, low confidence to 5, high confidence. Some of the sentences will be repetitions. Remember, all I want you to do is say whether the sentence was in the acquisition set of sentences you heard or not."

With each group of subjects (both Imagers and Memorisers) the experiment took about 25 minutes.

RESULTS

The results were analysed in a 2 (imagers vs memorisers) x 6 (type of recognition sentence) analysis of variance. The overall means for each of the conditions is shown in Table 3.4.

For data analyses, each recognition response received a value between +5 and -5, excluding zero: "old" responses were considered positive "new" responses negative, and the numbers one through five correspond to degrees of confidence from "very low" through "very high."

Group	Old	Equiva-lent	True New Pair	Relation Reversal	Subject Object Reversal	False New Pair
Imagers	2.37	2.45	1.72	- 1.33	- 1.35	- 1.79
Memorisers	1.22	0.91	0.92	0.27	0.85	1.08

Table 3.4: Mean recognition scores for sentence categories

Imagers and Memorisers scores were significantly different overall. Memorisers were more likely to claim sentences were "old" ($F1=8.50$, $df=1,19$, $P<0.01$; $F2=34.70$, $df=1,22$, $P<0.001$).

Over both Imagers and Memorisers there were significant differences between categories ($F1=16.16$, $df=5,95$, $P<0.00001$; $F2=21.57$, $df=5,22$, $P<0.001$) and in order to further investigate these Memorisers and Imagers were analysed separately. Different categories were very significant for Imagers ($F1=16.16$, $df=5,95$, $P=0.00001$; $F2=65.38$,

df=5,20, P<0.00001). There were also marginal differences for Memorisers on F1 (F1=2.66, df=5,95, P<0.05; F2=1.53, df=5,20). Distribution of these differences was assessed using Newman Keuls tests.

Newman Keuls tests showed that for Imagers, means for true sentence categories did not differ reliably, nor did those for false sentence categories. However, all comparisons between true and false sentence categories were significant (critical values of F at the 0.01 level were used). Memorisers results were much less clear-cut, using critical values of F at the 0.05 level, F1 analysis showed RELATION REVERSALs to be significantly different from OLDs, NEW FALSE and SUBJECT-OBJECT REVERSALs while on F2 there were no significant differences.

Details of actual results appear as Appendix 3(b) and details of analyses appear as Appendix 3(c).

DISCUSSION

The results show that when subjects are instructed to concentrate on the meaning of the sentence and construct a complete model of what the sentences convey they are better at distinguishing sentences that are true of the array from those that are false, but cannot distinguish between the actual old and actual new sentences. When the instructions specify a memory task there was only a slight tendency for subjects to distinguish those "old" from other sentence categories, but subjects showed no overall difference between those sentences true of the array and those false of the array.

It is worthwhile comparing my results with those from Barclay (1973), to enable comparison of representation of temporal and locative information. Results are compared in Table 3.5:

Group	Old	Equiva-lent	True New Pair	Relation Reversal	Subject Object Reversal	False New Pair
Barclay						
Imagers	3.35	2.91	3.03	- 3.81	- 4.09	- 4.23
Memorisers	1.04	0.74	0.19	0.56	0.83	- 0.92
Me						
Imagers	2.37	2.45	1.72	- 1.33	- 1.35	-1.79
Memorisers	1.22	0.91	0.92	0.27	0.85	1.08

Table 3.5: Comparison between Barclay and this experiment

Although the overall pattern of results betwen the two experiments is similar, there is a marked difference between the Imagers scores in Barclay and my experiments. His subjects were much better at distinguishing those sentences true of the array from those false than my subjects were. This might indicate that locative sentences are easier to represent in pictorial form.

On the other hand, Barclay's procedure differed from mine in one important respect, immediately after hearing the acquisition set the Imagers described the array on 3 x 5 in cards. Memorizers knowledge of the array was not assessed until after the recognition task. This would at the very least, serve to clarify the array in Imagers' minds, and could have been partly responsible for the impressive difference shown by his Imagers between those sentences true of the array and those false of the array.

For memorisers Barlay's subjects rated False New pairs significantly below all others, but otherwise showed no difference between groups. My subjects showed little significant different between groups either. The original linguistic form of the temporal sentences was distinguished more easily than in the locative sentences, which may indicate some element of imagery crept into the memory strategy of Barclay's Memorisers group perhaps showing locative sentences were easier to imagine.

Even with Barclay's Imagers group, however, subjects were better at remembering the original form of the sentence, which suggests that some trace the linguistic form is left even after a model has been built up.

EXPERIMENT 4

INTRODUCTION

Garnham suggests that word meanings should be thought of as procedures that interact with knowledge about the world in the setting up of mental models of situations described in texts. There need be no separate semantic representations. Just as syntactic information can be "thrown away" after it has been used so can semantic information, though neither need be. This, it is suggested, is what allowed the "New True Sentences" in the previous experiment to be classified as "Old".

People should be unable to distinguish between sentences compatible with what they have heard, even when those sentences have different meanings. One way this hypothesis can be tested is to use a passage in which two

or more descriptions are, as a matter of contingent fact, coreferential. A pair of descriptions such as the man with the martini and the man standing by the window have different semantics but in some contexts may designate the same individual. In these contexts, sentences such as:

The man with the martini is tall.
The man standing by the window is tall.

will both be true or false together. They are either both compatible or both incompatible with the mental model listeners set up when they hear the passage.

If one of the two sentences occurs in a passage, and both appear in a subsequent forced-choice recognition test, subjects who were not expecting the text should be confused about which of the two was in the passage. Previous results suggest that warning of a memory test should eliminate the confusion (e.g. Johnson-Laird and Stevenson, 1970). However, in the course of normal language processing the semantics of sentences are probably not retained, only a mental model of the situation described. In general, the semantics of the sentences in a passage are not recoverable from the mental model representing the passage, so subjects who can remember what they were told cannot necessarily remember how they were told it.

Garnham presented the following eight sentence passage to 12 subjects: 6 of his subjects were warned they would be given a memory test, the others were not.

The party had been in progress for about four hours. Around the sitting room the guests were talking in groups. By the window was a man with a

martini. He commented on the decor to a woman who was wearing a diamond brooch and smoking a perfumed cigarette. She asked him if he had complimented the host on his taste. The man standing by the window shouted to the host. The other guests looked towards the pair. The woman wearing the diamond brooch told the man with the martini to leave her.

The third sentence etablished the coreferentiality of the man with martini and the man standing by the window and the fourth sentence that of the woman wearing the diamond brooch and the woman smoking the perfumed cigarette.

There was an 8-AFC recognition test for the sixth sentence and one for the eighth sentence. Each test included the sentence, with the coreferential description substituted, for example.

The man with the martini shouted to the host.

and sentences derived from these two by reversing the roles of the characters, for example:

The host shouted to the man with the martini.
The host shouted to theman standing by the window.

Of the subjects who knew about the tests, only one out of six failed to pick the original sentences as their first choice. However, the six subjects who did not expect to be tested made nine errors in their first choices, with each of the six making at least one error. The difference between the numbers of subjects making errors, as was the difference in the total number of first choice errors was significant.

Garnham interpreted these results to show that subjects construct a representation of the situation described by a passage, but unless they

know they are to receive a memory test, they do not remember the meanings of the sentences that conveyed the information.

The aim of this particular experiment was to see if the representation of the situation constructed by subjects has events that happen at the same time represented together, so that unless they know they are to receive a memory test they do not remember the sentences that conveyed the information.

METHOD

Subjects

20 first year undergraduate psychology students took part in this experiment. Their ages ranged from 18 to 35 and there was an equal number of males and females. 10 took part in the "aware" condition and 10 in the "naive" condition.

Materials

A passage was constructed with sentences that paralleled those in the Garnham passage, as under

Each day in the local school was packed with incident and this Monday was no exception. At playtime the children played tag and there was lots of shouting and laughing. Five minutes before the bell Linda Todd grazed her knee. When the bell went and the children were lining up in the playground John Wilks punched Terry Clay. The pupils filed back full of energy and Mr Roberts had to shout to be heard. Linda had to see the school nurse because she had fallen over. Mr Roberts asked John Wilks to tell him what had happened as they were lining up. John said he thought Terry had pushed Linda over.

Sentence 3 establishes a time and an event which occurred then. Sentence 6 establishes another event that happened at the same time. Subjects were given a 4 AFC between the sentence appearing in the passage, "Five minutes before the bell Linda Todd grazed her knee." and the sentence with the time but the event mentioned later in the passage, 2Five minutes before the bell Linda Todd fell over." and two sentences decribing events that did not happen.

Similarly, sentence 4 contained two events happening at the same time (the bell went and the children were lining up) which acted as reference time for the event John punched Terry. Sentence 7 asks what happened at one of those times. Subjects were given a 4-AFC between the sentence appearing in the passage "Mr Roberts asked John Wilks to tell him what had happened as they were lining up." and a sentence where the co-occurring event is substituted "Mr Roberts asked John Wilks to tell him what had happened as the bell went." and two sentences where the roles of John Wilks and Mr Roberts were reversed.

The passage was printed on one piece of paper, with blank lines following it for a continuation. The 2 sets of 4 alternative sentences were printed on a second piece of paper, in two different orders.

The Garnham test passage and materials and my test passage and materials appear in Appendix 4(a).

Design and Procedure

Subjects were required to write a continuation to a passage and 2

minutes later were given 2 sets of 4 sentences and asked to select out of each set of 4 alternatives the sentence they had actually read in the passage, giving 2nd and 3rd choices. Independent groups were used. There were two conditions "naive" subjects who did not know a memory test was to follow, and "aware" subjects who did.

There were 10 subjects in each group. Subjects were tested individually.

Group 1 (Naive) subjects were asked to take part in an experiment relating to the way passages of text were naturally continued. They were asked to write one or two sentences continuing the passage they had been handed.

Group 2 (Aware) subjects were asked to take part in a memory experiment and were asked to write one or two sentences continuing the passage they had been handed and that later they would be asked some questions about the passage.

For both groups - two minutes after they completed the continuation they were given a second piece of paper with both sets of alternative sentences and asked for each block of four sentences to mark a "1" by the sentence that had appeared in the passage, and to put "2" and "3" by their second and third choices, even if they were certain which sentence they had read.

RESULTS

Factors in this experiment were

aware vs naive subjects

type of sentence recognised (original/compatible/incompatible)

original sentence	warning of test	original	compatible	incompatible
grazed her knee	yes	4	6	0
	no	5	5	0
children lining up	yes	5	5	0
	no	6	4	0

Table 4: Sentences chosen first in the recognition test

From Table 4 it can be seen that there was no significant difference between the number of "1" choices in the two conditions ($F1=1$; $F2<1$). Details of raw data appear in Appendix 4(b) and of analyses in Appendix 4(c).

DISCUSSION

This experiment shows no significant difference between those subjects aware of a memory test to follow and those unaware. Both groups of subjects were equally likely to chose the exact sentence that had occurred in the text or a sentence which had not occurred in the text but which was compatible with the meaning of the text.

The lack of difference between the two groups is at odds with other findings (Johnson-Laird & Stevenson 1970, Barclay 1973, my own experiment 14) and this may be because this experiment provided a

written passage, so that subjects were able to retain a picture image of the text as well as a model of what the text said.

The experiment provides support for an argument that two events that occur together are represented together in a mental model, so that when a subject is required to select a linguistic form this is unavailable and she has to chose between the sentences that are compatible with the model on the grounds of meaning alone, and in this experiemnt there were two equally likely candidates.

EXPERIMENT 5

INTRODUCTION

This experiment was designed to test the idea that there are similarities between the way that information about temporal order of events conveyed in language is represented and the way that information about location of objects is represented. It is very similar to one carried out by Bransford, Barclay & Franks (1972).

In order to show that what is retained in the representation is not the linguistic information, but rather a wholistic description of the situation, Bransford, Barclay & Franks presented subjects with text containing spatial information, as in the following:

There is a tree with a box beside it, and a chair is on top of the box. The box is to the right of the tree. The tree is green and extremely tall.

They used six passages, which were read to subjects with instructions

that they should attempt to comprehend them as they would later be asked some questions about their meanings. Half the subjects were given recognition sentences as in Block A, and the other half as in Block B, both shown below:

Block A
a) The box is to the right of the tree
b) The chair is to the right of the tree
c) The box is to the left of the tree
d) the chair is to the left of the tree

In Block A only A(a) occurred in the original passage, however, if subjects forget the exact linguistic form their representation should enable them to pick sentences consonant with the overall semantic descriptions constructed, even if such sentences were not heard during the acquisition task. In this block A(b) is such a sentence because "chair" is an object that co-occurs with box, i.e. shares the same location. 42% of subjects in this experiment recognised A(a), 29% A(b), i.e. 71% of subjects recognised a sentence consonant with the overall description. There was, however, some evidence that the original linguistic form left some trace.

Block B
a) The tree is to the left of the box
b) The tree is to the left of the chair
c) The tree is to the right of the box
d) The tree is to the right of the chair

None of the sentences in block B were heard in the acquisition task, but sentences (a) and (b) preserve the situation described. (a) reverses connective and original nouns whereas (b) reverses connective and substitutes the co-occuring object for one of the original nouns. Both (c) and (d) are incorrect in not preserving the situation described. When subjects were given block B there was no difference between the

number of subjects chosing B(a) and (b), but 70% subjects chose (a) or (b) in a recognition task.

Bransford, Barclay and Franks' argument was that once a mental model had been built up, a sentence describing a co-ocurring object (the chair in the example above which occurred in the same location relative to the tree as the box) in relation to the first object would be confused with the original sentence because the representation would show the co-occurring object in that relation to the first object, and, as it was a correct description of the representation, once the linguistic form was lost there was no evidence that this was not the original sentence.

Their results showed that subjects showed a preference for the exact linguistic form where it was available (in set A) but that in set B where the exact linguistic form was not available, there was no preference for sentences with the original content nouns over those containing a noun occurring in the same location as one of the originals.

In order to further investigate the extent of similarities between representation of locative and temporal information it was decided to carry out a temporal analogue of this experiment.

If there are similarities between the two types of information it could be expected that in set A subjects would show some preference for the exact linguistic form, with the sentence containing the co-occurring event coming second, as it also correctly described the situation.

However, where subjects were given set B where the exact linguistic form in the original passage was not available, subjects would be equally likely to chose either of the two sentences correctly describing the situation.

The aim of this experiment is to provide evidence that representation of the temporal order of events is analagous to representation of location of objects, with events co-occurring at the same time represented in relation to events occurring at other times in the same way as objects located in the same space are represented in relation to other objects.

METHOD

Subjects

22 First year psychology undergraduates took part in this experiment. There was an approximately equal number of males and females and ages were between 18 and 35.

Material

Five locative passages were composed to follow the same form as in the Bransford, Barclay and Franks experiment. Each one had the following form:

Sentence 1 - Two objects (a and b) are located side by side
Sentence 2 - One object (c) sharing the same location as one of the objects in sentence 1 (say a)
Sentence 3 - A sentence using to the left of or to the right of to relate the location of the object introduced in sentence 2 (c) to the object mentioned in sentence 1 but not sentence 2 (in this case b)
Sentence 4 - A descriptive sentence, not temporally related, referring to object b

For example:

Passage

The chair is next to the table. The book is on the chair. The chair is to the right of the table. The chair is wooden and very solid.

Recognition Sentences

A (a) The chair is to the right of the table.
(b) The book is to the right of the table.
(c) The chair is to the left of the table.
(d) The book is to the left of the table.

B (a) The table is to the left of the chair.
(b) The table is to the left of the book.
(c) The table is to the right of the chair.
(d) The table is to the right of the book.

Five temporal passages were composed. However, in composing these there was a problem because beside or next to are neutral with respect to left or right and there is no concept which is their temporal equivalent. And was used instead and any tendency to assume first mentioned event in a sentence joined by and is the first occurring event was controlled for by alternatively making this event the first and second. Each passage had the following form:

Sentence 1 - Two events (a and b) joined by "and"
Sentence 2 - One event (c) happening at the same time as one of the events in sentence 1 (say a)
Sentence 3 - A sentence using after or before to temporally relate the event introduced in sentence 2 (c) to the event mentioned in sentence 1 but not sentence 2 (in this case b)
Sentence 4 - A descriptive sentence, not temporally related, referring to event b

For example:

Passage

The mouse ran and the cat meowed. As the cat meowed the child jumped. The child jumped after the mouse ran. The mouse was grey and ran fast.

Recognition sentences

A (a) The child jumped after the mouse ran.
(b) The cat meowed after the mouse ran.
(c) The child jumped before the mouse ran.
(d) The cat meowed before the mouse ran.

B (a) The mouse ran before the child jumped.
(b) The mouse ran before the cat meowed.
(c) The mouse ran after the child jumped.
(d) The mouse ran after the cat meowed.

Two sets of answer sheets were prepared. Each had five sets of recognition sentences of style 'A' and five of style 'B'. Sentences (a) and (b) in each block correctly described the situation in the passage, although only A(a) has exactly the same linguistic form. The variations were made up by

i) using same connective or opposing connective (i.e. to the left of instead of to the right of, or before instead of after or vv)

ii) changing order of objects/events in passage, so that, for example in reversed order with same connective the sentence incorrectly described the situation, whereas in reversed order with opposing connective the sentence correctly described the situation.

iii) substituting the co-occurring object/event for the one quoted in original sentence in the variations in (i) and (ii) above.

[(iii)was the important condition as far as Bransford, Barclay and Franks were concerned as they argued that once a mental model had been built up the co-ocurring object was represented as being in the same relation to the other object in the sentence as the original one, so that once the linguistic form was lost, subjects could not distinguish sentences with the original objects from those with the co-occurring objects.]

These three variations combine to give us eight sentences as in Table 1 below:

	objects/events				connective			
	same as in passage		substitution of co-occurring object/event		same	opposing	correctly describes situation	wrongly describes situation
	same order	reversed order	same order	reversed order				
Aa	x				x		x	
Ab			x		x		x	
Ac	x					x		x
Ad			x			x		x
Ba		x				x	x	
Bb				x		x	x	
Bc		x			x			x
Bd				x	x			x

Table 5.1: Details of composition of recognition sentences

NOTE - The set of B sentences does not include the original sentence.

A
(a) exact passage
The child jumped after the mouse ran.
(b) substitution of co-occurring object/event in (a)
The cat meowed after the mouse ran.
(c) two original objects/events and opposite connective
The child jumped before the mouse ran.
(d) substitute co-occurring object/event in (c) and opposite connective
The cat meowed before the mouse ran.

B
(a) original objects/events reversed and opposite connective
The mouse ran before the child jumped.
(b) substitute co-occurring object/event in (a) and opposite connective
The mouse ran before the cat meowed.
(c) original objects/events reversed and original connective
The mouse ran after the child jumped.
(d) substitute co-occurring object/event in (c) and original connective
The mouse ran after the cat meowed

The complete set of 5 temporal and 5 locative passages and recognition sentences appears as Appendix 5(a).

2 sheets of recognition sentences were prepared. Sheet 1 had Block A of recognition sentences for passages 1, 3, 5, 7 and 9 and recognition Block B for sentences 2, 4, 6, 8 and 10; while sheet 2 had Block A of recognition sentences for passages 2, 4, 6, 8 and 10 and recognition Block B for sentences 1, 3, 5, 7 and 9.

Design and Procedure

The acquisition passages were recorded on a tape recorder with a 5 second gap between passages, temporal and locative passages were read alternately. All subjects heard all 10 acquisition passages, five temporal and five locative, in the same order. Instructions were "Listen carefully to the 10 passages I am about to read to you and attempt to comprehend them because you will later be asked some questions about their meanings."

After a 3 minute break subjects were given a recognition sheet with blocks of sentences typed on it and they were told to indicate which sentences from each block they had actually heard during the acquisition task. Half the subjects were given recognition sheet 1 and half recognition sheet 2, so that 11 subjects saw recognition block A and 11 saw recognition block B for each passage.

RESULTS

The results were analysed in a 2 (A vs B) x 2 (temporal vs spatial) x 2 (correct vs incorrect description) x 2 (original vs co-occurring object/event) analysis of variance. The overall means in each of the categories are given in Table 5.2 below.

Results were as under:

		temporal		spatial	
		A	B	A	B
correctly describes situation	original objects/events	61.3	50.5	59.0	43.8
	substitute objects/events	3.0	3.8	14.3	16.6
incorrectly describes situation	original objects/events	14.3	19.6	23.4	30.2
	substitute objects/events	21.1	25.6	3.0	9.0

Table 5.2: % of sentences in each category ticked by subjects.

For each sentence subjects saw either set A or set B, (where B did not contain exact sentence in passage). There was no difference between sets A and B ($F1<1$; $F2=1$).

There was no difference between temporal and spatial passages ($F1=1.9$; $F2=1$).

More subjects chose a sentence that correctly described the situation than one that did not. Over both the temporal and spatial passages,

out of a possible 5 correct, 3.475 chose a correctly description while 2.0 chose an incorrect one. (F1=10.5, df=1,21, P<0.005; F2=40.9, df=1.8, P<0.001)

	correct description	incorrect description
Temporal	3.2	2.3
Spatial	3.7	1.7

Table 5.3 : Interaction between those sentences correctly and incorrectly describing situation and temporal/spatial factor.

The figures are shown in Table 5.3. There was an interaction on F2 but not on F1 between those sentences that correctly described the situation and those that did not and the temporal/spatial factor showing subjects were more likely to chose a correct description on spatial tasks (F1=1.5; F2=6.2, df=1,8, P<0.05).

	original events/objects	co-occurring events/ objects substituted
Correct Description	6.0	0.95
Incorrect description	2.25	1.75

Table 5.4 : Interaction between correct and incorrect descriptions and original nouns or where co-occurring event/object substituted

Table 5.4 shows an interaction between sentences correctly describing the situation and those incorrectly describing the situation

and whether the original nouns were used or whether the co-occurring event/object was substituted ($F1=38$, $df=1,21$, $P<0.0001$; $F2=37.4$, $df=1,8$, $P<0.001$). This shows that subjects were least likely to chose a description where the co-occurring event/object has been substituted even though that sentence was a correct description of the whole situation.

This was different for spatial and temporal passages and there was a significant interaction ($F1=24.6$, $df=1,21$, $P<0.0005$; $F2= 7.6$, $df=1,8$, $P<0.01$). This can be seen in Table 5.5 below.

	original events/objects	co-occurring events/ objects substituted
TEMPORAL		
Correct description	6.0	0.4
Incorrect description	1.8	2.8
SPATIAL		
Correct description	6.0	1.5
Incorrect description	2.7	0.7
	4.1	1.4

Table 5.5 : Interaction between correct and incorrect descriptions and original nouns or where co-occurring event/object substituted and temporal/spatial factor

Raw data is shown in Appendix 5(b) and details of analyses in Appendix 5(c).

DISCUSSION

Bransford, Barclay and Franks (1972) used only spatial passages and found that when subjects had the exact sentence as a possible choice they chose that more often than the other consistent one, but chose one of these two consistent descriptions 71% of the time. Where neither of the consistent descriptions was the exact sentence subjects chose a consistent description 70% of the time, and were almost equally as likely to chose the one with the subject-object and relation reversed as the one with the object/event substituted.

My experimental results were different however. Subjects were less likely to choose a description where the co-occurring event/object had been substituted even though the sentence was a correct description of the situation.

However this conceals a great difference between spatial and temporal passages. Overall more correct descriptions were scored for spatial passages.

With temporal passages subjects were very unlikely to choose a correct description where the co-occurring event had been substituted. They were much more likely to choose an incorrect description, especially, strangely enough, where the co-occurring event had been substituted.

With spatial passages there was slightly more likelihood of subjects choosing the correct description with the co-occurring object substituted, but they were still more likely to choose the incorrect

description with the original objects than the correct description with the substituted objects.

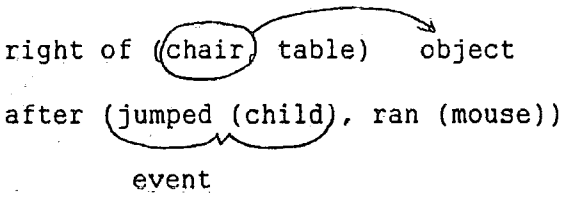
The fact that with spatial passages subjects do recognise sentences with co-occurring objects substituted more often than with temporal passages supports the suggestion from experiment 3 that it may be more easy to build up a model which represents a spatial array after which the linguistic form is lost than it is to build a model which represents a temporal order of events.

My results, for spatial passages, are not so different from the results obtained by Bransford, Barclay and Franks. 66% of my subjects overall chose sentences consistent with the description for spatial passages. It's just that they showed much more propensity to go for the original objects.

For temporal again, 59% of the subjects chose passages consistent with the passage - this group differs from the spatial one in its increased reluctance to opt for a sentence containing a substitute event.

It may be that the use of and has had some effect as and is not explicitly temporal in the same way that next to and beside are explicitly locative.

There is also the probability that temporal relations are more complex than spatial as the temporal relationship is between events not objects. An event is described by a proposition whereas an object is described by an element in a proposition, e.g.



This could help to explain the 3-way interaction along with the suggestion that both materials and task may lead to a concentration on remembering the objects and events at the expense of the relations between them. Perhaps because the difficulty of the temporal task (relating to events rather than objects) leads to a memorising strategy because of memory overload. If so it suggests that relations between objects and events are forgotten before the events/objects themselves are forgotten. The materials in this experiment may well be difficult relative to those in previous experiments because the relationships described by the passages in this experiment are arbitary and do not form a story.

It seems that I have provided evidence that temporal and spatial information can be represented in a similar form and its representation affected by similar things (e.g. instructions for experiment). Spatial information forming an array seems to be easier to represent than temporal representation, and it is possible this is because it is easier to "picture" an array containing several objects in relationships with each other, whereas it is not possible to similarly "picture" a series of events <u>simultaneously</u>.

GENERAL DISCUSSION

Overall memory for temporal order and temporal items in the first two

experiments was better than I had been led to expect from Sturt's work,

In experiment 2 where I provided a question asking if subjects recognised a paraphrase of sentences in the story, results from this test led me to suspect comprehension of these stories is not strictly typical of normal comprehension when no memory test is expected. This would explain the lack of difference between the temporal confusions where sentences describe two events at the same time or far apart in time. In anticipation of a memory test, subjects are actually remembering the linguistic form.

However, the experiments in this chapter have produced some evidence to confirm Sturt's findings that temporal and locative information are remembered to a similar extent. Within the field of temporal information, I found some difference between memory for order between what I distinguish as in or out of main story line (which is similar to what Bartlett (1932) calls narrative and descriptive order) but although information in what Trosberg calls logical order was remembered better than that in arbitrary order this difference did not reach significance.

Experiment 1 indicated that not all non-factive before clauses are represented correctly, i.e. as not having occurred. It was shown that this appeared to differ, although not significantly so, with the strength of the information given in the text to confirm its non-factivity, i.e. where an alternative was given the number of incorrect responses was reduced. The indeterminate nature of the representation is further emphasised by experiment 2, which showed that

asking a question in a different way, i.e. to cast doubt upon the occurrence of the non-factive before clause, affected the numbers of correct responses and overall in experiment 2 only 70% of the time did subjects correctly remember the non-occurrence of the before clause.

Experiments 3 and 4 showed that when a model was built up and subjects were unaware that a memory test was to follow, while detail of temporal order and relationships was recalled, the linguistic form in which this information had been presented was lost.

Although in experiment 4 this information was totally lost, experiment 3 showed that some trace of the original linguistic form was still retained and this was confirmed by experiment 5 where, when subjects had the choice of original form they opted for this above other options.

There was evidence that there were similarities in the way that spatial and temporal information was represented. Results from experiment 3 were comparable to those from Barclay's (1973) experiment, and in experiment 5 where spatial and temporal passages were compared directly, both showed similar tendencies in answering; exact linguistic form was chosen most often, then other descriptions compatible with the situation described by the passage, then incompatible descriptions.

In both these experiments, however, temporal information appears to be more difficult to build into a model than spatial information, suggestions why this may be so are made at the end of experiment 5 and I follow these up in Chapter 6.

CHAPTER III - NON-FACTIVE BEFORE CLAUSES

GENERAL INTRODUCTION

This chapter aims to look further at the factors examined by Heinamaki (1974) in her discussion of before clauses, and test whether our language understanding accords with her intuitions. This is done by both conscious measures (asking subjects for their intuitions ("Did the before clause happen?") and unconscious measures, (reading times for sentences when the ostensible task is to answer a following question).

At the end of the chapter I would like to be able to provide an answer to the question "Does the indeterminate factivity of many before clauses make language understanding more difficult?" The answer should give us some valuable information about the nature of the linguistic representation.

In Chapter 2 I showed that often indeterminacy in the form of a non-factive before clause was not always remembered at the end of text. The experiments in this chapter investigated more closly the nature of non-factivity in before clauses. They look at the degree to which different people perceive before clauses differently (experiment 6) and whether people perceive clauses as definitely factive or non-factive or whether instead they perceive uncertainty (experiment 7). They also look at whether sentences take longer to read if they are non-factive. If factive is a natural reading a sentence continuing from a before sentence as if it was factive will always be read with ease and experiment 8 tests this. If not, are factive continuations only

read faster after sentences perceived as factive while non-factive continuations are read faster after sentences perceived as non-factive, (experiment 9) which would indicate equal ease of comprehension of both factive and non-factive sentences.

EXPERIMENT 6

INTRODUCTION

As discussed in Chapter 1, Heinamaki (1974) points out that before clauses can be factive, non-factive, or intermediate. This experiment was a preliminary to investigating our comprehension of these different types of sentences, and was designed to test whether in fact most people do understand before clauses as having different meanings.

METHOD

Subjects

23 first year psychology undergraduates from Durham University acted as subjects for this experiment. Ages were between 18 and 24 years. There were approximately equal numbers of males and females.

Materials

36 sentences were composed, 18 of these sentences were in main-subordinate clause order, and the other 18 in subordinate-main

read faster after sentences perceived as factive while non-factive continuations are read faster after sentences perceived as non-factive, (experiment 9) which would indicate equal ease of comprehension of both factive and non-factive sentences.

EXPERIMENT 6

INTRODUCTION

As discussed in Chapter 1, Heinamaki (1974) points out that before clauses can be factive, non-factive, or intermediate. This experiment was a preliminary to investigating our comprehension of these different types of sentences, and was designed to test whether in fact most people do understand before clauses as having different meanings.

METHOD

Subjects

23 first year psychology undergraduates from Durham University acted as subjects for this experiment. Ages were between 18 and 24 years. There were approximately equal numbers of males and females.

Materials

36 sentences were composed, 18 of these sentences were in main-subordinate clause order, and the other 18 in subordinate-main

clause order. Before was the subordinating conjunction in all sentences. 12 of the sentences were intended to have a subordinate clause giving a non-factive reading, 12 giving a clearly factive reading and 12 an intermediate reading. Sentences given in Appendix 6(a).

Sheets of paper were prepared for the answers giving the numbers 1 to 36 down the left-hand side.

Design and Procedure

Answer sheets were handed out to the subjects, who were then given the instruction. "Listen to the sentence and question read out to you and then answer "Yes" or "No" beside the appropriate number on the sheet in front of you."

The 36 sentences were then read out at normal reading speed, followed by a question of the form "Did x happen?" (x being the event in the before clause). For example:

The train crashed before it got to Paddington.
Did the train get to Paddington?

The entire experiment, including giving the instructions, took between 5 and 10 minutes.

Number of "Yes" and "No" answers were counted for each sentence.

RESULTS

The results are shown in Appendix 6(b). They reveal that, instead of

falling clearly into the three categories, "Factive", "Intermediate" and "Non-factive", responses actually formed a continuum of understanding from sentences where all 23 students believed the before clause to be factive to those where all 23 believed the before clause to be non-factive.

DISCUSSION

This experiment shows that different people understand the before clauses as factive in different degrees. Before clauses, when presented on their own (out of context) are not usually understood as falling either into a factive band, or a non-factive band with only a small number being indeterminate between the two. For 86% of the sentences there was some disagreement between subjects as to the clause's factivity.

EXPERIMENT 7

INTRODUCTION

The results from Experiment 6 left me with the possibility that, although different subjects obviously had different opinions on the factivity of the sentences in question, each subject actually saw an individual sentence as being clearly factive or non-factive. In order to check on this point a graded scale was devised to allow subjects to express degrees of uncertainty about factivity.

Because questions about memory for non-factive sentences had been asked

of both 12-year olds and undergraduates, it was decided to see whether these two groups responded differently to the opportunity to show uncertainty.

METHOD

Subjects

36 12-13 year old pupils from a Hartlepool Comprehensive School and 36 undergraduate Psychology Students at Durham University (aged 18 to 24 years) participated in this experiment. The number of males and females in both groups was approximately equal.

Materials

Materials used in this experiment were 48 2-clause sentences where one clause begins with the subordinating conjunction before; followed by a question asking if the event in the subordinate clause happened. Sentences were presented in both main-subordinate and subordinate-main clause order. Sentences were printed on the left side of a page and on the right-hand side were five columns headed "Yes", "Probably", "Maybe", "Unlikely" and "No" for example:

She crossed the road before Peter recognised her.
Did Peter recognise her?

Yes	Probably	Maybe	Unlikely	No

The 48 sentences included the 36 used in experiment 6 and are listed (with clauses in main-subordinate order) in Appendix 7(a).

Design and Procedure

All sentences were presented in both main-subordinate and subordinate-main order. Each subject received only 16 of these sentences, 8 in main-subordinate order and 8 in subordinate-main order. Presentation of main-subordinate and subordinate main sentences was alternated.

The sets of 16 sentences were printed on two pieces of paper which were given out to subjects who were asked to place a tick beside each question in the column they thought appropriate.

The 12 yr old subjects took part in the experiment in an English lesson at school, while for the psychology students it formed part of a first-year practical session. Both groups took between 5 and 10 minutes to complete the questionnaire and hand it back to the experimenter.

In order to achieve a statistical measure of results, answers were scored for factivity as follows (Yes= factive, No=non-factive):

No - 0
Unlikely - 1
Maybe - 2
Probably - 3
Yes - 4

These scores were then totalled, so when analysed by sentence, 6 subjects would see each sentence in each form, and a total score would be between 24 (obtained if all subjects said "Yes" to a sentence) and 0 (if all subjects said "No" to a sentence). A high score thus indicated a high degree of agreement that the before clause was understood as

factive. Similarly, when analysed by subject, each subject saw 8 sentences in each clausal order, so if they answered "Yes" to every question, they would obtain a score of 32, if "No", 0.

It was of interest to see how many subjects responded with an intermediate response, i.e. Not "Yes" or "No". Number of intermediate scores per sentence were counted.

Sentence (F2) and subject (F1) analyses were carried out.

RESULTS

Factors analysed were: All sentences

Adults v 12-yr olds
main-subordinate v subordinate-main order

Intermediate scores only

Adults v 12-yr olds
main-subordinate v subordinate-main order

	Factivity Score out of possible total of 32*		
	Main-Subordinate	Subordinate-Main	Mean
Adults	17.44	15.86	16.65
12-year olds	17.19	15.64	16.42
Mean	17.32	15.75	16.53

Table 7.1 : Difference in factivity scores by subject according to clausal order and age-group of subject

*(i.e. "Yes" response, scoring 4 for each of the 8 sentences in each condition seen by each subject - high score indicates more factive)

Table 7.1 gives the total results for both age groups. A comparison of the scores of adults and children was carried out to see if there was

any difference in whether the two groups saw the sentences as factive. This was non-significant (F1<1, F2<1).

Both groups were more likely to find sentences in main-subordinate clause order factive than those in subordinate-main clause order (F1=4.26, df= 2.7, P<0.05; F2=7.84, df=1,47, P<0.01).

All adult subjects and 89% 12-year olds took advantage of the opportunity to express degrees of certainty (or possibility) about factivity.

	No of Intermediate answers out of possible 6		
	Main-Subordinate	Subordinate-Main	Mean
Adults	2.85	2.54	2.70
12-year olds	2.19	2.23	2.21
Mean	2.52	2.39	2.45

TABLE 7.2 : Difference in number of intermediate answers given according to clausal order and age-group of subject

Table 7.2 shows the mean number of answers falling into intermediate categories ("maybe", "probably", and "unlikely" responses). These were analysed. Clausal order did not affect the likelihood of an intermediate answer (F1<1; F2=<1). Adults were more likely to give a result falling into an intermediate category than 12-yr olds but this was only significant on F2 (F1=2.3; F2=0.63, df=1,47, P<0.01).

Details of raw data appear as Appendix 7(b) and details of analysis as

Appendix 7(c).

DISCUSSION

This experiment shows that when people read a non-factive before sentence in isolation they experience doubt about its factivity. Both groups were more likely to see sentences in main-subordinate order as more factive than those in subordinate-main order. The only difference was that adults were marginally more likely to perecive the possibility of an intermediate answer.

This leads to questions of whether this difference in factivity, which we have shown is readily perceived in single sentence presentations, affects language processing and, if so, how.

EXPERIMENT 8

INTRODUCTION

We have seen from experiments 6 and 7 that subjects recognise different degrees of factivity and I suggested that this raises questions about language processing. I am treating language processing as the building of a model to represent the text heard, and if we take our lead from Mani and Johnson-Laird (1982) we would expect indeterminate descriptions to be processed differently from determinate ones, i.e. to remain as a linguistic representation rather than become part of a model.

This experiment was designed to look at this aspect, and used the

findings of Haviland and Clark (1974) that a target sentence which assumes some prior knowledge is read faster if that prior knowledge is explicitly stated in a previous sentence than if the previous sentence does not introduce the relevant knowledge, to predict that the more factive a before clause, the faster would a second sentence be read that assumed the factivity of the first sentence.

METHOD

Subjects

16 subjects were used. These were undergraduates from Durham University. Ages ranged from 18 to 35 years. There were 9 females and 7 males.

Materials

The 36 sentences from experiment 6 were used as test material for this experiment. In experiment 6 they had been found to form a continuum from factive to non-factive meanings. The sentences used are in Appendix 6(a) with the results plotted in a continuum in Appendix 6(b).

For each of these 36 sentences, a second sentence was then composed which was intended to follow naturally from the first sentence if the before-clause in the first sentence was interpreted factively.

e.g. She went to the seaside before she finished her essay.
The teacher was pleased when she handed it in.

Two lists were arranged so the 36 first sentences were presented in both

main-subordinate and subordinate-main clausal order, with subjects receiving half in main-subordinate order and half in subordinate-main order. The second sentence was the same in both conditions. After the second sentence a question which required a "Yes" or "No" answer was asked to ensure the subject's continued attention.

A full set of materials appears as Appendix 8/9(a).

Design and Procedure

A self-paced reading time task was used in a repeated measures design. Half the subjects received the first 18 sentences in main-subordinate clausal order and the second 18 sentences in subordinate-main clausal order. The remaining subjects received the first 18 sentences in subordinate-main clausal order and the second 18 sentences in main-subordinate clausal order.

In order to prevent expectations being built up the experiment was run in conjunction with a similar reaction time one, where 32 sets of three sentences followed by a question were presented. The sets of sentences from the two experiments were presented to the subjects at random.

A practice series of 11 sets of sentences similar to those in both experiments was provided.

Subjects were tested individually and asked to sit in front of a computer screen and place their hands on the keyboard so that their thumbs were on the space bar and the forefingers of each hand over

two keys labelled "yes" and "no". They were told to read the sentences carefully as they appeared and press the space bar when they had read the sentence. They were told this procedure would be timed but the most important thing was that they should read the sentences carefully.

Sentences were presented on a BBC Microcomputer. Subjects were instructed to press the space bar to obtain the first sentence, when they had read it to press the space bar again for the second sentence to appear. When they had read this they should press the space bar again and the question would appear. The question required a "yes" or "no" answer and subjects were required to press the "yes" or "no" key.

During presentation of the 11 practice sets the experimenter remained with the subject to ensure that the instructions were fully understood and then withdrew before the main part of the experiment began. Subjects took 20-25 minutes to complete the whole experiment.

Time between the appearance of the sentence on the screen and the subject pressing the space bar was measured in milliseconds for both sentence 1 and sentence 2. As the question was only asked to maintain the subject's attention reading time information and details of answers were not analysed. As there were different numbers of words in the test sentences reading rates were used to analyse the data.

Sentences were ranked according to their factivity as follows: Where 23 of the subjects in experiment 6 answered "no" to the question "Did ..... happen?" it was ranked 1. Where 23 subjects answered yes to the question "Did ..... happen?" it was ranked 36. A rank of 1 thus meant a low

degree of factivity and a rank of 35 a high degree of factivity. (In Appendix 6(a) the sentences are shown ranked as above, with those in the same place on the "factivity index" bracketed together.)

RESULTS

The results were analysed in a 2 (sentence position) x 2 (clausal order) analysis of variance. Data were analysed to see whether clausal order caused any difference in reading time overall. Also to see whether non-factive sentences had slower reading times than factive ones, either when blocked together or correlating with the continuum of factivity already found. Response times were also examined to see if there was any interaction between clausal order and factivity.

Sentence-Differences

The overall mean in each of the categories is given in Table 8.1.

	1st sentence	2nd sentence	Total
main-sub order	3.72	4.39	4.01
sub-main order	3.43	4.10	3.77
Both clause orders	3.58	4.25	3.89

Table 8.1: Mean Reading Rates for first and second sentences according to clausal order (wps)

The first sentence (mean reading rate 3.6 wps) was always read more slowly than the second sentence (mean reading rate 4.3 wps) (F1=11.23,

df=1,15, P<0.005; F2=17.91, df=1,35 P<0.0005).

First sentences were read more quickly in main-subordinate order than in subordinate-main order, but this difference was not significant (F1=2.88; F2=2.59).

Second sentences were also read more quickly when the first sentence was in main-subordinate order and although not significant by subject (F1<1) this was marginally significant by sentence (F2=3.07, df=1,35, P<0.1).

It should be noted that where main-subordinate and subordinate-main differences are shown, whether in sentence 1 or 2, they refer to the clausal order in sentence 1 (sentence 2 is not a 2-clause sentence and results are only analysed in these two conditions to see if there is an effect of having different clausal orders in the previous sentence).

Factivity Differences

For the calculation of correlations for this experiment, only by-sentence analysis (F2) was possible because subjects received each sentence on the "factivity index" only once.

Pearson's correlation co-efficient was calculated using SPSSX to correlate the reading rates for the 1st and 2nd sentence with the factivity index calculated as described above. The correlation has been calculated on the basis that the lowest score (most non-factive before clause) would correlate with the slowest reading rate and the most factive with the fastest reading rate. The correlations are shown

in Table 8.2:

Sentence 1			Sentence 2		
main-sub	sub-main	combined	main-sub	sub-main	combined
-0.03	-0.15	-0.09	0.26	0.24	0.27
P=0.4	P=0.2	P=0.3	P=0.09	P=0.08	P=0.06

Table 8.2: Sentence 1 and Sentence 2 correlations with factivity score

There was no significant correlation between sentence 1 and the factivity index, neither for main-sub (r=-0.03) nor sub-main (r=-0.15) nor for both clausal orders together (r=-0.09). With sentence 2, while neither clause order individually correlated with the factivity index - main-subordinate (r=0.26); subordinate-main (r=0.24), when the two clause orders were combined there was a marginally significant correlation with the factivity index, (r=0.27, P<0.06).

A second analysis was performed taking the first 12 of the 36 sentences on the factivity index and grouping them together as "non-factive" and the last 12 of the 36 sentences and grouping them together as "factive" and comparing these two groups. Clause orders were combined.

Results are given in Table 8.3 below:

	Sentence 1	Sentence 2	Both
Non-factive	3.83	4.09	4.01
Factive	3.72	4.62	4.17
Mean	3.78	4.36	

Table 8.3: Means of reading rates for sentences 1 and 2 divided into factive and non-factive (by subject)

"Factives" were read faster than "non-factives". This was not significant on F2 ($F2<1$) but was significant on F1 ($F1=5.4$, $df=1,15$, $P<0.05$). There was no interaction with sentence ($F1<1$; $F2<1$).

Details of raw data appear in Appendix 8(a) and details of analyses appear in Appendix 8(b).

DISCUSSION

The results show that, although the second sentence was always read faster than the first, this difference was greatest when the first sentence was in main-subordinate order. Although sentence 1 did not correlate with the factivity continuum sentence 2 did. Comparing block of most factive before sentences with most non-factive, produced faster reading times both for sentence 1 and for sentence 2.

Although sentence 2 was read faster than sentence 1 overall, the difference was much greater after sentences from the most factive group than after those from the most non-factive group.

There are two possible explanations for the faster reading times for sentence 2, (1) factivity is the "normal" case and therefore always expected and always will lead to quicker reading time for the continuation sentence, (2) factivity and non-factivity are both likely and a sentence intended to follow a non-factive reading of sentence one will produce opposite effects to those found here, i.e. be read faster after non-factive clauses and slower after factive ones.

EXPERIMENT 9

INTRODUCTION

This experiment was a replication of experiment 8 with the addition of a contrasting condition, where sentence 2 would confirm a non-factive reading of the first sentence.

METHOD

Subjects

20 subjects were used. These were undergraduates from Durham University. Ages ranged from 18 to 35 years. There were 11 females and 9 males.

Materials

The 36 sentences from experiment 6 were again used as test material for this experiment. Sentences were ranked according to their factivity in

the same way as in Experiment 8. A rank of 1 meant a low degree of factivity and a rank of 35 a high degree of factivity. (In Appendix 6(a) the sentences used are shown, ranked as above, with those in the same place on the "factivity index" bracketed together.)

For each of these 36 sentences, two continuations a sentence long were composed, one of these was intended to follow naturally from the first sentence if the before-clause was interpreted factively (as in Experiment 8) and one which was intended to follow naturally from the first sentence if the before-clause was interpreted non-factively.

e.g. She stopped crying before she reached the shops.
She bought a cream cake to cheer herself up. (factive)
She turned round and went to see Julie instead. (non-factive)

The 36 first sentences were then altered to produce two lists. All sentences would be presented in both main-subordinate and subordinate-main clausal order, with subjects receiving half main-subordinate and half subordinate-main. Half the sentences in each clausal order were presented with factive continuing sentences and the other half with non-factive continuations, giving four conditions. The full set of materials is shown in Appendix 8/9(a).

Design and Procedure

A self-paced reading time task was used in a repeated measures design with four conditions as under:

first sentence main-subordinate order - second sentence factive

first sentence main-subordinate order - second sentence non-factive

first sentence subordinate-main order - second sentence factive

first sentence subordinate-main order - second sentence non-factive

Each subject received 9 sentences from each condition.

At the end of the second sentence a question was asked which required a "Yes" or "No" answer. This question was asked to ensure the subjects' comprehension and answers were not reported. For example:

She took her dog to the kennels before she went on holiday.
She went to Turkey and then flew to Italy.
Did she have a cat?

No filler sentences were used - the 36 sentences were presented to the subjects at random. A practice series of 6 sets of sentences similar to those in the experiments was provided.

Subjects were tested individually. They were asked to sit in front of a computer screen and place their hands on the keyboard so that their thumbs were on the space bar and the forefingers of each hand over two keys labelled "yes" and "no". They were told to read the sentences carefully as they appeared and press the space bar when they had read the sentence. They were told this procedure would be timed but that the most important thing was that they should read the sentences carefully.

Sentences were presented on a BBC Microcomputer. Subjects were instructed to press the space bar to obtain the first sentence, when they had read it to press the space bar again for the second sentence to appear. When they had read this they should press the space bar again and the question would appear. The question required a "yes" or "no" answer and subjects were required to press the "yes" or "no" key.

During presentation of the 6 practice sets the experimenter remained with the subject to ensure that the instructions were fully understood and then withdrew before the main part of the experiment began.

Time between the appearance of the sentence on the screen and the subject pressing the space bar was measured in miliseconds.

Data were analysed to see whether clausal order caused any difference in reading time overall. Also to see whether non-factive sentences had slower reading times than factive ones, either when the 12 most factive and 12 most non-factive were blocked together or when correlated with the continuum of factivity already found. Reading times for the two types of continuation were examined to see if they varied with the difference between factive and non-factive first sentences.

It should be noted that where "main-subordinate" and "subordinate-main" labels are used for either sentence 1 or 2, they refer to the clausal order in sentence 1 (sentence 2 is not a 2-clause sentence and results are only analysed in these two conditions to see if there is an effect of having different clausal orders in the previous sentence).

RESULTS

Sentence differences

The results were first analysed in a 2 (1st or 2nd sentence) x 2

(sentence 1 in main-subordinate or subordinate-main clause order) analysis of variance and the results are given in Table 9.1 below:

Clausal order of sentence 1	1st sentence	2nd sentence (mean of both conditions)	Total
main-sub order	3.47	4.32	7.79
sub-main order	3.49	4.23	7.72

Table 9.1: Mean Reading Rates for first and second sentences according to clausal order of sentence 1

The first sentence (mean reading rate 3.48 wps) was always read more slowly than the second sentence (mean reading rate 4.27 wps) ($F1=65.5$, $df=1,19$, $P<0.001$; $F2=56.16$, $df=1,35$, $P=0.001$).

There was no difference between the two different clausal orders in the first sentence ($F1<1$; $F2<0$). Nor was there a significant difference between reading time for either of the two conditions of sentence 2 (those intended to follow a factive reading of the first sentence and those intended to follow a non-factive reading of the first sentence) and the clausal order of sentence 1 ($F1<1$; $F2<1$).

Factivity Differences

For the calculations of correlations for this experiment, only by-sentence analysis (F2) was possible because subjects received each sentence on the "factivity index" only once.

Reading rates for the first and second sentences were correlated with the factivity ranking of the first sentence as described above. Pearson's correlation co-efficient was calculated using SPSSX and the results given in Table 9.2 below.

Sentence 1		
main-sub	sub-main	Both together
-0.03	0.16	-0.01
p=0.4	p=0.2	p=0.5

Table 9.2: Correlations between sentence 1 reading rates and "factivity index"

There was no significant correlation between reading rate for sentence 1 and the factivity index (main-sub, r=-0.03, sub-main r=0.16, both clausal orders r=-0.01).

Sentence 2 correlations are shown in Table 9.3, below:

Factive			Non-Factive		
main-sub	sub-main	combined	main-sub	sub-main	combined
0.31	0.26	0.32	-0.14	0.03	-0.07
P=0.03	P=0.06	P=0.03	P=0.20	P=0.42	P=0.33

Table 9.3: Factive and Non-Factive Second Sentences - correlations with factivity score.

From Table 9.3 it can be seen that although the correlations are usually in the expected direction (the non-factive continuation following a subordinate-main order sentence 1 being the exception supporting the

idea that subordinate-main order more likely to be assumed factive) these only reach significance for the factive continuations.

The prediction was that a positive correlation would be obtained where the second sentence confirmed the factive reading (i.e. slowest reading time would be for the sentence following the first sentence judged most non-factive) and a negative correlation would be obtained where the second sentence confirmed the non-factive reading, i.e. fastest reading time would be for the sentence following the first sentence judged most non-factive.

A second analysis was performed using a similar procedure to that used in experiment 8, by taking the first 12 sentences from the continuum of 36 sentences to form a "non-factive" group, and the last 12 sentences from the continuum to form a "factive" group. The two conditions in Sentence 2 were treated in a similar way to give factive/non-factive groups. An analysis of variance was calculated with just these 24 sentences (those most clearly either factive or non-factive). The means for the first sentence are shown in Table 9.4 below:

	factive	non-factive	mean
1st sentence	3.5	3.7	3.6

Table 9.4: Differences between factive and non-factive reading rates for sentence 1

There was no significant difference between the factive and non-factive groups for sentence 1, ($F1=2.07$, $F2<1$).

The Means for the second sentence are shown in Table 9.5 below:

	2nd sent factive reading	2nd sent non-factive reading	Mean
1st sent non-factive	3.8	4.5	4.1
1st sent factive	4.4	4.3	4.4
	4.1	4.4	4.3

Table 9.5: Differences in reading rates between factive/non-factive second sentences according to factivity/ non-factivity of first sentence

Those second sentences confirming factive readings were read more quickly than those confirming non-factive readings. This difference was significant by subject but not by sentence ($F1=8.47$, $df=1,19$, $P<0.01$; $F2=2.0$).

There was a significant interaction between those second sentences intended to confirm a factive and those intended to confirm a non-factive meaning for sentence 1 and the factivity of sentence 1 ($F1=22.40$, $df=1,19$, $P<0.0005$; $F2=8.3$, $df=1,23$, $P<0.005$).

This indicates that when a non-factive sentence is followed by a sentence continuing the non-factive reading, the second sentence is read more quickly than if it continues a factive reading. By contrast, both factive and non-factive continuations are read quickly when they follow a factive sentence.

Using the 24 most factive and non-factive sentences only, an analysis of variance was carried out to see if there was an interaction between clausal order of first sentence and 2nd sentence confirming factive/non-factive reading and the means are given below in Table 9.6:

	2nd sentence Confirming factive reading	2nd sentence Confirming non-factive reading	Mean
1st sent sub-main	4.2	4.2	4.2
1st sent main-sub	4.0	4.6	4.3

Table 9.6: reading rates for 2nd sentence confirming factive/non-factive reading according to clause order of 1st sentence.

The interaction between whether the 1st sentence was in subordinate-main or main-subordinate clausal order and whether the second sentence was intended to confirm the factive or non-factive reading of this sentence, was significant ($F1=3.63$, $df=1,19$, $P<0.1$; $F2=6.04$, $df=1,22$, $P<0.05$). This shows that non-factive continuations were read faster after a first sentence in main-subordinate order, suggesting main-subordinate order more compatible with non-factivity, and subordinate-main sentences with factivity.

Details of raw data are attached as Appendix 9(b) and details of analyses are attached as Appendix 9(c).

DISCUSSION

Results show that the first sentence was read more slowly than second, and its clausal order did not affect its reading time, nor that of sentence two in either condition. There was a correlation between the factive 2nd sentence and the factivity continuum but none between continuum and first sentence nor continuum and non-factive 2nd sentence. Comparing the blocks of the 12 most factive sentences with the 12 least factive, showed that when a non-factive sentence is followed by a sentence continuing the non-factive reading the second sentence is read more quickly than if it continues a factive reading. By contrast both factive and non-factive continuations are read quickly when they follow a factive sentence.

When we hear a before sentence which is apparently factive it seems we read a second sentence taking it as non-factive just as quickly as one which gives it a factive reading. A non-factive first sentence however, seems to slow down reading time for a continuation which is factive.

Non-factive continuations were read faster after main-subordinate order sentences than after subordinate-main sentences (suggesting main-subordinate condusive to non-factivity) whereas factive continuations were read equally fast after both clause orders.

GENERAL DISCUSSION

From the experiments in this chapter I have suggested that factivity is not an all-or-nothing phenomenon in a given sentence. We understand

different degrees of factivity and accept there is uncertainty in many sentences. At present it is difficult to know how this indefiniteness is represented in a discourse model.

The indeterminacy of many before clauses appears to make language understanding more difficult in that factive sentences are more quickly understood than non-factives. The finding that continuations from before sentences are understood equally quickly for the two types of sentence, as long as the continuations are consistent with the factivity bias of the first sentence, indicates that the construction of the representation is not impeded for long by the slight uncertainty.

Given the right context any sentence with a before clause can be read as non-factive, for example "She made the tea before Peter arrived" can be followed with "and then the phone rang to say his mother had been taken ill and he was not coming". In this case Peter does not arrives, the before clause is non-factive and from the results of experiment 9 it would seem we are not taken by surprise by this. After a factive before sentence the continuation, sentence was read just as quickly whether it took the before as occurring or not occurring.

However, the non-factive sentences in these experiments were very clearly non-factive without the necessity for any extra contextual detail, sentences where, as Heinamaki pointed out, the main clause was sufficient to prevent the occurrence of the subordinate clause. After such a sentence the factive continuation often seemed very off and this took a longer reading time.

The experiments described in this chapter do not support a constant relationship between clause order and factivity. Experiment 7 showed that main-subordinate order sentences are thought to indicate factivity more often than subordinate-main ones - but this is when subjects are forced to consider the issue and make a firm decision. From experiments 8 and 9 it appears that when simple reading tasks are performed main-subordinate order sentences suggest non-factivity.

CHAPTER IV - SALIENCE

GENERAL INTRODUCTION

Sanford, Moxley and Barton (1990) claim "A technique for determining what is in focus following a given utterance is to invite people to write the next sentence following the utterance. If reference back to certain characters, objects, events, etc, ocurs in a systematic way, then those things are said to be in focus." They use this technique with quantifying expressions to determine which set (those of which the predicate is true and those of which it isn't) is in focus. Continuations thus show the preferred focus pattern and this chapter concentrates on this in order to explore further the nature of non-factive before sentences and other wider issues concerned with temporal connectives.

Continuation experiments might help us answer questions about what aspect of language guides us in the construction of a story, and this in turn would indicate what we would expect to be the subject of the continuation of a sentence when we are processing (either reading or listening to) a piece of text.

It is possible that the choice of continuation of a two clause sentence is guided by syntax (i.e. either main or subordinate clause, or order of mention), by semantics (i.e. by real world order of the two events described) or by our model which combines the description of the situation with our general knowledge of the usual outcome of the situation described by the sentence.

When varying degrees of factivity are involved, as with before sentences, it seems likely that this will influence the nature of the continuation.

The idea that before does not end up in linear order is a useful way of dealing with frequent non-factivity of before clauses but possible evidence against this would be if the clause ever forms the basis of the story line in the next sentence. In sentences with non-factive before clauses, do sentences always continue from the main clause or do they sometimes follow from the subordinate clause? This chapter investigates this and also attempts to answer whether this is different for when, before and after and whether there are differences between continuations from factive and non-factive before clauses?

EXPERIMENT 10

INTRODUCTION

Experiment 10 tests some preliminary ideas about sentence continuations from before sentences, looking to see if the perceptible differences between different types of before clause lead to regular differences in continuations.

Young subjects were chosen to see if they had problems with understanding the non-factivity of some of the clauses, which was a possibility indicated by the memory experiment in chapter 2.

METHOD

Subjects

26 12-13 Year old pupils from a Hartlepool Comprehensive School acted as subjects for this experiment. There were approximately equal numbers of females and males.

Materials

8 short passages (7-8 lines long) were constructed. The last sentence in the passage was a 2-clause sentence with the subordinate clause beginning with before. The sentences were designed so that

- 2 had factive before clauses

  e.g. She cooked dinner before she went swimming.

- 2 had non-factive before clauses

  e.g She struggled and escaped before they could put the handcuffs on.

- 2 had before clauses whose factivity was "immaterial"

  e.g She slipped through a hole in the hedge before a teacher came out.

- 2 had before clauses which were neutral between factive and non-factive

  e.g. She crossed the street before he recognised her.

These four types of sentence were present in four different ways.

1. One sentence

   (a) subordinate-main order (For example, "Before he recognised

her she crossed the street.")

(b) main-subordinate order (For example, "She crossed the street before he recognised her.")

2. Each of the two clauses forming a separate sentence, giving a 2-sentence equivalent of

(a) subordinate-main order (For example "He recognised her. Before that she crossed the street.")

(b) main-subordinate order (For example, "He recognised her. Then she crossed the street.")

It should be noted that changing a one sentence prompt into a two sentence prompt involved resolving any ambiguity in the Before clause, i.e. making it either factive or non-factive.

Full details of materials used are given in Appendix 10(a).

Design and Procedure

The experiment took place as part of an English lesson and subjects were handed the materials and told "Please complete the passages in any way you feel appropriate".

Subjects received all eight passages, organised so that they received two of each of the four types of final sentence. These were presented on two pages, four passages to a page with passage followed by two blank lines.

The continuations so obtained were divided into the following categories:

Main Clause continuations

(a) The major part of the sentence came from the main clause with no mention of subordinate clause (For example Text: "She struggled and escaped before they could put the handcuffs on." Continuation: "She ran and they ran, she tripped up the curb and the police caught up to her and took her to the station."

(b) The major past of the sentence came from the main clause with later mention of subordinate clause (For example Text: "Before she went swimming she cooked dinner." Continuation: "After she cooked dinner she washed up and the doorbell rang. It was June so she got her things and went off to the baths.")

(c) The major part of the sentence came from the main clause with something mentioned in subordinate clause brought in obliquely later (For example Text: "She struggled and escaped before they could put the handcuffs on." Continuation: "As she ran she stumbled and the crowd held her down until the police arrived to handcuff her.")

Subordinate clause continuations

(a) The major part of the sentence came from the subordinate clause with no mention of main clause (For example Text: "She crossed the street before he recognised her." Continuation: "She didn't want him to recognise her because she was going to marry him a few years before, but she ran off with someone else instead.")

(b) The major part of the sentence came from the subordinate clause

with later mention of main clause (For example Text: "She bumped into a teacher before she ate the icecream.2 Continuation: "Unfortunately the cornet flew out of her hand and hit the teacher in the face. She stared at the teacher wiping icecream off her face for a while then she ran back into the shop.")

Other

(a) Major part comes from neither clause, instead continuation comes from someting mentioned in the text prior to the sentence (For example Text: "He took the bread out of the oven before it burnt." Continuation: "He finished all the jobs and sat down for tea. After tea he watched a good film them went to bed.")

(b) Major part comes from neither clause with something mentioned in subordinate clause brought in obliquely later (For example Text: "She got the washing in before it started raining." Continuation: "She tried to close the door but it was jammed and letting the rain in. The washing was still damp so it had to be put in the tumble drier.")

(c) Major part comes from both clauses (For example Text: "She got the washing in before it started raining. Continuation: "She gave a sigh of relief and started hanging the washing up inside the house".)

RESULTS

These results were analysed by sentence only. By-subject analysis was not possible as subjects only received two sentences in each of the four

before categories in each of the four syntactic conditions.

A preliminary analysis was carried out and showed no difference for results from the one and 2-sentence conditions ($F2<1$) and that this factor was not involved in any interactions. One- and two-sentence data was therefore combined for the following tables.

Overall means can be seen in Table 10.1 below. Because number of subjects varied between conditions, percentages were calculated and used for comparison.

	Main-subordinate	subordinate-main	Mean
Main clause continuation	54%	80%	67%
Sub clause continuation	40%	11%	26%

Table 10.1: Interaction between clause order of sentence and clause from which continuation comes (percentages)

From observation of the above table it can be seen that there were many more continuations from the main clauses than the subordinate clauses.

Inspection of Table 10.1 indicates that there is an interaction between the number of main clause continuations and the clausal order of

sentences. This arises because there are more subordinate clause continuations after main-subordinate order and more main clause continuations after subordinate-main order, i.e. there is a main-clause continuation strategy overlaid by a last clause continued strategy.

Table 10.2 shows the results divided into the 4 different categories of before.

	Non-factive	Immaterial	Neutral	Factive	Overall Means
Continuations from					
Main Clause	87%	60%	64%	56%	66%
Subordinate Cl	0%	21%	30%	42%	23%

Table 10.2: Interaction between type of before clause and clause continuation from

From inspection of the above table it can be seen that there was a different pattern of continuation from main or subordinate clause depending on the type of before sentence. This arose because sentences containing a non-factive before clause had no subordinate clause continutations. The number of subordinate clause continuations rose as the sentence became more factive to the factive sentences where there were an almost equal number of continuations from the main and subordinate clause.

See Appendix 10(b) for Table of raw data.

DISCUSSION

The results showed that overall more continuations came from the main clause, but this was especially the case when sentences were in subordinate-main order. More non-factive than factive sentences led to main clause continuations.

The number of main-clause continuations supports Partee's idea that linear narrative continuing from the main clause is the 'unmarked' preference, but the interaction of this with clause order, so that more main clause continuations came from sub main order sentences, and more subordinate continuations came from main-sub sentences indicates that the order in which events are mentioned in the text or the order of the clauses influences the likelihood of a continuation from the main or subordinate clause.

Although it was disappointing that no difference was found with various categories of before it is perhaps not surprising in view of the small number of sentences in each category and my next experiments will need to increase the numbers and compare these results which were for 12-year olds with those of adults. The fact the majority of non-factive sentences led to main clause continuations reinforces our intuition that an event rather than a non-event will be salient material for the next sentence. The number of occasions where I detected an oblique mention of the subordinate clause subject in later material indicates that this may well still form part of the representation, and be available for easy reference.

EXPERIMENT 11

INTRODUCTION

The previous experiment was with 12-year olds and included only two sentences in each of the categories of *before* clauses. In this experiment 8 sentences were included in each category and the subjects were adults.

In order to investigate the importance of temporal order in the linguistic description, additional sentences contained two clauses conjoined by *after*.

METHOD

Subjects

16 psychology undergraduates acted as subjects for this experiment. There were 8 males and 8 females. Ages ranged between 18 and 25 years.

Materials

Two event sentences were composed using *before* and *after* as subordinating conjunctions. The full set of sentences is given in Appendix 11(a). There were 40 sentences in all, including the 8 that were used in experiment 5 and these fell into the following categories:

8 sentences where the before clause was non-factive e.g. She caught the ball before it hit Mr Todd's greenhouse.

8 sentences where the before clause was immaterial e.g. They left the country before there was a civil war. (It is not known - and immaterial - whether a civil war occurred)

8 sentences where the before clause was neutral e.g. The phone rang before she sat down.

8 sentences where the before clause was factive e.g. She fed the chickens before she milked the cows.

8 sentences using after e.g. She decided to go swimming after she finished work.

Each subject received all 40 sentences, but subjects 1 to 8 received the first 4 out of every set of 8 in main-subordinate clause order and the second 4 out of every set of 8 in subordinate-main clause order. Subjects 9 to 16 received the first 4 out of every set of 8 in subordinate-main clause order and the second 4 out of every set of 8 in main-subordinate clause order.

Design and Procedure

This was a repeated measure design.

The 40 sentences were printed in random order on paper, allowing 5 lines between each sentence to give subjects space to write a continuation. The experiment took place in the first year practical laboratory after a practical lesson and subjects were handed a printed booklet containing the sentences (five pages in all), and given the instructions "Please

write another sentence which continues the ones given as naturally as possible".

The continuations so obtained were assesed by two judges as falling into four categories:

Those where continuation followed from main clause

Those where continuation followed from subordinate clause

Those where continuation followed from both clauses

Those where continuation followed from neither clause

The continuations from both and neither clauses were excluded from the analysis which therefore only contains information about continuations clearly from the main clause or the subordinate clause.

RESULTS

All sentences

The first comparison was a one-factor analysis of variance which confirmed first perusal of the data, that from all types of continuation sentences, in both clause orders, continuations are more likely to come from the main clause (4.08 out of a possible 8) than the subordinate clause (1.43 out of a possible 8) ($F1=73.7$, $df=4,60$, $p<0.001$; $F2=54.4$, $df=1,35$, $p<0.00001$)

Before sentences

Results for before sentences only were analysed in a 2 (clause order) x 2 (clause from which continuation continued) x 4 (type of before) analysis of variance. By-subject means are shown in Table 11.1 below:

	To Main		To Sub		Mean
	main-sub	sub-main	main-sub	sub-main	
non-factive	2.0	1.8	0.7	0.4	1.2
immaterial	1.9	2.6	0.9	0.6	1.5
neutral	1.4	1.8	1.1	1.1	1.4
factive	1.6	2.8	1.1	0.3	1.4
Means	1.7	2.3	1.0	0.6	1.4

Table 11.1: By-subject means for different types of before sentences by clausal order and clause continuation continues from (continuations to "both" or "neither" clause excluded)

For all types of before where continuations were classed as to main or sub clause only more sentences were continued to the main clause than to the subordinate clause ($F1=46.75$, $df=1,28$, $P<0.0001$; $F2=40.63$, $df=1,28$, $P<0.0001$).

There were no significant main effects for clausal order ($F1=2.6$, $df=1,15$; $F2<1$, $df=1,28$) but a marginally significant F1 effect of type of before ($F1=2.50$, $df=3,45$ $P<0.1$; $F2=1.04$, $df=1,28$).

However, there was an interaction between clausal order of the sentence and the clause the continuation continued from ($F1=6.9$, $df=1,15$, $P<0.05$;

F2=8.76, df=1,28, P<0.01). Results are given in Table 11.2 below.

	main-sub	sub-main
to main	3.5	4.6
to sub	1.9	1.1

Table 11.2: Interaction between clause order and clause from which continuation came

The last mentioned event, whether in a main or subordinate clause, is more likely to give rise to a continuation from that event, even though this does not override the fact that main clause continuations are more likely.

There was a significant interaction on F1 between clause from which continuation continued and type of before (F1=3.03, df=3,45, P<0.05; F2=1.57, df=1,28).

This can be seen in Table 11.3 below:

	to main	to sub	mean
Non-factive	1.91	0.53	1.22
Immaterial	2.28	0.75	1.52
Neutral	1.63	1.13	1.38
Factive	2.22	0.66	1.44
Mean	2.01	0.77	1.39

Table 11.3: Interaction between type of before and clause from which continuation came

This can be seen more clearly from the following histogram (Table 11.4).

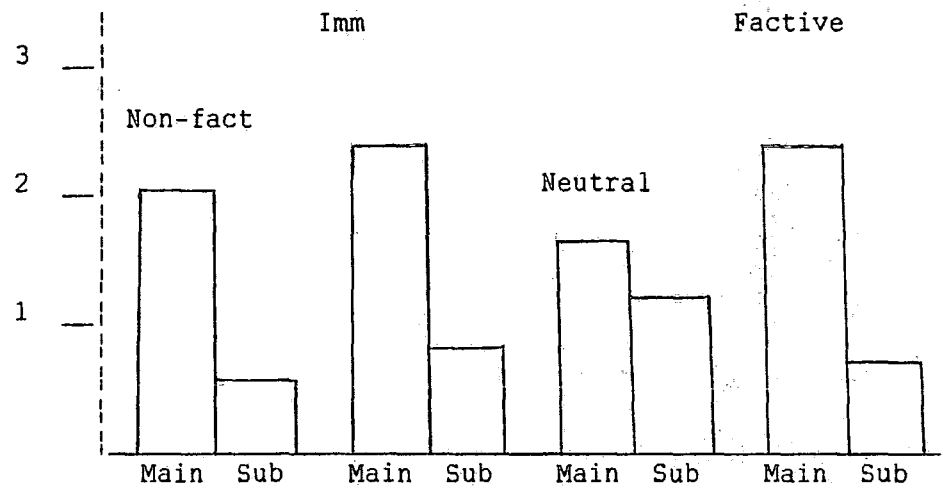


Table 11.4: Interaction between type of before and clause from which continuation came

This shows that the preference to continue the main clause was greatly reduced in the neutral sentences.

After and Factive Before Sentences

After and factive before results were analysed in a 2 (after vs before) x 2 (clause order) x 2 (clause from which continuation continued) analysis of variance and the results are given in Table 11.5 below:

	Before		After		Mean
	main-sub	sub-main	main-sub	sub-main	
to main	3.2	5.6	4.0	4.6	4.4
to sub	2.1	0.5	1.1	1.3	1.3
	2.7	3.1	2.6	3.0	2.9

Table 11.5: Interaction between clause order and clause from which continuation came showing after and factive before sentences separately

There is no main effect of after vs before (F1<1, df=1,15; F2<1, df=1,14). However there is a main effect of clause order (F1=4.35, df=1,15, P<0.06; F2=4.67, df=1,14, P<0.05), together with a main effect of clause from which continuation continues (F1=68.35, df=1,15, P<0.0001, F2=39.23, df=1,14, P<0.0001) as there are more continuations from subordinate-main order and more continuations continuing from main clause.

These effects interact with the two connectives however as after shows less effect of clausal order and shows only the preference for main clause order (F1=7.4, df=1,15, P<0.05; F2=7.2, df=1,1,14, P<0.05).

Raw data is given in Appendix 11(b) and analyses in Appendix 11(c).

DISCUSSION

The results showed that, once again, main clause continuations are most likely but that with before, this is modified by a tendency to continue from last mentioned event. This tendency was more apparent in neutral before sentences than in other kinds of before sentences. After sentences show less effect of clausal order, with similar numbers of main clause continuations coming from both main-subordinate and subordinate-main clauses.

We have clear support from this experiment that while continuation normally comes from the main clause this is by no means always the case and two of the factors that affect this are the order of mention of the

two events in before sentences and the type of the before clause.

With after sentences continuations are overwhelmingly from the main clause (which is the second event in real time).

With before sentences it is easier to see the effect of linguistic order, as it attains statistical significance. Continuations are more often from the main clause (which is the first event in real time) but this is reduced when sentences are in main-subordinate order, i.e. second event in real time is also last mentioned. That is, there are more continuations from subordinate clause in main-subordinate order.

The influence of type of before is subtle, which is not surprising considering that four rather crude divisions have been made in what I found in chapter 3 to be a continuum of meaning, where indeterminacy appears to abound in the single sentence. What we do see, however is that neutral before clauses are influenced by the order of events in the world and show no preference to continue with the main clause. In neutral cases the subject seems to continue in such a way as to clarify the indeterminacy of the neutral clause.

Often when the continuation continued from the subordinate clause it seemed to be to establish the factivity or non-factivity of the subordinate clause.

Many subjects, when asked for a new sentence, continued the old one by using a conjunction, so, but, and... This made me wonder how many of this type of sentence would stand on their own in natural text. People

seemed to want to set a scenario and used the continuation as opportunity to give a reason for the two events in the given sentences.

EXPERIMENT 12

INTRODUCTION

This experiment was designed to tease out some of the different factors which affect which clause of a sentence forms the basis of the next sentence. These factors were obscured in previous continuation experiments by attempts to investigate the different degrees of factivity in before sentences. It was felt that some clear distinction should be made between different possibilities.

a) Sentences always continue from main clause

b) Sentences always continue from last event mentioned

c) Sentences always continue from latest event happening in the world described

Previous experiments had shown that all three of these factors were involved but it would not be possible to predict from one sentence whether the continuation would continue from the main or subordinate clause. It seems to me that this cannot be done without some notion of the salience of different parts of the text. In this experiment however I further investigate the effects of the above three factors.

It was hoped that the use of after, before and when to manipulate temporal order in the world described would help because, although they serve various purposes in language, after and before do,

often, work in opposite ways to describe the temporal order of events, and when is most commonly thought of conjoining two co-temporal events. (After probably has a role in the drawing of boundaries between different areas of focus; before clauses form a continuum from factive to non-factive, and when clauses are often ambiguous as to exactly which point of the "nucleus" event described by the when clause they refer.)

METHOD

Subjects

20 undergraduate psychology students at Durham University volunteered to be subjects for this experiment. There was an approximately equal number of male and female subjects, and ages ranged from 18 to 24 years.

Materials

24 sentences were composed which described two events which should occur in a clearly defined order, each event having a different actor. In each sentence both actors were of the same gender. A continuation was required beginning with the appropriate third person pronoun for that gender, i.e he... or she...

For example, the two events, "Jane bought a card and Mary wrote it" could be described

1. Jane bought the card before Mary wrote it. She..
2. Before Mary wrote the card Jane bought it. She ..

3. Mary wrote the card after Jane bought it. She..

4. After Jane bought the card Mary wrote it. She..

Twelve sentences were also composed which described two events conjoined by when. These were presented to subjects in either subordinate-main or main-subordinate clause order.

5. When Sharon apologised Jenny took no notice. She..

6. Jenny took no notice when Sharon apologised. She..

Full details of material appear as Appendix 12(a).

Design and Procedure

Subjects were required to give completions to sentences following a two-clause sentence conjoined by before, after or when. With before and after sentences, each subject received 6 sentences in each of the four possible forms described above, and with when sentences, each subject received 6 sentences in both orders.

4 lists were compiled, each of which contained 36 sentences and 5 subjects saw each list. Subjects were asked to complete the sentences as seemed appropriate to them.

The replies were scored as to whether the continuation referred to the subject in the main or subordinate clause. Ambiguous reponses were referred to an independent judge and those which could not be resolved were excluded from the analysis.

A by-subject analysis (F1) and a by-sentence analysis (F2) were carried out.

RESULTS

Before and After

The results were analysed in a 2 (before vs after) x 2 (clause order) x 2 (clause continuation continues from) analysis of variance and the means are given in Table 12.1 below:

	Before		After	
continuations	Main Clause	Sub Clause	Main Clause	Sub Clause
Clause order				
Main-sub	85	30	100	14
Sub-Main	85	30	96	23
Totals	170	60	196	37

TABLE 12.1: No of continuations from after and before sentences in main-subordinate and subordinate-main clausal order coming from main and subordinate clauses.

The results in Table 12.1 show no main effect of before vs after ($F1<1$ df=1,19; $F2<1$, df=1,23) nor of clause order ($F1<1$, df=1,19, $F2=2.00$, df=1,23). There was a strong effect of clause continuation continues from, as continuations were mainly from the main clause ($F1=79.48$, df=1,19m $P<0.0001$, $F2=212.74$, df=1,23, $P<0.0001$).

There was no interaction between before vs after and clausal order

(F1=2.44, df=1,19; F2=2.00, df=1,23), but there was an interaction between before and after and clause continuation continues from F1=5.39, df=1,19, P<0.05; F2=5.4, df=1,23, p<0.05). More main clause continuations came from after sentences than from the before sentences.

When sentences

The results were analysed in a 2 (clause order) x 2 (clause continuation continues from) analysis of variance. The overall means are given in Table 12.2:

	Main Clause	Sub Clause
Main-sub Sub-Main	5.35 5.20	0.55 0.8
Totals	10.55	1.35

TABLE 12.2: No of continuations from when sentences in main-subordinate and subordinate-main clausal order coming from main and subordinate clauses.

From Table 12.2 it can be seen that again continuations come overwhelmingly from the main clause (F1=245, df=1,19, P<0.00001; (F2=190, DF=11.1, P<0.0001). The difference made by clausal order in the presented semtence is again not significant (F1<1; F2<1).

Details of raw data appear as Appendix 12(b) and analyses as Appendix 12(c).

DISCUSSION

When, before and after sentences were all more likely to lead to main clause continuations and there was no effect of clause order. Before sentences were more likely to lead to subordinate clause continuations (which were actually continuations from last event in the real world) than after sentences.

There is a marked difference between before and after which corresponds to their oppositional difference in meaning. The syntactic preference to follow from the main clause is operative with both connectives, but with before clauses this is less prevel nt than with after clauses. This shows that the order of events in the world described having an effect. Before clauses describe the second of two events, and these are more likely than after clauses (which describe the first of two events) to lead to continuations.

The results for when are more similar to those for after than for before and this corresponds closely to their similarity in meaning - in terms of the temporal situation they describe, as when if not describing simultaneous actions, tends to describe the earlier of two events as after does. With after sentences, more continuations were likely to follow from the main clause in main-subordinate order than in sub-main - this indicates that linguistic order of events does not influence the continuation, if it did we would expect the opposite result with more main clause continuations from subordinate-main sentences.

If we take the views of Hopper (1979) that after serves to mark off the end of one area of discourse and start a new one, then we have another reason for the difference. To return to the after clause would provide a jumpy, discontinuous flow of text, whereas before clauses could mark the beginning of a new area of discouse or could simply continue the same area as the main clause, and in both these cases the text can naturally follow from the before clause.

GENERAL DISCUSSION

This chapter has looked at salience in text through the mechanism of sentence continuations. I accept there are limitations to this method, for example, that a sentence presented on its own, without context is not typical of the language we deal with in everyday life and, as I've commented in experiment 11, some of the continuatons seems to be attempts to give a reasonable "scenario for the two events in the sentence. Another problem is that some subjects, instead of beginning a new sentence as is clearly indicated both by the full stop at the end of the given sentence before the lines for the continuation, and by the instructions, wish to continue the old sentence with "and", "so", "but", etc, again I feel trying to provide reasonable contexts for the described events.

Given these limitations (and no doubt others I haven't mentioned) I feel I have demonstrated that Partee is right that main clauses are most salient as main clause continuation is the "normal" pattern. However, this is modified by 2 semantic effects:

1. real world time of the two events so the event described later is

more salient in the model.

2. type of the before clause, although this is not such a strong effect there does appear to be some indication that clauses where the factivity is indeterminate ("neutral" ones in experiment 11) lead to continuations from the indeterminate subordinate clause. I would suggest these arise from a desire to clarify the determinacy of this clause.

Neither of these two findings supports the idea the before clauses fall outside the main-story line as Partee suggests. Although subordinate clause continuations of before sentences are a minority they are a substantial minority (26%, 40% and 35% in experiments 10, 11 and 12 respectively), of the continuations.

The notion of salience demands that rather than retaining an exact linguistic model we build up a more structered model and that factors such as pronoun interpretation depend on knowing which part of the narrative world are prominent rather than which features of the text. Morrow (1985) comments that the importance of some factors is enough to overcome recency and I have argued that it is this notion which explains on which occasions the last feature or the last occurring of 2 events gives rise to the continuation rather than the more common continuation from the main clause.

Hopper (1979) claims that narratives tend to divide into two sections the foreground or the sequence of completed events that define the plot and narrative line and the background or the rest of the narrative which introduces, comments on or concludes the plot. This seems to offer a

clear dichotomy which does not correspond with my understanding of language as able to encompass much vagueness and nuance. The notion of salience on the other hand, has been seen as a graded concept (Crawley and Stevenson 1986) and in this way gives more scope for fine differences in meaning.

Although there are certain structural features which account for the prominence of some individuals (e.g. pronoun assignment is more likely to protagonist participating in foregrounded event (Morrow 1985)) and the prominence of the first mentioned character (Gernsbecker 1988) I would suggest the salience of one or other event in a two clause sentence is unlikely ever to be completely specifiable from the language alone as details of context can alter salience. For example, when hearing "She arranged the flowers before we drank our tea", the most salient event for the listener may well alter depending on such contextual features as whether we are drinking our cup of tea or whether we can see the flower arrangement.

CHAPTER V - ON-LINE PROCESSING

GENERAL INTRODUCTION

Under the heading of On-line Processing is a slightly amorphous set of experiments. What they have in common is certainly a method - all are reading time experiments, but also a common interest which inspired them. They are concerned with trying to tease out a little more carefully and exactly how temporal order affects the way a representation might be (a) brought into being and (b) updated - and how various factors might affect this.

I accept that when reading a single sentence without a context, its presuppositions form a context against which it is understood, but instead of working from this insight of Altman and Steedman (1989) in this series of experiments I provide context sentences for the target, to see how different aspects of context affect reading time.

Bever and Townsend (1978) suggest comprehension is easier if causal links are provided, Partee (1983) suggests that order of mention corresponding to real world order of events may assist processing and that subordinate clause-main clause order may be optimal for processing of sentences.

Experiments 13 and 14 aim to explore the effect of providing different contexts for a target sentence and aim to discover whether the effect of context is different for sentences with temporal and causal connectives. These experiments should show whether:

a) manipulating the prior context sentence to provide context for main clause or subordinate clause

- affects reading time for one clause order rather than the other
- affects reading time for either causal or temporal subordinate clauses

b) sentences with either causal or temporal subordinate clauses have faster reading times - this might support Bever and Townsend (1978)'s "cause and first-event" first strategy

Experiments 15 and 16 also provide context sentences but this time the conext sentence and the two following it build a description of a series of four events in a definite temporal order. The experiments use reading time to see what factors help speed up processing and which factors inhibit fast and easy processing, so as to provide information about how we normally "deal with" the language we read/hear.

It might also add support to the idea that we form a representation of temporal events analagous to the sort of representation shown by Barclay (1973), Ehrlich & Johnson-Laird (1982), Mani & Johnson-Laird (1982) for location of objects and that the same factors (continuity and determinacy) are important.

Partee's idea that the subordinate clause is processed first to form a basis for the main clause is contradicated by evidence (Bever and Townsend 1978) showing that meaning of main clause is available first. Can I produce evidence confirming either (a) that meaning of the main clause is available first, or at least (b) showing by reading times for

separate clauses whether Partee's account is supported by evidence.

The last experiment (No 17), uses reading time to explore the issue of temporal anaphora, by comparing reading times for target sentences where there was one clear temporal antecedent ("reference time") and two possible temporal antecedents to see whether the effect on reading time is similar to a similar manipulation of nominal anaphora.

EXPERIMENT 13

INTRODUCTION

The first experiment was aimed at determining whether a two-clause target sentence was read faster (this assumes that its addition to a model is easier) if its main clause was linked to the previous sentence or if its subordinate clause was. There is widespread agreement that the subordinate clause contains a presupposition, which might indicate the natural linkage is from the context sentence to the subordinate clause of the target sentence. On the other hand, Partee argues that the main story line is carried through the main clause which would mean sentence was read faster with a main clause context.

It is possible that the order of the clauses in the target sentence might interact with the context to facilitate processing. It was possible that a context for subordinate clause might lead to faster reading when the target sentence was in subordinate-main order and a context for main clause might lead to faster reading when the target

sentence was in main-subordinate order.

The target sentences were joined by two temporal connectives and two causal connectives. Was there a differences between the processing of these two types of sentence?

After clauses and the clauses begun by the two causal connectives (because and since) refer to the first event of two, so when the sentences were in subordinate-main order the order of mention of the two events corresponded to their order of occurrence in the world described and main-subordinate order reversed this order. With before, the opposite was the case. An interaction with the context sentence might be expected because a context for the subordinate clause with after or the causal connectives would provide a context for the first event and thus describe events in their order of occurrence. With before sentences we might expect faster reading times when a context is given for the main clause as this again would correspond with order of events.

METHOD

Subjects

32 undergraduate psychology students from Durham University, volunteered to act as subjects in this experiment. There were 14 males and 18 females. Ages ranged from 18 to 24 years.

Materials

64 sentences were composed. They were all two-clause sentences, 16 joined by before, 16 by after, 16 by because and 16 by since. These sentences were presented in either main-subordinate or subordinate-main clause order.

For each sentence two "context" sentences were composed. One context sentence linked to the main clause of the target sentence and one linked to the subordinate clause.

Subjects received pairs of sentences, in four conditions:

1. context for main clause + target sentence in main-subordinate order
   The tourists were anxious to get a drink.
   The cafe opened before the ship left port.

2. context for main clause + target sentence in subordinate-main order
   The tourists were anxious to get a drink.
   Before the ship left port the cafe opened.

3. context for sub clause + target sentence in main-subordinate order
   The ship was ten minutes late leaving.
   The cafe opened before the ship left port.

4. context for sub clause + target sentence in subordinate-main order
   The ship was ten minutes late leaving.
   Before the ship left port the cafe opened.

Each subject received four target sentences with each of the four connectives (subordinating conjunctions) in each condition, making a total of 64 sentence pairs. After each sentence pair a question was asked which required a yes or no answer.

A full list of materials is attached as Appendix 13/14(a).

Design and Procedure

This was a repeated measures design.

In order to provide filler sentences, this experiment was run in conjunction with two similar reaction time ones, one where 64 and one where 12 sets of two sentences followed by a question were presented. The sets of sentences from the three experiments were combined and presented to the subjects at random.

A practice series of 14 sets of sentences similar to those in the three experiments was provided.

Subjects were asked to sit in front of a computer screen and place their hands on the keyboard so that their thumbs were on the space bar and the forefinger of each hand over two keys labelled "yes" and "no". They were told to read the sentences carefully as they appeared and press the space bar when they had read the sentence. They were told this procedure would be timed but the most important consideration was that they should answer the questions accurately.

Sentences were presented on a BBC Microcomputer. Subjects were instructed to press the space bar to obtain the first sentence, when they had read it to press the space bar again for the second sentence to appear. This procedure was repeated for the question. The question required a "yes" or "no" answer and subjects were required to press the "yes" or "no" key.

During presentation of the 14 practice sets the experimenter remained with the subject to ensure that the instructions were fully understood and then withdrew before the main part of the experiment began.

Time between the appearance of the sentence of the screen and the subject pressing the space bar was measured in miliseconds.

Subject (F1) and sentence (F2) analyses were carried out and the results are presented below. Because target sentences contained different numbers of words reading rates rather than reading times were used for comparison.

RESULTS

The results were analysed in a 2 (clause for which context is provided) x 2 (clause order) x 2 (temporal vs causal) x 2 (individual connective) analysis of variance. The overall means in each of the categories is given in Table 13.1 below:

	main clause context		sub clause context		
	main-sub	sub-main	main-sub	sub-main	mean
Before	4.609	4.495	4.645	4.562	4.578
After	4.684	4.475	4.278	4.390	4.457
Temporal	4.647	4.485	4.462	4.476	4.517
Because	4.403	4.478	4.053	4.361	4.324
Since	4.536	4.541	4.598	4.437	4.528
Causal	4.470	4.510	4.326	4.399	4.426
Temp & Causal	4.559	4.498	4.394	4.438	
Overall Means	4.528		4.416		

Table 13.1: overall means for all conditions (reading rates)

There was no main effect of clause order, (F1<1; F2<2) and no main effect of individual connective (F1<1; F2<2), but when context was provided for the main clause reading time was faster than when context was provided for subordinate clause and this was marginally significant (F1=3.23, df=1,31, P=0.08; F2=2.4, df=1,60)

There was a marginal effect of type of connective with temporal being faster than causal (F1=3.27, df=1,31, P<0.0.08; F2<1, df=1,60). However, there was an interaction between type of connective (temporal/causal) and individual connective (before/after vs because/since), (F1=11.65, df=1,31 P<0.005; F2=1.75, df=1,60). The slower rates for the causal connectives is due solely to because sentences. Finally there was an interaction between these two factors and the clause for which context is provided (F1=6.91, df=1,31, P<0.05, F2=3.09, df=1,60, P=0.08) as can be seen from Table 13.2 below:

	before	after	because	since
main clause context	4.552	4.580	4.441	4.539
sub clause context	4.603	4.334	4.207	4.517

Table 13.2 : Interaction between context, and individual connective

Table 13.2 shows that before sentences are read faster with a subordinate clause context while after, because and since are read faster with a main clause context.

Raw Data is given in Appendix 13(b) and details of analyses in Appendix 13(c).

DISCUSSION

The results showed that, overall, main clause context led to faster reading time. Clause order did not affect reading time. Sentences with before, after and since were faster than those with because. In addition, before sentences were read faster with a subordinate clause context while after, because and since sentences were read faster with a main clause context.

This is thus another experiment (in addition to expts 8 and 9) where clause order does not affect reading times. The implications of this will be explored later.

The results support Partee's assertion that main story line is continued through main clauses, with important reservations, i.e. when target sentence has a before clause, a subordinate clause context, (one which provides some of the presuppositions) seems to aid comprehension.

It may be that there is more value in the idea that the temporal relations rather than the causal relations between the two clauses has an effect, as after, because and since clauses share the property of describing the first event of two, while not on all occasions of their use sharing the causal implications.

These three connectives are all faster after a main clause context, which is odd because if we imagine representation of events forming a line, so that 1st 2nd and 3rd events will occur

__1_____2_____3_____

along this line, the context becomes event 1, but with these connectives, the main clause event is not event 2, following directly from the context, but event 3, because the event in the after, because or since clause falls either at the same time as the context or between the context and the main clause, making it come second along the time line.

Alternatively, before is fastest giving a context relating to the subordinate clause. If we again imagine representation of events forming a line conforming to a strict temporal pattern, the context and the subordinate clause follow each other, and the main clause falls either between these two or at the same time as the context.

This does not support the idea that discourse will always be easier to process if events in discourse are described in a parallel order to that in which they occur in the world, which is what Partee suggests.

There is evidence that different words with similar temporal/locative meanings have different reading times also (e.g. Smith and McMahon 1970 whose subjects had different reading times for sentences with precede and lead and with trail and follow). This should suggest we exercise caution before accepting a strategy such as the causal processing strategy proposed by Bever and Townsend (1978) and look carefully at the possibility that variations between different connectives might be caused by such individual variation.

The difference between because and since is difficult to explain by the causal processing strategy. Any semantic

explanation would appear to indicate the difference should be the other way round, with since taking longer because it has other meanings (i.e. a temporal one). Bever and Townsend (1978) also found on various tasks that because and since were treated differently and do not try explain this in terms of their causal processing strategy, and I feel some explanation is necessary before it is be accepted.

The difference between before and after is more understandable as they have semantically different functions. After designates the clause it begins to be the first event of the sentence and relevant to the main clause in some way, possibly even causally. Before indicates the clause it begins to be the second event of the sentence if it is not prevented by the first clause (i.e. non-factive).

Sentence reading times obscured differences in times between the actual clauses within a sentence, which might help show in detail the way language processing proceeds.

EXPERIMENT 14

INTRODUCTION

How was reading time distributed over the two clauses in the sentences used as material in experiment 13? In order to discover this the same material was used but the target sentence was presented clause by clause upon the v.d.u. screen.

METHOD

Subjects

32 undergraduate psychology students from Durham University acted as subjects for this experiment. There were 13 males and 19 females.

Materials

The same 64 sets of sentences and questions that had been presented in experiment 13 were used as material but in this experiment the two clauses in the target sentence appeared separately on the screen.

Design and Procedure

Design and Procedure were the same as in experiment 13, except that, after the context sentence, the target sentence was presented clause by clause, with subjects required to press the space bar after they had read the first clause to obtain the second clause. After reading the second clause the subject was required to press the space bar again to obtain the question.

Material from this experiment was presented with material from the same two experiements as in experiment 13 with the second sentence in those experiments also presented clause by clause.

Analyses were conducted on the reading rates of the two clauses in sentence 2.

RESULTS

The results were analysed in a 2 (target clause - main vs subordinate) x 2 (order - 1st vs 2nd) x 2 (context - main vs subordinate) x 2 (type of connective) x 2 (individual connective - example 1 vs example 2) analysis of variance. The overall means in each of the categories is given in Table 14.1:

Target	-		MAIN		SUBORDINATE				
Order	-		1st		2nd		1st		2nd		
Context -	MAIN	SUB	MAIN	SUB	MAIN	SUB	MAIN	SUB	Mean
Before	4.802	5.264	5.184	5.445	5.033	4.759	5.410	4.992	5.111
After	4.988	4.949	5.261	4.952	4.750	4.761	5.106	5.075	4.980
Temporal	4.895	5.107	5.222	5.198	4.891	4.760	5.258	5.034	5.046
Because	5.186	4.693	5.171	4.837	4.630	5.054	5.141	5.396	5.013
Since	5.518	5.181	5.475	5.563	5.100	5.493	5.303	6.003	5.455
Causal	5.352	4.937	5.323	5.200	4.865	5.274	5.222	5.699	5.234
Mean	5.124	5.022	5.272	5.199	4.878	5.017	5.240	5.366	
	5.073		5.236		4.949		5.303		

Table 14.1: Overall means of reading rates for all conditions (Subject Data)

The only significant main effect was that of position in sentence. Second clause whether main or subordinate was read faster (5.27wps) than first clause (5.01wps) ($F1=10.1$, $df=1,31$ $P<0.005$; $F2=28.0$, $df=1,60$, $P<0.0001$).

Whether clause was main or subordinate was not significant (F1<1, F2=1.1).

Target (i.e. whether main or subordinate) interacted with type of connective (temporal/causal) on F1 but not on F2 (F1=7.25, df=1,31, P<0.01; F2<1). This interaction can be seen in Table 14.2 below:

	Temporal	Causal
Main	5.11	5.20
Subordinate	4.99	5.27

Table 14.2 - Interaction between target and type of connective

Subordinate clause was read more slowly when it contained a temporal connective. As would be expected, there was no effect of type of connective on the reading rates for main clauses.

There was also an interaction between target, context and type on F1 but not F2 (F1=37.5, df=1,31, P<0.001; F2<1)). This interaction can be seen in Table 14.3 below:

	Temporal	Causal	diff
Main Clause context			
Main	5.06	5.34	+0.28
Subordinate	5.08	5.04	-0.04
Sub Clause context			
Main	5.15	5.07	-0.08
Subordinate	4.90	5.49	+0.59

Table 14.3 - Interaction between target, context and type of connective

The 3-way interaction shown in Table 14.3 suggests that the 2-way

interaction between target and type of connective is different in the two context conditions. With a main clause context, main clauses are read more quickly when the sentence contains a causal connective. With a subordinate clause context, subordinate clauses are read more quickly when they contain a causal connective.

What appears to be a significant main effect of temporal and causal on F1 (F1=9.6, df=1,31, P<0.005) is not significant on F2 (F2=1.6) and is nullified by a main effect of individual connective (F1=5.59, df=1,31, P<0.05> Since clauses are read more quickly than the other three connectives.

There were no other significant effects.

The raw data is attached as Appendix 14(b) and results as Appendix 14(c).

DISCUSSION

The results showed that the second clause was always read faster than the first clause, irrespective of clausal order. Subordinate clauses were always read faster when they contained temporal connectives, but the type of connective had no effect on reading times for the main clause. However, this was modified by the context sentence as main clause context caused main clauses to be read faster with causal connectives while subordinate clause context meant that subordinate clauses were read more quickly with a causal connective.

In experiment 13 whole sentences were read faster after a main clause context and experiment 14 results confirm this as a general trend, while showing that in some cases, i.e. with a causal connective, subordinate clauses are read faster with subordinate clause context.

Again, the effect of different connectives is visible, as in experiment 13, with since clauses being read faster than those with before, after or because.

In the introdution I quoted Johnson-Laird (1983) as showing there is not a uniform semantics for if, irrespective of the meanings of the individual clauses and pointed out that neither isthere one for when, or before. It may be that the connective acts as some sort of additional indicator as to the relationship between two clauses, rather than as the exact specifier of this relationship. This would mean that looking for constant reading times dependent on connective would tend to failure without taking on board much more detail about the relationship specified between the two events.

Even because which I have claimed as an unambiguously causal connective, can, (Schiffrin 1987) indicate three temporal directions:

He bandaged his hand	- because he had cut it	- past
	- because it was bleeding	- present
	- because he wanted her sympathy	- future

Overall findings support those of experiment 8 and 9 where second sentences were read faster than first sentences that people are slower at initial construction of a model than modifying it with further information - this effect is visible within the same sentence in this

experiment, as in between sentences in experiments 8 and 9. However, when main clause context is available (which speeded up reading time in general in experiment 13), temporal connectives give the greatet difference while with subordinate clause context causal connectives give the greatest difference between the two processes.

EXPERIMENT 15

INTRODUCTION

Work by Ehrlich and Johnson-Laird (1982) and Mani and Johnson-Laird (1982) is described in the introduction and in order to see whether the same factors which affected processing language into a model with spatial terms (i.e. referential continuity and determinacy) affect processing language containing temporal terms, an analogue of the Ehrlich and Johnson-Laird (1982) experiment was prepared.

As pointed out in Chapter 2, it is not new to suggest that language processing is similar for spatial and temporal terms. According to this argument interchangeability of first, last, before, after, in front of, behind, etc mirrors similarities in our representation of these two media. These ideas have led to questions about whether temporal descriptions can be affected in similar ways to spatial descriptions, but there may be additional factors to be considered as far as temporal factors are concerned.

Partee suggests that forward descriptions are more usual and hence easier to process into a model. The imbalance of events being described

in forward order as opposed to from the most recent to the most distant in the past is not present in spatial description, where the equality of to the left of and to the right of is visible in expressions such as beside , or on one side of which have no equivalent in a description of temporal relationships. The dimension of forward versus backward in time was included in this experiment to see if it affected reading time.

Partee suggests that subordinate-main order sentences might be easier to process and follows Hinrichs account on the asymmetry of main and subordinate clause. She says "Hinrichs treatment is compatible with the traditional truth conditions, but distinguishes the role of main and subordinate clauses with respect to the dynamics of reference time. The main clause is interpreted with respect to a reference time descriptively characterised by the subordinate clause, and, by the usual rules, if the main clause is an event clause, the last step in its processing is the resetting of the reference ti e to a time "just after" the main clause event. Thus the reference time in effect after the complete sentence is processed depends on which clause was the main clause; this corresponds with the informal observation that it is the main clauses that carry the main story line along in a narrative."

I found no support for this idea from experiments 13 and 14 but wished to submit this to further investigation.

METHOD

Subjects

16 subjects were used. These were undergraduates from Durham University. Ages ranged from 18 to 35 years. There were 9 females and 7 males.

Materials

Eight sentences were composed, each had two clauses, the verb "played" was used in both clauses. "Played" was used because it could be combined with many different nouns. Sentences were presented in both subordinate-main and main-subordinate clause order with after, before, once and until used as subordinating conjunctions. After and before have already featured in much research and I wished to include two additional words which related the subordinate clause to the main clause in similar ways so that, for example once functions similarly to after in that the reference clause it begins contains the first of two events, and the reference clause begun by until, like before contains the second of two events.

Within each sentence the two events can be described either in the actual order they occurred or the reverse order to which they occurred. When after or once appear in a sentence in subordinate-main order the order of mention of the two events in that sentence corresponds to the order in which they occurred, whereas when the sentence is in

main-subordinate order the order of mention is reversed. Before and until function in the opposite way. This is illustrated in Table 1 below (notice using once requires the subordinate clause to be in the past perfect):

Order of mention corresponds to order of occurrence (OOM)
After/Once (sub-main order)
After she played with the ball she played with the train. Once she'd played with the ball she played with the train.
Before/Until (main-sub order)
She played with the ball before she played with the train. She played with the ball until she played with the train.
Order of mention does not correspond to order of occurrence (ROOM)
After/Once (main-sub order)
She played with the train after she played with the ball. She played with the train once she'd played with the ball.
Before/Until (sub-main order)
Before she played with the ball she played with the train. Until she played with the ball she played with the train.

Table 15.1: Illustration of how events can be described within a sentence corresponding or not corresponding to their order or occurrence

Each of these 8 sentence was expanded into a set of three sentences, and these sets were presented in four different conditions, giving a total of 32 different sets. 16 were given in continuous and 16 in discontinuous order (analagous to Ehrlich and Johnson-Laird's study), and of these half described the order in which the toys were played with in a forward direction (i.e. corresponding to natural time) and half in a backward order. The complete pattern of temporal reference is shown in Table 2.

After Continuous Forward

main-subordinate		subordinate-main	
b after a	a b	after a b	a b
c with b	bc	with b c	bc
d after c	c d	after c d	c d

Backward

main-subordinate		subordinate-main	
a after b	b a	after b a	b a
b with c	cb	with c b	cb
c after d	d c	after d c	d c

Discontinuous Forward

main-subordinate		subordinate-main	
b after a	a b	after a b	a b
d after c	c d	after c d	c d
c with b	bc	with b c	bc

Backward

main-subordinate		subordinate-main	
a after b	b a	after b a	b a
c after d	d c	after d c	d c
b with c	cb	with c b	cb

After - in main-subordinate order = ROOM
- in subordinate-main order = OOM

Before Continuous Forward

main-subordinate		subordinate-main	
a before b	a b	before b a	a b
b with c	bc	with c b	bc
c before d	c d	before d c	c d

Backward

main-subordinate		subordinate-main	
b before a	b a	before a b	b a
c with b	cb	with b c	cb
d before c	d c	before c d	d c

Discontinuous Forward

main-subordinate		subordinate-main	
a before b	a b	before b a	a b
c before d	c d	before d c	c d
b with c	bc	with c b	bc

Backward

main-subordinate		subordinate-main	
b before a	b a	before a b	b a
d before c	d c	before c d	d c
c with b	cb	with b c	cb

Before - in main-subordinate order = OOM
- in subordinate-main order = ROOM

Table 15.2 - Temporal relationships between clauses in difference conditions with before and after

The temporal pattern remained constant over the 32 sets of sentences. This was, ball then (train and clock together) then jigsaw

```
                ( Train )
      Ball      (       )     Jigsaw
                ( Clock )
```

For example, for the Continuous (forward) condition the ROOM sentence using <u>after</u> as a connective would be in main-subordinate order and expanded into:

She played with the train after she played with the ball.
She played with the train and the clock at the same time.
She played with the jigsaw after she played with the clock.

(where first and third sentences were of the same pattern)

The continuous (backward) group of sentences again was based on the same eight sentences but this time the description of the toys began with the last toys in the sequence. So, for the above sequence:

She played with the jigsaw after she played with the clock.
She played with the clock and the train at the same time.
She played with the train after she played with the ball.

The discontinuous forward and backward sets are similar to the above except that the order of sentences 2 and 3 are changed. So that the discontinuous forward were as follows:

She played with the train after she played with the ball.
She played with the jigsaw after she played with the clock.
She played with the train and the clock at the same time.

And the discontinuous backward was as follows:

She played with the jigsaw after she played with the clock.
She played with the train after she played with the ball.
She played with the clock and the train at the same time.

The sets were followed by a question of the form "did she play with the

..... last/first?" The questions were arranged so half were first, half were last and one half of each required a yes answer, one half a "no". These were distributed across the set so no pattern could be discerned.

A full set of material appears as Appendix 15(a).

Design and Procedure

This was a repeated measures design and each subject saw a different random order of sets of sentences.

Each subject received the 32 sets described above. The basis on which the sets were constructed varied along four different dimensions, continuous/discontinuous, forwards/backwards, subordinate-main clausal order/main-subordinate clausal order, different connectives. The toys in each block were altered between subjects so that no effects of a particularly memorable or forgettable toy or combination of toys could have an effect.

Eight filler sets of sentences were used which described objects in the pattern

```
    Ball   )
           )   Clock      Jigsaw
   Train   )
```

In order to prevent further any expectations being built up the experiment was run in conjunction with a similar reaction time one, where 36 sets of 2 sentences followed by a question were presented. The sets of sentences from the two experiments were combined and presented

to the subjects at random.

A practice series of 11 sets similar to those in both experiments was provided.

Subjects were asked to sit in front of a computer screen and place their hands on the keyboard so that their thumbs were on the space bar and the forefingers of each hand over two keys labelled "yes" and "no". They were told to read the sentences carefully when they appeared and press the space bar when they had read the sentence. They were told this procedure would be timed but the most important consideration was that they should answer the questions accurately.

Sentences were presented on a BBC Microcomputer. Subjects were instructed to press the space bar to obtain the first sentence, when they had read it to press the space bar again for the second sentence to appear. This procedure was repeated for the third sentence and then for the question. The question required a "yes" or "no" answer and subjects were required to press "yes" or "no" key.

During presentation of the 11 practice sets the experimenter remained with the subject to ensure that the instructions were fully understood and then withdrew before the main part of the experiment began.

Time between the appearance of the sentence on the screen and the subject pressing the space bar was measured in miliseconds.

RESULTS

Because all sentences had similar numbers of words it was possible to use reading time data for analyses. A by-subject analysis (F1) was carried out and the results are presented below. A by-sentence (F2) analysis was not possible as each subject received only one of each of the 32 different sets of sentences.

All conditions were not relevant to all sentences. The continuous/discontinuous and forward/backward conditions would have no effect on reading time for sentence 1, for example. Also, because the second sentence in the continuous sets and the third sentence in the discontinuous sets did not contain a connective, order of mention and clause order are not applicable in these sentences.

Because it seems there are two separable combinations of factors here; two separate analyses were necessary to encompass them:

1. The results were analysed in a 3 (sentence position) x 2 (continuous vs discontinuous) x 2 (forward vs backwards) analysis of variance.
2. The results were analysed in a 3 (all first sentences vs 2nd sentences from discontinuous sets vs 3rd sentence from continuous sets) x 2 (order of mention vs reversed order of mention) x 2 (reference connective [after/once or before/until]) analysis of variance.

The overall means in each of the categories for the first of these analyses is given in Table 15.3 below:

	Sentence 1		Sentence 2		Sentence 3		
	Cont	Disc	Cont	Disc	Cont	Disc	Mean
Forward	4238	4201	3297	4812	4253	5079	4313
Backward	4537	4241	3385	5015	5044	7000	4870
Mean	4388	4221	3341	4913	4648	6040	4870
Sentence Mean	4304		4127		5344		

Table 15.3 : Overall sentence means (reading times in ms)

There was a main effect of sentence ($F1=5.08$, $df=2,30$, $P<0.05$) with Sentence 3 taking longer than sentences 1 and 2 and a main effect of continuous vs discontinuous, with continuous being read more quickly than discontinuous ($F1=8.62$, $df=1,15$, $P<0.01$).

There was also a main effect of forward vs backward ($F1=6.03$, $df=1,15$, $P<0.05$) with backward taking longer than forward.

From Table 15.3 it can also be seen that there was an interaction between sentence and continuous/discontinuous ($F1=3.83$, $df=1,15$, $P<0.05$). As the discontinuous set progressed sentences took progressively longer to read, whereas with continuous sets, the second sentence was actually read faster than the first and the third sentence at the same speed as the first.

Sentence 2 and 3 reading times in this analyses are a combination of sentences containing a connective and sentences describing two events occurring at the same time. That is, sentence 3 from the continuous sets and sentence 2 from the discontinuous sets contained connectives

while sentence 2 from the continuous sets and sentence 3 from the discontinuous sets contained events occurring at the same time.

From Table 15.3 it can also be seen that there was a marginally significant interaction between sentence and forward/backward ($F1=2.66$, $df=1,15$, $P=0.085$). with sentences in backward sets taking progressively longer to read.

There was no statistically significant interaction between forward/backward and the continuous/discontinuous dimension ($F1<1$).

For the second analysis of order of mention and effect of particular temporal connective, only one sentence at a time can be looked at. For this purpose only sentence 1 of each set concerns constructing a representation. Sentences 2 and 3 require the current representation to be updated.

In discontinuous sets both the first and second sentence contains a temporal connective (e.g. she played with ..... before she played with .....). In continuous sets the first and third sentence contain temporal connectives. In those sentences concerned with updating a representation, additional processing problems may highlight features of the comprehension process hidden by our normally fast and trouble free reading of sentences. That is, their response times may reveal the processes involved in updating a representation, as opposed to constructing a representation. The latter process is required for sentence 1.

For this reason it has been necessary to analyse sentence 1 against sentence 2 of the discontinuous blocks and sentence 3 of the continuous blocks, as sentence 2 (discontinuous) and sentence 3 (continuous) are the sentences containing the temporal connective where the model is being updated.

Overall means for order-or-mention factor and reference connective factors are given in Table 15.4 below:

	Sentence 1		Sent 2 (Disc)		Sent 3 (Cont)		
	Forward	Backward	Forward	Backward	Forward	Backward	Mean
OOM							
Before/Until	3994	3747	3872	4742	3563	4259	4030
After/Once	4506	4434	4807	4679	3703	5847	4663
Mean	4250	4090	4339	4710	3633	5053	
ROOM							
After/Once	4119	4487	5590	5163	3910	5066	4723
Before/Until	4182	4298	4978	5474	5833	5004	4962
Mean	4151	4392	5284	5218	4871	5035	

Table 15.4: Overall means for order of mention vs reversed order of mention with different reference connectives

There was no effect of sentence (F1=2.29, df=2,30).

There was an effect of forward vs backward (F1=6.15, df=1,15, P=0.024) with forward being read faster than backward.

There was a significant effect of order-of mention (F1=13.03, df=1,15, P<0.005). Overall reversed order-of-mention produced slower reading

times than natural order-of-mention. The exception was Sentence 3 Backward.

There was no effect of reference connective (F1<1).

There was a significant interaction between sentence and order-of-mention (F1=6.04, df=2,30, P=0.01) which is shown in Table 15.5 below:

	Sent 1	Sent 2 (Disc)	Sent 3 (Cont)	Mean
OOM	4296	4525	4208	4343
ROOM	4248	5305	4922	4825
Mean	4274	4915	4565	

Table 15.5: Mean response times for each of the three sentences in order-of-mention and ROOM conditions

Order of mention sentences were read father than reversed order-of-mention in both sentence 2 (discontinuous) and sentence 3 (continuous) conditions.

There were no interactions between sentence and reference connective F1<1, df=2,30) nor forward/backward and order-of-mention, (F1=2.13, df=1,15) nor forward/backward and reference connective (F1<1).

There was however an interaction between order-of-mention and reference connective (F1=12.60, df=1,15, P<0.1) which appears in Table 15.6 below:

	OOM	ROOM	Mean
Before/until	4030	4962	4496
After/once	4663	4722	4693
Mean	4346	4842	

Table 15.6: Mean response times for reference connectives in order-of-mention and ROOM conditions

From this table it can be seen that reversed-order-of-mention sentences are always read slower than sentences in natural order-of-mention. This was more noticable for sentences with before and until.

There were no other significant effects.

Details of raw data appear as Appendix 15(b) and analyses appear as Appendix 15(c)

DISCUSSION

The results showed that continuous sets of 3 sentences were read more quickly than discontinuous sets of three sentences and this interacted with sentences so that as the discontinuous set proceeded, each sentence took longer to read, while with continuous sets, reading time remained constant for the three sentences.

Although there was no main forward/backward effect, this factor interacted with sentence position to give a similar effect to that of

continuous/ discontinuous and sentence position, i.e. backward sets took progressively longer while forward sentences were read in similar amounts of time.

Other effects are within-sentence effects, which were examined by comparing sentence 1 with sentence 2 from discontinuous sets and sentence 3 from continuous sets. The results here confirm sentence 2 discontinuous takes longer than the others and that presentation in forward order aids the reading task.

It is in this comparison that order-of-mention can be seen to have an effect - reading time is faster for sentences 2 and 3 where the two events in a sentence have the same order as they do in the world. This is not so in sentence 1 which indicates that it is an effect which may have been obscured in previous studies which concentrate on the building of a model and use single sentences as material.

Sentence 2 was read more slowly than sentence 1 in both forward and backward conditions, but sentence 3 was read faster in forward and more slowly in backward.

The results support the idea that updating is different from initial building of a model, and show that factors which may only have marginal effect in the building can show up in the updating, e.g. processing being speeded up where order-of-mention of events in the text corresponds to the order of their occurrence in the world described.

I have supported, by a rather crude device, the idea that language is

easier to understand when it describes events moving forward in time. Describing events beginning from the last and working back to the first slows reading time on sentences progressively. An interesting factor here, however, is that the order-of-mention effect is not visible in sentence 3 (backwards). In this sentence reversed order of mention is faster than order of mention. This suggests that once subjects have gathered the idea that the description is proceeding in a backward direction, they find it easier to process sentences with the events described in the same direction, i.e. reversed-order-of-mention..

The main finding, however, is that this experiment provides support for the idea that similarities between temporal and spatial expressions appear to be paralleled in reading processes and in representation. The same factors that aid processing of sentences describing spatial arrays aid processing of sentences describing a temporal order.

EXPERIMENT 16

INTRODUCTION

Experiment 15 was an analog of Ehrlich and Johnson-Laird (1982) and showed that "discontinuous" sets of sentences took longer to process than "continuous" sets when describing a temporal pattern in a similar way to sets of sentences describing a spatial pattern. However, the design included so many different conditions it was not possible to do a by-sentence analysis of data because each subject received only 1 sentence in each of the 32 different combinations of conditions.

In order to test the findings from experiment 15 experiment 16 was conducted. This was similar to experiment 15 with the following modifications.

1) The Forward/Backward condition was discontinued. This was not analagous to anything in the Ehrlich & Johnson-Laird paper, and although the dimension of whether a temporal description worked from the earliest event to the latest or vice versa, did make a significant difference to reading times, this was only on the last sentence.

2) 2 connectives were used instead of four as in experiment 1. In experiment 1, once was used because it served a similar function to after in that it begun a clause denoting the first of two events, and until was used because it stood in a similar relation to before. However, after and once and before and until were actually shown to behave in the same way, it was felt unnecessary to replicate this part of experiment 1.

This left 4 variables -

continuous/discontinuous
order-of-mention/reversed-order-of-mention
clause order
sentence position

The first factor only becomes relevant over the set of three sentences whereas the second and third factors may have an effect within each sentence as well as over the whole set. The factor of sentence position (1st, 2nd, 3rd) should show how the above factors contributed to the building up of a model over a series of sentences.

In order to prevent subject fatigue and effects of practice it was decided to use independent samples for the continuous/discontinuous

conditions, and this meant it was only necessary for 4 sentences to be given in each condition, giving 16 sets of sentences for each subject.

METHOD

Subjects

40 psychology students both undergraduate and postgraduate volunteered for this experiment. Ages ranged between 18 and 30 and there were approximately equal numbers of males and females. 20 took part in the Discontinuous condition and 20 in the Continuous condition.

Material

16 sentence frames were constructed with a verb (e.g. bought) and four nouns (e.g. scarf hat coat shoes).

The first two of the nouns were used to make four sentences, in two of which the order of mention of the events in the sentence corresponded to the order of events in the world described (order-of-mention condition or OOM), and in two of which order of mention of the events in the sentence reversed the order of events in the world described (reversed-order-or-mention condition or ROOM).

order-of-mention
after - After she bought the scarf she bought the hat.
before - She bought the scarf before she bought the hat.
reversed-order-of-mention
before - Before she bought the hat she bought the scarf.
after - She bought the hat after she bought the scarf.

The first example in each condition is in subordinate-main order and the second example in main-subordinate order.

The sentence form was then used with the other two nouns to expand the first sentence into a set of three sentences, describing four events in a determinate temporal order. Thus each of the 3 sentences in a set describes two events in either real world order (OOM) or reverse order (ROOM), e.g.

After she bought the scarf she bought the hat.
After she bought the hat she bought the coat. (OOM)
After she bought the coat she bought the shoes.

She bought the scarf before she bought the hat.
She bought the hat before she bought the coat. (OOM)
She bought the coat before she bought the shoes.

She bought the hat after she bought the scarf.
She bought the coat after she bought the hat. (ROOM)
She bought the shoes after she bought the coat.

Before she bought the hat she bought the scarf.
Before she bought the coat she bought the hat. (ROOM)
Before she bought the shoes she bought the coat.

The example above is from the continuous condition. In this condition the second event described by the first sentence is also mentioned in the second sentence and the second event described by the second sentence is also mentioned in the third sentence. This enables the reader to build up a continuous model of the series of events.

The sets of sentences in the discontinuous condition differed from those in the continuous condition only because the position of the second and third sentences in the sets were changed. This meant that neither of

the two events mentioned in the second sentence were described by the first sentence, preventing the subject from building up one unified model of the series of events until the third sentence was presented which described how the two events in the first sentence were related to the two events in the third sentence. Discontinuous sets were as under:

After she bought the scarf she bought the hat.
After she bought the coat she bought the shoes. (OOM)
After she bought the hat she bought the coat.

She bought the scarf before she bought the hat.
She bought the coat before she bought the shoes. (OOM)
She bought the hat before she bought the coat.

She bought the hat after she bought the scarf.
She bought the shoes after she bought the coat. (ROOM)
She bought the coat after she bought the hat.

Before she bought the hat she bought the scarf.
Before she bought the shoes she bought the coat. (ROOM)
Before she bought the coat she bought the hat.

Each subject in both continuous and discontinuous conditions received the sixteen sentences from the sentence frames expanded into three-sentence blocks as above, four sets in each of the four different sentence forms.

At the end of each set of three sentences a question was asked to ensure the subject's continued attention. Half the questions required "Yes" answers and half "No" answers.

A full set of materials for both conditions appears as Appendix 16(a).

8 filler sentences were used, for the continuous subjects the fillers were discontinuous blocks and for the discontinuous subjects the fillers were continuous blocks. In order to further prevent expectations being

built up, in the filler sentences earlier than and once were used instead of before and after.

Design and Procedure

Independent samples were used for the continuous/discontinuous dimension with order-of-mention, clause order and sentence position being within-subjects factors. Each subject saw a different random order of sentences.

Each subject received 16 sets of sentences as described above plus 8 fillers. A practice series of 4 sets similar to those described above was provided.

Subjects were asked to sit in front of a computer screen and place their hands on the keyboard so that their thumbs were on the space bar and the forefingers of each hand over two keys labelled "yes" and "no". They were told to read the sentences carefully when they appeared and press the space bar when they had read the sentence. They were told this procedure would be timed but the most important consideration was that they should answer the questions accurately.

Sentences were presented on a BBC Microcomputer. Subjects were instructed to press the space bar to obtain the first sentence, when they had read it to press the space bar again for the second sentence to appear. This procedure was repeated for the third sentence and then for the question. The question required a "yes" or "no" answer and subjects were required to press the "Yes" or the "No" key as appropriate.

During presentation of the four practice sets the experimenter remained with the subject to ensure that the instructions were fully understood and then withdrew before the main part of the experiment began.

Time between the appearance of the sentence on the screen and the subject pressing the space bar was measured in miliseconds.

By-subject and by-sentence analyses were carried out and the results are presented below.

RESULTS

The results were analysed in a 2 (continuous vs discontinuous) x 2 (order-of-mention vs reversed-order-of-mention) x 2 (subordinate-main vs main-subordinate) x 3 (sentence position) design. The overall means of the reading rates for each of the groups are shown in Table 16.1:

	SENT 1				SENT 2				SENT 3			
	OOM		ROOM		OOM		ROOM		OOM		ROOM	
	SM Aft	MS Bef	SM Bef	MS Aft	SM Aft	MS Bef	SM Bef	MS Aft	SM Aft	MS Bef	SM Bef	MS Aft
Cont	2.05	2.21	2.12	2.26	3.31	3.03	2.27	3.04	4.17	3.63	3.35	3.72
Disc	2.04	2.07	2.18	2.13	2.36	2.93	2.35	2.19	2.27	2.37	1.96	1.76
Total	2.05	2.14	2.15	2.19	2.83	2.98	2.31	2.61	3.22	3.00	2.66	2.74

Table 16.1: Mean reading rates for all conditions in experiment 16

There was a main effect of continuous/discontinuous, continuous having a reading rate of 2.930wps and discontinuous 2.218wpS (F1=5.68, df=1,38, P<0.05; F2=87.70, df=1,30, P<0.00001).

There was a main effect of sentence position, with reading rates as follows, Sentence 1: 2.132wps, Sentence 2: 2.684wps, Sentence 3: 2.905wps (F1=12.44, df=1,38, P<0.0001: F2=76.72, df=1,30, P<0.00001).

There was a main effect of order-of-mention (2.703wps) vs those with reversed-order-of-mention (2.445wps) (F1=13.86, df=1,38, P<0.001: F2=3.34, df=1,30, P<0.07).

There was an interaction between sentence position and continuous vs discontinuous (F1=13.12 df=2,76, P<0.0001: F2=84.17, df=2,60, P<0.00001), as shown in Table 16.2 below:

	Sentence 1	Sentence 2	Sentence 3	Mean
Cont Disc	2.160 2.104	2.911 2.458	3.718 2.091	2.930 2.218
Mean	2.132	2.685	2.905	2.574

Table 16.2: Reading rates for separate sentences in continuous and discontinuous conditions

With continuous sets reading was faster from sentence 1 through 3, whereas with discontinuous sets, although the second sentence was read faster than the first, the last sentence was read much more slowly.

There was also an interaction between sentence position and

order-of-mention vs reversed order-of-mention (F1=8.48, df=2,76, P<0.001: F2=9.69, df=2,60, P<0.0005), as shown in Table 16.3 below:

	Sentence 1	Sentence 2	Sentence 3	Mean
OOM	2.092	2.906	3.110	2.930
ROOM	2.178	2.463	2.834	2.218
Mean	2.135	2.685	2.972	2.574

Table 16.3: Reading rates for separate sentences in OOM and ROOM conditions

For sentence 1, OOM sentences were actually slower than ROOM, but especially for sentence 2, and also for sentence 3, OOM sentences were read more quickly than ROOM.

There was no effect of clausal order (F1<1, df=1,38; F2<1, df=1,30) and this factor did not interact with any other factor.

There were no other significant effects.

Details of raw data are given in Appendix 16(b) and details of analyses in Appendix 16(c).

DISCUSSION

The results showed continuous sets were read more quickly than discontinuous. Sentences were read faster as they became second/third in a set with continuous sets but this pattern was disrupted in sentence 3 with discontinuous sets. There was a main effect of order-of-mention

being faster than reversed order-of-mention.

As in experiment 15, on the first sentence there was no effect of order-of-mention, but sentence 2 and sentence 3 both showed effects of reversed-order-of-mention slowing down processing considerably.

The results support my experiments in chapter 2 on memory for temporal information which confirm similarities exist between representations of temporal and spatial information. They also confirm findings from experiment 15 that order of mention in a sentence becomes significant in updating rather than on initial construction of, representations.

EXPERIMENT 17

INTRODUCTION

One piece of text provides context for the next sentence to be read. If the next sentence contains a pronoun we expect the antecedent of that pronoun to be available in the model built up from the previous text, or from some deictic gestures.

If no antecedent is readily available the discourse is what Kaplan (1976) calls "inconsiderate", and one would expect reading time to be slower where a reader has to struggle unsuccessfully to find an antecedent in previous text.

The presence of a reference time in previous text has often been likened to the presence of a nominal antecedent (see e.g. Partee 1983) and this

analogy can be pursued by examining whether the absence of a clear temporal referent disrupts language processing in the same way as the absence of a clear nominal antecedent does.

In order to test this analogy it was decided to compare reading time for sentences following a context sentence with one clear nominal antecedent with sentences following the same context sentence but with two possible antecedents. This would check that the disruption of normal processing affected reading time and provide a comparison for the temporal factors.

Sets of temporal sentences were similar in that the first sentence could provide either one or two temporal antecedents and it was expected that where there were two antecedents for the temporal reference reading time for sentence 2 would take longer.

METHOD

Subjects

32 undergraduate psychology students took part in this experiment. Ages ranged from 18-40 and there were approximately equal numbers of males and females.

Material

12 "nominal" sets of sentences were composed. The first contained two nouns that could serve as antecedents for a pronoun in the second

sentence, the second sentence contained a pronoun and the third was a question e.g. Peter ate a pie and a chocolate bar.
It made him feel sick.
Did he eat a salad?

12 "temporal" sets of sentences were composed. The first contained two different events happening at different times which could serve as reference times to be referred to by the second sentence, the second sentence contained a reference to one of the events and the third was a question e.g. Dave was filming in Rome all January and Milan all March.
It was a tiring month.
Was Dave a film star?

All 24 sets were also produced so that only one antecedent (nominal or temporal) was present. This was done by omitting the first object from the first sentence of even numbered sets and the second object from odd numbered sets to avoid any bias from position in sentence. The questions were worded so they produced appropriate answers to one and two antecedent sets. Half the questions were designed to give "yes" answers and half "no" answers.

The sets of sentences were used to produce 2 lists of material as follows

	List 1	List 2
Sentences 1- 6	Temporal - 1 antecedent	Temporal 2 antecedents
Sentences 7-12	Temporal - 2 antecedents	Temporal 1 antecedent
Sentences 13-18	Nominal - 1 antecedent	Nominal 2 antecedents
Sentences 19-24	Nominal - 2 antecedents	Nominal 1 antecedent

A full set of material appears as Appendix 17(a).

Design and Procedure

This was a repeated measures design as subjects saw both temporal and nominal sentences in either 1 or 2 antecedent conditions.

Subjects received either List 1 or List 2. The sets of sentences were presented at random to subjects interspersed with 120 other sets of sentences from another experiment (on thematic roles).

Subjects were tested individually. They were asked to sit in front of a computer screen and place their hands on the keyboard so that their thumbs were on the space bar and the forefingers of each hand over the two keys labelled "yes" and "no". They were told to read the sentences carefully when they appeared and press the space bar when they had read the sentence. They were told this procedure would be timed but the most important consideration was that they should answer the questions accurately.

Sentences were presented one at a time on a BBC Microcomputer. Subjects were instructed to press the space bar to obtain the first sentence, when they had read it to press the space bar again for the second sentence to appear. Then they should press the space bar to obtain the question. The question required a "yes" or "no" answer and subjects were required to press the "yes" or "no" key.

There was a practice set of 6 sentences during which the experimenter remained with the subject before the experimenter withdrew and the main experiment began.

RESULTS

The results were analysed in a 2 (temporal vs nominal) x 2 (1 antecedent vs 2 antecedent) analysis of variance. Sentence 2 was the critical sentence - where the antecedent for the pronoun had to be found. Mean reading rates for sentence 2 for the four groups are shown in Table 17.1 below:

Temporal		Nominal	
1 antecedent	2 antecedents	1 antecedent	2 antecedents
5.62	4.84	5.63	5.21

Table 17.1 Reading rates for sentence 2 in all four conditions

There was no difference between reading rates for Temporal (5.20wps) and Nominal (5.38wps) sentences ($F1=2.61$, $df=1,31$; $F2<1$, $df=1,11$).

For both nominal and temporal sentences there was a significant difference between those sentences where the pronoun had one antecedent and those where it had two antecedents, ($F1=14.9$, $df=1,31$, $P<0.001$; $F2=11.1$, $df=1,11$, $P<0.01$).

There was no significant interaction.

Details of raw data appear as Appendix 17(b) and of analysis as Appendix 17(c).

DISCUSSION

This experiment shows that with both temporal and nominal sentences pronouns were resolved faster where there was only one possible antecedent.

This supports an approach such a Partee's which explores similarities between the two types of anaphora.

GENERAL DISCUSSION

Drawing together the findings from the apparently disparate series of experiments in this chapter I am led to 7 main conclusions.

1. Clause order does not affect reading time, i.e., no effect is found in experiments 13, 14, 15 and 16.

   Thus, however we decide that processing proceeds we cannot take the same course as Partee does and lay down a set of principles which apply to preposed adverbial clauses while making no predictions about postposed ones. Any theory should take on board the fact that whatever processing strategies we use for the two types of clauses they must account for both orders taking the same time except under very extraordinary circumstances.

2. Effect of individual connectives - in experiments 13, 14 and 15, different connectives with similar meanings (because/since, after/once), produced different reading times in the

sentences/clauses (depending on which unit was being measured) which contained them.

This suggests there may be some doubt about any theory which claims relations, e.g. first/last, to the right of/to the left of, more causal/less causal are processed in any preferred order without stringent tests that it not a word effect such as, more frequent words being read more quickly, more common expressions aiding comprehension, etc.

3. That context could aid or inhibit easy processing. Subordinate clause and main clause contexts in experiments 13 and 14 had different effects depending on the type of connective, with subordinate clause context tending to facilitate processing of temporal sentences (before only sentences in expt 13) and main clause context speeding processing of causal sentences.

4. Order of mention of events in sentences proved a very important factor in experiments 15 and 16 - as the model construction became more complicated order-of-mention had a very significant effect on speed of reading - what appears from these is an effect of constructing a model. It seems from 13 and 14 that where processing does not make quite such high demands i.e. where sentences are more similar to normal discourse, order-of-mention may not be important even in the updating of a model.

5. The difference between continuous and discontinuous sets of sentences was found to be important, indicating

parallels can be drawn between this experiment and that of Ehrlich and Johnson-Laird (1982).

6. Experiment 15 indicated that temporal order of events, i.e. whether sentences moved forward or backward in time may affect processing, and there was some suggestion this may be because this is the way events are commonly described.

7. The presence of more than one antecedent is shown to disrupt comprehension in a similar way for both temporal and nominal anaphora.

CHAPTER VI - CONCLUDING REMARKS

6.1 Mental models

6.1.1 General

The idea that discourse can be represented in a format similar to that of perceived or imagined events was mooted by Johnson-Laird (1970) and is similar to ideas of Bransford, Barclay and Franks (1972). I began with the assumption that Johnson-Laird's (1983) "mental models" approach is able to explain most linguistic phenomena. As we "deal with" "text" in any way (reading or listening), there are two sorts of representations available to us - propositional representations and mental models which are an integrated version of the text, with all ambiguities and pronouns resolved.

As we read/hear "text" under "normal" processing conditions, a mental model is built up, and details of propositional form are lost very quickly. However Johnson-Laird and Stevenson (1970) and Stevenson (1988) showed that knowledge that a memory test was to follow a piece of text could change this and cause a more propositional representation of the passage to be retained.

If processing conditions are such that we can build a model - how much detail of temporal order is retained in it? It may be true that we don't remember them as well as we remember other detail from text (Sturt 1925), or that we do not readily represent sequential episodic information but I would argue we do to some extent at least, remember

the temporal order of events in a passage. Stenning (1990) argues that rather than remembering the sequence of arbitarily ordered events on the basis of one occurrence, we retain order information on the basis of general knowledge of regularities, for example remembering that he ate bacon before he ate lettuce one day might be largely on the basis of his knowledge of his dietary habits.

This may be part of the explanation of our memory of temporal order in text but I feel he misses out one very important source of our knowledge of serial order - causality. Our understanding of the world involves our perceiving causal relationships between two events, and this is so deeply part of our cognitive understanding it imposes its own ordering without our conscious awareness. We see a woman put up an umbrella and know that this is because at some earlier moment it started to rain, snow or hail. Linked to causality is the idea of intentionality which is again intimately and inseperably bound up with serial order. If we take a book down from the shelf because we intend to read it, opening the book becomes another event necessitated by the intention which has to come between taking the book down and beginning to read. Even if we never actually read a word those two actions are placed into a temporal order by our (unfulfilled) intention.

As already mentioned in the introduction, there is evidence that children find it easier to understand sentences containing this type of information, i.e. when 2 events are logically connected, (Trosberg 1981, French and Brown 1982) and reversing the logical order has such a strong effect on adults they often read sentences wrongly (Fillenbaum 1974). Experiment 1 findings support this as memory for events in

logical order was better than for arbitary order.

It may help us understand the way we comprehend temporal order from language to note that we seem to produce language in a coherent form which made it quite difficult for me to select events which fell outside logical order when designing the experiment. An event which appeared to fall outside logical order at first glance was often co-temporal with an event which was in logical order and therefore would be almost equally remembered. For example "the water was very hot" would be remembered as being relevant to and co-temporal with the children getting washed and therefore also fall logically between their getting up and going out.

This is supported by other findings from experiment 1, that more information was remembered about order of events and temporal items from the "main story line". This term is used by Partee, and as she doesn't definite it clearly, I am taking a common sense meaning which likens it to what Bartlett (1932) calls "gist" , and also to what is now know as focus (c.f. Grosz, 1971).

The main story line is marked by the salience of the events described in it, which would be linked by causal and intentional relations as mentioned above.

Peripheral events are tied in to the main story line to different degrees but do not have the same strong intricate connections to order of other events and thus are more easily disconnected from the temporal line running through events in the main story line.

I wanted to look at which factors might lead to clear continuation through main-story-line and while it seemed possible syntactic factors, such as main story line continuing through syntactic categories (main clauses) might be involved, regularities of the nature described above seemed to depend very much on the semantics and pragmatics of the sentences involved. This posed a problem as far as experiments were concerned as stabilising various elements in the story-framework could have involved imposing an element of uniformity on them which could often seem at odds with naturalistic language.

However, in order to test more exactly the way in which a discourse model might be constructed from a series of sentences it was decided a more formal framework for material might provide interesting data about model building. In particular the importance of referential continuity and the effect clausal order has on relative ease/difficulty of model building and updating could be examined. For this purpose an experiment along the lines of Ehrlich and Johnson-Laird (1982) could be designed to deal with temporal order which would examine the influence of referential continuity and clause order as well as provide groundwork for later work comparing spatial and temporal representation.

Ehrlich and Johnson-Laird (1982) showed that referentially continuous descriptions led to more accurate diagrams being drawn than referentially discontinuous ones. Subjects tried to construct an integrated representation sentence by sentence as they read it. I have shown (in experiments 15 and 16) that similar factors play a role in the representation of temporal order of events and also that there are other parallels between the representation of spatial

layouts and representation of temporal patterns.

In both experiments 15 and 16 continuous sets of 3 sentences were compared with discontinuous sets of 3 sentences. Continuous sets were always read more quickly than discontinuous, supporting Ehrlich and Johnson-Laird's results, and confirming a model is built up using the referential continuity of sentences in this condition. Discontinuity disrupts the processing and prevents a model being built up.

Reading speeds for individual sentences cast more light on how this factor worked over the whole pattern. In continuous sets of sentences the second and third sentences were read slightly faster than the first sentence. In discontinuous sets, however, the second sentence took somewhat longer than the first, and the third sentence, where information from the two previous sentences had to be integrated took half as long again to read as the first sentence. Here is an indication that referential links aid building a representation and may well contribute to a well-defined main-story-line.

Another clue might be Partee's suggestion that a series of events moving forward in time might be easier to represent, and in some way a more "natural" ordering of events than events described in reversed order. She refers to this mainly with respect to information contained <u>within</u> a sentence, however, experiment 15 showed that where sentences described events happening from the latest to the earliest,

e.g. She played with the car before she played with the ball
She played with the dog before she played with the car
She played with the van before she played with the dog

(where the order is van - dog - car - ball) "backward" sets took longer

than "forward" sets, the difference occurring in the reading time for the third sentence.

This factor also occurred within sentences, where two events can be mentioned in the order in which they occur in the real world.

She danced and then she sang.
She danced before she sang.
After she danced she sang.

or reversing the order in which they occur in the real world.

Before she sang she danced
She sang after she danced

Previous findings conflict on whether processing is affected by this factor, with reversed order of mention sometimes being found to increase processing difficulty, especially among young children (Clark and Clark 1970).

My experiments indicate that this factor might be more important at the stage of updating a representation, than on initially hearing a sentence. In both experiments there is no effect of order-of-mention corresponding to the ordering of events in the real world aiding processing in the first sentence but this factor increases reading time on sentences 2 and 3.

If when constructing a representation, instead of immediately starting from the assumption that events move forward in time, we actually gather this pattern as subsequent sentences are added to the discourse representation we might expect a different pattern to emerge where the events unfold in a backward direction, and in fact there is

some sign that this is the case. Sentence 3 in a backward direction is the only place where events in reversed order of mention are read more rapidly than events in forward order of mention. By this stage in building a representation subjects have realised they are adding events on earlier than the original sentences and this find it increasingly easy.

It has been shown that another factor which disrupts fast trouble-free processing of text is when the resolution of anaphoric reference is not straightforward. If there is no one clear antecedent in previous text reading time will be lengthened. Partee draws on similarities between nominal anaphora, (where an object or person is the antecedent for the pronoun) and temporal anaphora, (where the reference time for one sentence is contained in the previous sentence "We had a party. Sam got drunk.")

Experiment 17 shows both types of anaphora act in the same way if processing is disrupted by the absence of a clear antecedent or temporal referent.

As I found with composing material for experiment 5, there were problems which seemed to throw light some of the limitations which exist on the ways we can express temporal relationships.

The idea was to provide two temporal referents in the context sentence and see if this disrupted processing when a second sentence (the target) was read where it was not clear which was the temporal antecedent.

It was discovered that sentences had to be of the form "She went to the pictures on Saturday afternoon and the theatre on Sunday afternoon", for the target "It was a very good afternoon."

A more general antecedent, "Peter went to a party on Monday and a leaving do on Tuesday. He got drunk." is easily interpreted as happening at both mentioned times rather than disrupting processing because the reader has to decide whether the antecedent is Monday or Tuesday. Similarly, with "We went to the park this afternoon and stopped at the river on the way home. It was very lovely. Instead of there being two possible antecedents, "It" is easily interpreted as referring to the latest of the two events, i.e. the stopping at the river.

We have shown some general properties of mental models as far as temporal processisng is concerned.

1. That main story line and logical order aid memory, possibly because of the way we normally organise serial order according to conventional, causal or intentional relations.

2. That smooth building up of a model is aided by referential continuity and events being described in forward direction.

3. That when serial order is being described, having order-of-mention in sentences in the same order as in the real world aids processing (normally we describe events forwards in time but there is some indication that under certain circumstances backwards description might be as easy).

4. That lack of an unambiguous temporal reference disrupts processing.

6.1.2 "Temporal Confusions"

Garnham (1986) felt that one important fact about mental models was that they were more than just a semantic representation. Having heard "By the window was a man with a martini" subjects would mistakenly identify having heard "The man by the window shouted to the hostess", when in fact the test passage had said "the man with the martini shouted to the hostess.". Once the propositional form is lost, what is left is a mental model which is an almost pictoral representation of the world described by the text.

In the previous section I have argued that it is habitual, causal or intentional relationships that often allow us to discern temporal order. We "have a good idea" of the temporal relationships of many of the events in our lives, thus knowing when and in what order two things usually happen together.

When a text describes two events which co-occur it seems reasonable that they are represented together, linked by their co-occurrence if by no other habitual, causal or intentional relationship. If the propositional form was lost we might well expect to lose the semantic distinction that A happened at, say 6 o'clock and B occurred at the same time as A, and would expect that we would be left, in the interests of brevity and simplicity, with "A and B both occurred at 6 o'clock". At the end of a passage subjects would be unable to remember the exact linguistic form in which this information had occurred.

If this is so, it is possible the extent to which this happens is modified by whether or not subjects know a memory test was to follow (Johnson-Laird and Stevenson, 1970; Stevenson 1988).

In both story experiments there was evidence that the two co-occurring events were being represented in some form which made the original propositional information difficult to recover. In the first experiment, 65% of subjects claimed they had the "temporal confusion" sentence e.g. after reading "At 7.30 Jan packed the last of the bedding. At the same time Margo made some breakfast." 65% subjects claimed to have read "At 7.30 Margo made some breakfast."

In the second experiment where there were six stories, it is possible that results were affected by the expectations subjects had built up about the questions they would be asked. Two adjoining sentences describing two events co-occurring, of the form described above were compared with two adjoining sentences describing events some time apart.

The test sentence in both cases took the time from the first sentence and the event from the second.

Two co-occurring events would be, for example, "Just as she was leaving her boss had asked her to get a call to New York. Then the Managing Director had arrived and delayed her." and the recognition sentence "Just as she was leaving the Managing Director had arrived and delayed her."

Two events far apart would be, for example, "Last week she had put some trifle sponges at the back of the fridge. Yesterday she had bought an orange jelly." and the recognition sentence "Last week she had bought an orange jelly."

The subjects' knowledge of the type of question they would be asked seemed to influence processing, so that subjects recognised paraphrase sentences included as controls; combined sentences of two co-occurring events, and combined sentences of two events far apart all about 30% of the time, a lower proportion than found by Johnson-Laird and Stevenson and by me in experiment 1.

The lack of difference between the two events at the same time and those a distance apart can be explained using the arguments from the previous section. In order to select items that occurred some length of time apart, for example a week in the extract above, it was necessary to chose two events which were not important to the main story line and which were not closely habitually, causally or intentionally related. In these cases the length of time apart becomes irrelevant to the temporal ordering of events in the main story line and so is as likely as two events close together to be confused, which they were about 30% of the time. This finding can be taken as supporting, and perhaps explaining Sturt's more general conclusion that temporal detail is often poorly remembered.

In Experiment 4, set up expressly to test for the effect of temporal confusion, a very strong effect was found of temporal confusion with half the subjects in both groups (aware of the memory nature of the

experiment and unaware of the memory nature of the experiment) confusing the two. This confirms the likelihood of two related or two co-occurring events being associated in the representation.

6.1.3 Spatial and Temporal Representation

Clark (1973) proposed the human concept of time is actually a spatial metaphor. Children spontaneously gain knowledge of physical space as a result of their early perceptual and motor experiences. Time is learned by analogy to this fundamental, cognitively prior, perceptual model of physical space. Linguistic references to time are metaphoric extensions of the dimensional semantics of space.

This allows him to claim that, when acquiring language, spatial expressions should appear before time expressions and in particular that terms that can be used both spatially and temporally should be used spatially first. Richards and Hawpe (1981) test this, looking at word pairs before-after, ahead-behind and first-last, which could be used both spatially and temporally.

They found "each word pair appears to be acquired in one of its multiple uses earlier than the other, but the pattern of acquisition varies with the word pair. Before-after are acquired earlier in reference to temporal sequence or to spatial sequence implying temporal sequence than in reference to spatial position alone. Similarly the sense of first-last acquired earliest is primarily temporal. In contrast ahead-behind are acquired earlier in reference to spatial position and spatial position implying temporal sequence than in reference to

temporal sequence alone". (P.501)

In common with my experiments 13, 14, 15 and 16, Richards and Hawpe found differences between individual words within a concept, which should act as a warning against too hasty generalisation into categories, such as "spatial", "causal" or "temporal".

The differences are illustrated by the findings that between ages 4 to 6, although there was a significant improvement across age,

before-after both words equal at both ages

first-last first superior to last at both ages

ahead-behind behind superior to ahead at both ages

Although, it seems from this that we do not acquire temporal terms as derivatives of our spatial understanding, the co-incidence of words having both temporal and spatial meanings, and the frequency of spatial metaphors for time led me to feel that there may well be similarities in our representations of the two dimensions, and that this was an avenue which could be usefully pursued. It was therefore thought useful to continue the theme begun in the analog of the Ehrlich and Johnson-Laird (1982) experiment by comparing our understanding of temporal terms with our understanding of locative terms.

Sturt (1925) found from her short stories that space and time details were remembered to a similar extent and my experiment 2 verified this. Subjects were asked the temporal order of four events and the location in which four different events happened and scores were similar to both types of questions.

However, with other questions in this experiment I raised the possibility that foreknowledge of the memory test would encourage the construction and retention of a different type of representation. Under "normal" reading or listening conditions the reader/listener tries to obtain a clear understanding of what the speaker/writer is trying to communicate.

Barclay's (1973) experiment which investigated representation of a spatial array was therefore altered to investigate representation of a series of events in a definite temporal order. Results showed similarities between the way that spatial and temporal information can be represented.

Barclay showed that the instructions given to subjects affected the way in which they dealt with the information presented. Instructions that made clear a memory test of the sentences was to follow led subjects to retain detail about the linguistic form in which the information was originally given to them. Instructions to work out the order of the objects in the array led them to lose this linguistic detail and instead show a high level of accuracy in distinguishing sentences accurately describing the array (but often not the original sentences) from those not true of the array.

An initial review of my results shows comparable processes at work. Subjects told to work out the order of the events described were significantly more likely to say they recognised those sentences true of the array than those false of the array, but could not distinguish

the sentences actually presented. Those told to memorise the sentences were slightly more likely to recognise the original sentences but did not distinguish those true of the array from those false of the array.

Despite initial similarity, it seems to me that the level of difference between my results and those of Barclay is enough to support the suggestion that temporal information is harder to represent than spatial, especially when subjects were asked to construct a model of the situation described.

On a confidence rating of 1 to 5, Barclay's subjects gave an average score of 3.10 to having heard sentences true of the array before and an average 4.04 not having heard sentences false of the array before. Comparable figures from my experiment are 2.18 for those true and 1.49 for those false.

This would accord with an account of model construction which envisages it as similar to "forming a picture in the mind". It is possible to form a picture of an array of five animals, such as Barclay's sentences described, while not possible to form a simultaneous picture of five events, if these are represented pictorally it would be in a form like the Bayeux tapestry, with events ocurring in a temporal order represented along a spatial dimension. We cannot keep the whole display in mind at any one time but have to concentrate on one part of it, thus making it more difficult to keep a clear picture of the temporal order.

The results of an experiment carried out to explicitly test differences between spatial and temporal representation support this conclusion.

Bransford, Barclay and Franks (1972) gave 10 spatial passages to subjects, for example - "The chair is next to the table. The book is on the chair. The chair is to the right of the table. The chair is wooden and very solid." and discovered that, often, especially if the exact sentence was not available as an option, subjects would mistakenly recognise "The book is to the right of the table." which is consistent with the array described but different from the original wording.

They claimed that subjects had formed a representation in the form of a model, or picture of the situation and once the linguistic form had been lost, the mistakenly recognised sentence was consistent with the representation and therefore judged correct.

I gave subjects five spatial and five temporal passages (where a temporal one would be, for example "The mouse ran and the cat meowed. As the cat meowed the child jumped. The child jumped after the mouse ran. The mouse was grey and ran fast.") Subjects were asked whether "The cat meowed after the mouse ran" appeared in the passage.

My experimental results were different from those of Bransford, Barclay and Franks. For both spatial and temporal passages subjects were less likely to choose a description where the co-occurring event/object had been substituted even though the sentence was a correct description of the situation. However this conceals a great difference between spatial and temporal passages. Overall more correct descriptions were scored for spatial passages.

With temporal passages subjects were very unlikely to mark a correct

description where the co-occurring event had been substituted. Whereas,with spatial passages there was slightly more likelihood of subjects marking the correct description with the co-occurring object substituted. This again suggests to me that it may be more easy to build up a model which represents a spatial array after which the linguistic form is lost than it is to build a model which represents a temporal order of events. As suggested in Chapter II, this may be because of the increased complexity of temporal over spatial relationships - spatial relationships involve objects while temporal ones involve events. The increased memory load when subjects try to remember temporal relationships may then lead to a strategy where people concentrate on remembering the actual events rather than the relationships between them.

The increased difficulty of building a temporal model over building a spatial one is also reported in a paper by Oakhill and Garnham who use the Ehrlich and Johnson-Laird (1982) experiment as a basis for an experiment looking at effects of referential continuity, transitivity, and temporal vs spatial relations. They point out that although Johnson-Laird asserts that there are many types of mental model - abstract as well as spatial he does not make any specific claims about the relative difficulty of constructing each type. Oakhill and Garnham contrasted on the right of/on the left of (spatial) with older than/newer than (temporal).

The also compared sets of sentences where transitive inferences were possible:

The racquet is older than the hockey stick.
The football is newer than the hockey stick.
The racquet is to the right of the cricket bat.

with those where they weren't:

The racquet is to the right of the hockey stick.
The football is newer than the hockey stick.
The racquet is older than the cricket bat.

They predicted that while descriptions that permitted transitive inferences would always be easier than those that did not, the advantage would be greater for the spatial than for the temporal relation.

They tested immediate comprehension by asking a question about each description as soon as subjects heard it, and later gave an unexpected recognition memory test.

There were differences in experimental technique between their experiment and my analog of Ehrlich and Johnson-Laird; subjects were read the sets of sentences and they were asked to circle a "yes", "no" or "can't tell" answer on a piece of paper. My sentences were presented on a VDU and although my subjects were asked a question at the end of each description, my data were the reading times for each of the three sentences in a set.

Oakhill and Garnham found passages where there were two spatial relations easier than those where there were two temporal terms. Transitive sets were easier than non-transitive ones. There was also an interaction with transitive vs non-transitive because spatial were very much easier than non-spatial relations in the transitive condition but only slightly easier in the non-transitive.

The recognition sets that were given after the experiment were intended to be memory for "gist" - giving subjects a choice between exact linguistic form, paraphrase and two sets of sentences inconsistent with original set. Spatial relations in this task were less well remembered as were transitive descriptions. The authors explain this by saying that as subjects were under no time pressure at encoding they spent longer on the descriptions they found more difficult (temporal and non-transitive ones) and hence had processed these better and so the difficult descriptions were subsequently more easily remembered.

Their evidence backs up my results that a model of a temporal series of events is more difficult to built up than one of a spatial array of objects.

Their second experiment used a similar measure to mine, - reading time for the individual sentences. In their experiment subjects took progressively longer to read the successive sentences of the descriptions. The effect of discontinuity showed up in the final sentence of transitive descriptions but on the second sentence for non-transitive descriptions. Descriptions containing two spatial relations were read more rapidly than those with two non-spatial only when they were also transitive.

In that the final sentences of discontinuous descriptions took longer than the final sentences of continuous descriptions their results are similar to those of Ehrlich and Johnson-Laird (1982) and of my experiments 15 and 16. The second sentence in the discontinuous

description also took a relatively long time to read and they explain their results by saying that memory load at this point is greatest where subjects have four objects between which no links can be made, and this explanation also accounts for a similar finding in my two experiments. Reading times also support the finding of their first experiment that when a model supports useful inferences, its construction is easier with spatial than with non-spatial terms.

Because the material used by Oakhill and Garnham involves a different sort of temporal relationship (older/newer) than in my experiments, these relationships to appear to be, at least superficially, between objects in the same way as spatial relationships. The fact that even with this material temporal models took longer to construct supports a hypothesis that there may be something inherently more difficult about representing temporal relationships between arbitary objects than representing spatial relationships between arbitary objects.

6.1.4 Structure and Salience of Events

It has been argued that when reading/listening to a sentence we build a propositional representation and usually, somewhat later, a mental model. The time course of these two processes is not yet certain. Crain and Steedman (1986), for instance, suggest that a fairly semantic representation is built up word by word whereas others disagree. For example Bever and Townsend (1978), argue we immediately obtain semantic information for main clauses, while only obtaining on-line propositional information from subordinate clauses and not until the clause boundary is the complete representation available.

This means that we are uncertain with reading time experiments like those in Chapter 5, at exactly what point in the construction process we are interrupting and it is only when the question is answered at the end of the third sentence that we can be certain that processing has been completed. However, as argued in the introduction, if the experimental task is writing a continuation, we can be sure that the previous sentence or sentence fragment has been fully understood and in this respect continuation experiments seem to be a useful way to obtain an indication of the structure of the discourse model and the relative salience of the events within it.

I expected the temporal order of events to be one of the aspects which structures discourse models, for instance, I expected something that occurred recently to be more salient than something that occurred 5 days ago, all other factors being approximately equal.

Partee (1983) seems to agree with me in that she claims that simple linear progression is probably the unmarked value of discourse structure. She says "in construing a piece of narrative as linear we assume that successively introduced reference times strictly follow one another." So, (1) in the simple linear case an event clause moves the narrative forward by bringing in a new reference time "just after" the given event. We shall examine how her argument specifically applies with main and subordinate clauses in a later section.

Partee feels clausal structure of the sentence is another factor affecting salience, and talking about the time at which the next event

will be deemed to occur, states (2) "the reference time in effect after the complete sentence is processed depends on which clause was the main clause - this corresponds with the informal observation that it is main clauses that carry the main story along in a narrative."

In order for this to be possible she has to construe before clauses as not part of the linear narrative - otherwise (2) would conflict with (1). By doing this she also accounts for the ease with which before clauses are understood as non-factive.

I wanted to check on some of these statements and see what does determine what is salient in the mental model after sentences containing temporal connectives. For example, if before is not part of the linear narrative I would expect before clauses to be salient for continuations less often than after clauses.

My first experiment with before showed 67% continuations from the main clause, 26% from the subordinate clause. A substantial minority thus come from the subordinate clause and this leads me to doubt (a) that main clause continuation is the "unmarked" option and (b) that before clauses are in some sense "unusual" in not forming part of the linear narrative.

It was unclear whether different types of before (factive, non-factive, neutral) led to differences in salience. A general conclusion would be that neutral before clauses tend to lead to more subordinate clause continuations. I have suggested this may be because subjects experienced a need to clarify what they saw as an ambiguous previous sentence and

doing so involved making clear the factivity or non-factivity of the before clause, leading to more continuations from this clause.

In both experiments with only before sentences (numbers 10 and 11) more subordinate clause continuations came from sentences in main-subordinate order than those in subordinate-main order. This may support either (a) last mentioned event in text being most salient; or (b) last occurring event in the world described being most salient.

Experiment 12 shows that clausal order of sentences (whether main-subordinate or subordinate-main) with after, when and factive before has no effect on the ratio of main and subordinate continuations. This indicates that order-of-mention in text has no effect - if it did we would expect more main clause continuations with all connectives from sentences in subordinate-main order and more subordinate clause continuations with all connectives from sentences in main-subordinate order. This indicates the increased number of subordinate clause continuations with before is due to last event in real world time.

More main clause continuations came from after sentences than before sentences, showing an effect of order in the real world, and providing some support for Partee's idea that events in before clause do not form part of the main narrative.

With when, again majority of continuations came from main clause and again clausal order was not significant.

Here we see the syntactic main clause/subordinate clause distinction having the major effect on salience as expressed by the form of continuations. This is modified by the semantic/pragmatic effect of order in the the real world. Order of mention in the text does not appear to play a part.

6.2 NON-FACTIVE BEFORE

Partee (1973) mentioned that if before clauses do not end up in the main linear narrative it might account for the ease with which before clauses are understood as non-factive. If, however before clauses are not represented differently from other temporal clauses, and I can find little evidence that they are, we must look for an explanation in terms of processing strategies which apply to other aspects of language as well.

There does not appear to be much written about the existence of non-factive before with the exception of the extensive analysis by Heinamaki (1974). However, Kiparsky and Kiparsky (1970) deal with the factivity of different verbs. They compare those that commit the reader to the factivity of the object "I bought a sandwich" versus those that do not "I want a sandwich"; to know x and to believe x are also good examples of this distinction. Although there are obvious differences between these verbs and before sentences, this at least establishes that in our everyday language we deal with non-factivity without problem or question.

It seems to be that it is often only when we begin to examine closely

the meaning of our utterances that we even realise that there is a difference. With non-factive before sentences, when I read subjects a list of before sentences with varying degrees of factivity and asked "Did the before clause happen?", subjects were surprised to discover that sometimes they answered "yes" and sometimes "no".

Accepting that factivity and non-factivity both regularly occur in text I wondered how I could discover more about the way it was represented. I began by verifying that when the non-factivity of the before clause was reiterated in some way (by providing an alternative ending for the main clause) subjects were more likely to answer "No" to the question "Did the before clause happen?".

They were significantly more likely to remember the non-occurrence of the non-factive clause when there was a positive alternative ending but even so, about one third of subjects thought the event described in the before clause had happened. This may indicate that a linguistic representation has been retained, (where the exact words would leave a trace) instead of a mental model. A mental model would represent the non-factive information separately from information about events in the real world so would leave very little ambiguity (Johnson-Laird 1983, pp 430-437).

The answer was also affected by the wording of the question asked - asking an indirect question seemed to affect answers in a similar way asking leading questions affected eye-witness testimony. Loftus (1967) found that asking "Did she stop at the Yield sign" would increase subjects likelihood to respond "Yes" to a later question "Was there a

Yield sign?" In a similar way, asking "How much whisky did she drink?" increases the likelihood that subjects will claim that she drank at least some whisky.

We should begin by taking Moens and Steedman's (1986) concept that a reference time should be seen as an event instead of as a point. A representation of an event is not just a process or culminated process, but consists of preparatory process, culminated process and consequences.

Just as they use this to explain the ease of reference, after "When the built the 39th Street Bridge" of "they prevented a bottleneck in the city centre", it will similarly account for "They built the 39th Street Bridge before a bottleneck developed in the city centre".

The event of building the 39th Street Bridge is represented in a way that has some indication of its consequences, and these might be a before clause, factive, or non-factive, or in fact it might be followed by any purely temporal clause.

I have shown that before clauses are easily, naturally understood as exhibiting a wide spectrum of factivity, and that when presented to people as single sentences, subjects often prefer to express some uncertainty about their occurrence rather than place them clearly into either a factive or non-factive category. Sentences in main-subordinate clause order were more likely to be read as factive

than sentences in subordinate-main clause order.

It often appeared that a second sentence following the test sentence would have decided the factivity of the before clause in one direction or the other. For example, it is difficult to continue a sentence I would classify as ambiguous, e.g. "The government objected before the book was published." so as to continue the ambiguity. It is much easier to clarify it, for instance, "however the publishers decided publication was in the public interest and proceeded." or "After two lengthy court cases they succeeded in suppressing it."

Similarly, it is impossible to split a before sentence into two sentences, one from each clause, without resolving ambiguity in it. This was the case when preparing the materials for experiment 10 when sentences with a subordinate before clause were split into two sentences to see how this affected continuation. It was found that when the before clause was uncertain or non-factive it was necessary to clarify its status to produce two sentences, thus:

She went back to work before she got well. had to become
She went backto work. Then she got well. or
She went back to work. This meant she didn't get well.

Does non-factivity disrupt processing? The easiest way to investigate this would seem to be by measuring reading time for sentences which produced different numbers of "yes" responses to the question "Did (before clause) happen?". A second sentence was added to the one containing the before clause and, acting on the assumption that factivity was the "natural" or "unmarked" reading, this sentence took the first clause as factive and continued as if it was.

Reading time experiments were thought to be good indicators of the difficulty people had with non-factive before clauses as opposed to other before clauses. Sentences did not show a clear increase in reading time correlating with perceived non-factivity but there was a difference between the 12 most factive and the 12 most non-factive, with the 12 most non-factive taking longer.

In order to confirm that the "natural" reading was not factive, but either factive or non-factive depending on the semantic relationship of the two clauses, two different types of sentences were constructed to follow on. One took the meaning of all before clauses as factive, and continued the text as if they were and one took them all as non-factive and continued as if they were.

The factive continuations correlated with perceived factivity. A factive continuation after a factive before clause was read much faster than a factive sentence after a non-factive before clause.

However, the position is not simple. After a factive first sentence, a continuation giving a non-factive reading to the before clause was understood just as quickly, leading me to claim that an overtly factive before sentence can be continued factively or non-factively without disrupting language processing. The position is different with first sentences with an overtly non-factive before clause. A non-factive continuation is processed easily. A sentence taking the before clause as factive seriously disrupts processing however.

These findings show that before clauses which are not specifically non-factive can easily be interpreted as factive or non-factive. One important implication of this is that the decision as to the factivity of the before clause is not been made at the end of the first sentence as the continuation which determines factivity does not occur until the second sentence.

The difference with unambiguous non-factive before sentences appears to be due to semantic/pragmatic factors. As Heinamaki points out, the main clause prevents the before clause from happening and whatever happens subsequently cannot change this. For example, with the sentence "She escaped before they put the handcuffs on", the only way handcuffs can subsequently be applied is by the ocurrence of an intervening event (i.e. the fugitive's recapture).

Partee's claim that before clauses do not end up in the main linear narrative implies there is no difference between processing the factive and non-factive sentences (one of the main advantages of her claim is that it allows for similar processing of both types of clause). My results suggest that there may be differences between sentences with non-factive befores and sentences with other before clauses.

If we argue that the usual form of a representation is clear and unambiguous, then it is the sentence with the non-factive before clause which conforms to this description. It may produce a more coherent picture to argue that the representation contains shades of meaning to allow for different consequence to follow from the event These consequences may actually confirm the before

clause as non-factive.

6.3 CAUSAL PROCESSING

Bever and Townsend (1978) and later Townsend (1983) hypothesise a "causal processing model" based on two separate assertions

1. Main clauses are initially processed semantically, while subordinate clauses are initially processed propositionally.
2. Subordinate clauses vary in the depth of their propositional processing according to the causality of the connective beginning them. The more causally connected a subordinate clause is to the main clause, the more semantically it will be processed.

I don't feel their experiments were sufficiently stringent to prove the complicated hierarchy suggested by (2) for the reasons that

1. experiments give too few examples of sentences with each connective to each subject - 2, 3 or 4 seems common
2. few examples of sample sentences are given in papers and when examples are given they seem slightly unusual,

e.g. When the cat killed the parrot, Sam left the house for a week.
Harry began raising snakes on his farm. Therefore kids visited the farm every day.

3. Results often only reach a marginally significant $P<0.1$
4. Connectives used somewhat unpredictably

(a) <u>because</u>, the only unambiguously causal connective is only used in two experiments

(b) <u>since</u> not reported in one experiment where its results came out between because and when/while

(c) B&T (1979) while, if, since, when, though in exp 1 & 2

since, when, while, though in exp 3

Townsend (1983)

since and while used in exp 1

since and though used in exp 2

because, after, when, and, before, although in exp 4

because, since, after, when, while, before in exp 5

therefore, afterwards, no connective, meanwhile,

previously, however in exp 6

because, while and although in exp 7

The findings that led up to 1 could be reflecting something about how we process clauses. However, it should be borne in mind that the difference between subordinate clause and main clause processing does show considerable variation according to the task involved. If we reject the "causal processing strategy" to explain this variation it suggests the possibility that the variation between processing of the two types of clause found by Bever and Townsend may be comparable to the unexpected differences in processing time involved in clauses begun by different connectives, irrespective of "causal efficacy".

I am tempted to treat Bever and Townsend's findings of variations between the clauses introduced by different connectives as almost anarchic variations, akin to differences in reading time for words that are more or less frequent in language. Smith and McMahon (1970) looked at order information in sentences, where lead and precede indicate one relation and follow and trail another, yet found a

"words-within-meaning" effect so that sentences containing lead took 3.94 seconds to read while those with precede took 4.27, sentences containing follow took 4.12 and those with trail 4.16.

My experiment 15, using after, before, once and until found similar differences in reading times for the sentences depending on the connective used, which did not correspond with their meanings.

A similar effect can be seen with interactions between context and connective introducing the clause (in experiments 13 and 14) , with no clear relationship that can be drawn along the lines for instance of those suggested by Bever and Townsend, and yet where significant differences exist which cannot easily be explained.

In experiment 13, sentences with before, after and since were faster than those with because, but before sentences were read faster with a subordinate clause context while after because and since sentences were read faster with a main clause context. In experiment 14, since clauses were generally read faster than those with before, after and because.

The clausal structure of language is assumed by linguists to be important in language understanding and constructing representations. For example, Partee explains the asymmetry between main and subordinate clauses in terms of the effect they produce on the establishment of reference time. In her actual processing rules the subordinate clause is always processed before the main clause and introduces the reference time in respect to which the main clause is

is interpreted.

Partee's account appeals on an intuitive level. "Yes - that's how we must process main and subordinate clauses." But it is impossible to reconcile with Bever and Townsend's findings above. Given that I have reservations about Bever and Townsend's findings, I should say my reading time experiments (Nos 8, 9, 13,14, 15 and 16) also cast doubt on Partee's ideas as they show that sentences in subordinate-main order are not read more quickly, which is what would be predicted from Partee's findings.

However, experiment 13 suggests she is right that narrative line continues through main clause, as main clause context led to faster reading time.

These results rule out the possibility that as subordinate clauses contain presuppositions and as these are brought into being in the model as the sentence is read, as Crain and Steedman (1985) have shown, that providing context for the subordinate clause would speed up processing the presuppositions.

Experiment 13 also casts doubt on Bever and Townsend's causal processing strategy as sentences with temporal connectives were read faster than those with causal connectives.

Experiment 14 again did not support Bever and Townsend or Partee in as much as reading times can be judged to indicate different types of processing. Timing each clause independently showed that instead of

main clause or subordinate clause being read faster whichever position it was in, it was clause position which had the deciding weight, with whichever clause came second being read faster.

There was no interaction between subordinate or main clause and position of clause, indicating that there is no evidence subordinate-main or main-subordinate order is a preferred order (as Partee) nor that there are different types of processisng (as Bever and Townsend).

The first clause taking longer to read and the lack of difference between main and subordinate clause is in line with the "structure building framework" (Gernsbacher, Hargreaves and Beeman, 1989).

According to this theory, the goal of comprehension is to build a coherent mental representation of the information being comprehended. This "structure" is built by first laying a foundation and then mapping on information when that incoming information coheres with the previous information. If the incoming information is less continuous comprehenders employ a different process - they shift and initiate a new substructure.

For this reason, most representations comprise several branching substructures. The authors use this framework to explain several aspects of language understanding. The advantage of first mentioned participants (Chang 1980, Corbett & Chang 1983; Gernsbacher & Hargreaves, 1988; Stevenson 1986; Von Eckardt & Potter 1985) is explained because they are more accessible because they form the foundations for their sentence-level structures and because it is

through them that subsequent information is mapped onto the developing structure.

This is supported by other phenomena - the initial word of a sentence takes longer to read than other words in a sentence except final word (Aaronson & Ferres 1983; Aaronson & Scarborough 1976; Chang 1980). Phonemes and words are identified more slowly when they occur at the beginning of their sentence or phrase than when they occur later (Cairns & Kamerman, 1975; Cutler & Foss, 1977; Foss, 1969, 1982; Hakes, 1971; Marslen-Wilson, Tyler, & Seidenberg, 1978; Shields, McHugh & Martin, 1974).

It may well be that this is related to the ease with which words are understood once a context has been established for their comprehension and I shall return to this later.

Gernsbacher & Hargreaves (1988) demonstrated the advantage of first mentioned participant does not depend on semantic agency, nor on the first mentioned participant being the subject of the sentence. They also demonstrated that the preposing of an adverbial phrase "two weeks ago" did not affect the advantage of first mentioned participant.

On the other hand, immediately after subjects read or heard a 2-clause sentence, words from the most recently heard or read clause are more accessible than words from an earlier clause, giving an advantage to the the most recently or second-mentioned participant (Bever and Townsend, 1978; Caplan, 1972, Chang, 1980; Flores d'Arcais, 1978; Jarvella, 1970, 1971, 1973, 1979; Jarvella & Herman, 1972; Marslen-Wilson et al, 1978;

von Eckardt & Potter, 1985).

Gernsbacher et al's "structure building framework" explains this taking into account that words and sentences that change the ongoing topic, point of view or setting take longer to comprehend than those that continue it. This suggests that such words and sentences trigger comprehenders to shift and begin laying the foundation for a new substructure (Anderson, Garrod, & Sanford, 1988; Black, Turner & Bower, 1979; Daneman & Carpenter 1983; Dee-Lucas, Just, Carpenter & Daneman 1982; Haberlandt, Berian & Sandson, 1980; Lesgold, Roth & Curtis, 1979; Lorch, Lorch & Mitchell, 1985; Mandler & Goodman 1982; Olson, Duffy & Mack, 1980).

A change in topic, point of view or setting also makes it more difficult to retrieve information presented before it than after it. (Anderson et al, 1983; Clements, 1979; Mandler & Goodman, 1982). This suggests to Gernsbacher et al that information presented before the change is represented in one substructure, while information presented after the change is represented in another.

They tested their assumptions with a number of experiments on two-clause sentences where each clause contained actions matched along several dimensions. They had to last about the same period and be of equal importance and neither action could be the impetus for the other. For example "Tina gathered the kindling as Lisa set up the tent". Their materials for experiment 3 consisted of some two-clause sentences where the subordinate clause was begun by before and after.

Their results show the same pattern as for two clause sentences joined by and. At the earliest test point, immediately after the sentence had been read, second mentioned participants were more accessible, 150ms later the two sentence participants were equally accessible, after 1400ms and 2000 ms the first-mentioned participant was more easily accessed.

These results suggest to Gernsbacher that comprehenders represent each clause of a two-clause sentence in its own substructure. Comprehenders have greatest access to the information in the substructure that they are currently developing (i.e. the most recent clause) but at some point the first clause becomes more accessible because the substructure representing the first clause of a two-clause sentence serves as a foundation for the whole sentence-level representation.

These results indicate a symmetry of processing both main and subordinate clauses at odds with the work of Bever and Townsend and Partee. However, Gernsbacher et al do allow that some substructures will be more closely connected than others and that more dependent clauses are represented in more connected substructures and accept their clauses in their experiments were semantically very independent. There were, for example, no causal or what I have called "habitual" relationships between them.

They link their work into other work on comprehension of language in units larger than a sentence,and suggest their "structure building framework" is as applicable over whole stories and texts. Where they begin to link it into work on sentences is where the more semantic

aspects come in. The results of Anderson, Garrod and Sanford (1983) on "episode shift" show an effect of the semantic/pragmatic fact of length of time an event is expected to last.

The make no mention of the role of context in the understanding of sentences and the part this may play in enabling faster comprehension of later occurring words and sentences. Kamp points out (Kamp, 1985) "Not only do the utterances we produce orally and in writing, often depend on context for their interpretation - they often do much to determine what the context is."

What Gernsbacher et al refer to as the process of building the framework on the foundation is also the process of interpreting each word in relation to the context provided by the word(s) already read. The context so generated would limit the possibilities of the following word and thus act to reduce processing time in comparison to earlier words in the phrase which have less context.

6.4 A Representation of Representation?

Johnson-Laird's mental model is thus seen as a useful basis on which to model our ideas of human language processing. However, it may be that the distinction between propositional representation and mental models may have been artifically inflated by the amount of work on anaphora. The antecedent of anaphoric reference tends to be either in the discourse model or not in it, which makes the contents and boundaries of mental models seem clear, distinct and quantifiable. This is counter-intuitive as my idea of language is of subtle nuances and using

words in a way that is often vague, hazy and alive with unrealised possibilities.

Although I have found scant evidence to support the causal effectiveness model of Bever & Townsend (1978), their idea that some events are more closely bound into the story reflects the idea of focus (Grosz 1977), theme, etc, and narrative-story-line (Partee).

The work of Keenan (1968) shows there is a graded structure of likely links between sentences - when we hear a sentence some continuations are very likely, some extremely unlikely - it is this difference that I measured with sentences with before clauses judged factive and non-factive. After a non-factive before clause a non-factive continuation was read faster and a factive continuation slower.

Within a model some events are more salient than others. There are traces of this idea in the levels of processing approach of Craik and Lockhart (1973). Craik and Tulving (1975) systematically manipulated presented material and found that tasks that required deeper processing, as measured by time to complete were recalled better.

Items in memory studies (which are often unrelated) being processed to different levels, indicated the existence within mental capacity of various levels and instead of the "all or nothing" represention of a mental model, a model of a more gradational nature would provide a framework which could take on board the vagaries of much of our present language.

A before clause that was not definitely factive or non-factive could remain part of this graded structure nearer the definite or indefinite end depending on perceived likelihood.

Another distinction which people have assumed is a dichotomy like propositional representation and discourse model, is the given/new distinction. Stevenson and Crawley (1986 unpublished) suggest that a graded notion of both salience and familiarity may be more in accord with our understanding of text. Salience will be graded by virtue of the number of features in the text which signal it. Familiarity is graded because of the characteristics of the entity with respect to the discourse model. The most familiar end of such a gradation would be items in explicit focus (Garrod and Sanford, 1983) which could be referred to by a pronoun, in the middle would be items in implicit focus (which could be referred to with the definite article ("We went into the kitchen. The door was open.")) and at the least familiar end would be "new" items.

Perhaps we need something like a multi-dimensional mental model where layers of possibility, probability and familiarity can all be represented. Sperber & Wilson (1986) suggest we understand discourse as having different strengths - under normal circumstances "I'd like a cup of tea" would be stronger (more likely) than "I'd like a million pounds" although we could imagine contexts where the second would be stronger than the first.

If we take these ideas seriously they could suggest that Moens and Steedman (1986) nucleus event could be represented as being of different

strengths surrounded by possibilities radiating outwards, of varying likelihoods (or requiring different numbers of linking inferences) of previous causes and future consequences. A small proportion of these are developed by the continuing text and these become nucleus events in their own right.

The nature of the link between the events would often be clear from context. "The bat hit the ball. The ball soared into the air. As the ball came down it went straight through the greenhouse roof." But it is at these linking points that connectives would also be found in text. Where the connective specified time or some other relational feature exactly there would be two sources of information, language and context. Where there was no connective, contextual information would still supply the relationship. The question arises whether this would take longer to obtain where there was no connective.

As pointed out at the end of Chapter 14, my results support a view which sees connectives as indicators rather than <u>definers</u> of context. When there are occasions that a connective is used in a clear unambiguous, directive way it may speed comprehension compared with times when there is no connective, or its meaning is unclear (e.g. <u>before</u> clauses where factivity is indefinite) or if it is ambiguous, e.g. with <u>since</u> or <u>while</u>.

Schiffrin (1987) performs a comparative analysis of the connectives <u>so</u>, <u>because</u>, <u>and</u>, <u>but</u> and <u>or</u> among other "discourse markers" in conversational discourse. She concludes that these markers provide contextual co-ordinates which aid in the production and interpretation

of coherent conversation at both local and global levels of organisations.

Her work supports the idea that many temporal connectives have unclear or multiple meanings. She looks at now and then and finds now has two distinct uses, as discourse marker and as adverb, while although then has the same uses, its not clear that the two functions are totally distinct.

Work by Cattell (1978) who discusses the relationship between "why" questions and verbs of volunteered stance, such that the question "Why do the police believe Sue killed Harry?" has two readings, as does the answer "The police believed Sue killed Harry because he had a large life insurance policy." and Schiffrin's findings that because and so have multiple realizations leads her to certain conclusions. She claims that because he had a large life insurance policy can warrant either the fact that Sue killed Harry or the fact that the police believed Sue killed Harry.

She suggests that the multiple realisations of "cause" and "results" relations is due to our understandings of causality rather than being a product of because or so. We probably draw conclusions about cause and effect which are often not based on observations which empirically warrant them - instead we base our interpretations on our own (culturally relative) schemata for making such interpretations. Since we assume that others are following parallel procedures - basing their inferences on their own schemata - we interpret many statements from others as conclusions warranted by the speaker's own perspective.

In conclusion, then, I have argued for a representation which allows for multiple layers of meanings to be present, as this is the only form which explains how, when a sentence has an ambiguous meaning (as with many before sentences), we can just as easily understand a continuation coming from one interpretation as from another. Instead of claiming that at some definite point in the text (e.g. at clause boundaries)a model is formed with one definite meaning, I assume that it is possible for uncertainties to remain unresolved indefinitely in the model until some further information comes along to confirm or disconfirm it.

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STORY 1

The two kids were happy. It was Saturday. On Wednesday Uncle Eric had given them 50p each. On the same day they'd earned a pound from Auntie Joan. Now they had their pocket money as well and were going to the shops to buy a new football. Joy of joys, the sun was shining. They brushed their teeth and washed their faces with the scantest of attention - the regulation three shredded wheat were wolfed down with no regard for their digestive systems and they were off to the town, running down the pavements.

Gary kicked an empty pepsi can in an absent minded sort of way - Peter intercepted it before it flew into someone's garden and immediately they were taking part in the FA Cup Final - they weaved in and out of the other pedestrians who'd been lured into the open by the sunlight and ignored the occasional worried toot from a driver imaging a squashed boy under the wheels. The pace was hot and frantic until the inevitable happened and a too-enthusiastic kick from Peter sent the can flying high into the road.

A still moment, until they remembered the nature of their errand and headed for the shops again. They tried Woolworths first - it had a good toy section. Walking past the school equipment Gary saw a rubber shaped like a hedgehog. He paused for a moment, reached out to touch it - was it really all rubber? He felt a heavy hand on his collar "Come on you - out of here - no messing around - and your mate too". Gary instinctively tried to shrug off the offending hand. It gripped tighter, hurting him as the fingers dug in, he wriggled more, trying to lessen the pain. "Quit that or I'll get the cops" the gravelly voice spoke again.

Gary gave in and was still. The fingers still hurt. His face was red, he was gasping for breath, trying not to cry from the pain and the shame as other shoppers began to look round interestedly watching the scene. He kicked the guard in the shin. "Bloody hell" the man said. His grip loosened for a moment as he almost gave in to the impulse to rub his leg.

Peter had been frozen in shock for a moment. He had been ahead of Gary and turned round when the man spoke. He couldn't believe what he saw. His big brother held prisoner by a uniformed stranger. He flew at the man, just as his grip on Gary's shoulder was loosened and knocked him off balance.

The guard tried to get the same grip on Peter as he had on Gary, at the same time holding them as far away as possible from his body to avoid the punishing kicks which they were both now inflicting on him. One of the spectators laughed. No-one else moved.

The guard tried to change his grip on the lads to pinion their arms to their side. He yelled "Sid" and then he yelled "ouch" immediately after - he had inadvertantly let his wrist stray within biting distance of Peter's mouth and Peter had taken full advantage of the opportunity. As he dug his teeth in deeper, all the guard's faculties became focused on removing his arm from danger. He let go of Gary and used his free hand to push Peter away, releasing his grip on him at the same time.

The boys took a frantic look around them, saw the guard let go of his wrist ready to reach for them again, saw another burly uniform approaching from the back of the shop and fled in the opposite direction, pushing through the knot of bystanders who had gathered.

They were out of the shop and along the High Street as if pursued by devils - outside Littlewoods Peter looked back and saw no pursuers, but it was only when they got to Boots they both slowed their pace and of one accord, went down the alley beside the petshop.

A door was open into an empty back yard. Gary pulled Peter in after him and they sat down, gasping for breath. As his breathing slowed down, Gary thought of their happiness as they came into town and how quickly things had gone wrong. Peter burst into tears suddenly and Gary put his arm round him.

Story 1 - Questions

1. Can you remember what was happening when one of the spectators laughed?

2. Put these events in order:
   the guard's grip loosened
   the car tooted
   they ran past Littlewoods
   they brushed their teeth
   Peter burst into tears
   they got out of bed
   Peter flew at guard

3. In what order did the run past the shops?

4. At what point did the guard swear?

5. What did Gary touch that started all the trouble?

6. (a) Was it morning or afternoon?

   (b) How do you know?

7. What made Peter turn round and see the guard holding Gary?

8. What was the name of the second security guard?

9. What did they have for breakfast?

10. (a) What day was it?

    (B) How do you know?

11. Where did the pepsi can end up?

12. Was this sentence in the story?
    "Last Wednesday they earned a pound from Auntie Joan"

Story 2

The weather seemed quite suitable for moving house. There was no wind and although it was cold and cloudy the forecast hadn't mentioned rain. Jan and Margo had taken the day off work. They got up at 6.30 a.m. and started work. At 7.30 Jan packed the last of the bedding. At the same time Margo made some breakfast. At 8 a.m. they went off in their Escort to collect the van. At the van hire depot Jan signed all the papers and paid a deposit of `50 and gingerly started up the Luton van that she had been directed to. Margo drove their car home slowly and Jan followed at a sedate 30 miles an hour.

When they got back Carol and Sue were already there. They had agreed two help two weeks previously and Jan breathed a sigh of relief to see them both as Sue had a reputation for being scatterbrained and it would have been fairly typical of her to have forgotten the day, though she had kept repeating "A week on Tuesday, a week on Tuesday" to herself.

Getting their priorities right, as usual, they sat down and had a cup of coffee in the strangely bare kitchen. The pictures had been taken down and packed and so had the mugs and the mug tree. The plants were all outside, packed into large, flat cardboard boxes and already the place seemed alien, as if they didn't belong anymore.

Freddie the cat wandered in casually and looked round at the chaos with a suspicious glean in his eye. They he spotted Carol and got ready to jump. He loved sitting on her shoulders. Margo dived for him before he did his circus trick and Jan held the cat basket while Margo squeezed him in gently. His pathetic meows got too much for them and Margo put the basket in the hall.

They chatted about plans for the move, agreeing that as the new house was only two miles away it wouldn't matter too much if everything didn't fit in the van the first time round. Margo said nothing but vowed to herself to do her best to get all the furniture moved in one go. The whole business seemed to have taken forever, though she admitted it was less than four months since they had first put the house on the market. She had unhappy memories of the place and was anxious to put them all behind her and make a clean start.

The coffee finished, they packed the mugs and kettle into the last crate in the space left for them by the ever-practical Jan and before long any watching neighbours could almost have heard the hum of activity as beds, settee, table, chairs, were all taken out of the front door and stored carefully in the back of the van.

Carol took first turn standing in the van and it was her job to manoeuvre the furniture carelessly placed in the entrance into a suitable place to allow further stacking. She managed this fairly well but when the fridge freezer followed the settee into the van she found herself unable to get either of them where she wanted it and Jan jumped up to help. When they had got the two large articles stacked Carol took a turn bringing things from the house and Jan stayed in the van.

The crates and cardboard boxes came next, they seemed much heavier than expected. Jan remembered from her last move five years ago that books and records were much heavier than expected and they had tried very hard to spread the load between different containers. The van was beginning to look very full but they all agreed it would be silly to come back for the few bits and pieces that were left so Carol's car was filled with plants and the stereo. The cat, sitting stoically in his box was transported to Margo's car and surrounded with bags of clothes and bedding and the television set went in the passenger seat of the van, to be moved onto Sue's knee when they finally came to set off.

And that was it, a final look round, a note for the new owners warning them that the wall in the back garden had some loose bricks and was liable to collapse if walked upon and they walked out of the front door and slammed it behind them.

Story 2 - Questions

1. a) What day was it?

   b) How do you know?

2. In what order did the following people arrive in the house?
   Carol and Sue
   Jan in the van
   Margo in the car

3. When were the plants packed into cardboard boxes?

4. How long ago had Sue agreed to help?

5. Did Freddie have the chance to leap on Carol's shoulders?

6. a) What time of year was it?

   b) How do you know?

7. How long had the house been on the market?

8. Who stacked furniture in the van first, Carol or Jan?

9. What went onto the van first, the fridge-freezer or the settee?

10. What made the kitchen look bare?

11. Did they take long to start work once they'd finished coffee?

12. Was this sentence in the story?
    "At 7.30 Margo made a cup of tea."

Story 3

Mary was seven years old. Most of her friends hadn't had birthday parties this year. They were getting a bit old for such affairs. Jelly and trifle and passing the parcel seemed to be more suited to children before they went up to Juniors. So this year, in March, she'd been ice skating with Clara and three of her friends, in June they went to see "The Pirates of Penzance" with Marcia, Elizabeth and Nadine, and in July Samantha's mother had taken five children into London to see Paul Daniels.

Mary's birthday was in November, which was a pretty dismal time of year anyway, once Guy Fawkes day was over. It began to get dark about 6 o'clock and her friends wouldn't want to stay out too late. She talked to her mother a few times about what they could do but her mother hadn't helped much. She said she could only take ONE friend if they went up to London for the day, to go to the Zoo or to the Tower of London, and there was no way at all they could afford to go to see Starlight Express or Cats.

Mary would have quite liked to go to the zoo, but the problem of deciding which friend to take was too much for her - she didn't want to offend all the other girls in her class. So, she decided to have a traditional birthday party. She went to bed the night before half excited, half worried. Once she was in bed her mother began baking fairy cakes. At the same time her father began wrapping presents for "Pass the Parcel". By midnight all was finished, even the balloons blown up and the hundreds and thousands sprinkled on the top of individual trifles in waxed paper dishes.

The next day all three of them were nervous. Mary spent hours getting dressed in brand new clothes and just KNEW she didn't quite look right. Her parents were just wishing the whole thing was over and vowing that there wouldn't be a party the following year.

The first guest was Samantha, who arrived on the dot of three, dressed in something that looked like black lace pajamas, but before Mary's dad could make any rude comments the doorbell had rung again, and it was Nadine, in high-heeled shoes with her hair in a bun - she was almost as tall as Mary's mum. Five minutes later all 11 guests had arrived and were all perched sedately on the edge of chairs spread round the room.

Mary's heart sank, tea wasn't till four, how were they going to pass a whole hour sitting around making polite conversation? When her mother went to the record player Mary didn't know where to put herself, how could she face school on Monday after her friends had sat through an afternoon of Cliff Richard and the Beatles.

Two seconds later the first notes of the number one record were heard - now Mary understood the whispered conversation she'd heard between her parents outside Smiths that morning. Her father stood up and explained the rules of musical chairs - the girls must dance until the music stopped and then find a chair to sit on. Each time the music started another chair would be taken away so they must be fast to get the chairs that were left.

They all started dancing and when the music stopped there was a mad scuffle. After a few minutes they were down to four chairs and the sounds of happy laughter and anguished shrieks could be heard. Samantha's "pajamas" looked crumpled and Nadine's neat hair was sticking out all over the place. In the kitchen Mary's mother smiled

to herself and relaxed, "Poor things", she thought, "they don't get much time to be kids these days. I bet they talk about this party for weeks to come".

Mary wandered disconsolately into the kitchen before her mother could say anything of this to her husband. One look at her face stopped her mother in her tracks. Before she could ask her what was wrong, Mary burst out "They'll never forget this ever - when they get home they'll feel really silly and on Monday they'll blame me - say they were just humouring me - that they didn't enjoy it at all!". She flew out of the back door which closed with a crash after her. In the sitting room the party continued.

Story 3 - Questions

1. What time did the first guest arrive?

2. What happened when the music stopped?

3. In what order had she been to
   Pirates of Penzance
   Ice Skating
   Paul Daniels

4. What did her father say about Samantha's outfit?

5. When had Mary heard her parents whispering?

6. What was for tea?

7. a) Where would the kids be on Monday?

   b) How do you know?

8. What records did her parents like?

9. a) What day of the week was it?

   b) How do you know?

10. When did her parents wrap up the parcels for pass the parcel?

11. What month was Mary's birthday in?

12. Was this sentence in the story?
    "Once she was in bed her father began wrapping presents for "pass the parcel"".

Story 4

Kevin and Kelly decided it was a lovely day to walk along the cliffs from Whitby to Robin Hood's Bay. Kevin made cheese and pickle sandwiches while Kelly looked for the thermos flask which she was SURE she'd last seen in the garage when they came back from their holiday in May. It wasn't there now though, and she went next door to see Jenny to see if she had one that was suitable.

Immediately the doorbell rang, Sam the dog began to bark furiously. At the same time Jenny apppeared at the door. As usual, she had a tale to tell of the doings of the mischievous squirrel which stole peanuts off her birdtable and it was ten minutes before Kelly managed to edge slowly backwards out of the kitchen door with Jenny's voice floating after her "... it climbed right up ...". When she got back Kevin had finished the sandwiches, found the thermos because he remembered he'd had it in the attic when he was mending the water tank, and made the coffee.

Before Kevin could start washing up Kelly bundled him out of the house and locked the door. She backed the car out of the garage and Kevin threw the rucksack with provisions into the back seat, together with the two anoraks they would no doubt need. They decided to park at Whitby, walk to Robin Hood's Bay and have a drink there before getting the bus back to Whitby. Kelly had a job finding a parking space as the car park was packed, but she assumed most people had gone to see the Abbey or into Whitby itself and that the path wouldn't be too crowded.

Sure enough, once they'd gone over two stiles, there was not another person to be seen, and the only sounds audible were the bleating of sheep and the screaming of seagulls as they circled over the cliff. To one side was the North Sea, to the other stretched green fields, as far as the eye could see. A sense of contentment overcame the two walkers and they ambled along in companiable silence, each knowing the other one's thoughts as if they were inside each others' head.

The silence was broken by loud shouting coming from ahead, interrupted by the unmistakable sound of a child screaming hysterically. They walked on more quickly, towards a small family group where some drama was obviously taking place. One little girl about eight was holding something in her hands, the man of the party, presumably the father of the children was trying to take it away from her. The screaming had come from a little boy of about five who was now crying quietly and repeating "Don't kill it, please don't kill it."

The path was so narrow that Kelly couldn't have walked part the scene if she'd wanted to, but when she got close enough she saw that what the little girl was holding looked like a small rabbit or squirrel she didn't want to leave the situation as it was. She asked the woman in the party, probably the mother, who was looking sad and upset, what was going on.

The interruption by an outsider seemed to still the rest of the family and they were quiet while the mother explained that the girl had found the baby rabbit just lying by the side of the path. Her father had said it was probably poisoned and the best thing would be to put it out of its misery but the two children disagreed.

The little girl looked pleadingly up at Kelly and even the father seemed to accept her in the role of arbiter. Kevin watched with admiration his wife's tact as she explained to the little girl that her father was probably right, but that the baby rabbit did have a chance and would she let Kelly take it home with her and try to look after it. The outcome was a foregone conclusion. The father mumbled a little bit about "putting you to so much trouble". But Kelly explained that all her life she'd collected small and ailing animals and he was mollified. The family walked on towards Whitby.

Kevin and Kelly walked on towards Robin Hoods Bay. Kelly had one arm tucked into her husbands and the other in her pocket, holding and comforting the small bundle of warm fur.

Story 4 - Questions

1. What was the boy doing when Kelly began talking to his mother?

2. a) What time of year was it?

   b) How do you know?

3. Did Kevin wash up before they left the house?

4. When did they go on holiday?

5. a) What time of day was it when they met the family?

   b) How do you know?

6. How long was Kelly in Jenny's?

7. Put these in order
   - Parking car
   - Finding thermos
   - Making sandwiches
   - Listening to Jenny
   - Finding rabbit
   - Mending water tank

8. How long had Kelly looked after ill animals?

9. How far did they have to go before there no more people about?

10. Who drove the car?

11. When did the boy stop screaming?

12. Was this sentence in the story
    "Immediately the doorbell rang Jenny appeared at the door."

LOGICAL vs ARBITARY TEMPORAL ORDER

Story	Question No	Logical	Arbitary
1	2	50	
1	3		0
2	2		29
2	9		86
3	2	86	
4	7	50	
		62	38

ORDER OF EVENTS/TEMPORAL ITEMS In/Out of Main Story Line

Story	Question No	In Main Story	Out of Main Story
Events			
1	1		0
1	4	50	
2	8		29
3	5	57	
4	1	50	
4	11		0
Temporal Items			
2	4		29
2	7		86
3	1	100	
3	10	100	
3	11	86	
4	2		67
4	6	50	
4	8		50
		70	37

NON-FACTIVE BEFORE CLAUSES

Story	Question No	Positive alternative	No positive alternative
1	11	83	
2	5	71	
3	4		44
4	3		66
		77	55

Experiment 1 Analyses

LOGICAL VS ARBITARY ORDER

U =2.5
U'=6.5

Critical value for U for n1=3, n2=3 at P<0.1 significance level = 0, therefore null hypothesis cannot be rejected.

ORDER OF EVENTS/TEMPORAL ITEMS IN vs OUT MAIN STORY LINE

	DF	SS	MS	F	PROB
Temp Inf In vs Out Main Story Line	1	17360.6429	17360.6429	60.8485	0.00054
	6	1711.8571	285.3095		

NON-FACTIVE BEFORE WITH/WITHOUT ALTERNATIVE ENDING

U =9
U'=0

Critical value for U for n1=3, n2=3 at p<0.1 significance levels = 0. Therefore null hypothesis can be rejected

Story 1 - A Walk in the Country

Tina and Chris walked along silently. The path was rising slightly. To the left the ground sloped away to a rushing stream, to the right there was a wooded hillside where they could hear the birds singing. Last time they were here Chris spotted a woodpecker. This time Tina pointed out a robin, sitting on a low branch of a young beech tree, and they stopped and watched as it flew down to within a few feet of them, and began scratching in the fallen leaves.

Chris couldn't believe that in half an hour they would have to get back in their car and drive back to the big city. Tomorrow at 8.30 they would both be at work at their desks, in stuffy rooms and the memory of this walk would fade, just as the sunlight was already beginning to dwindle in the evening air.

She sighed deeply and the noise was enough to startle the robin who flew back to the safety of his beech sapling. Tina looked sympathetically at Chris, as if sharing her thoughts and then decided to shake her out of her dreary mood. "Come on, I'll race you," she said suddenly and the two of them tore up the narrow track, laughing as a nervous squirrel hurried out of their way, and then, when it was sitting in a holly bush, gave them a scandalised look. Such goings on indeed!

Before they got to the large oak tree they were gasping for breath. They stopped and grinned at each other and, as of one accord, started down a small diversion from their path, which led down towards the rushing water. There were small gorse bushes on either side and, when her foot slipped because the path was quite steep and very muddy, Tina grabbed onto one for support. She let go again quickly because it was prickly and stood for a moment regaining her balance.

They picked their way carefully down the last few yards to the side of the stream. The ground sloped steeply just beyond where they were standing and the stream went over a little waterfall. As they reached the top, Chris bent down to pick up a small rounded pebble. At the same moment Tina stopped, entranced with the moving water. Chris, too, was fascinated by the every-moving, ever-changing flow for a while She lost interest fairly quickly however and looked over to the other bank where there were some orchids the last time they were here.

Tina was taking no notice of anything but the water, she was always almost hypnotised by waterfalls, or waves, and Chris waited patiently for a full five minutes, keeping a hopeful eye out for the otter they'd seen months ago, until Tina sighed and turned away from the stream. They turned homeward and began the ascent.

Story 1 - A Walk in the Country

1 How wide was the stream?

2 Was this sentence in the story?
"Chris found it incredible that in thirty minutes they would have to drive back into town."

3 Which side of the path were the prickly bushes on?

4 Was this sentence in the story?
"She lost interest fairly quickly however and looked over to the other bank where there were some orchids."

5 What caused Tina to slip?

6 What type of bush did Tina grab for support?

7 What time did they start work?

8 Where did the steep path lead?

9 In what order were these events suppposed to have happened?
Tina saying "Come on, I'll race you"
Heard birds signing
They startled a squirrel
They saw otter

10 What sort of work did they do?

11 What startled the robin?

12 When did they see a woodpecker?

13 Where was the robin sitting?

14 Did they pass a large oak tree?

15 Was this sentence in the story?
"Chris slipped right over and Tina helped her to her feet."

16 What sort of bush did the squirrel retreat to?

17 Was this sentence in the story?
"She let go again quickly because it was prickly and stood for a moment regaining her balance."

18 As the story starts, on which side of them was the wooded hillside?

19 Was this sentence in the story?
"As they reached the top Tina stopped, entranced with the moving water."

20 How close to them did the robin come?

Story 2 - The Party

Helen had been looking forward to her party for weeks, she'd askef Colin and Linda, Joanne, all the crowd that she met in the pub on a Tuesday, Susan from work, her sister Kate who was bringing her weird boyfriend Ali, Louise - probably some more people as well, but she couldn't remember who. It was the first party she'd given since she'd left home and she'd done all the preparations herself.

Half an hour before the guests should arrive she began to feel the first twinge of nervousness. The telephone rang shrilly and she thought "I bet that's someone to say they can't come", but it was only her mother asking if everying was okay, had she got enough plates, glasses etc and chatted for five minutes about the vicar's visit. Last week she'd broken one of her best tea cups. She was pleased because today Helen had found a replacement in an exclusive shop in town.

When her mum rang off Helen began to have serous second thoughts about the party. She poured herself a large whisky but put it down before she could take a sip. She knew Sunday wasn't an ideal day, but it was the only day when everyone was free, and people had said it was fine. Still, here it was, 10 minutes before the party, the heating had been on for 2 hours to warm the house through, all the food set out in the kitchen, the drinks table organised in the sitting room, the place sparkling like a new pin (though why people cleaned before a party she couldn't imagine) and no-one was there.

The last party she had been to there had been crackers for people to pull, hung on cotton from the ceiling and when everyone was pleasantly merry the crackers had provided silly party hats for them. She'd thought about it and rejected the idea - it seemed too much like copying other people, so she had just put a few balloons hanging from the ceiling in the dining room and she knew her guests well enough to know they would be patted around and eventually burst before the end of the evening.

The doorbell went and her heart jumped, someone was five minutes early and she flew to the door in a panic, but no, it was the charity collector, come for the Shelter envelope he'd delivered the day before. As she was handing this over Jo and Steve, complete with a bottle of champagne arrived she could see another car pulling up over the road. Before she could feel relieved she was busy directing Steve to the drinks table, juggling with coats on one arm and Jo's champagne in the other, wondering desperately how to take the bottle of Reisling from Kate who had just appeared.

Kate, realising her sister's problem and efficient as ever, grabbed the champagne bottle from Helen and thrust it, and the bottle of Reisling she had bought, at Jo and said "put these somewhere can you?" She lifted the coats from Helen's other arm and dumped them on Ali who was standing in shy and self-effacing silence behind her. "Put these in the bedroom at the top of the stairs" she said sweetly to him.

He stumbled as he meekly started off up the stairs but Kate turned calmly to Helen and gave her a hug "Isn't this exciting - who else is coming?" she asked in one breath, and Helen started to giggle helplessly.

Story 2 - The Party

1 Where was the drinks table?

2 How long before the guests arrived did she begin to feel nervous?

3 Where were the balloons?

4 In what order were these events supposed to have happened?
Mother dropped cup
Saw crackers hanging from ceiling
Telephone rang
Poured whisky

5 What had her mother broken?

6 What would happen to the balloons?

7 When was the shelter envelope delivered?

8 Where had the vicar visited?

9 How much whisky did she drink?

10 What was Helen's sister called?

11 Was this sentence in the story?
"Ali was wearing a duffel coat and bobble hat."

12 Was this sentence in the story?
"'Put these in the bedroom at the tope of the stairs, can you my love.' she said sweetly to him."

13 Where was she when Jo and Steve arrived?

14 Was this sentence in the story?
"When her mum rang off she poured herself a large whisky."

15 How had the crackers been fixed to the ceiling?

16 Where was the food set out?

17 Was this sentence in the story?
"It was to be the first party in her own home and she had prepared everything alone."

18 Where did she usually meet "the crowd" on Tuesdays?

19 Was this sentence in the story?
"Last week Helen had found a replacement in an exclusive shop in town."

20 Did Ali say anything?

Story 3 - The Shopping Trip

Liz and Kath were a bit later than they'd planned, breakfast had been enlivened by a political argument with their dad over the relative merits of student grants versus loans and then they realised they must put their washing in the maching before they came away. The bus was packed and Gail was sitting right at the back, hemmed in by a huge woman with a child on her knee. They could do no more than wave at her and she shrugged her shoulders in good-natured despair. She would be going to the hair-dressers, one stop further than them, she always did on a Saturday.

The bus stopped twice more, each time packing people more and more like sarines and when they arrived in town the girls were hot and dishevelled. They went into Debenhams first, Liz wanted a skirt and still had some birthday money left, but either Debenhams had very poor choice today, or else she was in the wrong mood. They tried another couple of smaller shops before Kath pronounced herself ready for a drink. They walked past the newsagents and were just about to call in for their dad's gardening magazine when they remembered they didn't have to as their mother had collected it the day before.

The cafe was overflowing with people, not only were all the tables full, but there were people waiting. They usually went in at 6.30 after college and it was always empty then. Before they got to the counter they had a quick discussion and decided to get a couple of cans of pepsi and sit by the gardens in the square instead.

The park wasn't that crowded as although the flowers were still beautiful the height of summer had passed. While they were deciding on a seat Liz felt in her pocket and found a packet of sweets she'd bought the previous Saturday and forgotten about. They munched them as they drank the pepsi. At the same time they discussed all the other people sitting round in the park, who they were and what they might be talking about.

After twenty minutes or so they realised they were getting a bit cold, and besides they'd hardly spent any time yet looking at shoes, which had been one of the main reasons for the trip to town. Liz also had some record tokens that were burning a hole in her pocket. They got up slowly, and walked past a litter bin in which they deposited two empty pepsi cans and an emply sweet packet before they wandered back onto the busy high street. In the record shop they met their cousin Alison who was a couple of years younger than them and had been an embarrassment on their last trip, but today they were in a good mood and friendly towards the world, and asked her if she'd like to wander round the shops with them.

She was usually on her own, as she had three older brothers who tended to stick together and was really pleased with the invitation. Her cousins were pleased with the results of their impulse as she turned out to have a good eye for spotting bargains. Liz had got a new brown jacket last week and Alison found some shoes exactly the same shade for `11.

They invited her home with them for lunch and to listen to the new records they'd bought, but she was meeting her mother later so had to say goodbye regretfully at the bus stop.

Story 3 - The Shopping Trip

1 Where was Alison meeting her mother?

2 How long were they in the park?

3 What time did they usually go in the cafe?

4 Where was there a queue of people?

5 In what order were these events supposed to have happened?
waved at Gail
father's magazine bought
bought packet of sweets
went to Debenhams

6 Who had they argued with?

7 What did they argue about?

8 Where had Alison been an embarrassment?

9 Where were the flowers?

10 Were they at the cafe counter when they decided to go to the park?

11 What sort of tokens did Liz have?

12 How many brothers did Alison have?

13 Was this sentence in the Story?
"The cafe was overflowing with people, not only were all the tables full but there were people waiting."

14 Where was Gail going?

15 Was this sentence in the story?
"They munched them as they discussed all the other people sitting round in the park, who they were and what they might be talking about."

16 What relation was Alison to them?

17 Was this sentence in the story?
"Kath would have like a new jumper but had no money to spend."

18 Was this sentence in the story?
"The bus stopped again and again, each time crowding the passengers more tightly and by the time they got to town they felt hot and bothered."

19 Where did they put their empty drinks cans?

20 Was this sentence in the story?
"Liz bought a new brown jacket and Alison found some shoes exactly the same shade for `11."

Story 4 - Going Swimming

Denise half enjoyed and half hated taking the kids swimming. This morning they seemed to be in the right sort of mood, energetic and boistrous, but not demanding or argumentative, and she hoped they could have a pleasant morning without one of the tantrums which had become all too common. She bundled the children out of the door before the phone could ring, and they started off, battling aginst the strong March wind.

She had the towels and swimsuits ready. They walked down the road into town so their breakfast would have time to digest before they went in the water. Tom, who was seven, was holding onto her hand and leaping up and down as he told Marta about something that had happened at school the day before. "And it was half-past three, home time and the guineapig ran between Mark's legs and he screamed and the teacher was so busy telling him off she didn't notice me catching the guineapig and putting it in Pete's desk ...."

Denise sighed and pitied the poor guineapig. She often thought she wasn't cut out for motherhood and wondered how on earth a teacher coped with a class of 30 or so children like Tom. Surely they were different at school, did what they were told, sat still for longer than ten seconds, but then, to judge from Tom's stories, they were just the same.

She looked over at the old people's home where she'd waved to an old man in the garden the week before. As they got closer to the baths she began to have doubts about whether they'd be open. The last few weeks it seemed they were closed more often than not, what with the carnival and the sponsored swim. Still the kids had enjoyed these events anyway, even if it meant she'd missed out on her exercise.

By the time she'd finished her reflections they were at the door and Tom's story had come to an end with the eventual safe recapture of the classroom pet. Se gave him the money and he claimed his right as the eldest to go up to the entrance kiosk and ask for "one and two halves, please". He thanked the woman so nicely, with such a pleasant smile, that Denise felt an involuntary stab of pride. Marta asked Denise if she could pay next week, and Denise said she'd think about it. How difficult it was to reconcile the demands of custom and fairness. Maybe she could find something else Marta could do, and then get them to take turns.

"You can get the cocoa from the machine afterwards", she said to Marta in a flash of inspiration. Tom, returning, proudly bearing tickets, heard the last remark and began his usual pout. "And, next week, if you like, you can swop over and you get the tickets and Tom can get the drinks", Denise continued desperately. Tom's face changed as he thought about that one, then Denise relaxed as she saw the dawn of acceptance.

"Come on, lets go and get ready" she said and led the way to the family changing room. The smell of chlorine was comfortingly familiar and she began to look forward to the idea of diving into the clean blue water and swimming at least a couple of lengths while the pool attendant kept an eye on the kids.

Story 4 - Going Swimming

1 Was this sentence in the story?
"She looked over at the old people's home and waved to an old man in the garden."

2 Was this sentence in the story?
"She longed for the time Marta would go to school all day."

3 What was Tom's sister called?

4 What time was hometime?

5 Where had Tom put the poor quinea-pig?

6 In what order were these events supposed to have happened?
Tom came back with tickets
the carnival
the teacher told Mark off
Tom began to pout

7 Who would keep an eye on the children while Denise swam?

8 How many children in Tom's class?

9 When was Tom going to get cocoa from machine?

10 Where were they when she gave Tom the money?

11 Did the phone ring before they went out?

12 How did Denise feel when Tom thanked the woman?

13 What sort of mood were the kids in when they started off?

14 Was this sentence in the story?
"Denise half enjoyed and half hated taking the children swimming."

15 Where was the woman that Tom smiled so pleasantly at?

16 Was this sentence in the story?
"They walked into town with Tom, who was seven, holding onto her hand and leaping up and town."

17 Who led the way to the changing room?

18 Which of the children was liable to tantrums?

19 Was this sentence in the story?
"Denise felt sorry for the poor guineapig."

20 Where were they going to get changed?

Story 5 - Preparing for a Meal

Why on earth did she always invite people round for a meal on a Friday? It always meant a rush as she didn't finish work till after lunch and then had to get the shopping in before getting home to clean the house. Just as she was leaving her boss had asked her to get a call to New York. Then the Managing Director had arrived and delayed her. The queues in the supermarket were horrendous as usual and she was hot and harrassed when she finally got in.

She was planning egg mayonnaise, lasagne and trifle. She put the kettle on which was always a good start and began looking for ingredients. Last week she had put some trifle sponges at the back of the fridge. Yesterday she had bought an orange jelly. She made up a pint of orange jelly with syrup from a tin of peaches and arranged the peaches on top of the trifle sponges in the bottom of the large glass bowl her mother had given her last Christmas. Then she poured over the orange jelly and put the trifle base on the cool window sill to set before turning back to the bags of shopping still waiting to be unpacked.

She sighed when she saw the bags hadn't magically unpacked themselves and put the kettle on again for a cup of tea. She half-heartedly put away a few tins of beans from one bag, then seemed to mentally shake herself and moved faster, arranging the vegetables she was going to need for tonight's meal on the work surface, putting the things that belonged in the fridge in the fridge. By the time the kettle boiled she had just finished putting the carrier bags into the box reserved for empty carrier bags.

She thought for a minute, and then took out of the fridge the box of eggs she had just put in there, and placed four in the saucepan, covered them with boiling water from the kettle and turned the stove on. There was still enough water for a cup of tea, so she made herself one and went to sit down in the sitting room for ten minutes to work out a plan of campaign.

In the sitting room she was horrified at the mess - every letter she's received during the previous week was on the mantel piece, and before she sat down she swept them up and threw them into a drawer. She grabbed a tissue and began to dust, and then realised that the plants were crying out for water as the summer sun had dried them out. As she would have to go back to the kitchen to get a jug she began to collect up the empty mugs she saw strewn around the various bits of furniture and took them back in with her. The eggs were bubbling furiously and she turned the stove down. She was almost back in the sitting room before she remembered the water and had to go back for it.

Once she'd done the plants into the sitting room she went into the bedroom to water the ones there and stopped aghast at the scene of devastation. She put the jug on the bedside table and began to fling most of the clothes into a heap by the door for washing. A few were put back on hangers and after 10 minutes she looked at the room with a vague sense of satisfaction. She gathered up an armful of washing to go in the machine and made her way back to the kitchen, where the eggs had almost boiled themselves dry. She ran cold water into the saucepan for a few minutes while she put the washing in the machine. Then she turned the tap off, got the hoover out of the cupboard and made her way back to the sitting room where her cup of tea, greasily cold, was still sitting on the table.

Story 5 - Preparing for a Meal

1 Where did she go between leaving work and getting home?

2 Was this sentence in the story?
"Last week she had bought an orange jelly."

3 Was this sentence in the story?
"The place looked as if she'd had a party the night before."

4 Where did she put the trifle base to cool?

5 How long did she spend in the bedroom?

6 Where had she had to get a call to?

7 In what order were these events supposed to have happened?
unpacked shopping
made jelly for trifle
got eggs out of fridge
made herself a drink

8 What were the first items unpacked?

9 How many times did she boil the kettle?

10 For how long had letters been accumulating on the mantel piece?

11 Where were the trifle sponges?

12 Did she sit down in the sitting room?

13 How many eggs did she boil?

14 What was she planning as the main course?

15 Was this sentence in the story?
"She ran cold water into the saucepan for a few minutes while she put the washing in the machine."

16 Where did she leave the jug of water?

17 Was this sentence in the story?
"Just as she was leaving the Managing Director had arrived and delayed her."

18 Where did most of the clothes she picked up end up?

19 Was this sentence in the story?
"She made herself a cup of coffee and went into the sitting room."

20 Was this sentence in the story? "The kettle boiled just as she had put the last carrier bag into the carton in which she kept empy carrier bags."

Story 6 - School Scandal

As the lunch hour drew to a close, Mark and Phillip were still involved in a serious discussion of the moral issues involved in the latest school scandal. The autumn day was chilly and damp, but the boys didn't notice it in the heat of their discussion. Had Ms Evans really given a detention to Jo for writing on the music room desk when Sam had really done it? And, if so, why hadn't Sam confessed and taken her punishment? They were actually discussing Jo's dilemma really, should she tell Ms Evans who it was, or merely continue to deny her guilt? The twelve-year olds found themselves with a moral problem. What Sam should do was clear. But if she didn't, was it more important not to be a tell-tale or to make a stand for justice.

Last week they had had a talk in R.E. on the importance of honesty in all relationships. Yesterday they'd watched a television programme emphasising justice as a worthy moral principle. It had just occurred to them that this was their problem as well - they were just as able as Jo to put the picture straight. Mark thought they should forget about it, Phillip that they should tell Ms Evans.

When a state of deadlock appeared to have been reached and it seemed as if this problem would worry them all through the weekend, they looked round for someone who was in authority and who could be trusted. Across the playing field Mark's elder sister Lynn who was a prefect and very sensible was talking to a bunch of her friends. She was sitting on the wooden fence that kept the students from the school pond, swinging her legs and laughing. When she appeared to look over in their direction, Phillip nudged Mark. Mark jumped up and down and waved. Lynn waved back happily.

Mark thought of going over but the bell went for afternoon school before he could take one step in that direction. As they turned to go in they saw Sam coming up behind them and hesitated, should they talk to her or shouldn't they? She solved the problem, by smiling and saying "Hi", in a very miserable voice. They said awkwardly. "Hi", and Mark, known to his friends as one who said what he was thinking, said "Have you told Ms Evans yet?".

"I can't", she said desperately, "if I tell her I'll get a detention and I'll not get home till 6 o'clock and my dad will go mad with me, honestly you've no idea what he's like when he's annoyed." She swallowed, "But if I don't no-one will ever talk to me again, and I feel awful and I don't know what to do". She was nearly in tears and Mark and Phillip were silenced.

There was quiet for a few minutes, while Sam bit her lip and them Mark said, "The only thing I can think of is to go to old Evans and tell her." He held up his hand before Sam could repeat that her dad was really fearsome when angry, "No, listen, if you do that I think she'll be okay, keep you in at lunch time or something, especially if you lay it on thick about your dad. Go on, go now while you dare."

Sam looked a bit more cheerful and Mark and Phillip walked her as far as the door of the main block before they ran off to the technical block so as not to be late for woodwork.

Story 6 - School Scandal

1 Was this sentence in the story?
"They didn't say any more because she was almost crying."

2 Where was their afternoon lesson?

3 Was this sentence in the story?
"Last week they'd watched a television programme emphasising justice as a worthy moral principle."

4 Whose sister was Lynn?

5 What had the talk in RE emphasised?

6 What time would Sam get home after detention?

7 Where did Mark and Phillip walk Sam to?

8 In what order were these events supposed to have happened?
they thought of asking Lynn
Sam said 'Hi'
Mark waved at Lynn
they hesistated about talking to Sam

9 What did Sam think would happen if she didn't confess?

10 Was this sentence in the story?
"The twelve year olds found themselves with a moral problem."

11 How long did it take Mark to say what he was thinking?

12 In which room was the desk which had caused all the trouble?

13 Did Mark take a step towards Lynn?

14 What lesson did they have that afternoon?

15 Who had been given the detention?

16 Was this sentence in the story?
"Lynn waved back happily."

17 What was behind the fence Lynn was sitting on?

18 Was this sentence in the story?
"Across the playing field Mark's elder sister, Lynn, was sitting on the wooden fence that kept the students from the school pond, swinging her legs and laughing."

19 Who was Sam frightened of?

20 Was this sentence in the story?
"Mark's father was a vicar."

TEMPORAL ORDER vs LOCATION

	Sentence Data	
Story No	Temporal Order	Location
1	9.00	7.00
2	9.00	10.50
3	8.00	9.75
4	11.00	12.00
5	8.00	10.25
6	9.00	9.75

	Subject Data	
Sub No		
1	6.00	4.75
2	6.00	4.50
3	6.00	5.25
4	0.00	3.25
5	4.00	4.00
6	3.00	3.75
7	5.00	4.50
8	4.00	3.75
9	4.00	3.25
10	2.00	3.75
11	5.00	3.50
12	2.00	4.00
13	3.00	3.50
14	3.00	4.75

NON-FACTIVES - Direct vs Indirect Question
(No who correctly said non-factive did not happen)

Sentence Data	
Direct Question	Indirect Question
13	6
11	8
12	8

	Subject Data	
Sub No	Direct Question	Indirect Question
1	3	2
2	2	2
3	2	2
4	3	0
5	3	1
6	3	3
7	2	1
8	1	2
9	1	2
10	3	3
11	3	2
12	3	0
13	2	3
14	3	2

TEMPORAL CONFUSION vs CLOSE TOGETHER IN TEXT

Sentence Data

Story No	Temp Conf	Close Tog Text
1	5	10
2	6	14
3	3	11
4	8	14
5	13	10
6	7	5

Subject Data

Sub No	Temp Conf	Close Tog Text
1	6	5
2	5	5
3	4	5
4	5	5
5	5	4
6	4	4
7	5	4
8	3	3
9	5	3
10	3	4
11	5	3
12	4	5
13	3	5
14	6	4

VERBATIM vs PARAPHRASE

(No saying sentence had not been in story)

Sentence Data

Story No	Verbatim	Paraphrase
1	2	14
2	1	10
3	8	14
4	3	2
5	6	7
6	1	14

Subject Data

Sub No	Verbatim	Paraphrase
1	0	83
2	17	83
3	33	83
4	17	83
5	17	66
6	33	66
7	17	66
8	50	50
9	17	50
10	50	66
11	17	50
12	33	83
13	50	83
14	0	66

Experiment 2 Analyses

TEMPORAL ORDER vs LOCATION

Sentence Data

	DF	SS	MS	F	PROB
SUBJ	5	13.6719			
Temporal order	1	2.2969	2.2969	2.024	0.21308
vs Location	5	5.6719	1.1344		
W	6	7.9688			

Subject Data

	DF	SS	MS	F	PROB
SUBJ	13	31.2768			
Temporal order	1	0.4375	0.4375	0.404	0.54188
vs Location	13	14.0625	1.0817		
W	14	14.5000			

NON-FACTIVE BEFORE - Direct Vs Indirect Question

Sentence Data

	DF	SS	MS	F	PROB
SUBJ	2	0.3333			
Direct vs	1	32.6667	32.6667	15.0769	0.05817
Indirect Question	2	4.3333	2.1667		
W	3	37.0000			

Subject Data

	DF	SS	MS	F	PROB
SUBJ	13	8.1786			
Direct vs	1	2.8929	2.8929	3.2400	0.09219
Indirect Question	13	11.6071	0.8929		
W	14	14.5000			

TEMPORAL CONFUSIONS VS CLOSE TOGETHER IN TEXT

Sentence Data

	DF	SS	MS	F	PROB
SUBJ	5	71.0000			
Temp Conf vs	1	12.0000	12.0000	1.0169	0.36140
CTT	5	59.0000	11.8000		
W	6	71.0000			

Subject Data

	DF	SS	MS	F	PROB
SUBJ	13	11.4286			
Temp Conf vs	1	0.5714	0.5714	0.7123	0.58150
CTT	13	10.4286	0.8022		
W	14	11.0000			

VERBATIM vs PARAPHRASE

Sentence Data

	DF	SS	MS	F	PROB
SUBJ	5	79.6667			
Verbatim	1	133.3333	133.3333	8.0645	0.03586
vs paraphrase	5	82.6667	16.5333		
W	6	216.0000			

Subject Data

	DF	SS	MS	F	PROB
SUBJ	13	2849.4643			
Verbatim vs	1	14040.3214	14040.3214	58.0330	0.00003
Paraphrase	13	3145.1786	241.9368		
W	14	17185.5000			

ACQUISITION SET

1 The hen clucked after the boy yelled
2 The cat meowed before the mouse ran
3 The dog barked before the boy yelled
4 The cat meowed before the boy yelled
5 The mouse ran before the dog barked
6 The cat meowed before the mouse ran
7 The dog barked after the cat meowed
8 The boy yelled before the hen clucked
9 The hen clucked after the mouse ran
10 The hen clucked after the cat meowed
11 The hen clucked after the mouse ran
12 The boy yelled after the dog barked
13 The hen clucked after the boy yelled
14 The dog barked after the cat meowed
15 The boy yelled before the hen clucked
16 The mouse ran after the cat meowed
17 The cat meowed before the boy yelled
18 The mouse ran before the dog barked
19 The mouse ran after the cat meowed
20 The boy yelled after the dog barked
21 The hen clucked after the boy yelled
22 The mouse ran before the dog barked
23 The mouse ran after the cat meowed
24 The dog barked before the boy yelled
25 The cat meowed before the mouse ran
26 The dog barked before the boy yelled
27 The hen clucked after the mouse ran
28 The hen clucked after the cat meowed
29 The dog barked after the cat meowed
30 The cat meowed before the boy yelled
31 The boy yelled before the hen clucked
32 The hen clucked after the cat meowed
33 The boy yelled after the dog barked

RECOGNITION SET
(Random Order 1)

1 The dog barked before the cat meowed
2 The hen clucked before the dog barked
3 The hen clucked before the cat meowed
4 The hen clucked before the mouse ran
5 The boy yelled after the cat meowed
6 The hen clucked after the cat meowed
7 The hen clucked after the mouse ran
8 The boy yelled before the cat meowed
9 The mouse ran before the dog barked
10 The cat meowed before the hen clucked
11 The cat meowed before the boy yelled
12 The cat meowed after the hen clucked
13 The mouse ran after the hen clucked
14 The cat meowed after the boy yelled
15 The mouse ran after the dog barked
16 The dog barked before the hen clucked
17 The hen clucked after the dog barked
18 The dog barked after the mouse ran
19 The cat meowed after the mouse ran

20 The cat meowed before the dog barked
21 The boy yelled after the mouse ran
22 The mouse ran before the boy yelled
23 The dog barked before the mouse ran
24 The mouse ran before the hen clucked
25 The dog barked after the cat meowed
26 The boy yelled before the mouse ran
27 The cat meowed after the dog barked
28 The boy yelled after the hen clucked
29 The boy yelled before the cat meowed
30 The dog barked before the mouse ran
31 The cat meowed before the hen clucked
32 The mouse ran after the dog barked
33 The boy yelled after the mouse ran
34 The mouse ran before the hen clucked
35 The hen clucked after the dog barked
36 The mouse ran before the boy yelled
37 The dog barked before the hen clucked
38 The cat meowed after the boy yelled
39 The cat meowed after the mouse ran
40 The cat meowed before the dog barked
41 The hen clucked after the cat meowed
42 The hen clucked after the mouse ran
43 The mouse ran before the dog barked
44 The mouse ran after the hen clucked
45 The cat meowed after the dog barked
46 The boy yelled after the hen clucked
47 The dog barked before the cat meowed
48 The dog barked after the mouse ran
49 The hen clucked before the cat meowed
50 The dog barked after the cat meowed
51 The boy yelled after the cat meowed
52 The boy yelled before the mouse ran
53 The hen clucked before the mouse ran
54 The cat meowed before the boy yelled
55 The cat meowed after the hen clucked
56 The hen clucked before the dog barked

Experiment 3 Data

Sentence Data

Old		S/O Rev		New True		Sub Rev		Ob Rev		New False	
Im	Mem	Im	Mem	Im	Mem	Im	Mem	Im	Mem	Im	Mem
7.63	6.43	7.10	6.25	6.76	5.40	3.50	5.53	4.52	6.45	4.20	6.15
7.58	6.03	7.50	5.58	6.95	5.88	3.05	5.05	3.00	5.33	4.00	6.18
6.85	6.15	7.03	5.90	7.10	6.20	3.10	5.23	3.02	5.20	3.15	6.03
7.18	6.00	7.58	6.55	5.95	5.18	4.80	5.95	2.72	5.88	3.40	5.45
8.18	6.33	7.60	5.83			4.30	6.10	4.25	6.58		

Subject Data

Imagers						Memorisers					
Old	S/OR	N/Tr	S/R	O/R	N/Fls	Old	S/OR	N/Tr	S/R	O/R	N/Fls
5.6	5.0	6.8	5.0	6.1	3.2	5.5	6.4	6.3	5.6	5.7	6.8
7.2	8.2	5.6	0.0	0.1	0.1	5.8	5.4	5.8	4.5	7.1	5.5
5.3	6.1	5.1	5.3	5.6	4.0	6.8	6.0	7.5	3.3	7.2	5.6
5.3	5.6	5.6	4.9	5.1	5.0	5.9	4.9	5.4	4.8	5.1	6.6
7.1	5.9	6.3	9.5	6.5	4.7	7.4	7.8	8.3	7.1	7.4	5.8
6.6	7.1	7.5	3.2	3.2	3.7	7.0	3.3	8.0	6.2	4.1	7.0
10.0	9.9	10.0	0.0	0.1	0.0	6.3	7.2	5.8	4.0	4.5	6.0
6.9	8.4	7.4	2.8	1.8	2.9	5.7	6.9	6.4	5.5	5.4	5.5
9.8	10.0	10.0	0.0	0.0	0.0	7.3	5.9	7.3	7.0	8.1	6.5
9.6	9.9	10.0	0.0	0.1	0.0	5.5	5.2	5.0	6.3	5.6	5.5
9.4	8.6	9.5	0.0	0.0	3.2	5.8	6.0	3.9	4.7	4.9	5.6
6.8	6.2	5.1	6.1	8.0	4.1	4.8	5.3	4.4	5.5	5.4	4.8
7.9	5.1	4.7	6.3	5.4	1.7	5.6	5.5	6.0	5.2	5.4	6.3
6.4	7.1	6.4	2.7	4.2	4.0	7.6	6.7	6.8	5.8	6.8	7.0
9.4	7.3	2.9	4.6	4.9	3.0	5.7	5.7	4.7	5.6	5.2	7.3
5.5	7.4	4.9	5.6	5.1	3.9	6.4	6.4	5.9	5.7	6.4	6.1
9.0	9.0	9.1	0.9	1.8	1.0	5.5	4.6	5.5	5.5	5.5	5.4
6.1	6.7	5.3	4.9	3.1	5.9	5.2	6.5	4.7	3.8	7.0	5.1
7.6	7.7	5.9	6.9	6.9	8.0	7.6	5.5	5.5	6.1	5.6	7.4
5.9	7.7	6.3	4.6	4.9	5.8	7.0	7.0	5.1	3.2	4.5	5.8

Experiment 3 Analyses

Sentence Data

SOURCE	SS	DF	MS	F	PROB
Sentence Types	49.381	5.	9.876	21.574	0.001
	10.071	22.	0.458		
Imagers vs	3.041	1.	3.041	34.708	0.001
Memorisers	40.041	5.	8.008	91.392	0.001
Im v Mem & Sen Type	1.928	22.	0.088		

Subject Data

	DF	SS	MS	F	PROB
SUBJ	19	62.8241			
Imagers vs	1	16.9070	16.9070	8.4948	0.00872
Memorisers	19	37.8155	1.9903		
Sentence Types	5	241.1627	48.2325	16.3802	0.00000
	95	279.7331	2.9446		
Imagers vs Mem	5	182.8897	36.5779	12.3170	0.00000
& Sent Types	95	282.1228	2.9697		
W	220	1040.6308			

IMAGERS BY SENTENCE

SOURCE	DF	SS	MS	F	PROB
SUBJ	4	2.0569			
W1	5	95.5574	19.1115	65.3797	0.00000
EW1B	20	5.8463	0.2923		
W	25	101.4037			

MEMORISERS BY SENTENCE

SOURCE	DF	SS	MS	F	PROB
SUBJ	4	0.6946			
W1	5	1.3046	0.2609	1.5334	0.22385
EW1B	20	3.4033	0.1702		
W	25	4.7079			

IMAGERS BY SUBJECT

SOURCE	DF	SS	MS	F	PROB
SUBJ	19	59.1483			
W1	5	413.4368	82.6874	16.1629	0.00000
EW1B	95	486.0082	5.1159		
W	100	899.4450			

MEMORISERS BY SUBJECT

SOURCE	DF	SS	MS	F	PROB
SUBJ	19	41.4913			
W1	5	10.6157	2.1231	2.6592	0.02667
EW1B	95	75.8477	0.7984		
W	100	86.4633			

NEUMAN KOELS TESTS

Imagers by Subject

	NF	S/OR	RR	NT	Eq	Old
Means	3.210	3.645	3.665	6.720	7.445	7.370
order	a	b	c	d	e	f

category	a	b	c	d	f	e
a	-	0.44	0.46	3.51**	4.16**	4.23**
b		-	0.02	3.07**	3.72**	3.80**
c			-	3.05**	3.70**	3.78**
d				-	0.65	0.73
f					-	0.08
e						

Truncated range	2	3	4	5	6
at 0.99 level	1.87	2.12	2.28	2.38	2.48

** denotes significantly different at 0.99 level

Imagers by Sentence

	NF	S/OR	RR	NT	Eq	Old
Means	3.688	3.502	3.750	6.690	7.362	7.484
order	a	b	c	d	e	f

category	b	a	c	d	e	f
b	-	0.19	0.25	3.19**	3.86**	3.98**
a		-	0.06	3.00**	3.67**	3.80**
c			-	2.94**	3.61**	3.73**
d				-	0.67	0.79
e					-	0.12
f						-

Truncated range	2	3	4	5	6
at 0.99 level	0.92	1.02	1.10	1.16	1.21

** denotes significantly different at 0.99 level

Memorisers by Subject

	NF	S/OR	RR	NT	Eq	Old
Means	6.080	5.845	5.270	5.915	5.910	6.220
order	a	b	c	d	e	f

category	c	b	e	d	a	f
c	-	0.58**	0.64	0.65	0.81**	0.95**
b		-	0.07	0.07	0.24	0.38
e			-	0.00	0.17	0.31
d				-	0.17	0.31
a					-	0.14
f						-

Truncated range	2	3	4	5	6
at 0.95 level	0.56	0.67	0.74	0.78	0.82

** denotes significantly different at 0.95 level

Memorisers by Sentence

	NF	S/OR	RR	NT	Eq	Old
Means	5.952	5.888	5.572	5.666	6.022	6.188
order	a	b	c	d	e	f

category	c	d	b	a	e	f
c	-	0.09	0.32	0.38	0.45	0.62
d		-	0.22	0.29	0.36	0.52
b			-	0.06	0.13	0.30
a				-	0.07	0.24
e					-	0.17
f						-

Truncated range	2	3	4	5	6
at 0.95 level	0.53	0.64	0.71	0.76	0.80

None significantly different at 0.95 level

Garnham (1981) original passage

The party had been in progress for about four hours.
Around the sitting room the guests were talking in groups.
By the window was a man with a martini.
He commented on the decor to a woman who was wearing a diamond brooch and smoking a perfumed cigarette.
She asked him if he had complimented the host on his taste.
The man standing by the window shouted to the host.
The other guests looked towards the pair.
The woman wearing the diamond brooch told the man with the martini to leave her.

"Semantic confusions"

The man standing by the window shouted to the host.
The man with the martini shouted to the host.

The woman wearing the diamond brooch told the man with the martini to leave her.
The woman smoking the perfumed cigarette told the man with the martini to leave her.

Passage in Exp 4

Each day in the local school was packed with incident and this Monday was no exception.
At playtime the children played tag and there was lots of shouting and laughing.
Five minutes before the bell Linda Todd grazed her knee.
When the bell went and the children were lining up in the playground John Wilks punched Terry Clay.
The pupils filed back full of energy and Mr Roberts had to shout to be heard.
Linda had to see the school nurse because she had fallen over.
Mr Roberts asked John Wilks to tell him what had happened as they were lining up.
John said he thought Terry had pushed Linda over.

"Temporal Confusions"

Five minutes before the bell Linda Todd grazed her knee.
Five minutes before the bell Linda Todd fell over.

Mr Roberts asked John Wilks to tell him what had happened as they were lining up.
Mr Roberts asked John Wilks to tell him what had happened as the bell went.

Experiment 4 Data

Sentence data

		1st choice			2nd choice			3rd choice		
	Sent	corr	tem/con	wrong	corr	tem/con	wrong	corr	tem/con	wrong
Aware	1	4	6	0	4	4	2	2	0	8
Aware	2	5	5	0	4	5	1	1	0	9
Unaware	1	5	5	0	4	6	2	2	0	8
Unaware	2	6	4	0	4	4	0	0	0	9

Subject data (First choice)

Aware			Unaware		
Correct	Temp Conf	Wrong	Correct	Temp Conf	Wrong
1	1	0	2	0	0
1	1	0	0	2	0
1	0	1	1	1	0
2	0	0	0	2	0
2	0	0	0	2	0
1	1	0	0	2	0
0	2	0	2	0	0
1	1	0	0	2	0
0	2	0	2	0	0
0	2	0	1	0	0

Experiment 4 Analyses

Sentence Data

SOURCE	DF	SS	MS	F	PROB
SUBJ	3	0.0038			
Correct vs	1	0.0012	0.0012	0.0010	0.97569
temp confusion	3	3.8038	1.2679		
W	4	3.8050			

Subject Data

SOURCE	DF	SS	MS	F	PROB
SUBJ	9	0.4000			
Aware vs Unaware	1	0.0000	0.0000	0.0000	1.00000
	9	0.5000	0.0556		
Correct vs	1	0.4000	0.4000	0.8780	0.62401
Temp Conf	9	4.1000	0.4556		
Aware/Unaware	1	0.1000	0.1000	0.0402	0.83929
v corr/temp conf	9	22.4000	2.4889		
W	30	27.5000			

Experiment 5 Material

The mouse ran and the cat meowed. As the cat meowed the child jumped. The child jumped after the mouse ran. The mouse was grey and ran fast.

A
(a) The child jumped after the mouse ran
(b) The cat meowed after the mouse ran
(c) The child jumped before the mouse ran
(d) The cat meowed before the mouse ran

B
(a) The mouse ran before the child jumped
(b) The mouse ran before the cat meowed
(c) The mouse ran after the child jumped
(d) The mouse ran after the cat meowed

The radio is next to the microwave. The cubpboard is under the microwave. The radio is to the left of the microwave the radio is covered in dust.

A
(a) The radio is to the left of the mircowave
(b) The cupboard is to the left of the mircowave
(c) The radio is to the right of the mircowave
(d) The cupboard is to the right of the mircowave

B
(a) The mircrowave is to the right of the radio
(b) The mircrowave is to the right of the cupboard
(c) The mircrowave is to the left of the radio
(d) The mircrowave is to the left of the cupboard

The camera clicked and the woman waved. As the woman waved the car hooted. The woman waved before the camera clicked. She was wearing a grey jumper and jeans.

A
(a) The woman waved before the camera clicked
(b) The car hooted before the camera clicked
(c) The woman waved after the camera clicked
(d) The car hooted after the camera clicked

B
(a) The camera clicked after the woman waved
(b) The camera clicked after the car hooted
(c) The camera clicked before the woman waved
(d) The camera clicked before the car hooted

The chair is next to the table. The book is on the chair. The chair is to the right of the table. The chair is wooden and very solid.

A
(a) The chair is to the right of the table
(b) The book is to the right of the table
(c) The chair is to the left of the table
(d) The book is to the left of the table

B
(a) The table is to the left of the chair
(b) The table is to the left of the book
(c) The table is to the right of the chair
(d) The table is to the right of the book

The kettle boiled and the toast was done. As the toast was done the children appeared. The toast was done after the kettle boiled. The toast smelt fresh and made them hungry.

A
(a) The toast was done after the kettle boiled.
(b) The toast was done after the children appeared.
(c) The toast was done before the kettle boiled
(d) The toast was done before the children appeared.

B
(a) The kettle boiled before the toast was done.
(b) The children appeared before the toast was done.
(c) The kettle boiled after the toast was done.
(d) The children appeared after the toast was done.

The clock is next to the fridge. The plant is on the fridge. The clock is to the left of the fridge. The fridge is white and rather old.

A
(a) The clock is to the left of the fridge
(b) The clock is to the left of the plant
(c) The clock is to the right of the fridge
(d) The clock is to the right of the plant

B
(a) The fridge is to the right of the clock
(b) The plant is to the right of the clock
(c) The fridge is to the left of the clock
(d) The plant is to the left of the clock

The door opened and the phone rang. As the phone rang Lisa sighed. The phone rang after the door opened. It rang twice loudly and then was silent.

A
(a) The phone rang after the door opened
(b) The phone rang after Lisa sighed
(c) The phone rang before the door opened
(d) The phone rang before Lisa sighed

B
(a) The door opened before the phone rang
(b) Lisa sighed before the phone rang
(c) The door opened after the phone rang
(d) Lisa sighed after the phone rang

The brother and sister sat side by side. The baby sat on the brother's lap. The brother was on the left of the sister. The baby screamed loudly.

A
(a) The brother was on the left of the sister
(b) The baby was on the left of the sister
(c) The brother was on the right of the sister
(d) The baby was on the right of the sister

B
(a) The sister was on the right of the brother
(b) The sister was on the right of the baby
(c) The sister was on the left of the brother
(d) The sister was on the left of the baby

The alarm went off and the window broke. The window broke and the dog barked at the same time. The window broke before the alarm went off. The alarm was connected to the police station.

A
(a) The window broke before the alarm went off.
(b) The dog barked before the alarm went off.
(c) The window broke after the alarm went off.
(d) The dog barked after the alarm went off.

B
(a) The alarm went off after the window broke.
(b) The alarm went off after the dog barked.
(c) The alarm went off before the window broke.
(d) The alarm went off before the dog barked.

The tree was next to the house. The bird sat on the house. The tree was on the left of the house. The house was old and almost derelict.

A
(a) The tree was on the left of the house
(b) The bird was on the left of the house
(c) The tree was on the right of the house
(d) The bird was on the right of the house

B
(a) The house was on the right of the tree
(b) The house was on the right of the bird
(c) The house was on the left of the tree
(d) The house was on the left of the bird

Experiment 5 Data

Sentence Data

Temporal

A				B			
a	b	c	d	a	b	c	d
7	2	0	2	2	1	4	4
8	0	2	1	7	0	0	4
5	0	3	3	6	0	1	4
7	0	1	3	4	1	3	3
6	0	2	3	8	0	2	1

Spatial

A				B			
a	b	c	d	a	b	c	d
8	1	2	0	5	1	4	1
6	0	5	0	6	1	4	0
5	4	2	0	7	0	2	2
6	3	2	0	2	5	2	2
8	0	1	2	7	0	3	0

Subject Data

Temporal

A				B			
a	b	c	d	a	b	c	d
50	0	50	0	33	0	0	66
50	0	50	0	33	0	0	66
50	0	0	50	66	0	0	33
100	0	0	0	0	0	33	66
50	0	0	50	66	33	0	0
100	0	0	0	66	0	33	0
50	0	50	0	33	0	33	33
0	0	0	100	100	0	0	0
100	0	0	0	66	0	33	0
100	0	0	0	33	0	66	0
100	0	0	0	66	0	33	0
33	0	66	0	100	0	0	0
100	0	0	0	50	0	50	0
66	0	33	0	50	0	50	0
100	0	0	0	50	0	0	50
33	0	0	66	0	50	0	50
100	0	0	0	50	0	50	0
0	33	0	66	0	0	0	100
0	33	33	33	0	0	0	100
33	0	0	66	100	0	0	0
33	0	33	33	50	0	50	0
100	0	0	0	100	0	0	0

Spatial

A				B			
a	b	c	d	a	b	c	d
66	33	0	0	50	50	0	0
33	33	33	0	50	50	0	0
66	0	33	0	0	0	50	50
0	0	66	33	50	50	0	0
66	33	0	0	0	0	50	50
100	0	0	0	50	50	0	0
66	0	33	0	50	50	0	0
100	0	0	0	50	0	50	0
33	33	0	33	0	0	100	0
66	33	0	0	50	50	0	0
100	0	0	0	50	0	50	0
0	0	100	0	66	0	33	0
100	0	0	0	100	0	0	0
100	0	0	0	0	0	100	0
50	50	0	0	100	0	0	0
50	0	50	0	0	33	66	0
50	0	50	0	100	0	0	0
0	50	50	0	66	0	0	33
50	0	50	0	33	0	0	66
50	50	0	0	33	33	33	0
50	0	50	0	0	0	100	0
100	0	0	0	66	0	33	0

A

correct
(a) exact wording
(b) substitute noun
incorrect
(c) change connective
(d) substitute noun

B

correct
(a) change connective & rev nouns
(b) " " & rev " sub noun
incorrect
(c) reverse nouns
(d) reverse & substitute noun

Experiment 5 Analyses

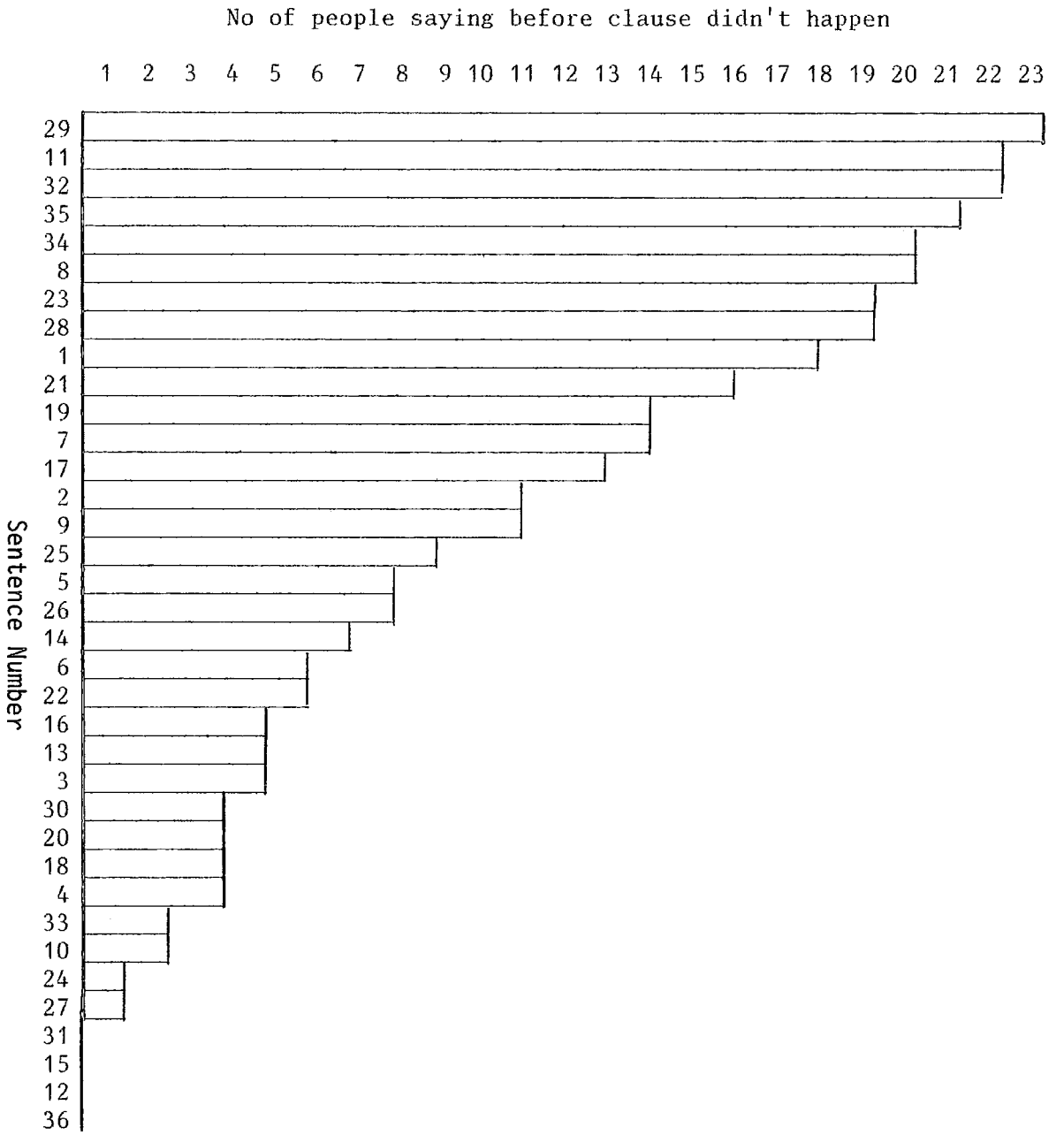
Sentence Data

	DF	SS	MS	F	PROB
SUBJ	9	0.1125			
Temp vs Spatial	1	0.0125	0.0125	1.0000	0.65177
	8	0.1000	0.0125		
A vs B	1	0.0125	0.0125	1.0000	0.65177
Temp/Spat v A/B	1	0.0125	0.0125	1.0000	0.65177
	8	0.1000	0.0125		
Corr vs Incorrect	1	43.5125	43.5125	40.9529	0.00042
Temp/Spat v C/Inc	1	6.6125	6.6125	6.2235	0.03593
	8	8.5000	1.0625		
Orig vs Subst	1	154.0125	154.0125	37.2236	0.00052
Temp/Spat v O/Sub	1	4.5125	4.5125	1.0906	0.32813
	8	33.1000	4.1375		
A/B vs C/Inc	1	7.8125	7.8125	2.5720	0.14522
Temp/Spatial v	1	0.0125	0.0125	0.0041	0.94912
A/B v C/Inc	8	24.3000	3.0375		
A/B vs Orig/Subst	1	2.1125	2.1125	0.9441	0.63816
Temp/Spat v	1	0.1125	0.1125	0.0503	0.82202
A/B v Or/Sub	8	17.9000	2.2375		
Corr/Inc v Or/Sub	1	103.5125	103.5125	37.4706	0.00051
Temp/Spat v	1	21.0125	21.0125	7.6063	0.02391
Corr/Inc v Or/Sub	8	22.1000	2.7625		
A/B v C/In v Or/Sub	1	1.0125	1.0125	0.2989	0.60403
Temp/Spat v	1	0.0125	0.0125	0.0037	0.95186
A/B v C/Inc v O/Sub	8	27.1000	3.3875		
W	70	477.3750			

Subject Data

	DF	SS	MS	F	PROB
SUBJ	21	0.8324			
Temporal v Spatial	1	0.0256	0.0256	1.8713	0.18306
	21	0.2869	0.0137		
A/B	1	0.0028	0.0028	0.1927	0.66862
	21	0.3097	0.0147		
Corr/Incorrect	1	15436.2528	15436.2528	10.5160	0.00410
	21	30825.5597	1467.8838		
Original/Subst	1	58117.9801	58117.9801	33.7553	0.00005
	21	36156.5824	1721.7420		
Temp/Spat vs A/B	1	0.0710	0.0710	0.4272	0.52701
	21	3.4915	0.1663		
Temp/Spat vs c/Inc	1	1241.2528	1241.2528	1.5332	0.22751
	21	17000.8097	809.5624		
Temp/Spat vs O/Sub	1	614.2756	614.2756	0.7813	0.60944
	21	16510.0369	786.1922		
A/B v Corr/Inc	1	2835.2301	2835.2301	3.8520	0.06022
	21	15456.8324	736.0396		
A/B v Or/Sub	1	1032.9801	1032.9801	1.3460	0.25806
	21	16116.3324	767.4444		
Corr/Inc v Or/Sub	1	30136.5028	30136.5028	39.3591	0.00003
	21	16079.3097	765.6814		
Temp/Spat v A/B v C/Inc	1	47.2756	47.2756	0.0275	0.86423
	21	36164.5369	1722.1208		
Temp/Spat v A/B v Or/Sub	1	47.2756	47.2756	0.0878	0.76684
	21	11302.2869	538.2041		
Temp/Spat v C/Inc v Or/Sub	1	10571.1392	10571.1392	24.6115	0.00018
	21	9019.9233	429.5202		
A/B v Corr/Inc v Orig/Subst	1	1271.4801	1271.4801	0.8917	0.64180
	21	29944.5824	1425.9325		
Temp/Spat v A/B v Corr/Inc v Or/Sub	1	48.7528	48.7528	0.0907	0.76350
	21	11292.0597	537.7171		
W	330	367273.4375			

29	The train crashed before it got to Paddington.	0	1
11)	She escaped before they could put the handcuffs on.	1	2.5
32)	Before the bread burnt he took it out of the oven.		2.5
35	She wore all her clothes before they were ironed.	2	4
34)	Before the house burned down the fire engine arrived.	3	5.5
8)	Before he mentioned the holiday she changed the subject.		5.5
23)	She had a nervous breakdown before she finished her thesis.	4	7.5
28)	Before she finished the letter the taxi called.		7.5
1	She went to the seaside before she finished her essay.	5	9
21	She lost her temper before he said a word.	7	10
19)	She checked she had some candles before there was a power cut.	9	11.5
7)	She stopped the car before she reached the shops.		11.5
17	The police spotted her before she hid in the alley.	10	13
2)	Before they ate all the cake the others arrived.	12	14.5
9)	She bumped into a teacher before she ate all the ice-cream.		14.5
25	She crossed the road before Peter recognised her.	14	16
5)	They held the race before the horse got better.	15	17.5
26)	She put on her coat before she heard it was cold.		17.5
14	Before they finished decorating the house she moved out.	16	19
6)	Before she crossed the street he saw her.	17	20.5
22)	Before they decorated the house she moved in.		20.5
16)	Before the flames reached her she fainted.	19	23
13)	Mary recognised her before she crossed the road.		23
3)	The roads had been sanded before they had an accident.		23
30)	Before the electrician arrived she fixed the light.	20	26.5
20)	Before they had tea they went to the park.		26.5
18)	Before she got well she went back to work.		26.5
4)	Before it started raining she got the washing in.		26.5
33)	The chicken clucked before she laid the egg.	21	29.5
10)	Before the pub closed she drank six pints of guinness.		29.5
24)	Before the river flooded all had seemed so calm.	22	31.5
27)	Before the nine o'clock news came on she went to bed.		31.5
31)	There was a thunderstorm before the children got home.	23	34.5
15)	She stopped crying before she reached the shops.		34.5
12)	Before she went swimming she cooked dinner.		34.5
36)	Before she went on holiday she took her dog to the kennels.		34.5


No of people saying before clause didn't happen
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Sentence Number
29
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36

Experiment 7 Material

The train crashed before it got to Paddington.
She escaped before they could put the handcuffs on.
He took the bread out of the oven before it burnt.
She wore all her clothes before they were ironed.
The fire engine arrived before the house burned down.
She changed the subject before he mentioned the holiday.
She had a nervous breakdown before she finished her thesis.
The taxi called before she finished the letter.
She went to the seaside before she finished her essay.
She lost her temper before he said a word.
She checked she had some candles before there was a power cut.
She stopped the car before she reached the shops.
The police spotted her before she hid in the alley.
The others arrived before they ate all the cake.
She bumped into a teacher before she ate all the ice-cream.
She crossed the road before Peter recognised her.
They held the race before the horse got better.
She put on her coat before she heard it was cold.
She moved out before they finished decorating the house.
He saw her before she crossed the street.
She moved in before they decorated the house.
She fainted before the flames reached her.
Mary recognised her before she crossed the road.
The roads had been sanded before they had an accident.
She fixed the light before the electrician arrived.
They went to the park before they had tea.
She went back to work before she got well.
She got the washing in before it started raining.
The chicken clucked before she laid the egg.
She drank six pints of guinness before the pub closed.
All had seemed so calm before the river flooded.
She went to bed before the nine o'clock news came on.
There was a thunderstorm before the children got home.
She stopped crying before she reached the shops.
She cooked dinner before she went swimming.
She took her dog to the kennels before she went on holiday.
She was rescued before he hurt her.
The car hit the crossing gates before the brakes worked.
The tide came in before they found any shells.
It started to rain before they could start playing.
There was a power cut before the kettle boiled.
The firm went bankrupt before the product went on the market.
The Government objected before the book was published.
Julie caught the ball before it hit the window.
Sarah died before she saw her grandchildren.
Sarah died before her grandson was born.
She ate her tea before the phone rang.
She fed the chickens before she milked the cows.

Experiment 7 Data

SENTENCE DATA

Adult		Child	
MS	SM	MS	SM
8	11	11	7
16	16	14	13
15	17	15	17
20	24	23	15
16	15	15	20
17	16	20	12
9	12	12	10
10	7	12	9
17	16	16	14
20	21	24	24
0	1	1	0
21	23	22	11
12	16	14	13
14	5	14	3
21	20	19	21
14	14	15	15
17	6	10	1
14	16	18	15
14	15	14	15
20	15	23	22
10	5	7	2
19	16	11	21
2	4	8	9
24	23	24	24
13	15	12	8
15	16	19	17
23	16	24	19
6	3	10	4
0	0	1	0
22	13	16	17
22	17	18	23
0	0	0	0
22	23	15	18
10	12	6	9
14	4	3	8
23	22	22	22
0	8	1	1
9	3	13	5
6	3	1	0
11	1	10	10
0	0	1	3
4	0	8	3
5	7	14	14
1	0	1	1
4	2	6	3
20	21	21	21
18	20	17	21
22	22	21	18

SUBJECT DATA

Adult		Child	
MS	SM	MS	SM
28	15	20	17
22	17	19	16
22	20	27	21
24	14	23	17
25	16	31	26
24	18	10	11
17	18	28	9
22	21	21	15
16	21	22	12
19	22	24	17
16	20	24	7
16	18	20	18
23	10	17	14
23	14	14	20
17	11	19	22
23	12	12	20
20	14	20	19
23	12	18	20
12	19	15	25
20	21	13	21
15	23	12	12
11	16	9	20
17	25	20	14
15	19	19	21
14	12	15	10
20	12	14	9
19	11	17	9
14	9	15	13
20	13	20	12
12	11	20	16
9	15	10	12
11	17	8	12
10	15	12	17
12	12	13	16
8	13	12	16
9	15	16	7

INTERMEDIATE DATA

Adult		Child	
MS	SM	MS	SM
2	5	5	2
2	2	3	4
2	3	4	1
0	0	1	3
3	3	5	2
4	3	2	6
2	4	4	3
3	1	5	4
5	5	6	5
3	2	0	0
0	1	1	0
2	1	2	3
4	5	6	4
4	1	5	2
2	4	4	3
5	5	6	6
2	4	2	1
4	3	4	3
3	5	5	5
2	1	1	1
3	1	3	1
3	4	4	2
2	3	5	5
0	1	0	0
2	3	3	2
4	4	2	2
1	2	0	1
5	2	4	2
0	0	1	0
2	4	4	6
2	3	4	1
0	0	0	1
1	1	2	4
4	0	4	5
2	0	2	5
1	2	2	2
0	3	1	1
2	2	2	3
1	3	1	0
5	1	2	3
0	0	1	1
3	0	5	3
1	4	5	5
1	0	1	1
0	1	0	1
0	3	3	3
5	0	2	2
1	2	3	2

Experiment 7 Analyses

Sentence Data

	DF	SS	MS	F	PROB
SUBJ	47	9482.4792			
Adult vs Child	1	0.0208	0.0208	0.0024	0.96021
	47	410.9792	8.7442		
MS vs SM Clause Order	1	77.5208	77.5208	7.8442	0.00735
	47	464.4792	9.8825		
Ad/Ch v MS/SM	1	0.1875	0.1875	0.0248	0.86992
	47	354.8125	7.5492		
W	144	1308.0000			

Subject Data

	DF	SS	MS	F	PROB
SUBJ	71	1864.9375			
Adults vs Child	1	0.3403	0.3403	0.0128	0.90643
	70	1864.5972	26.6371		
MS vs SM Clause Ord	1	105.0625	105.0625	4.6550	0.03233
Ad/Ch v MS/SM	1	0.5625	0.5625	0.0249	0.86950
	70	1579.8750	22.5696		
W	72	1685.5000			

INTERMEDIATE RESULTS

	DF	SS	MS	F	PROB
SUBJ	47	327.8281			
Adult vs Child	1	11.5052	11.5052	7.8660	0.00728
	47	68.7448	1.4627		
MS vs SM Clause Order	1	0.8802	0.8802	0.6329	0.56396
	47	65.3698	1.3908		
Ad/Ch v MS/SM	1	1.5052	1.5052	0.8871	0.64659
	47	79.7448	1.6967		
W	144	227.7500			

Factive continuations

The train crashed before it got to Paddington.
The passengers were 20 minutes late.

She escaped before they could put the handcuffs on.
They clicked them tight and pushed her in the car.

He took the bread out of the oven before it burnt.
He chopped the black bits off and threw them away.

She wore all her clothes before they were ironed.
She did her ironing every Monday morning.

The fire engine arrived before the house burned down.
We searched through the ashes for valuables.

She changed the subject before he mentioned the holiday.
For the hundredth time he said he liked skiiing.

She had a nervous breakdown before she finished her thesis.
It was read with great interest by everyone.

The taxi called before she finished the letter.
She posted it in the box at the station.

She went to the seaside before she finished her essay.
The teacher was pleased when she handed it in.

She lost her temper before he said a word.
The word he said was unprintable.

She checked she had some candles before there was a power cut.
They spent three hours without a cup of tea.

She stopped the car before she reached the shops.
She bumped into Mary outside Woolworths.

The police spotted her before she hid in the alley.
She waited there until the fuss died down.

The others arrived before they ate all the cake.
There were only dry biscuits to offer them.

She bumped into a teacher before she ate the icecream.
She gave the last bite to her dog.

She crossed the road before Peter recognised her.
He asked her how Sarah was doing at school.

They held the race before the horse got better.
It won by a length and the crowd cheered.

She put on her coat before she heard it was cold.
The radio forecast said it would freeze.

She moved out before they finished decorating the house.
It looked lovely after the finishing touches.

He saw her before she crossed the street.
Once she was on the pavement he said hello.

She moved in before they decorated the house.
They did every room, including the hall.

She fainted before the flames reached her.
The fireman got to her as the flames licked her feet.

Mary recognised her before she crossed the road.
Once she was over she dodged into a shop.

The roads had been sanded before they had an accident.
The got compensation for the insurance company.

She fixed the light before the electrician arrived.
He charged `20 for checking the connection.

They went to the park before they had tea.
They had crumpets with lashings of butter.

She went back to work before she got well.
She was soon back in training for the netball team.

She got the washing in before it started raining.
The kids got soaked walking home from school.

The chicken clucked before she laid the egg.
It was a lovely brown one and I had it for tea.

She drank six pints of guinnes before the pub closed.
When the last customer left she went on to a party.

All seemed so calm before the river flooded.
The water came in through several front doors.

She went to bed before the nine o'clock news came on.
She didn't hear the money had been found.

There was a thunderstorm before the children got home.
They came in laughing and giggling as usual.

She stopped crying before she reached the shops.
She bought a cream cake to cheer herself up.

She cooked dinner before she went swimming.
The pool was nearly empty and the water was warm.

She took her dog to the kennel before she went on holiday.
She went to Turkey and then flew to Italy.

Non-Factive continuations

The train crashed before it got to Paddington.
Luckily no-one was injured.

She escaped before they could put the handcuffs on.
She ran down the road and hid in a garden

He took the bread out of the oven before it burnt.
It was perfectly cooked all through.

She wore all her clothes before they were ironed.
She always looked as if she's slept in them.

The fire engine arrived before the house burned down.
Only the kitchen was badly damaged.

She changed the subject before he mentioned the holiday.
She started talking about a film she had seen.

She had a nervous breakdown before she finished her thesis.
She got a job washing dishes instead.

The taxi called before she finished the letter.
She decided to finish it on the train.

She went to the seaside before she finished her essay.
The teacher was angry when it was late.

She lost her temper before he said a word.
He stood silently while she raged on and on.

She checked she had some candles before there was a power cut.
She still keeps them in the cupboard just in case.

She stopped the car before she reached the shops.
The sun was shining so she walked across the fields.

The police spotted her before she hid in the alley.
The pounced on her and threw her in the van.

The others arrived before they ate all the cake.
They shared what was left out between them.

She bumped into a teacher before she ate the icecream.
She threw it away so he didn't see it.

She crossed the road before Peter recognised her.
She breathed a sigh of relief as he went past without stopping.

They held the race before the horse got better.
It limped its way to the finishing tape.

She put on her coat before she heard it was cold.
When the sun came out she realised her mistake.

She moved out before they finished decorating the house.
Her new house needed no work at all.

He saw her before she crossed the street.
He stopped her as the lorry thundered by.

She moved in before they decorated the house.
Every room was in need of repainting.

She fainted before the flames reached her.
The fireman lifted her up and whisked her away.

Mary recognised her before she crossed the road.
She grabbed her by the arm and said hello.

The roads had been sanded before they had an accident.
It was only that when stopped them skidding.

She fixed the light before the electrician arrived.
She rang to tell him there was no need to call.

They went to the park before they had tea.
They bumped into Mary and forgot it was tea time.

She went back to work before she got well.
From then on she got slowly worse.

She got the washing in before it started raining.
The clouds blew over and she put it out again.

The chicken clucked before she laid the egg.
The dog jumped at her and she flew into a tree.

She drank six pints of guinnes before the pub closed.
It made her forget to lock up at 11pm.

All seemed so calm before the river flooded.
The water subsided before it reached the houses.

She went to bed before the nine o'clock news came on.
She was pleased to hear the money had been found.

There was a thunderstorm before the children got home.
They waited at school until someone fetched them.

She stopped crying before she reached the shops.
She turned round and went to see Julie instead.

She cooked dinner before she went swimming.
The meal took so long the pool was closed.

She took her dog to the kennel before she went on holiday.
It got so upset at the gate she decided not to go.

Experiment 8 Data

Sentence Data - According to Factivity Index

RANK	Factive		Non-Factive		Fact	Non-F
	s-m	m-s	s-m	m-s	all	all
1.0	5.33	3.47	4.79	3.07	4.40	3.93
2.5	2.58	3.48	4.40	2.64	3.03	3.52
2.5	4.78	5.69	5.87	5.24	5.24	5.56
4.0	4.26	4.55	3.61	4.26	4.41	3.94
5.5	4.55	4.61	4.58	4.11	4.58	4.35
5.5	3.03	2.71	3.27	3.96	2.87	3.62
7.5	5.00	3.11	3.64	3.08	4.06	3.36
7.5	2.13	4.47	5.37	5.35	2.80	5.36
9.0	3.26	3.62	4.14	5.94	3.44	5.04
10.0	5.06	2.48	3.49	2.09	3.77	2.79
11.5	4.06	3.08	4.91	3.50	3.57	4.21
11.5	2.86	3.78	2.46	4.26	3.32	3.36
13.0	3.55	3.11	3.99	3.17	3.33	3.58
14.5	2.69	2.69	4.59	4.13	2.69	4.36
14.5	3.89	4.84	4.14	4.44	4.37	4.29
16.0	3.68	3.03	4.27	3.30	3.36	3.79
17.5	2.08	3.26	6.34	4.68	2.67	5.51
17.5	4.41	3.76	4.59	3.94	4.09	4.27
19.0	3.20	2.07	3.75	2.74	2.64	3.25
20.5	2.88	2.98	3.84	3.78	2.93	3.81
20.5	4.18	2.61	3.94	3.71	3.40	3.83
23.0	2.65	3.30	3.79	3.63	2.98	3.71
23.0	2.89	2.20	3.14	3.36	2.55	3.25
23.0	3.97	4.04	3.93	5.54	4.01	4.74
26.5	3.33	3.13	3.68	3.94	3.23	3.81
26.5	4.05	3.32	4.59	4.39	3.69	4.49
26.5	4.00	2.76	4.10	4.36	3.38	4.23
26.5	3.50	4.39	4.00	4.03	3.95	4.02
29.5	4.21	4.22	5.86	6.84	4.22	6.35
29.5	3.29	4.08	3.58	3.83	3.68	3.71
31.5	3.62	1.78	5.09	3.12	2.75	4.11
31.5	5.79	3.26	3.94	3.84	4.53	3.89
34.5	4.31	4.74	4.80	4.28	4.53	4.54
34.5	2.70	3.40	5.88	5.91	3.05	5.90
34.5	2.65	2.96	5.55	3.53	2.81	4.54
34.5	5.49	4.37	6.11	5.70	4.93	5.91

Subject Data - 12 most factive vs 12 most non-factive

Subject	Sentence 1				Sentence 2			
	SM		MS		SM		MS	
	NF	F	NF	F	NF	F	NF	F
1	5.01	5.49	4.35	5.89	5.39	5.35	4.87	6.90
2	4.75	4.61	4.33	4.86	4.80	4.75	4.61	3.74
3	2.30	2.57	1.45	1.68	3.34	3.15	2.23	3.32
4	3.17	1.11	3.75	3.34	3.16	4.69	2.88	3.84
5	5.12	4.78	5.24	4.38	4.75	4.37	5.06	5.76
6	3.11	4.48	2.36	5.58	3.94	3.50	5.17	2.49
7	3.73	3.29	3.66	2.44	7.14	6.13	2.97	4.54
8	1.88	2.58	4.06	2.78	3.74	3.13	2.61	3.62
9	5.08	4.69	4.84	3.47	3.39	5.13	4.42	4.76
10	4.81	4.53	4.91	5.24	4.64	5.13	4.40	4.59
11	2.53	4.48	3.46	3.24	5.24	6.02	4.39	4.39
12	2.61	3.87	3.25	3.35	2.90	2.54	2.25	3.41
13	3.60	2.99	3.00	2.73	2.53	3.33	3.26	3.33
14	4.17	3.75	1.88	1.88	6.00	7.09	4.73	5.29
15	1.75	2.32	3.00	2.44	1.87	3.82	1.96	2.89
16	4.53	6.46	2.87	3.74	3.36	5.63	2.82	6.74

Experiment 8 Analyses

Pearson Rank Correlation Coefficients

	RANK	SMF	MSF	SMNF	MSNF	F	NF
RANK	1.0000	-.0256	-.1539	.2254	.2350	-.0851	.2670
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .	P= .441	P= .185	P= .093	P= .084	P= .311	P= .058
SMF	-.0256	1.0000	.2366	.0263	-.0402	.8314	-.0099
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .441	P= .	P= .082	P= .439	P= .408	P= .000	P= .477
MSF	-.1539	.2366	1.0000	.2946	.5588	.7267	.5039
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .185	P= .082	P= .	P= .041	P= .000	P= .000	P= .001
SMNF	.2254	.0263	.2946	1.0000	.4890	.1734	.8440
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .093	P= .439	P= .041	P= .	P= .001	P= .156	P= .000
MSNF	.2350	-.0402	.5588	.4890	1.0000	.2816	.8805
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .084	P= .408	P= .000	P= .001	P= .	P= .048	P= .000
F	-.0851	.8314	.7267	.1734	.2816	1.0000	.2679
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .311	P= .000	P= .000	P= .156	P= .048	P= .	P= .057
NF	.2670	-.0099	.5039	.8440	.8805	.2679	1.0000
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .058	P= .477	P= .001	P= .000	P= .000	P= .057	P= .

Subject Analysis - 12 most Factive v 12 most Non-Factive

SOURCE	DF	SS	MS	F	PROB
SUBJ	15	97.0202			
1st vs 2nd sent	1	9.3474	9.3474	5.7550	0.02839
	15	24.3633	1.6242		
Clause Order	1	2.6479	2.6479	2.7179	0.11690
	15	14.6138	0.9743		
Fact vs NF	1	4.1436	4.1436	5.4261	0.03252
	15	11.4546	0.7636		
1st/2nd vs Cl Ord	1	0.1961	0.1961	0.2385	0.63688
	15	12.3309	0.8221		
1st/2nd vs F/NF	1	1.5466	1.5466	1.4826	0.24088
	15	15.6480	1.0432		
Cl Ord vs F/NF	1	0.0003	0.0003	0.0009	0.97454
	15	4.5105	0.3007		
1st/2nd v Cl Ord v F/NF	1	0.3434	0.3434	0.5868	0.53861
	15	8.7780	0.5852		
W	112	109.9243			

Sentence Analysis - 12 most Factive vs 12 most Non-Factive

SOURCE	DF	SS	MS	F	PROB
SUBJ	11	16.8862			
Fact vs Non-Fact	1	1.1094	1.1094	0.6138	0.54469
	11	19.8814	1.8074		
1st vs 2nd sent	1	7.9811	7.9811	26.1308	0.00055
	11	3.3597	0.3054		
Clause Order	1	1.7120	1.7120	1.8708	0.19664
	11	10.0662	0.9151		
F/NF v 1st/2nd	1	2.5091	2.5091	1.6332	0.22609
	11	16.8994	1.5363		
F/NF vs Cl Ord	1	0.0975	0.0975	0.0969	0.75846
	11	11.0743	1.0068		
1st/2nd vs Cl Ord	1	0.0000	0.0000	0.0002	0.98628
	11	2.2067	0.2006		
F/NF v 1st/2nd v Clause Order	1	0.0551	0.0551	0.0769	0.78232
	11	7.8837	0.7167		
W	84	84.8356			

Experiment 9 Data

Sentence Data

RANK	Sentence 1			Sentence 2					
				Factive		Non-Factive		All	
	SM	MS	BOTH	SM	MS	SM	MS	F	NF
1.0	3.06	3.92	3.49	3.64	3.87	3.53	3.28	3.75	3.41
2.5	3.93	3.05	3.49	3.37	3.37	5.30	5.89	3.37	5.60
2.5	3.81	4.72	4.27	5.99	4.22	3.34	4.50	5.11	3.92
4.0	3.44	3.89	3.67	4.22	3.68	4.60	5.82	3.95	5.21
5.5	3.04	3.34	3.19	3.11	2.86	2.99	3.50	2.99	3.25
5.5	2.96	2.93	2.95	4.50	4.12	4.49	4.71	4.31	4.60
7.5	3.89	4.21	4.05	3.62	3.44	4.01	4.88	3.53	4.45
7.5	3.63	2.72	3.18	5.03	3.72	4.17	4.80	4.38	4.48
9.0	3.79	3.67	3.73	3.66	5.76	3.99	4.66	4.71	4.38
10.0	3.12	2.98	3.05	2.41	2.63	3.18	5.13	2.52	4.16
11.5	4.16	3.72	3.94	4.31	3.94	5.47	6.22	4.13	5.85
11.5	3.53	2.93	3.23	3.16	3.31	3.77	4.64	3.24	4.21
13.0	3.60	3.34	3.47	4.40	4.34	5.63	5.22	4.37	5.43
14.5	3.26	3.23	3.25	3.33	4.09	4.75	4.29	3.71	4.52
14.5	3.64	4.03	3.84	3.69	4.84	5.06	4.22	4.27	4.64
16.0	2.92	3.13	3.03	2.84	3.38	6.33	3.10	3.11	4.72
17.5	2.81	3.01	2.91	5.27	5.11	4.67	4.03	5.19	4.35
17.5	3.43	4.05	3.74	3.83	4.16	4.11	4.36	4.00	4.23
19.0	3.29	3.00	3.14	3.33	4.09	4.62	4.17	3.71	4.40
20.5	3.18	3.19	3.19	4.87	4.32	3.62	3.76	4.65	3.69
20.5	3.24	2.60	2.92	2.85	3.75	3.35	3.77	3.30	3.56
23.0	3.26	3.10	3.18	3.55	5.15	5.80	5.69	4.35	5.75
23.0	3.26	2.91	3.09	3.41	3.74	5.98	4.25	3.58	4.87
23.0	3.34	3.31	3.33	4.04	4.29	4.34	3.95	4.17	4.15
26.5	3.48	3.58	3.53	3.40	3.17	6.52	7.14	3.29	6.83
26.5	3.62	3.82	3.72	3.72	3.00	3.50	4.12	3.36	3.81
26.5	4.00	3.85	4.94	4.77	5.19	4.16	3.35	4.98	3.76
26.5	3.77	3.68	3.73	4.53	3.70	4.39	3.41	4.12	3.90
29.5	3.18	3.69	3.44	5.64	6.02	3.40	5.31	5.83	4.36
29.5	4.07	3.52	3.35	4.56	5.48	5.00	3.78	4.92	4.39
31.5	2.41	3.49	2.95	3.58	3.53	3.01	5.16	3.56	4.09
31.5	4.11	4.16	4.14	3.76	2.93	4.38	4.78	3.35	4.58
34.5	3.95	3.68	3.82	4.95	4.32	3.76	4.18	4.64	3.97
34.5	4.10	3.57	3.84	4.73	5.70	4.69	3.79	5.22	4.14
34.5	3.11	2.63	2.87	4.45	4.92	3.80	4.09	4.69	3.95
34.5	4.45	3.74	3.10	6.07	4.25	4.27	4.44	5.16	4.36

Subject Data -
12 most Factive vs 12 most Non-Factive

Sentence 1				Sentence 2							
Factive		Non-Factive		Sent 1 Factive				Sent 2 Non-Factive			
				SM	MS	SM	MS	SM	MS	SM	MS
SM	MS	SM	MS	Fact	N/F	Fact	N/F	Fact	N/F	Fact	N/F
3.50	3.52	3.82	3.18	3.26	4.42	3.27	4.20	3.51	3.85	4.23	4.60
2.85	3.03	3.20	3.54	4.26	4.42	3.16	4.81	3.60	3.72	4.69	4.48
3.60	3.14	3.93	3.46	2.96	3.52	2.82	6.02	4.62	2.45	5.20	5.65
3.86	4.68	3.49	5.52	4.33	4.42	3.09	5.48	4.08	3.47	3.42	4.98
4.21	4.11	4.63	4.91	3.93	5.87	4.50	6.11	5.29	4.48	2.77	6.78
4.44	4.80	4.86	4.83	3.68	5.27	5.09	4.28	7.55	3.71	5.17	3.68
2.40	2.63	2.31	2.98	2.72	3.51	2.67	3.12	3.63	2.46	3.52	3.19
5.50	5.53	4.45	5.71	6.60	7.13	4.91	4.80	4.63	3.19	6.77	6.72
4.00	4.92	3.71	4.50	5.07	4.66	5.16	3.46	2.92	5.19	6.39	4.52
4.68	4.36	3.52	3.80	3.93	4.52	4.15	2.83	7.78	4.40	5.21	5.43
3.48	3.82	3.73	3.41	2.79	3.23	3.66	4.29	4.08	3.76	5.52	3.97
2.81	1.27	3.10	2.60	2.44	3.16	2.60	3.34	2.87	3.40	5.18	2.32
3.93	3.89	4.09	3.86	4.24	4.26	3.85	4.63	5.50	5.49	5.76	4.68
3.46	3.75	3.73	3.03	3.72	3.23	3.84	4.90	4.20	6.22	7.48	3.50
3.20	3.50	3.22	3.53	4.38	4.55	4.41	5.06	3.78	3.08	5.50	4.28
3.88	4.12	4.10	4.28	5.10	5.69	4.18	3.28	4.11	5.39	4.62	3.90
1.65	2.06	1.56	3.06	2.23	3.55	1.60	2.67	2.29	2.87	3.91	3.39
3.85	4.42	4.23	4.42	4.91	6.04	4.59	3.67	4.42	5.80	6.18	5.55
1.52	2.98	2.52	2.39	3.57	4.14	3.03	3.10	4.37	4.29	6.14	2.47
2.55	2.34	2.82	1.86	1.01	3.72	3.30	3.04	3.43	4.08	2.50	1.74

PEARSON CORRELATION COEFFICIENTS

Sentence 1

	RANK	SM	MS	BOTH
RANK	1.0000	.1627	-.0275	-.0103
	(36)	(36)	(36)	(36)
	P= .	P= .172	P= .437	P= .476
SM	.1627	1.0000	.4628	.6440
	(36)	(36)	(36)	(36)
	P= .172	P= .	P= .002	P= .000
MS	-.0275	.4628	1.0000	.7785
	(36)	(36)	(36)	(36)
	P= .437	P= .002	P= .	P= .000
BOTH	-.0103	.6440	.7785	1.0000
	(36)	(36)	(36)	(36)
	P= .476	P= .000	P= .000	P= .

Sentence 2

	RANK	SMF	MSF	SMNF	MSNF	F	NF
RANK	1.0000	.2586	.3098	.0347	-.1435	.3223	-.0771
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .	P= .064	P= .033	P= .420	P= .202	P= .028	P= .327
SMF	.2586	1.0000	.5369	-.1394	-.0572	.8824	-.1198
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .064	P= .	P= .000	P= .209	P= .370	P= .000	P= .243
MSF	.3098	.5369	1.0000	.0682	-.1559	.8702	-.0507
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .033	P= .000	P= .	P= .346	P= .182	P= .000	P= .385
SMNF	.0347	-.1394	.0682	1.0000	.3281	-.0462	.8084
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .420	P= .209	P= .346	P= .	P= .025	P= .395	P= .000
MSNF	-.1435	-.0572	-.1559	.3281	1.0000	-.1194	.8187
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .202	P= .370	P= .182	P= .025	P= .	P= .244	P= .000
F	.3223	.8824	.8702	-.0462	-.1194	1.0000	-.0995
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .028	P= .000	P= .000	P= .395	P= .244	P= .	P= .282
NF	-.0771	-.1198	-.0507	.8084	.8187	-.0995	1.0000
	(36)	(36)	(36)	(36)	(36)	(36)	(36)
	P= .327	P= .243	P= .385	P= .000	P= .000	P= .282	P= .

12 Most Factive vs 12 most Non-Factive sentences
Subject Analysis sentence 1

SOURCE	DF	SS	MS	F	PROB
SUBJ	19	59.8750			
Clause Order	1	0.1665	0.1665	1.1615	0.29491
	19	2.7240	0.1434		
Fact vs NF	1	0.6753	0.6753	2.0696	0.16356
	19	6.1993	0.3263		
Cl Ord v F/NF	1	0.0015	0.0015	0.0103	0.91680
	19	2.8148	0.1481		
W	60	12.5815			

Subject Analysis Sentence 2

SOURCE	DF	SS	MS	F	PROB
SUBJ	19	90.5285			
F/NF Sent 1	1	6.6178	6.6178	8.4699	0.00879
	19	14,8453	0.7813		
Clause Order	1	0.6970	0.6970	0.9349	0.65232
	19	14.1647	0.7455		
F/NF 2nd sent	1	0.0856	0.0856	0.0940	0.75985
	19	17.2914	0.9101		
1F/NF vs Cl Ord	1	4.0641	4.0641	3.6275	0.06911
EW12B	19	21.2865	1.1203		
1F/NF vs 2F/NF	1	11.5993	11.5993	22.4032	0.00030
	19	9.8373	0.5178		
Cl Ord vs 2F/NF	1	1.2145	1.2145	0.9647	0.66007
	19	23.9214	1.2590		
1F/NF vs Cl Ord	1	0.1000	0.1000	0.0828	0.77322
vs 2F/NF	19	22.9550	1.2082		
W	140	148.6799			

Sentence Analysis - Sentence 1

SOURCE	DF	SS	MS	F	PROB
SUBJ	11	2.0188			
Fact vs NF	1	0.2160	0.2160	0.4410	0.52617
	11	5.3884	0.4899		
Cl Ord	1	0.0261	0.0261	0.1300	0.72452
	11	2.2106	0.2010		
F/NF vs Cl Ord	1	0.0065	0.0065	0.0560	0.81164
	11	1.2838	0.1167		
W	36	9.1314			

Sentence Analysis - Sentence 2

SOURCE	DF	SS	MS	F	PROB
SUBJ	11	4.5778			
1st sent Fact vs NF	1	1.4975	1.4975	0.7987	0.60578
	11	20.6236	1.8749		
Clause Order	1	1.7577	1.7577	1.3444	0.27039
	11	14.3815	1.3074		
F/NF Cont	1	0.6354	0.6354	2.1045	0.17240
	11	3.3211	0.3019		
1F/NF vs Cl Ord	1	2.9646	2.9646	1.8150	0.20307
	11	17.9665	1.6333		
1F/NF vs 2F/NF	1	0.4227	0.4227	1.2289	0.29145
	11	3.7833	0.3439		
Cl Ord vs 2F/NF	1	2.6368	2.6368	9.3304	0.01069
	11	3.1086	0.2826		
1F/NF vs Cl Ord vs 2F/NF	1	0.4634	0.4634	0.7855	0.60182
	11	6.4898	0.5900		
W	84	80.0523			

Experiment 10 Material

Continuation from final sentence of passsages as under:

one sentence - main-sub order
one sentence - sub-main order
two sentences - equivalent of main-sub order
two sentences - equivalent of sub-main order

A shop assistant recognised Mary Brown from the television news. She rang the police and in minutes the block was surrounded. They asked over the tannoy for Mary to give herself up and she walked calmly out of the shop and over to the police car. Everyone breathed a sigh of relief. As the police got the handcuffs ready for Mary the sound of a shot was heard and their attention was distracted. She struggled and escaped before they could put the handcuffs on.

It was one of those days. He couldn't get on with anything because of constant interruptions. He was trying to make some bread for tea and get the washing up done after lunch. It shouldn't have been impossible, but the phone had rung twice, once had been a wrong number, and the doorbell had gone once. Each time his hands had been covered in flour, dough or bubbles from the washing up. The doorbell went again and he told the man on the step that he didn't want to find Jesus today. He dashed back into the kitchen. Before the bread burnt he took it out of the oven.

Jill sat in the stuffy classroom and listened to the teacher explaining something about long division. She thought about her guinea-pigs at home and wondered if Lizzie had had her babies yet. She was longing to see them. They should be really pretty - the mother was black and the father ginger and white. Dare she slip home at playtime? She made up her mind. The bell went and Jill was the first in the playground. The teacher came out. Before that she had slipped out through a hole in the hedge.

She'd had a good morning - did the washing before the kids went to school and got it on the line before she came into town. She'd nearly finished the shopping when she realised the sun had gone in and big black clouds were hovering ominously on the horizon. She did a quick calculation - what had she left to do? Just some apples and oranges if she got them in Tescos she could be home in five minutes. To be exact, it was four and a half minutes later when she got to the front door. She got the washing in. Then it started raining.

She knew she should have gone back to school after lunch, but it was a lovely sunny day and she only had games that afternoon. She hated games. So she made her way to the beach instead of the school gates and walked along the sand for a while, paddling her feet in the cool water. When she began to feel hungry she walked towards the shops and bought herself a cornet. She bumped into a teacher before she ate the icecream.

Mary was doing her weekly shopping in town. The horse and cart were tethered outside the grocer's shop and Geoff, the lad who helped the grocer carried out a cardboard box full of purchases and stowed them away in the cart. She went over to the post office to see if there was any mail for the family and as she was coming out saw Pete through the window of the tavern. Before he recognised her she crossed the street.

It was Sunday, the whole of the family were coming that evening but she had the day to herself and she made the most of it - she had a lie-in, complete with breakfast in bed and finally got up about 11. She had a bath and pottered round for a while then she curled up in a chair with a book. She was meeting June to go swimming that afternoon so she got her swimming things ready. By then it was lunchtime. She went swimming. Before that she cooked dinner.

The last session of the day was painting. The twins always managed to get paint on their clothes, paint in their hair, paint on their teeth. Their mother wondered sometimes whether there was any paint left to go on the paper. The teacher assured her that they did get some there, in fact that they were quite good at art - but their mother still harboured secret suspicions. This Tuesday she waited for them to come home with a bath running and a change of clothes at the ready. There was a thunderstorm. Before that the children got home.

Experiment 10 Data

Sentence Data

SENT	Main-Sub Order		Sub-Main Order	
	Main Cl Cont	Sub Cl Cont	Main Cl Cont	Sub Cl Cont
1	100	0	100	0
1	100	0	100	0
2	66	0	86	0
2	57	0	83	0
3	83	17	83	17
3	0	100	100	0
4	57	0	50	0
4	17	17	86	14
5	57	43	86	0
5	66	17	100	0
6	29	71	100	0
6	33	66	43	43
7	0	83	83	17
7	71	29	57	43
8	57	43	83	17
8	43	57	50	50

Experiment 11 Material

NON FACTIVE
The rain stopped before the river flooded.
She caught the ball before it hit Mr Todd's greenhouse.
She watered the flowers before they died.
There was a power cut before the kettle boiled.
She struggled and escaped before they could put the handcuffs on.
He took the bread out of the oven before it burnt.
They ran out of petrol before they got to London.
She lost her voice before the school play.

IMMATERIAL
The carol singers went away before anyone opened the door.
They left the country before there was a civil war.
She swam early in the morning before any tourists arrived.
She slipped through a hole in the hedge before a teacher noticed.
She got the washing in before it started raining.
The foal was born before they called the vet out.
She read theannouncement in the paper before she left for work.
She finished her project before the word processor went wrong.

NEUTRAL
The government objected before the book was published.
She fixed the light before the electrician arrived.
The police saw her before she hid in the alley.
She bumped into a teacher before she ate the icecream.
She crossed the street before he recognised her.
The phone rang before she sat down.
She had a fit of giggles before she recited the poem.
The taxi called before she finished the letter.

FACTIVE
The village was sleepy and calm before the river flooded.
She took her dog to the kennels before she went on holiday.
She fed the chickens before she milked the cows.
She had breakfast before she went to the library.
She cooked dinner before she went swimming.
There was a thunderstorm before the children got home.
She checked all the doors were locked before she went to bed.
She kissed William goodbye before she left for work.

AFTER
The rabbits gradually reappeared after the rain stopped.
Her sense of dread grew stronger after she heard the church bells.
She became an accountant after many years of failing her exams.
The walls looked very bare after the decorations came down.
They went on the rampage after their team lost.
She decided to go swimming after she finished work.
She went for a walk after she had breakfast.
She lived a life of idle luxury after her book was published.

Experiment 11 Data

SENTENCE DATA

	Factive Before				Immaterial Before				Neutral Before				Non-factive Before				After			
	MS		SM		MS		SM		MS		SM		MS		SM		MS		SM	
Cont from:	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC
	2	2	4	0	7	0	4	0	3	3	5	2	3	2	5	1	4	0	4	2
	1	5	2	1	2	1	4	2	0	6	2	3	5	2	8	0	2	1	4	1
	7	1	3	0	4	3	7	0	5	1	5	0	3	2	4	0	7	1	6	0
	2	2	2	0	4	3	7	0	0	0	1	1	2	3	6	0	2	2	1	2
	6	0	5	1	3	1	3	2	2	4	6	1	4	1	6	0	5	1	5	3
	8	0	5	0	4	4	4	4	5	1	4	3	2	3	6	1	6	0	7	0
	5	0	5	1	6	0	7	1	3	0	4	1	1	3	5	1	4	0	5	1
	1	1	3	2	1	2	7	0	5	3	2	6	6	1	5	1	2	4	5	1

SUBJECT DATA

	Main-Subordinate										Subordinate-Main									
	Fact Bef		Imm Bef		Neut Bef		N/F Bef		Aft		Fact Bef		Imm Bef		Neut Bef		N/F Bef		Aft	
Cont from:	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC	MC	SC
	1	0	2	0	0	1	1	3	1	1	3	0	2	1	0	1	2	0	4	0
	2	0	1	2	0	0	1	0	1	1	1	1	1	1	0	3	0	1	2	1
	2	2	4	0	1	2	3	1	3	0	3	0	4	0	4	0	4	0	4	0
	2	2	1	2	2	0	3	0	1	0	3	0	2	2	4	0	4	0	1	3
	0	2	1	1	1	2	2	1	1	1	2	1	3	0	3	1	4	0	2	1
	1	1	3	1	2	1	0	3	2	1	2	0	3	1	1	3	4	0	4	0
	2	2	2	1	0	3	0	1	4	0	2	1	3	1	3	1	1	2	4	0
	2	1	3	0	2	1	3	0	2	0	2	1	2	2	1	2	3	0	1	0
	3	0	3	0	0	2	2	0	1	0	2	0	4	0	1	1	1	0	2	1
	3	0	0	1	1	1	2	0	0	1	1	0	1	0	2	0	3	0	2	0
	2	0	3	0	2	1	2	2	3	1	1	2	2	1	1	3	3	0	3	0
	3	0	3	0	2	1	2	0	2	0	2	0	3	0	1	0	4	0	0	1
	2	0	1	2	2	1	2	2	3	1	0	0	4	0	3	1	3	1	3	0
	2	0	0	2	3	0	1	0	2	1	1	0	3	0	1	0	2	0	0	2
	2	0	3	0	2	1	1	3	2	1	2	0	3	0	1	2	3	0	2	1
	3	1	1	2	3	1	1	1	4	0	2	0	2	1	3	0	4	0	3	1

Experiment 11 Analyses

Sentence Results - All Data

	DF	SS	MS	F	PROB
SUBJ	39	80.7438			
Connective	4	6.8375	1.7094	0.8095	0.52942
	35	73.9063	2.1116		
Clause Order	1	1.4063	1.4063	1.6881	0.19972
Conn v Cl Ord	4	5.6875	1.4219	1.7069	0.16971
	35	29.1563	0.8330		
Continued from	1	283.5563	283.5563	54.4086	0.00000
Conn v cont from	4	26.2875	6.5719	1.2610	0.30327
	35	182.4063	5.2116		
Cl Ord v Con from	1	24.8062	24.8062	8.7782	0.00557
Conn v Cl ord v continued from	4	18.5375	4.6344	1.6400	0.18530
	35	98.9063	2.8259		
W	120	670.7500			

Subject Results - All data

	DF	SS	MS	F	PROB
SUBJ	15	25.4500			
Cl Order	1	1.0125	1.0125	3.3844	0.08271
	15	4.4875	0.2992		
Connective	4	3.0438	0.7609	1.7935	0.14099
	60	25.4563	0.4243		
Continued from	1	135.2000	135.2000	73.7455	0.00001
	15	27.5000	1.8333		
Cl Ord v Conn	4	2.6437	0.6609	1.9972	0.10550
	60	19.8562	0.3309		
Cl Ord v Cont from	1	10.5125	10.5125	6.2112	0.02365
	15	25.3875	1.6925		
Conn v Cont from	4	13.1437	3.2859	2.1394	0.08602
	60	92.1563	1.5359		
Cl Ord v Conn v Cont from	4	9.7688	2.4422	2.0258	0.10126
	60	72.3313	1.2055		
W	304	442.5000			

Sentence Analysis - Befores Only

	DF	SS	MS	F	PROB
SUBJ	31	68.2422			
Type of Before	3	6.8359	2.2786	1.0390	0.39161
	28	61.4063	2.1931		
Clause Order	1	0.6328	0.6328	0.7150	0.59038
Cl Ord v Before	3	5.3359	1.7786	2.0097	0.13436
	28	24.7813	0.8850		
Continued from	1	207.5703	207.5703	40.6343	0.00001
Cont from v Before	3	24.1484	8.0495	1.5758	0.21637
	28	143.0313	5.1083		
Cl Ord v Cont	1	27.1953	27.1953	8.7620	0.00625
Cl Ord v Cont	3	15.6484	5.2161	1.6806	0.19277
v Before	28	86.9063	3.1038		
W	96	535.2500			

Subject Analysis - Befores Only

	DF	SS	MS	F	PROB
SUBJ	15	21.6523			
Before	1	0.4727	0.4727	2.6115	0.12383
	15	2.7148	0.1810		
Clause Order	3	3.0430	1.0143	2.4984	0.07056
	45	18.2695	0.4060		
Continued from	1	98.7539	98.7539	46.7532	0.00004
	15	31.6836	2.1122		
Before vs Cl Ord	3	2.4180	0.8060	2.3184	0.08704
	45	15.6445	0.3477		
Before vs Cont	1	11.8164	11.8164	6.8511	0.01851
	15	25.8711	1.7247		
Cl Ord v Cont	3	12.0742	4.0247	3.0318	0.03814
	45	59.7383	1.3275		
Cl Ord v Cont	3	8.3242	2.7747	2.3021	0.08870
v Before	45	54.2383	1.2053		
W	240	345.0625			

Sentence Results - After vs Factive Before

	DF	SS	MS	F	PROB
SUBJ	15	18.7500			
Bef v Aft (Conn)	1	0.2500	0.2500	0.1892	0.67302
	14	18.5000	1.3214		
Cl Ord	1	2.2500	2.2500	4.6667	0.04638
Cl Ord vs Conn	1	0.0000	0.0000	0.0000	1.00000
	14	6.7500	0.4821		
Continued from	1	156.2500	156.2500	39.2377	0.00008
Cont vs Conn	1	0.0000	0.0000	0.0000	1.00000
	14	55.7500	3.9821		
Cl Ord vs Cont	1	20.2500	20.2500	12.0638	0.00393
Bef vs Cl Ord vs Cont	1	12.2500	12.2500	7.2979	0.01646
	14	23.5000	1.6786		
W	48	277.0000			

Subject Results - After vs Factive Before

	DF	SS	MS	F	PROB
SUBJ	15	21.6523			
Clause Order	1	0.4727	0.4727	2.6115	0.12383
	15	2.7148	0.1810		
Connective	3	3.0430	1.0143	2.4984	0.07056
	45	18.2695	0.4060		
Continued from	1	98.7539	98.7539	46.7532	0.00004
	15	31.6836	2.1122		
Cl Ord vs Conn	3	2.4180	0.8060	2.3184	0.08704
	45	15.6445	0.3477		
Cl Ord vs Cont	1	11.8164	11.8164	6.8511	0.01851
	15	25.8711	1.7247		
Conn vs Cont	3	12.0742	4.0247	3.0318	0.03814
	45	59.7383	1.3275		
Cl Ord v Conn v Cont	3	8.3242	2.7747	2.3021	0.08870
	45	54.2383	1.2053		
W	240	345.0625			

Experiment 12 Material

The following sentences appeared in 4 conditions as under:

When Mary wrote the card Jane bought it.
Mary wrote the card when Jane bought it.
When Jane bought the card Mary wrote it.
Jane bought the card when Mary wrote it.

When Tom ate the cake Peter cooked it.

When Liz copied it down Sue wrote on the blackboard.

Before Mark went in Jack unlocked the door.

Before Jill borrowed the book Carol finished it.

Before John made tea Harry boiled the kettle.

Before Lisa made the jam June picked the cherries.

Before David broke the china dog Alan dusted it.

Before Ann warmed the tin of beans Pam opened it.

Before Barry put the roof on Derek built the walls.

Before Judy pulled out all the money Kate blew open the safe.

Before Tim picked her pocket Greg distracted her attention.

Before Liz broke the window Sue disconnected the alarm.

Before Mark preached the sermon Jack went into the church.

Before Jill set her hair Carol washed it.

Before John jumped on her Harry knocked her down.

Before Lisa changed the jumper June bought it.

Before David presented a certificate Alan passed his exam.

Before Ann caught the bus Pam stopped it.

Before Barry clapped hard Derek finished his solo.

Before Judy picked her up Kate fell down.

Before Timy laughed Greg told him a joke.

Before Mary slipped Jane dropped the banana skin.

Before Tom fed the baby Peter woke it up.

Experiment 12 Data

Appendix 12(b)

AFTER AND BEFORE SENTENCES

	BEFORE						AFTER					
	MAIN-SUB			SUB-MAIN			MAIN-SUB			SUB-MAIN		
No	main	sub	amb	main	sub	amb	main	sub	amb	main	sub	amb
1	3	1	1	3	1	1	4	0	1	5	0	0
2	3	2	0	4	1	0	4	1	0	5	0	0
4	3	2	0	4	1	0	3	2	0	4	1	0
5	3	2	0	5	0	0	5	0	0	5	0	0
7	5	0	0	4	1	0	5	0	0	4	1	0
8	4	1	0	2	2	1	3	1	1	4	1	0
10	4	1	0	3	2	0	5	0	0	5	0	0
11	2	3	0	2	3	0	4	1	0	4	1	0
13	3	2	0	4	0	1	5	0	0	4	1	0
14	3	2	0	3	2	0	5	0	0	4	1	0
16	2	1	2	3	2	0	5	0	0	5	0	0
17	3	2	0	4	1	0	5	0	0	5	0	0
19	5	0	0	5	0	0	3	0	2	3	1	1
20	4	1	0	4	1	0	4	1	0	4	1	0
22	4	1	0	2	2	1	5	0	0	2	3	0
23	3	1	1	2	2	1	5	0	0	5	0	0
25	3	2	0	4	1	0	3	2	0	5	0	0
26	5	0	0	5	0	0	3	2	0	3	2	0
28	5	0	0	4	1	0	4	1	0	5	0	0
29	3	1	1	1	4	0	2	2	1	4	1	0
31	4	1	0	5	0	0	5	0	0	2	3	0
32	3	2	0	3	2	0	4	0	1	4	1	0
34	4	1	0	4	1	0	4	1	0	2	3	0
35	4	1	0	5	0	0	5	0	0	4	1	0
	85	30	5	85	30	5	100	14	6	96	23	1

WHEN SENTENCES

	MAIN-SUB		SUB-MAIN	
Sent No	main	sub	main	sub
1	9	1	8	2
2	10	0	10	0
3	8	2	9	1
4	10	0	8	2
5	9	1	9	1
6	8	2	5	5
7	9	1	10	0
8	9	1	8	2
9	10	0	10	0
10	9	1	10	0
11	8	2	8	2
12	10	0	9	1
	109	11	104	16

Subject Data

Before						After						When					
Main-Sub			Sub-Main			Main-Sub			Sub-Main			Main-Sub			Sub-Main		
Mn	Sub	Amb	Mn	Sub	Amb	Mn	Sub	Amb	Mn	Sub	Amb	Mn	Sub	Amb	Mn	Sub	Amb
4	2	0	2	3	1	5	1	0	6	0	0	6	0	0	4	2	0
4	1	1	4	2	0	6	0	0	6	0	0	5	1	0	6	0	0
6	0	0	5	1	0	6	0	0	6	0	0	6	0	0	6	0	0
4	2	0	6	0	0	4	2	0	6	0	0	5	1	0	5	1	0
6	0	0	5	1	0	6	0	0	4	2	0	6	0	0	5	1	0
5	1	0	4	2	0	6	0	0	5	1	0	6	0	0	6	0	0
3	2	1	5	1	0	1	4	1	4	2	0	4	2	0	4	2	0
3	3	0	4	1	1	4	1	1	3	3	0	3	3	0	5	1	0
1	4	1	5	0	1	6	0	0	5	1	0	5	1	0	5	1	0
5	1	0	5	1	0	6	0	0	6	0	0	6	0	0	6	0	0
3	3	0	4	2	0	6	0	0	4	2	0	5	1	0	5	1	0
6	0	0	5	1	0	4	1	1	6	0	0	6	0	0	4	2	0
5	0	1	3	2	1	4	1	1	3	3	0	6	0	0	6	0	0
6	0	0	5	1	0	5	1	0	6	0	0	6	0	0	6	0	0
1	4	1	3	3	0	4	1	1	3	3	0	5	1	0	5	1	0
4	2	0	2	3	1	6	0	0	5	1	0	6	0	0	3	3	0
6	0	0	6	0	0	6	0	0	6	0	0	6	0	0	6	0	0
2	4	0	3	3	0	4	2	0	5	1	0	6	0	0	6	0	0
6	0	0	4	2	0	6	0	0	5	0	1	6	0	0	6	0	0
5	1	0	5	1	0	5	1	0	2	4	0	5	1	0	5	1	0

EXPERIMENT 12 ANALYSES

Sentence Analysis - After/Before

	DF	SS	MS	F	PROB
SUBJ	23	3.1198			
Before vs After	1	0.0469	0.0469	0.4182	0.53085
	23	2.5781	0.1121		
Cl Order	1	0.1302	0.1302	2.0035	0.16731
	23	1.4948	0.0650		
Continued from	1	376.8802	376.8802	212.7449	0.00000
	23	40.7448	1.7715		
Conn v Cl Order	1	0.1302	0.1302	2.0035	0.16731
	23	1.4948	0.0650		
Conn v Cont	1	12.5052	12.5052	5.4146	0.02754
	23	53.1198	2.3096		
Cl Ord v Cont	1	0.8802	0.8802	0.7297	0.59374
	23	27.7448	1.2063		
Conn v Cl Ord v Cont	1	0.8802	0.8802	0.6183	0.55452
	23	32.7448	1.4237		
W	168	551.3750			

Subject Data - After/Before

	DF	SS	MS	F	PROB
SUBJ	19	2.2500			
After vs Before	1	0.0000	0.0000	0.0000	1.00000
	19	1.5000	0.0789		
Continued from	1	151.2500	151.2500	32.9370	0.00007
	19	87.2500	4.5921		
Conn vs Cont	1	0.0000	0.0000	0.0000	1.00000
	19	46.5000	2.4474		
W	60	286.5000			

Sentence Data - When

	DF	SS	MS	F	PROB
SUBJ	11	0.2292			
Cl Order	1	0.0208	0.0208	1.0000	0.65975
	11	0.2292	0.0208		
Continued to	1	713.0208	713.0208	190.2350	0.00000
	11	41.2292	3.7481		
Cl Ord vs Cont	1	1.6875	1.6875	1.1208	0.31333
	11	16.5625	1.5057		
W	36	772.7500			

Subject Data - When

	DF	SS	MS	F	PROB
SUBJ	19	0.2375			
Clause Order	1	0.0125	0.0125	1.0000	0.66900
	19	0.2375	0.0125		
Continued to	1	427.8125	427.8125	229.3739	0.00000
	19	35.4375	1.8651		
Cl Ord vs Cont	1	1.0125	1.0125	0.9506	0.65644
	19	20.2375	1.0651		
W	60	484.7500			

Material for Experiments 13 & 14

Target sentence in main-subordinate order

Main clause context top line of set
subordinate clause context second line of set in brackets.

BEFORE

The school bus was always very prompt.
(The bus stop was three miles away.)
The bus left before the children got there.
Did they catch the bus?

Computers are very temperamental.
(Mary explained why she couldn't submit her essay.)
The word processor stopped working before Mary finished the essay.
Was the computer working?

Vera hadn't got any food in the house.
(Vera's relatives weren't due until 12 o'clock.)
She went shopping before the visitors arrived.
Did she go shopping?

Graham gardened according to the book.
(It was a lovely long autumn that year.)
He dug the garden before the winter set in.
Did Graham dig the garden?

Theresa decided to flee the country.
(The Civil War claimed many lives.)
She emigrated to Canada before the Civil War started.
Did she emigrate to the USA?

Keith sat down slowly on the bar stool.
(Liza was always ten minutes late.)
He had a double gin before Liza arrived.
Did Keith drink martini?

The tourists were anxious to get a drink.
The ship was 10 minutes late leaving.)
The cafe opened before the ship left port.
Was there a cafe on the ship?

The bus queue was long and dispirited.
(The bus was an hour late that day.)
The people queuing were all frozen before the bus arrived.
Was the bus on time?

John wanted to moan about the trouble at work.
(Mary was anxious to get home.)
He started to talk to Mary before she could get away.
Did John talk too much?

Helen was a good cook.
(There was going to be a celebration at work.)
She made a lovely cake before she went to the party.
Did Helen make a pie?

Kerry was in charge of keeping the room warm.
(It was hard to keep the fire alight.)
She put wood on the fire twice before it went out.
Did the fire go out?

We arrived at the seaside as it got dark.
(All the hotels were full.)
We drove round for an hour before we found a hotel.
Did we stay in a chalet?

The cows are in the back meadow.
(I enjoy helping in the milking shed.)
I have to herd them in before milking can start.
Do I enjoy milking the cows?

The man was held up by customs.
(The boat was ready to leave port.)
He got on board before the boat left.
Was the man arrested?

The car waited with its engine running.
(The robbery startled everybody.)
The car sped away before the alarm was raised.
Did the robbers get away?

Marie hated hearing the news.
(Marie was very tired that night.)
She turned the radio off before she went to bed.
Was the radio quiet?

AFTER

Joanne thought she deserved a treat.
(Joanne worked very hard in her revision.)
She went on holiday after she passed her exams.
Did she fail her exams?

Mark enjoyed watching television.
(Mark was hungry when he came home.)
He watched "Neighbours" after he ate his tea.
Did Mark like "Neighbours"?

Sally had been feeling well.
(Sally usually drank orange juice.)
She felt sick after drinking a bottle of whisky.
Did Sally deserve to feel sick?

Peter didn't like feeding the animals.
(Peter had an awful memory.)
He fed the chickens after the farmer reminded him.
Did Peter feed the chickens?

Jane knew all the hiding places.
(Liz wanted to spoil the cricket game.)
She found the ball after Liz hid it in the hedge.
Did Liz hide the ball in the gutter?

Agatha had escape plans ready.
(Agatha's lawyer managed to put up the money.)
She slipped the country after she got bail.
Was Agatha a criminal?

Max loved playing in the park.
(Max was watching the cartoons.)
He played on the swings after he grew tired of watching television.
Did he play on the roundabout?

Julie was not a conscientious worker.
(Julie's behaviour was scandalous at Christmas.)
She was fired after the office party.
Was Julie well behaved?

John has a bad temper.
(The teacher's really dozy.)
John threw a book on the floor after the teacher turned away.
Was the teacher alert?

The chimps were always popular.
(The kids were usually a noisy lot.)
The kids watched silently after they got to their cage.
Did the children like the chimps?

Mary was very tired.
(Peter always helped clear up after dinner.)
Mary went to bed after Peter washed the dishes.
Did Mary go to sleep?

Bathing around here can be dangerous.
(Flags can be useful signals.)
It's forbidden to swim after the red flag is hoisted.
Does the green flag mean its safe?

The piglets were very tired.
(The farmer was late doing the chores.)
They went to sleep after the farmer brought the food.
Were the piglets hungry?

Joe loved the kids' park.
(Joe's mother stood anxiously by the gate.)
He went on the swing after his mother went away.
Did Joe's mother go on the swing?

The committee met in the Board Room.
(The secretary came in with the coffee.)
The meeting adjourned after the coffee was served.
Did they have tea?

The customers were very dissatisfied.
(The waitress was very clumsy.)
They complained after the waitress spilled the soup.
Did the waiter spill the soup?

BECAUSE

Jane's father didn't see her often.
(Holidays are great fun.)
He gave her five pounds because it was Easter.
Was it Easter?

Suddenly the air was filled with noise.
(The intruder approached the gate.)
The dogs had started to bark because they saw the stranger.
Were the dogs noisy?

Singing was the children's favourite lesson.
(The singing master liked his job.)
They enjoyed music because the teacher was interesting.
Was the music teacher strict?

John hated spending money.
(The house had been empty for months.)
He thought the house was a bargain because it was neglected.
Did John buy a house?

Louise kept dozing off at work.
(Louise was looking forward to being a mother.)
She couldn't sleep at night because she was pregnant.
Was Louise a small child?

Not a soul could be seen in the corridor.
(The college closed for a week over Christmas.)
The building was quiet because it was the holidays.
Was it the holidays?

Irene was grinning at everyone in the pub.
(The game was over at last.)
She was happy because her team had won.
Was she unhappy?

The police station was overcrowded.
(The cocaine dealers were arrested the night before.)
The cells were full because of the raid.
Had there been some arrests?

Sam was easily upset.
(Sue was always picking a fight.)
Sam couldn't stop crying because Sue started to shout.
Was Sue crying?

Mary didn't want the teacher to find her.
(The register was taken at nine o'clock.)
She hid in the toilets because the bell rang for registration.
Did Mary go to registration?

It's nearly time for dinner.
(Everyone is looking forward to the weekend.)
We're eating fish today because it's Friday.
Are we eating meat?

We decided to go for lunch.
(The sun was extremely hot.)
We had to move because we'd begun to burn.
Do we laze around all the time?

Harvesting requires a certain know-how.
(The weather is always very fickle.)
We have to cut the corn because there's a dry spell.
Do you cut the corn when its dry?

Sally was easily frightened.
(The fire alarm was very reliable.)
She started trembling because the alarm went off.
Did the alarm go off?

Peter was a very moody child.
(The new maths mistress was a surprise.)
He sulked for hours because the teacher was strict.
Was Peter good tempered?

Joanne didn't know what to do.
(The news was very shocking.)
She didn't talk to anyone because the letter was secret.
Did Joanne talk about problems?

SINCE

The cat was really spoilt.
(Mark went shopping on his way home.)
The cat had salmon for tea since Mark called at the fish shop.
Does Mark have a cat?

The school mistress was really encouraging.
(Mary was a good scholar.)
She said the exam would seem easy since Mary worked hard.
Was there an exam in the near future?

Jenny is easily pleased.
(There are chickens in the garden.)
Jenny is very happy since the chickens laid some eggs.
Does Jenny like eggs?

The recipe is not always successful.
(I had to make do with what was in the cupboard.)
It works better since I've changed the ingredients.
Does the cake need a hot oven?

Nancy finished school last week.
(The weather has been changeable this week.)
She went to the beach yesterday since the sun was shining.
Does Nancy live near the sea?

All children like sweets.
(Mrs Smith emptied out her purse.)
Claire could buy some chocolate since there was some money left.
Does Claire like chocolate?

Liz was ready for elevenses.
(The shelves were very high in the kitchen cupboard.)
She couldn't have a biscuit since the tin was out of reach.
Did Liz get a biscuit?

The police van screeched to a halt.
(Tom kept hitting his opponent.)
Tom was arrested since the fight didn't stop.
Is Tom a pacifist?

The mayor was trying to keep order.
(The demonstration was very orderly.)
He let the marchers continue since they had been peaceful.
Had there been violence?

Judy looked after the children.
(The parents went away for the weekend.)
She took care of the children since there's no-one else at home.
Is their mother on holiday?

I usually make scones on Monday.
(We used all the flour yesterday.)
I can't do any baking today since there's no flour left.
Have we run out of flour?

I like going on holiday.
(The judge impounded my passport.)
I can't go abroad this year since I haven't got a passport.
Did I visit Portugal?

The hay's almost ready to cut.
(The weather has been very wet.)
The grass has grown quickly since there's been so much rain.
Is it time to harvest?

The choice of cars was very restricted.
(The luxury cruise was suddenly cancelled.)
Fiona's bought a sports car since she's not going on holiday.
Is she going on holiday?

Judy was very hungry.
(Judy really wanted some shellfish.).
She ate leek soup since there was no prawn cocktail.
Did she eat avocado pear?

Mark never had anything to wear.
(The invitation was a surprise.)
He had to buy a new suit since the dinner was very formal.
Was Mark going out?

Experiment 13 Results

By Sentence

Temporal				Causal			
Main-Sub		Sub-Main		Main-Sub		Sub-Main	
MC Contxt	SC Contxt	MC Contxt	SC Contxt	MC Contxt	SC Contxt	MC Contxt	SC Contxt
Before				Because			
3.85	4.70	3.85	3.38	4.93	3.93	5.67	4.19
4.87	3.95	4.70	4.67	4.26	4.59	4.90	4.73
4.30	4.63	4.35	4.73	4.12	3.45	3.85	3.73
4.85	4.64	5.16	4.09	4.33	4.54	4.81	5.03
3.45	3.42	4.70	4.49	4.27	4.71	4.40	5.26
4.49	4.55	4.95	4.45	4.56	4.94	4.79	4.82
3.54	4.24	4.10	3.42	4.40	4.82	4.82	4.02
4.88	4.54	4.24	3.83	4.47	3.85	5.93	4.87
5.26	5.41	4.38	5.14	3.81	2.95	3.56	3.75
5.76	4.66	5.05	4.87	5.08	3.06	4.89	4.44
5.13	4.37	4.27	4.59	4.63	3.70	3.94	3.94
5.50	4.57	4.87	5.46	3.68	4.50	2.76	4.89
3.81	5.08	3.64	4.12	5.07	4.95	4.39	5.02
4.10	5.20	3.92	4.50	4.31	3.76	3.95	4.13
4.48	4.67	4.64	4.83	4.28	3.69	5.06	3.64
5.46	5.67	5.12	6.41	4.26	3.42	3.92	3.29
After				Since			
5.59	5.38	5.41	4.83	4.71	4.52	5.00	4.08
5.40	3.24	4.06	4.09	4.21	4.42	4.37	4.17
4.65	4.69	5.15	5.39	4.77	5.02	5.32	4.03
3.91	3.29	3.81	4.06	4.20	4.22	4.37	3.72
3.58	4.28	4.95	4.96	5.07	4.06	5.44	4.45
4.43	4.07	4.07	4.22	3.94	3.78	3.52	4.00
3.86	4.39	4.69	4.67	4.37	5.54	5.18	6.17
3.96	4.84	4.59	4.07	3.38	3.96	4.00	3.89
5.28	4.51	4.71	4.77	4.29	4.06	4.26	3.82
4.06	3.40	3.88	3.59	4.78	5.37	4.49	4.50
5.36	3.72	4.73	4.39	4.94	4.68	5.34	4.60
6.10	5.05	4.96	5.35	5.55	5.67	4.57	5.96
5.28	4.72	5.02	3.44	4.25	5.14	3.51	4.65
4.68	3.84	3.86	3.92	4.26	3.50	3.47	3.98
4.93	4.30	3.64	4.60	4.04	4.27	4.26	3.79
3.87	4.73	4.07	3.87	5.83	5.34	5.55	5.20

Subject Results

Main-subordinate clause order

mc context				sc context			
bef	aft	bec	sin	bef	aft	bec	sin
3.57	4.42	4.20	3.90	4.78	4.38	4.78	4.01
5.92	5.82	5.61	4.53	4.73	4.91	7.15	4.67
4.81	3.75	6.00	5.15	5.06	4.69	3.38	5.95
3.57	3.91	4.40	3.36	4.45	3.47	3.82	3.71
3.26	3.54	3.13	3.67	3.35	3.00	2.26	3.30
6.79	7.52	6.69	5.57	7.31	6.58	4.90	6.91
3.31	4.47	3.57	3.51	3.33	2.91	3.63	4.28
3.34	3.60	3.12	3.28	3.10	3.45	3.13	3.39
4.74	5.44	4.55	5.26	4.44	4.99	4.17	4.47
5.93	6.89	6.08	5.57	6.10	5.77	5.57	5.90
6.18	5.25	5.79	5.78	6.29	6.06	5.39	6.13
2.87	4.08	4.16	3.42	4.11	3.55	2.61	4.42
5.39	5.33	4.66	5.86	5.13	4.15	4.65	4.27
7.17	5.44	4.96	4.39	3.63	5.25	3.96	4.79
5.54	4.82	4.07	5.02	4.87	3.76	4.99	4.35
3.45	4.79	4.47	4.85	5.07	4.31	4.19	3.66
3.58	3.79	3.71	3.41	3.03	2.53	3.58	3.24
3.17	3.67	2.61	4.53	2.74	4.99	4.76	3.91
3.77	3.97	3.47	5.75	6.84	3.87	3.13	4.76
3.37	3.05	4.56	2.61	2.89	3.19	3.13	4.69
5.31	4.56	3.13	5.06	7.02	4.50	3.74	4.45
5.39	5.48	4.04	4.67	4.86	4.41	3.64	4.60
5.27	5.94	4.85	5.16	4.68	3.99	4.09	4.77
4.46	4.08	4.76	4.29	4.88	4.23	3.31	4.87
4.26	4.50	4.15	4.76	3.22	4.07	3.04	4.14
4.58	4.56	4.36	3.82	4.46	3.53	3.58	4.35
3.12	3.75	3.01	2.95	3.35	3.41	3.12	3.38
5.03	3.91	4.00	4.51	5.03	5.12	3.84	6.53
4.44	3.78	3.03	3.69	4.97	3.69	3.41	3.97
5.58	5.97	4.75	6.20	5.00	3.60	5.07	4.21
7.38	6.37	8.18	6.90	6.81	7.06	7.47	7.24
2.95	3.44	2.84	3.73	3.11	3.49	2.22	3.82

Subordinate-main clause order

mc context				sc context			
bef	aft	bec	sin	bef	aft	bec	sin
5.02	4.21	3.15	4.12	4.69	4.23	4.03	4.57
4.85	5.36	4.86	5.45	5.90	4.57	4.26	4.89
5.04	5.52	4.85	4.67	5.29	4.96	4.67	4.75
4.30	3.76	4.59	3.52	3.77	4.15	3.96	3.18
2.55	3.11	3.66	3.35	2.76	3.08	2.53	2.93
5.61	6.58	7.19	7.14	4.48	5.40	6.56	5.71
3.29	3.18	4.18	3.64	3.55	3.24	4.08	3.52
3.33	3.84	3.21	3.09	3.75	3.66	2.79	3.13
5.93	5.06	4.16	6.00	4.99	4.68	3.18	4.52
6.60	6.05	4.57	5.65	6.48	5.18	5.73	5.81
6.88	6.00	5.44	7.06	6.29	5.12	5.37	5.08
3.68	2.85	4.24	3.75	3.33	4.21	3.63	4.23
4.59	5.24	3.97	4.91	3.54	4.93	4.87	4.42
5.47	4.57	4.64	5.03	4.37	5.67	4.60	5.45
3.96	5.47	4.78	4.53	5.95	5.18	3.93	4.61
5.53	4.60	4.75	4.23	5.67	4.54	3.73	4.98
3.47	3.26	2.76	3.32	3.01	2.78	3.15	3.30
2.09	3.43	3.07	4.48	4.48	3.05	3.35	3.43
3.89	4.45	5.79	3.27	3.73	4.50	4.54	4.72
3.38	2.76	3.03	3.10	2.73	5.01	3.84	2.94
4.39	4.23	4.90	5.05	4.49	4.11	5.58	4.30
5.73	5.30	5.47	4.96	4.66	4.90	4.67	4.92
5.24	4.94	6.09	4.27	4.59	4.86	4.47	4.85
4.65	4.44	4.66	4.65	5.13	4.09	4.14	4.85
4.35	4.94	4.01	4.00	4.67	3.84	4.30	4.95
4.81	4.25	3.73	4.29	5.50	3.35	4.18	3.75
3.28	3.13	3.65	3.78	3.25	3.53	4.01	2.87
4.18	4.72	3.05	4.45	5.37	5.27	5.35	4.24
3.19	3.71	3.55	3.98	3.44	3.91	3.75	3.86
4.67	4.12	5.11	3.69	4.62	3.84	5.38	5.42
7.41	7.28	8.57	8.12	8.62	7.24	7.72	7.95
2.57	2.85	3.63	3.76	2.87	3.39	3.20	3.85

Experiment 13 Analyses
Sentence Data

	DF	SS	MS	F	PROB
SUBJ	63	60.2856			
Temp vs Causal	1	0.5302	0.5302	0.5489	0.53171
Conn within T/C	1	0.1118	0.1118	0.1158	0.73447
Indiv Connective	1	1.6949	1.6949	1.7549	0.18726
	60	57.9488	0.9658		
Clause Order	1	0.0046	0.0046	0.0256	0.86794
Cl Ord v Temp/Caus	1	0.2672	0.2672	1.4717	0.22779
Cl Ord v Conn	1	0.1920	0.1920	1.0574	0.30867
Cl Ord v Ind Conn	1	0.3977	0.3977	2.1908	0.14032
	60	10.8917	0.1815		
Context	1	0.8134	0.8134	2.4232	0.12094
Context v Tem/Caus	1	0.0143	0.0143	0.0425	0.83180
Context v Conn	1	0.0278	0.0278	0.0830	0.77135
Context v Ind Conn	1	1.0366	1.0366	3.0881	0.08029
	60	20.1400	0.3357		
Cl Ord v Context	1	0.1748	0.1748	0.8784	0.64517
Cl Ord/C'text/T/C	1	0.0781	0.0781	0.3921	0.54059
Cl Ord/C'text/Conn	1	0.0109	0.0109	0.0547	0.81076
Cl Ord v Context v Ind Conn	1	0.4684	0.4684	2.3532	0.12644
	60	11.9423	0.1990		
W	192	46.4596			

Subject Data

	DF	SS	MS	F	PROB
SUBJ	31	483.1363			
Clause Order	1	0.0096	0.0096	0.0343	0.84833
	31	8.6916	0.2804		
Context	1	1.6155	1.6155	3.2266	0.07878
	31	15.5212	0.5007		
Temporal/Causal	1	1.0658	1.0658	3.2693	0.07691
	31	10.1060	0.3260		
Connectives	1	0.2211	0.2211	0.6076	0.55243
within Tem/Caus	31	11.2819	0.3639		
Cl Ord v Context	1	0.3486	0.3486	1.2278	0.27593
	31	8.8020	0.2839		
Cl Order v Tem/Caus	1	0.5434	0.5434	1.0627	0.31142
	31	15.8511	0.5113		
Cl Ord v conn	1	0.3850	0.3850	2.0184	0.16212
	31	5.9131	0.1907		
Context v Tem/caus	1	0.0291	0.0291	0.1041	0.74759
	31	8.6653	0.2795		
Context v Conn	1	0.0565	0.0565	0.1181	0.73289
	31	14.8335	0.4785		
Indiv Conn	1	3.3768	3.3768	11.6461	0.00214
	31	8.9884	0.2899		
Cl Ord v Context	1	0.1617	0.1617	0.5504	0.52980
v Temp/Caus	31	9.1090	0.2938		
Cl Ord v Context	1	0.0239	0.0239	0.0462	0.82564
v conn	31	16.0641	0.5182		
Cl Order v	1	0.8176	0.8176	1.1229	0.29783
Indiv conn	31	22.5718	0.7281		
Context v	1	2.0757	2.0757	6.9062	0.01271
Indiv conn	31	9.3173	0.3006		
Cl Ord v context	1	0.9453	0.9453	2.1313	0.15098
v Indiv conn	31	13.7499	0.4435		
W	480	191.1418			

Experiment 14 Data

Sentence Data

	Temporal						
1st sent pos				2nd sent post			
Main		Sub		Sub		Main	
Main	Sub	Main	Sub	Main	Sub	Main	Sub
Before							
3.15	4.91	4.45	4.51	5.07	3.57	2.84	6.44
4.74	5.34	4.38	4.71	5.53	4.26	4.78	5.87
3.57	3.52	4.56	3.80	5.01	3.40	3.63	4.71
5.30	6.05	4.22	4.81	5.72	4.54	4.26	7.17
4.12	3.77	4.44	4.96	4.28	3.74	4.47	3.21
3.69	5.15	5.30	3.36	6.86	3.50	3.23	4.18
4.80	3.92	3.37	4.58	3.54	5.57	4.64	3.36
5.87	5.31	4.44	3.65	7.73	3.50	3.83	4.53
5.62	5.76	4.91	6.22	5.03	7.85	7.69	5.51
6.03	8.03	6.05	4.75	6.55	5.86	5.47	7.04
5.33	5.89	4.88	5.53	5.52	7.05	5.48	6.16
5.00	5.89	5.56	6.44	4.62	8.51	7.01	5.01
4.48	5.67	6.19	3.54	6.74	3.81	5.54	6.83
4.83	5.02	5.69	3.94	5.32	3.57	6.32	6.07
5.00	4.85	4.89	5.32	4.40	5.21	5.93	5.29
5.33	5.15	7.19	5.99	4.63	5.93	7.82	5.75
After							
5.50	5.00	5.79	4.65	6.22	5.42	5.26	5.53
3.44	6.18	4.99	3.88	6.88	3.32	3.26	6.86
3.66	5.09	5.01	4.95	5.66	3.96	3.54	5.89
5.23	4.50	3.93	5.31	6.08	5.04	3.88	5.55
4.83	4.24	4.58	5.66	4.77	6.93	5.91	3.72
3.97	4.30	3.99	4.06	5.07	5.13	4.94	4.19
6.40	5.46	5.66	5.35	6.23	6.02	4.82	5.32
5.07	3.35	3.60	4.87	3.66	4.90	4.87	4.12
7.45	5.54	5.46	5.66	4.58	7.68	8.12	4.52
3.88	6.19	5.42	3.03	4.42	3.69	3.68	4.13
4.96	6.72	4.56	5.10	4.01	6.01	5.27	5.91
3.79	7.44	5.14	3.68	5.94	5.04	4.28	5.78
4.96	4.68	5.60	5.18	5.77	4.70	6.99	4.81
5.05	4.73	6.14	4.45	5.88	4.54	6.18	4.86
5.96	3.00	3.92	4.78	3.71	4.44	6.54	3.72
4.67	2.76	2.19	5.56	2.81	4.40	6.63	4.33

Causal							
1st sent pos				2nd sent post			
Main		Sub		Sub		Main	
Main	Sub	Main	Sub	Main	Sub	Main	Sub
Because							
6.17	4.66	3.86	6.56	5.60	5.07	5.35	6.44
5.06	4.65	3.95	5.84	5.20	6.49	3.94	5.57
4.02	3.74	4.54	5.47	5.65	4.28	3.46	6.85
6.37	4.94	3.81	5.22	4.77	4.79	4.69	4.77
4.83	6.14	4.59	4.40	6.26	5.78	4.71	6.11
6.75	3.70	5.46	5.76	6.35	5.17	5.87	4.55
6.45	3.67	3.78	5.08	5.16	6.34	5.20	3.47
5.39	4.42	4.55	4.59	5.40	5.79	4.83	4.52
4.02	6.68	3.79	3.65	3.80	4.52	4.00	3.94
5.47	6.65	5.18	4.65	5.25	6.19	6.75	4.84
3.80	4.09	3.77	4.16	3.59	5.61	5.56	4.40
4.31	5.46	4.40	4.99	4.02	6.04	4.17	4.51
5.41	5.17	7.54	5.44	7.05	5.23	6.54	6.08
5.71	2.62	4.03	5.69	3.79	5.15	6.94	2.91
4.57	4.45	5.36	4.97	4.64	5.44	5.88	4.32
4.66	4.06	5.44	4.41	5.69	4.42	4.86	4.11
Since							
5.99	5.12	4.73	6.80	5.03	4.18	4.34	7.83
6.83	4.76	4.44	8.91	4.78	5.74	5.39	6.02
5.61	4.43	4.90	4.55	6.29	3.81	3.87	6.92
4.20	4.90	4.47	4.04	4.88	4.69	3.01	5.20
5.80	4.87	5.18	4.56	6.95	5.95	5.38	4.72
6.94	4.00	4.56	5.42	5.59	6.12	5.63	4.26
7.00	5.07	4.62	6.01	6.04	8.97	6.69	4.74
6.37	4.29	4.27	4.74	4.57	5.59	4.55	2.93
3.96	7.16	4.18	4.33	3.87	6.03	3.96	5.13
4.78	8.54	5.87	5.16	4.13	7.64	6.79	4.93
5.20	5.46	4.72	5.33	4.75	7.59	6.32	6.25
6.23	6.81	5.85	6.17	6.86	9.09	6.26	5.51
4.75	4.98	5.45	5.97	5.15	6.07	6.75	6.11
4.10	3.52	4.93	4.23	4.31	4.45	6.38	4.93
5.28	3.76	6.03	4.98	4.36	5.05	6.54	4.85
5.25	5.25	7.39	6.66	7.29	5.08	5.73	8.67

Subject Data

MAIN CLAUSES

Main-Subordinate

1st to main				1st to sub			
bef	aft	bec	sin	bef	aft	bec	sin
4.09	4.30	4.66	4.94	4.44	5.82	4.17	3.41
2.71	1.99	1.77	2.49	2.88	1.85	2.49	2.39
3.79	3.58	4.97	4.29	6.92	4.16	4.63	4.88
2.58	3.58	2.79	4.10	3.88	3.55	2.73	3.93
3.12	4.09	2.70	3.15	2.19	1.86	3.73	2.72
6.12	4.78	4.72	5.56	4.97	4.29	4.47	4.79
4.46	5.20	5.29	5.13	4.10	5.09	5.13	4.81
6.76	6.26	7.53	5.21	7.34	7.09	5.59	5.64
5.74	4.40	6.43	7.47	4.77	4.24	5.48	6.64
5.55	6.16	9.47	8.17	7.27	5.86	6.50	6.38
6.29	7.04	9.42	9.87	9.69	12.09	10.42	11.94
5.25	4.25	5.85	6.93	5.41	6.88	6.10	6.04
6.13	4.83	4.79	6.44	6.74	3.02	3.48	4.56
7.01	6.78	5.56	6.50	5.99	5.46	5.89	5.63
4.53	4.10	3.97	3.32	4.27	3.99	3.94	3.92
4.57	5.04	5.05	2.93	4.61	4.89	3.74	5.16
2.37	2.90	3.83	3.17	4.12	3.73	3.15	3.84
5.05	6.90	7.30	8.27	5.65	5.75	6.06	5.92
6.99	10.59	8.20	9.03	8.64	10.30	10.22	10.15
4.14	4.89	7.21	7.21	7.33	6.30	5.16	7.77
6.16	4.73	5.15	5.79	6.98	4.54	4.40	4.61
5.62	4.34	5.32	3.59	5.45	3.81	3.87	3.57
6.87	8.80	7.00	10.73	6.88	7.48	7.00	7.15
3.70	3.44	3.35	4.30	4.65	4.47	3.39	3.39
4.14	4.59	4.15	5.71	3.18	4.04	4.30	3.98
3.86	4.42	5.62	5.04	4.01	3.43	3.69	3.88
3.31	3.35	2.66	5.28	2.98	3.39	2.09	5.15
4.61	5.23	5.74	5.50	6.29	5.11	4.39	6.06
4.59	6.06	3.64	5.55	5.03	4.69	3.97	5.04
5.18	4.56	3.31	3.77	4.02	2.67	2.81	4.09
3.93	4.40	3.72	3.58	3.51	3.87	3.18	3.74
4.45	4.05	4.77	3.56	4.26	4.66	4.01	4.61

MAIN CLAUSES
Subordinate-Main

1st to main				1st to sub			
bef	aft	bec	sin	bef	aft	bec	sin
4.41	6.15	6.09	6.66	5.75	4.07	3.19	6.74
4.10	3.74	2.61	3.34	3.48	1.81	2.36	2.81
5.72	4.27	5.32	4.34	4.52	4.09	5.12	5.43
3.54	3.68	3.74	2.84	4.87	3.32	4.90	4.09
2.24	3.06	3.04	4.10	3.22	2.05	3.64	3.38
3.80	2.83	4.63	4.49	3.60	3.50	3.92	4.42
3.48	5.17	4.67	5.71	6.67	5.04	4.77	6.95
4.63	6.41	7.15	7.08	9.55	7.05	6.07	7.48
7.73	6.47	6.44	6.11	7.56	4.57	7.66	6.73
9.85	8.48	6.46	9.81	9.89	7.25	6.83	9.67
11.58	11.90	5.77	9.29	8.95	7.56	7.81	10.77
5.90	6.77	6.34	7.04	5.78	7.06	6.28	6.43
4.75	4.81	4.40	2.79	4.00	5.23	5.34	4.84
4.69	5.20	5.88	6.77	4.57	5.98	6.09	4.30
2.86	3.11	4.40	4.71	3.82	4.07	3.62	3.18
3.02	5.27	5.50	5.35	4.77	6.18	3.45	3.77
4.38	2.82	2.68	3.22	3.31	2.62	2.38	4.60
9.06	4.60	7.73	6.78	7.52	6.06	4.21	7.70
8.69	10.15	11.50	11.10	8.50	11.65	7.49	9.20
6.31	6.28	6.41	4.92	5.56	5.33	6.80	7.09
3.88	5.07	4.21	3.38	3.79	4.23	4.24	4.00
3.68	4.54	3.93	4.10	4.06	5.21	5.92	3.93
7.21	9.67	7.17	9.47	9.53	7.42	7.62	9.18
3.89	3.86	4.25	3.92	4.42	3.50	2.87	3.83
5.58	6.07	4.06	3.61	4.32	4.29	3.80	6.95
6.21	4.38	4.90	7.13	6.04	4.73	4.41	3.93
2.46	3.12	4.05	4.80	3.52	3.67	3.79	3.77
7.03	6.50	5.31	6.46	6.68	5.00	5.04	5.18
4.62	3.43	4.57	4.50	3.75	5.17	4.48	4.89
3.36	2.94	4.19	3.08	3.57	3.33	3.69	3.56
3.26	3.48	3.50	3.19	4.40	3.55	2.92	4.05
3.96	4.12	4.56	5.10	4.26	3.88	4.06	5.18
3.50	4.73	3.67	3.44	3.02	4.28	3.77	5.04
3.25	3.13	3.14	2.99	4.07	3.26	2.89	3.93
4.19	4.56	4.30	4.65	3.88	3.67	4.05	4.99

SUB CLAUSES
Subordinate-Main

1st to main				1st to sub			
bef	aft	bec	sin	bef	aft	bec	sin
4.06	5.62	4.52	4.47	4.12	4.65	4.88	4.33
2.62	3.17	1.92	1.84	1.99	1.72	2.82	2.81
5.52	3.89	4.33	4.95	3.76	4.55	5.83	3.91
3.16	2.90	3.05	2.33	3.98	3.58	3.00	3.39
3.12	3.08	2.84	4.26	2.47	3.58	3.94	3.37
4.90	4.92	4.99	5.96	4.15	6.33	4.96	6.21
3.34	4.17	3.71	4.33	5.60	3.92	4.40	7.13
5.25	6.11	6.50	4.08	7.69	6.31	6.44	7.35
6.93	5.74	6.71	4.77	5.68	6.23	7.14	6.55
8.52	8.85	4.97	9.75	8.10	8.28	8.17	9.44
9.08	6.81	7.14	7.80	6.36	6.11	7.24	8.71
6.35	5.09	6.01	6.17	4.70	5.30	5.76	7.23
4.60	4.87	3.19	3.74	5.16	4.58	4.98	6.63
5.54	6.50	5.92	6.65	4.89	6.46	6.07	5.98
3.58	3.91	4.16	3.59	4.34	3.75	2.93	2.88
4.17	4.14	4.65	5.59	5.38	3.75	3.69	3.56
4.03	3.19	2.25	3.36	2.98	2.35	2.42	4.20
7.24	5.46	6.90	7.29	5.98	7.86	5.56	6.92
8.15	6.05	10.63	9.86	7.22	7.74	9.05	9.27
7.73	4.63	5.99	7.00	3.32	3.51	6.22	7.32
4.12	6.14	4.63	4.34	4.01	4.84	3.95	4.48
4.71	4.20	2.68	4.00	5.06	4.62	7.39	3.81
7.83	6.71	6.43	8.84	9.71	7.16	7.61	7.99
3.50	2.92	3.88	3.19	5.23	3.12	2.88	4.15
4.54	5.23	3.02	3.95	3.38	4.32	5.07	5.07
4.86	3.93	4.00	5.81	5.38	4.55	4.98	4.35
2.58	2.36	3.97	4.18	2.29	2.49	3.81	3.99
5.35	3.97	3.64	5.33	4.03	4.29	5.25	4.85
4.73	5.01	4.42	4.70	4.35	5.18	4.57	5.95
4.56	4.05	4.06	3.95	3.29	2.95	4.00	4.75
3.87	3.77	3.68	3.91	3.13	3.29	3.29	3.23
4.63	3.61	5.26	3.93	3.49	4.16	4.50	3.91

SUBORDINATE CLAUSES
Main-Subordinate

1st to main				1st to sub			
bef	aft	bec	sin	bef	aft	bec	sin
6.31	5.01	5.18	5.09	4.12	5.66	5.43	6.59
2.33	3.78	3.26	3.35	2.69	3.25	3.43	3.22
3.15	3.75	5.30	4.82	6.22	3.65	3.40	4.25
3.50	3.79	2.69	3.71	3.73	3.19	3.31	4.81
3.69	3.86	2.88	2.75	2.54	2.70	4.13	3.81
4.22	4.41	4.05	4.67	3.99	4.76	4.26	5.43
5.24	4.86	5.75	5.28	4.09	4.48	6.02	4.45
8.32	6.29	8.40	6.75	5.51	5.90	6.08	7.01
7.96	8.50	6.01	7.25	4.32	7.07	6.98	10.34
8.72	9.15	8.50	7.14	6.97	9.93	8.94	10.04
9.54	7.77	9.12	9.05	11.83	10.79	10.19	12.72
5.41	4.33	6.10	5.84	6.96	5.81	4.93	5.85
6.19	6.09	3.82	5.43	5.94	5.34	6.98	5.96
6.51	6.86	5.68	6.67	6.30	7.09	7.12	6.24
4.12	3.77	4.09	3.00	3.03	2.81	4.10	3.18
5.17	3.95	4.97	6.25	3.52	4.28	5.15	4.28
2.69	3.80	3.74	2.48	3.76	4.39	3.37	5.02
6.03	8.35	4.87	7.24	4.85	6.21	6.72	6.31
8.81	9.09	7.62	7.98	10.24	9.54	9.34	11.97
5.33	3.78	6.79	5.88	8.09	4.87	4.88	8.39
5.05	4.57	4.81	5.72	4.55	4.62	4.98	4.29
7.96	3.38	3.65	4.31	5.48	3.84	4.40	6.12
6.71	6.98	6.85	8.54	6.23	7.48	8.20	7.54
4.11	3.10	3.35	4.56	2.54	3.08	3.93	3.24
4.44	5.98	5.34	4.64	2.48	3.95	6.53	5.34
4.19	5.13	5.56	4.77	3.44	5.50	4.79	6.41
3.59	2.69	2.97	3.90	4.30	2.34	3.18	5.69
5.49	4.26	5.79	5.11	7.16	4.63	5.50	7.02
5.28	4.68	4.36	5.72	4.95	4.85	4.60	4.69

Experiment 14 Analyses

Sentence Results

	DF	SS	MS	F	PROB
SUBJ	63	197.5230			
Temp vs Causal	1	4.7201	4.7201	1.5811	0.21099
Conn within T/C	1	2.9282	2.9282	0.9809	0.67305
Indiv Conn	1	10.7532	10.7532	3.6020	0.05930
	60	179.1215	2.9854		
Sentence position	1	8.8778	8.8778	27.9522	0.00003
SP v T/C	1	0.0118	0.0118	0.0372	0.84190
SP v conn	1	0.0039	0.0039	0.0124	0.90789
SP v Ind conn	1	0.0279	0.0279	0.0879	0.76536
	60	19.0565	0.3176		
Clause	1	1.1045	1.1045	1.1430	0.28930
Cl v T/C	1	0.2565	0.2565	0.2655	0.61443
Cl v conn	1	0.0017	0.0017	0.0018	0.96535
Cl v Ind conn	1	0.1961	0.1961	0.2029	0.65844
	60	57.9765	0.9663		
Context	1	0.0903	0.0903	0.0816	0.77311
Cxt v T/C	1	0.4729	0.4729	0.4270	0.52298
Cxt v conn	1	0.2162	0.2162	0.1952	0.66437
Cxt v Ind conn	1	0.8745	0.8745	0.7897	0.61860
	60	66.4426	1.1074		
SP v Cl	1	0.0872	0.0872	0.2060	0.65613
SP v Cl v T/C	1	0.9661	0.9661	2.2833	0.13220
SP v Cl v conn	1	0.0017	0.0017	0.0039	0.94899
SP v Cl v Ind conn	1	0.0385	0.0385	0.0910	0.76163
	60	25.3851	0.4231		
SP v Cxt	1	0.0000	0.0000	0.0001	0.98739
SP v Cxt v T/C	1	1.0242	1.0242	7.1391	0.00947
SP v Cxt v conn	1	0.2547	0.2547	1.7754	0.18466
SP v Cxt v Ind conn	1	0.3013	0.3013	2.1000	0.14885
	60	8.6081	0.1435		
Cl v Cxt	1	0.0049	0.0049	0.0034	0.95228
Cl v Cxt v T/C	1	0.3130	0.3130	0.2199	0.64587
Cl v Cxt v conn	1	0.0996	0.0996	0.0699	0.78834
Cl v Cxt v Ind conn	1	0.0002	0.0002	0.0001	0.98775
	60	85.4219	1.4237		
SP v Cl v Cxt	1	1.4493	1.4493	0.5179	0.51861
SP v Cl v Cxt v T/C	1	7.9900	7.9900	2.8554	0.09245
SP/Cl/Cxt/T/C/conn	1	1.1438	1.1438	0.4088	0.53207
Cl v Cl v Cxt	1	1.7205	1.7205	0.6149	0.55798
v Ind Conn	60	167.8923	2.7982		
W	448	458.3121			

Subject Results

	DF	SS	MS	F	PROB
	31	741.4789			
Clause	1	0.2154	0.2154	0.2052	0.65793
	31	32.5343	1.0495		
Sentence Position	1	17.2303	17.2303	10.1060	0.00361
	31	52.8534	1.7049		
Context	1	0.1298	0.1298	0.1483	0.70429
	31	27.1363	0.8754		
Temporal/Causal	1	9.0733	9.0733	9.5985	0.00433
	31	29.3037	0.9453		
Connective	1	6.1768	6.1768	5.5905	0.02314
	31	34.2512	1.1049		
Cl v SP	1	2.3745	2.3745	1.7740	0.18981
	31	41.4941	1.3385		
Cl v Cxt	1	3.0987	3.0987	6.0268	0.01885
	31	15.9388	0.5142		
Cl v T/C	1	2.1234	2.1234	7.2560	0.01093
	31	9.0718	0.2926		
Cl v Conn	1	0.0168	0.0168	0.0168	0.89313
	31	31.0832	1.0027		
SP v Cxt	1	0.0044	0.0044	0.0158	0.89643
	31	8.7170	0.2812		
SP v T/C	1	0.0075	0.0075	0.0096	0.91933
	31	24.1095	0.7777		
SP v Conn	1	0.0243	0.0243	0.0822	0.77303
	31	9.1728	0.2959		
Cxt v T/C	1	1.0693	1.0693	0.8031	0.61941
	31	41.2750	1.3315		
Cxt v conn	1	0.3537	0.3537	0.4638	0.50768
	31	23.6380	0.7625		
Indiv connective	1	20.9449	20.9449	23.5111	0.00012
	31	27.6165	0.8909		
Cl v SP v Cxt	1	0.0259	0.0259	0.0112	0.91306
	31	71.9937	2.3224		
Cl v SP v T/C	1	0.4270	0.4270	0.5373	0.52437
	31	24.6351	0.7947		
Cl v SP v conn	1	0.0000	0.0000	0.0000	0.99260
	31	28.9368	0.9334		

Cl v Cxt v T/C	1	15.4768	15.4768	37.4779	0.00002
	31	12.8017	0.4130		
Cl v Cxt v conn	1	2.4954	2.4954	8.2131	0.00736
	31	9.4188	0.3038		
Cl v Ind conn	1	0.0456	0.0456	0.0518	0.81617
	31	27.2886	0.8803		
SP v Cxt v T/C	1	1.9018	1.9018	3.2715	0.07681
	31	18.0209	0.5813		
SP v Cxt v conn	1	0.6040	0.6040	2.3573	0.13127
	31	7.9433	0.2562		
SP v Ind conn	1	0.0879	0.0879	0.1585	0.69540
	31	17.2063	0.5550		
Cxt v Ind conn	1	1.9347	1.9347	3.0606	0.08659
	31	19.5959	0.6321		
Cl v SP v Cxt v T/C	1	0.5343	0.5343	0.2664	0.61525
	31	62.1620	2.0052		
Cl v SP v Cxt v con	1	0.1442	0.1442	0.1187	0.73233
	31	37.6520	1.2146		
Cl x SP v Ind con	1	0.4878	0.4878	0.2514	0.62518
	31	60.1492	1.9403		
Cl v Cxt v Ind con	1	3.6350	3.6350	12.4888	0.00164
	31	9.0229	0.2911		
SP v Cxt v Ind con	1	0.5037	0.5037	1.0685	0.31007
	31	14.6119	0.4714		
Cl v SP v Cxt v Ind Conn	1	0.0014	0.0014	0.0011	0.97251
	31	39.2058	1.2647		
W	992	959.9892			

Material for Experiment 15

CONTINUOUS - FORWARD

She played with the doll after she played with the lorry.
She played with the doll and the train at the same time.
She played with the clock after she played with the train.
Did she play with the lorry first?

She played with the rattle before she played with the ludo.
She played with the mouse and the ludo at the same time.
She played with the mouse before she played with the jigsaw.
Did she play with the ludo first?

Before she played with the lego she played with the tractor.
She played with the ball and the lego at the same time.
Before she played with the bear she played with the ball.
Did she play with the bear last?

After she played with the dog she played with the bat.
She played with the snap and the bat at the same time.
After she played with the snap she played with the monkey.
Did she play with the snap last?

She played with the farm once she'd played with the pencils.
She played with the balloon and the farm at the same time.
She played with the panda after she played with the balloon.
Did she play with the pencils first?

She played with the tent until she played with the rabbit.
She played with the book and the rabbit at the same time.
She played with the book until she played with the car.
Did she play with the rabbit first?

Until she played with the flute she played with the puzzles.
She played with the spaceship and the flute at the same time.
Until she played with the football she played with the spaceship.
Did she play with the football last?

Once she'd played with the blackboard she played with the radio.
She played with the ambulance and the radio at the same time.
Once she'd played with the ambulance she played with the computer.
Did she play with the ambulance last?

CONTINUOUS - BACKWARD

She played with the guitar after she played with the clock.
She played with the clock and the train at the same time.
She played with the train after she played with the doll.
Did she play with the train first?

She played with the lorry before she played with the mouse.
She played with the lorry and the jigsaw at the same time.
She played with the ludo before she played with the jigsaw.
Did she play with the mouse last?

Before she played with the rattle she played with the bear.
She played with the bear and the ball at the same time.
Before she played with the ball she played with the lego.
Did she play with the bear last?

After she played with the tractor she played with the snap.
She played with the tractor and the monkey at the same time.
After she played with the dog she played with the monkey.
Did she play with the dog first?

She played with the bat once she'd played with the panda.
She played with the panda and the balloon at the same time.
She played with the balloon once she'd played with the farm.
Did she play with the balloon first?

She played with the pencils until she played with the book.
She played with the pencils and the car at the same time.
She played with the tent until she played with the car.
Did she play with the book last?

Until she played with the rabbit she played with the football.
She played with the football and the spaceship at the same time.
Until she played with the spaceship she played with the flute.
Did she play with the football last?

Once she'd played with the puzzles she played with the ambulance.
She played with the puzzles and the computer at the same time.
Once she'd played with the blackboard she played with the computer.
Did she play with the blackboard first?

DISCONTINUOUS - FORWARD

She played with the radio after she played with the guitar.
She played with the clock after she played with the train.
She played with the radio and the train at the same time.
Did she play with the clock last?

She played with the doll before she played with the lorry.
She played with the mouse before she played with the jigsaw.
She played with the lorry and the mouse at the same time.
Did she play with the mouse last?

Before she played with the ludo she played with the rattle.
Before she played with the bear she played with the ball.
She played with the ludo and the ball at the same time.
Did she play with the rattle first?

After she played with the lego she played with the tractor.
After she played with the snap she played with the monkey.
She played with the tractor and the snap at the same time.
Did she play with the tractor first?

She played with the dog once she'd played with the bat.
She played with the panda once she'd played with the balloon.
She played with the dog and the balloon at the same time.
Did she play with the panda last?

She played with the farm until she played with the pencils.
She played with the book until she played with the car.
She played with the pencils and the book at the same time.
Did she play with the book last?

Until she played with the tent she played with the rabbit.
Until she played with the football she played with the spaceship.
She played with the tent and the spaceship at the same time.
Did she play with the rabbit first?

Once she'd played with the flute she played with puzzles.
Once she'd played with the ambulance she played with the computer.
She played with the puzzles and the ambulance at the same time.
Did she play with the puzzles first?

DISCONTINUOUS - BACKWARDS

She played with the blackboard after she played with the radio.
She played with the guitar after she played with the clock.
She played with the radio and the guitar at the same time.
Did she play with the radio last?

She played with the train before she played with the doll.
She played with the lorry before she played with the mouse.
She played with the train and the mouse at the same time.
Did she play with the lorry first?

Before she played with the jigsaw she played with the rattle.
Before she played with the bear she played with the ball.
She played with the rattle and the bear at the same time.
Did she play with the bear first?

After she played with the lego she played with the tractor.
After she played with the snap she played with the monkey.
She played with the lego and the monkey at the same time.
Did she play with the tractor last?

She played with the dog once she'd played with the bat.
She played with the panda once she'd played with the balloon.
She played with the bat and the panda at the same time.
Did she play with the bat last?

She played with the farm until she played with the pencils.
She played with the book until she played with the car.
She played with the farm and the car at the same time.
Did she play with the book first?

Until she played with the tent she played with the rabbit.
Until she played with the football she played with the spacechip.
She played with the rabbit and the football at the same time.
Did she play with the football first?

Once she'd played with the flute she played with the puzzles.
Once she'd played with the ambulance she played with the computer.
She played with the flute and the computer at the same time.
Did she play with the puzzles last?

Experiment 15 - Data

Sentence 1

Continuous

FORWARD

OOM				ROOM			
MS		SM		SM		MS	
Once	After	Bef	Until	Once	After	Bef	Until
4563	2420	2558	3923	3788	1862	3673	3029
4542	5766	2046	3942	3020	5142	3268	2158
3872	6686	7467	13029	7619	6515	8077	9541
2438	2379	1956	4980	3463	6136	3201	2353
2540	1955	2530	2511	3017	2776	2439	2228
6197	4015	2823	5406	3132	8713	3199	2425
6551	5748	5275	4087	7875	2476	14126	8269
8821	7837	4288	8245	6842	7212	4610	6326
1896	2817	2018	3329	2964	1363	2001	2010
1989	4270	1844	2123	2064	3553	1793	1839
3473	3134	4974	5590	3263	4518	4611	3570
3188	9482	3429	11100	2919	4587	2472	4915
1956	3600	3501	3191	2704	2844	2797	3606
3837	2811	2230	4895	12340	4267	3881	3441
2260	4353	2837	3594	2124	5173	4638	3855
4000	6806	3343	2762	2910	4466	2458	2027

BACKWARDS

OOM				ROOM			
MS		SM		SM		MS	
Once	After	Bef	Until	Once	After	Bef	Until
2564	4624	2179	5293	2211	1925	2491	3743
1969	6893	2055	3521	1507	3475	2836	3298
8409	7376	6767	9195	5057	6366	4900	6877
2906	4865	2828	9526	3186	7208	5153	4935
4451	3436	2732	2751	2511	1977	2465	2364
2392	5767	7226	14160	3684	4321	4585	14475
4091	9664	4994	4772	4033	4580	10627	6528
7614	3988	6946	3232	4434	4348	7636	8146
2125	1590	3647	2362	1625	2161	1537	3886
1706	1997	1872	2510	1897	2548	1766	1559
4184	4252	5270	3435	5006	3581	4665	2528
4923	3974	1973	10380	5185	5728	3322	9253
2428	3648	3801	3915	3885	5427	2240	3070
2089	5449	7092	7873	3295	3579	5182	16150
3187	2597	2051	2154	4232	6891	4438	5583
4281	2110	6284	2614	6532	7926	1358	5825

DISCONTINUOUS

FORWARD

OOM				ROOM			
MS		SM		SM		MS	
Once	After	Bef	Until	Once	After	Bef	Until
7281	2512	5400	2041	1838	7484	5206	2005
2305	1742	2150	4113	4119	3865	2223	2696
3907	6811	6358	6698	4454	4843	7867	10369
1687	2448	7467	1978	4153	4945	3321	2530
3453	2271	2778	3131	2801	3335	3071	2301
5554	4076	7938	3874	5361	6913	5546	4229
4348	12817	5585	4497	5612	2919	7679	3507
6945	4313	8363	4842	4971	3974	5843	4837
2263	1719	2508	1670	2379	1741	2036	2336
2046	1692	2597	2064	3415	2100	1905	1656
5020	5084	7377	3600	2614	3828	3447	3004
5272	3939	2944	3554	4327	3700	6415	3659
5498	3111	2299	2267	3141	2039	2608	3376
4234	6047	4905	2652	8049	6767	6202	3548
2980	3068	2870	3313	4673	4596	4033	3445
3991	3372	7906	4089	7815	11448	4198	2713

BACKWARDS

OOM				ROOM			
MS		SM		SM		MS	
Once	After	Bef	Until	Once	After	Bef	Until
3798	6627	1850	2920	2950	3755	6913	4779
3530	4052	2243	3684	2989	5119	4136	2570
0810	8593	4554	5207	7078	7289	5610	4961
3185	6710	3819	4893	6732	3714	2532	2375
2456	3975	5090	2592	3416	2963	2560	2146
3559	5241	3157	4077	5625	4979	4227	3430
3958	3269	5428	12962	8265	3537	6021	5162
4138	7264	7074	4645	5363	5072	4654	3126
1876	2692	3668	2412	1624	1530	2018	2213
2348	1992	2115	1769	2344	1560	2097	1939
5429	1953	3061	4968	6169	3285	4241	3032
3193	4730	3144	5739	7184	8945	2523	5736
2594	2347	3683	5993	3366	2550	2825	2856
5353	3041	9548	2890	5256	5942	7950	3976
9503	2772	3780	3604	2153	3530	2426	3633
4553	8034	4734	2234	3489	4122	4040	3184

Sentence 2

CONTINUOUS

FORWARD

OOM				ROOM			
MS		SM		SM		MS	
Once	After	Bef	Until	Once	After	Bef	Until
2673	2884	2900	2785	2216	3303	2549	2279
3318	3582	2258	5648	2609	2086	7247	5375
8654	4589	4825	3830	4882	7364	3187	4507
2385	2742	1787	3577	2388	5853	2560	1821
3400	2767	2416	3863	2325	3729	2506	2004
3369	4014	3113	6800	2534	3679	2515	2069
5322	1949	2754	4179	6029	2788	4752	6295
2590	5322	3774	4703	2859	4078	3047	3819
2525	2927	2051	2123	4517	2309	1942	2497
1693	3654	5942	1768	3179	2590	1596	2400
2693	3003	2848	2402	2575	3078	2293	3016
3376	4675	3320	3341	1911	4300	5484	3226
4487	2778	2475	2740	2251	3637	2875	2635
2930	3186	2908	4184	4067	2715	4674	2154
2747	2534	2527	2647	2551	3668	3775	3071
3646	2439	1771	2800	1129	1917	2690	2097

BACKWARD

OOM				ROOM			
MS		SM		SM		MS	
Once	After	Bef	Until	Once	After	Bef	Until
2600	1492	2207	1780	2776	1779	1621	1876
3143	4441	2960	3471	3666	6329	4571	2353
5389	5906	5969	5271	3034	5737	3104	3437
4569	2949	2274	1989	1884	2921	5654	3884
2219	2304	2527	3019	3105	2431	3414	1872
4182	4743	9065	4757	3131	2115	6291	1975
2776	3018	6012	4306	6482	2615	3894	3928
3218	3304	6916	5434	2945	5848	3530	2379
3151	1622	3898	2590	2584	3999	1775	2489
2256	2534	2059	2184	3478	4996	2074	1987
3448	2345	3533	2519	3186	2687	3020	3561
5063	2639	1955	2158	3098	4839	4265	2128
2843	3144	3297	4874	3370	5717	2608	3068
5377	3782	5026	3329	3401	2605	4494	3674
2860	3630	3734	2694	2999	3852	3115	2506
2105	2853	2068	1804	2826	2596	2271	1872

DISCONTINUOUS

FORWARD

OOM				ROOM			
MS		SM		SM		MS	
Once	After	Bef	Until	Once	After	Bef	Until
2540	2261	1659	2373	5383	1912	2624	2705
4150	4602	2173	7810	3909	11310	3763	5716
10908	7410	9617	8188	5848	10113	5377	11208
2785	5543	2463	3170	2868	1944	3760	2164
2089	5902	3882	2943	2146	1819	1976	2873
8512	7758	6192	9257	3819	9633	4287	3827
5625	9657	7787	7113	7660	6118	5363	5591
10063	8249	6643	7729	7326	8695	5408	5404
4387	2765	5189	3166	2624	3152	2198	2928
2191	1882	2132	2622	1960	1967	2168	1792
5693	3934	3918	4924	2685	2728	1964	4048
2301	7934	11347	6635	8888	2542	2008	2509
3916	4364	3211	1967	3275	3684	1976	2623
9107	5023	2958	2002	1717	5001	5390	3353
4833	14208	6401	4884	3860	6035	3340	6711
4768	3518	3332	5611	8956	4246	6432	2404

BACKWARD

Once	After	Bef	Until	Once	After	Bef	Until
OOM				ROOM			
MS		SM		SM		MS	
2223	1869	4760	8193	3831	1978	1867	2515
5573	3141	4391	3867	6219	5238	4556	3102
12705	9529	12036	7136	14507	3821	9166	15253
6036	3733	3546	6400	4827	3662	3665	5916
3392	3531	4490	3186	4030	2960	3513	2798
6050	6730	5669	6152	6333	6399	9631	8610
9938	3603	5991	10307	6385	10169	8470	12478
4956	7883	9015	4073	8259	6628	6786	3782
4265	6054	10101	4751	2328	2515	1555	5475
2800	1664	4999	3114	1840	1797	2597	1901
4257	54 47	3603	5583	5529	2195	3481	3126
3238	8953	6242	5928	8599	4554	2774	3685
3328	2364	2696	1767	3236	2837	3322	2429
8282	5961	3538	4130	1533	3913	2386	4199
3623	7006	7737	4682	3359	4475	3826	2940
3541	3532	4891	2223	3275	2483	3795	2142

Sentence 3

FORWARD

OOM MS				OOM SM			ROOM MS
Once	After	Bef	Until	Once	After	Bef	Until
3712	3796	8406	1819	2662	2877	2573	1623
3856	5523	3529	3073	2812	6967	2571	3823
2953	7958	9618	14584	9407	4333	6130	4427
3065	4988	2829	4179	3091	4594	3496	2850
2819	4285	3978	3462	2035	1559	2923	2408
3703	2261	7832	8611	2610	2310	3190	1554
4377	4121	5593	4986	6356	3132	2669	5874
3691	5206	5645	9048	2526	4687	5430	2296
2102	3470	4552	4697	3527	2378	2342	1890
1746	1809	2376	1406	2031	1902	1526	2383
6457	7551	6626	6862	5394	3338	4678	3001
3817	5410	7943	5961	8610	4907	4382	6645
2513	5458	3437	4997	2968	2293	2880	2687
2777	3720	10756	8235	2238	5464	5461	6055
2886	3444	5636	4498	3282	2263	3917	6586
3167	2480	5617	5873	2796	3175	2802	2953

BACKWARD

OOM MS				OOM SM			ROOM MS
Once	After	Bef	Until	Once	After	Bef	Until
7805	4769	1993	3929	8051	4602	1777	2866
3727	3450	2796	2967	3026	5762	5457	4050
7580	8284	6026	6191	10185	12508	10353	4618
2450	3746	3336	6565	5452	3150	4367	2333
4474	6197	2937	5165	3092	3463	3078	3924
2166	5306	3777	1988	3574	8264	2259	4212
2326	9281	4731	2819	6420	6724	2756	3919
5522	6406	5221	7208	6444	7883	4501	4216
3101	5219	3412	8001	2602	5563	4874	2120
2071	3398	2179	3893	1683	3805	2259	2962
4827	5006	10637	3376	7403	4857	4260	4612
15947	6169	4441	5667	9280	6540	7031	7021
2768	3083	2999	6117	2795	10419	2840	2302
3826	6932	5702	4505	5208	6468	5651	5799
5081	5658	19121	4564	5092	8754	4534	7749
2751	2799	3038	4836	3315	4730	3969	3610

DISCONTINUOUS FORWARD

OOM MS				OOM SM			ROOM MS
Once	After	Bef	Until	Once	After	Bef	Until
6564	7142	1651	1729	3549	3386	4032	5172
6475	5681	3857	4786	6961	2738	2661	2988
7818	5911	11204	7987	6875	5499	3989	7524
2237	4111	2651	3289	6618	3905	3387	1978
2691	3208	3657	5457	2538	3825	3522	2482
5894	7271	10836	3186	7780	8276	12249	4180
6030	6427	8367	9189	4974	4156	7909	4612
4079	3100	12313	2788	4536	1830	12025	2242
4412	4197	3634	4385	4840	4017	4370	3725
1910	2851	2832	3549	1797	3621	2158	1835
2421	4244	3328	3594	3778	3469	3952	5137
3530	13209	18905	2798	5976	3649	2603	2023
3454	3718	3754	2512	3522	3057	1729	2560
408	5046	5624	10700	4424	17394	7883	4911
2983	3824	12819	9231	4986	8212	3650	20371
2480	4832	4656	9389	2467	3412	2273	1155

DISCONTINUOUS BACKWARD

OOM MS				OOM SM			ROOM MS
Once	After	Bef	Until	Once	After	Bef	Until
4114	4439	2622	2798	1867	1234	1793	1679
3958	4721	4419	10809	2995	7258	3192	3857
7489	10922	6558	10418	12283	9807	15586	8061
8766	3093	2749	4254	1971	2140	3086	2285
3406	2614	2882	5632	4019	9901	8698	6397
19536	8434	5090	15321	6858	12133	7749	5759
6589	6360	8914	11314	8591	6381	8218	9857
8008	5361	3589	4463	3841	5989	5726	6389
6269	4981	9258	7256	3799	4583	3954	4990
2116	2207	2256	2485	2884	2023	2315	2451
5335	4139	8818	4161	2814	7000	6400	6916
4651	3779	4923	9414	12021	3340	5263	4854
3467	3054	3087	2430	3367	2750	3148	2574
7493	11276	4821	5834	4765	1424	6476	4861
20194	43584	24476	7488	17161	24453	64191	19631
3110	7326	4781	4743	3002	8686	2328	7128

Results from all experiment 15 data

	DF	SS	MS	F	PROB
SUBJ	15	2989554951.0000			
Sentence	2	442681084.4219	221340542.2109	5.0780	0.01248
	30	1307632126.2656	43587737.5422		
Cont/Disc	1	333754822.9401	333754822.9401	8.6205	0.00995
	15	580748113.3932	38716540.8929		
Forward/Backward	1	119189094.0000	119189094.0000	6.0308	0.02541
	15	296451775.6667	19763451.7111		
OOM/ROOM	1	32516073.4219	10838691.1406	1.7463	0.16984
	15	279294649.8281	6206547.7740		
Aft/once v Bef/unt	1	18234395.0104	18234395.0104	2.7263	0.11637
	15	100325319.9479	6688354.6632		
Sent vs C/Disc	2	233940354.5208	116970177.2604	3.8283	0.03217
	30	916628174.8333	30554272.4944		
Sent vs F/B	2	122597751.3906	61298875.6953	2.6564	0.08504
	30	692284887.2552	23076162.9085		
Sent vs OOM	2	51378760.4219	8563126.7370	1.4053	0.22052
	30	548429852.8906	6093665.0321		
Sent vs Conn	2	3235872.7708	1617936.3854	0.2778	0.76290
	30	174731439.5833	5824381.3194		
C/Disc vs F/B	1	10370419.3359	10370419.3359	0.8408	0.62319
	15	185016051.4141	12334403.4276		
C/Disc vs OOM	1	38158308.5339	12719436.1780	2.5520	0.06630
	15	224284457.3828	4984099.0530		
C/Disc vs Conn	1	8427423.8776	8427423.8776	0.7215	0.58649
	15	175206580.5807	11680438.7054		
F/B vs OOM	1	625989.3594	208663.1198	0.0246	0.99426
	15	381718452.8906	8482632.2865		
F/B vs Conn	1	13963664.2604	13963664.2604	1.9520	0.18015
	15	107303067.3646	7153537.8243		
OOM vs Conn	1	41431319.1510	13810439.7170	3.1733	0.03248
	15	195843761.1406	4352083.5809		
Sent v C/D v F/B	2	32960820.2969	16480410.1484	1.0765	0.35466
	30	459297607.0156	15309920.2339		
Sent v C/D v OOM	2	67064101.3021	11177350.2170	2.6784	0.01927
	30	375579360.8438	4173104.0094		
Sent v C/D v Conn	2	32233191.3490	16116595.6745	2.6402	0.08623
	30	183128502.7552	6104283.4252		

Analysis of all data (continued)

Sent v F/B v OOM	2	83940115.6719	13990019.2786	1.6027	0.15486
	30	785615269.5156	8729058.5502		
Sent v F/B v Conn	2	29687208.6302	14843604.3151	3.0203	0.06237
	30	147440233.9323	4914674.4644		
Sent v OOM v Conn	2	22192947.4271	3698824.5712	0.9567	0.53977
	30	347975418.7188	3866393.5413		
C/D v F/B v OOM	1	9519265.1589	3173088.3863	0.4538	0.71973
	55	314676154.1745	6992803.4261		
C/D v F/B v Conn	1	9408467.3151	9408467.3151	1.2087	0.28901
	15	116760266.0599	7784017.7373		
C/D v OOM v Conn	1	4457526.4193	1485842.1398	0.3559	0.78774
	15	187863483.2057	4174744.0712		
F/B v OOM v Conn	1	11784130.2552	3928043.4184	0.9939	0.59431
	15	177843200.2031	3952071.1156		
Sent v C/D v F/B v OOM	2	33293666.7240	5548944.4540	1.0577	0.39424
	30	472173028.6302	5246366.9848		
Sent v C/D v F/B v Conn	2	17046634.9427	8523317.4714	0.8355	0.55308
	30	306059582.3698	10201986.0790		
Sent v C/D v OOM v Conn	2	36691629.5573	6115271.5929	1.4389	0.20784
	30	382487036.0052	4249855.9556		
Sent v F/B v OOM v Conn	2	58983438.8698	9830573.1450	2.3955	0.03370
	30	369340277.2344	4103780.8582		
C/D v F/B v OOM v Conn	1	34230413.7943	11410137.9314	2.0407	0.12040
	15	251604850.7474	5591218.9055		
Sent v C/D v F/B v OOM v Conn	2	21867736.7448	3644622.7908	0.6062	0.72683
	30	541116091.7760	6012401.0197		

Sentence 1 v Sentence 2 (Discontinuous) v Sentence 3 (Continuous)

	DF	SS	MS	F	PROB
SUBJ	151	578175870.2383			
Sentence	2	52989612.8229	26494806.4115	2.2942	0.11655
	30	346461835.5938	11548727.8531		
Forward/Backward	1	19704023.7305	19704023.7305	6.1473	0.02426
	15	48079429.7070	3205295.3138		
ROOM/OOM	1	44599942.2201	44599942.2201	13.0293	0.00284
	15	51345598.4674	3423039.8978		
Ref Conn	1	1641967.6055	1641967.6055	0.7485	0.59524
	15	32903196.7487	2193546.4499		
Indiv Conn	1	2168243.8138	2168243.8138	0.8926	0.63772
	15	36438501.3737	2429233.4249		
Sent vs F/B	2	9037636.9688	4518818.4844	1.1943	0.31709
	30	113507192.5313	3783573.0844		
Sent vs OOM	2	27113541.7604	13556770.8802	6.0376	0.00645
	30	67361476.9896	2245382.5663		
Sent vs Ref Con	2	4373839.9688	2186919.9844	0.6590	0.52907
	30	99552485.3646	3318416.1788		
Sent vs Ind Con	2	1475012.5104	737506.2552	0.1907	0.82867
	30	116009379.7396	3866979.3247		
F/B vs OOM	1	8563019.5638	8563019.5638	2.1355	0.16175
	15	60147151.2070	4009810.0805		
F/B vs Ref Con	1	1234967.7201	1234967.7201	0.3989	0.54338
	15	46440929.8841	3096061.9923		
F/B vs Ind Con	1	298896.8763	298896.8763	0.0685	0.79235
	15	65406448.8945	4360429.9263		
OOM vs Ref Con	1	24261808.6055	24261808.6055	12.5997	0.00316
	15	28883798.4154	1925586.5610		
OOM vs Ind Con	1	487882.0951	487882.0951	0.1596	0.69666
	15	45860818.7591	3057387.9173		
Ref Con vs Ind Con	1	4560404.6367	4560404.6367	1.5636	0.22870
	15	43750254.8841	2916683.6589		
Sent v F/B v OOM	2	11150819.8229	5575409.9115	2.1767	0.12928
	30	76841896.8437	2561396.5615		
Sent v F/B v Ref Con	2	58228570.5729	29114285.2865	8.8689	0.00124
	30	98482516.0104	3282750.5337		
Sent v F/B v Ind Con	2	14068392.5417	7034196.2708	3.6855	0.03606
	30	57257788.1250	1908592.9375		

Analysis of Sent 1/Sent 2 (Disc)/Sent 3 (Cont) (continued)

Sent v OOM	2	19284294.9688	9642147.4844	2.0438	0.14549
v Ref Con	30	141533968.6979	4717798.9566		
Sent v OOM	2	2321902.1667	1160951.0833	0.2149	0.80981
v Ind Con	30	162062161.4167	5402072.0472		
Sent v Ref Con	2	9848981.6250	4924490.8125	1.7675	0.18655
v Ind Con	30	83585906.0417	2786196.8681		
F/B v OOM	1	768803.9076	768803.9076	0.2280	0.64415
v Ref Con	15	50576189.6966	3371745.9798		
F/B v OOM	1	3603237.0117	3603237.0117	1.8992	0.18592
v Ind Con	15	28458683.4258	1897245.5617		
F/B v Ref Con	1	714737.0326	714737.0326	0.3402	0.57441
v Ind Con	15	31515850.2383	2101056.6826		
OOM v Ref Con	1	4646185.1888	4646185.1888	1.1345	0.30426
v Ind Con	15	61432343.9987	4095489.5999		
Sent v F/B v OOM	2	2767560.3854	1383780.1927	0.4458	0.64989
v Ref Con	30	93117869.6979	3103928.9899		
Sent v F/B v OOM	2	2973214.3438	1486607.1719	0.4692	0.63544
v Ind Con	30	95055709.1563	3168523.6385		
Sent v F/B v Ref C	2	9315419.3854	4657709.6927	1.6438	0.20879
v Ind Con	30	85004155.5313	2833471.8510		
Sent v OOM v Ref C	2	4419840.9479	2209920.4740	0.4542	0.64470
v Ind Con	30	145981016.0521	4866033.8684		
F/B c OOM v Ref C	1	1853.1888	1853.1888	0.0005	0.98012
v Ind Con	15	53593810.0820	3572920.6721		
Sent v F/B v OOM	2	8567760.0417	4283880.0208	1.3229	0.28095
v Ref v Ind Con	30	97145703.3750	3238190.1125		

Material for Experiment 16

CONTINUOUS SETS

(Sentences in Sub-Main condition with after as connective)
Discontinuous sets formed by changing over sentences 2 and 3)

After she bought the scarf she bought the hat.
After she bought the hat the bought the coat.
After she bought the coat she bought the shoes.
Did she buy the scarf first?

After she broke the jug she broke the plate.
After she broke the plate she broke the cup.
After she broke the cup she broke the dish.
Did she break the plate first?

After she lost the money she lost the keys.
After she lost the keys she lost the gloves.
After she lost the gloves she lost the purse.
Did she lose the purse last?

After she baked the scones she baked the bread.
After she baked the bread she baked the pie.
After she baked the pie she baked the cake.
Did she bake the pie last?

After she fried the bacon she fried the eggs.
After she fried the eggs she fried the sausage.
After she fried the sausage she fried the tomatoes.
Did she fry the bacon first?

After she ate the apple she ate the orange.
After she ate the orange she ate the banana.
After she ate the banana she ate the peach.
Did she eat the orange first?

After she drank the beer she drank the water.
After she drank the water she drank the coffee.
After the drank the coffee she drank the gin.
Did she drink the gin last?

After she fed the dog she fed the cat.
After she fed the cat she fed the hamster.
After she fed the hamster she fed the canary.
Did she feed the hamster last?

After she played the flute she played the guitar.
After she played the guitar she played the violin.
After she played the violin she played the piano.
Did she play the flute first?

After she read the letter she read the paper.
After she read the paper she read the poem.
After she read the poem she read the book.
Did she read the paper first?

After she cleaned the cooker she cleaned the fridge.
After she cleaned the fridge she cleaned the sink.
After she cleaned the sink she cleaned the windows.
Did she clean the windows last?

After she wrapped the doll she wrapped the teddy.
After she wrapped the teddy she wrapped the jigsaw.
After she wrapped the jigsaw she wrapped the ball.
Did she wrap the jigsaw last?

After she drew the birds she drew the trees.
After she drew the trees she drew the house.
After she drew the house she drew the clouds.
Did she draw the birds first?

After she sewed the collar she sewed the hems.
After she sewed the hems she sewed the seams.
After she sewed the seams she sewed the cuffs.
Did she sew the hems first?

After she visited the castle she visited the church.
After she visited the church she visited the shops.
After she visited the shops she visited the museum.
Did she visit the museum last?

After she washed the skirt she washed the socks.
After she washed the socks she watched the vest.
After she washed the vest she washed the jumper.
Did she wash the vest last?

Experiment 16 -Sentence Data

Continuous				Discontinuous			
OOM		ROOM		OOM		ROOM	
SM Aft	MS Bef	SM Bef	MS Aft	SM Aft	MS Bef	SM Bef	MS Aft
			Sentence 1				
1.90	2.01	1.92	1.37	1.42	2.37	2.52	1.96
1.33	2.52	2.91	1.84	1.43	2.12	3.33	2.02
1.56	2.38	2.28	1.78	1.67	1.98	2.46	1.73
1.70	2.71	3.29	2.31	1.67	2.28	2.80	1.74
2.10	2.40	2.28	2.26	1.80	1.84	2.07	2.96
2.35	2.05	2.77	2.13	1.86	2.15	2.23	2.60
1.31	2.36	2.28	2.50	2.10	1.38	1.92	4.55
1.68	1.69	2.26	2.22	2.75	1.80	2.55	3.00
2.10	1.23	1.63	2.17	2.55	1.22	1.46	2.16
2.97	2.48	2.29	2.76	2.63	1.73	1.87	1.85
1.83	2.31	2.31	3.06	2.50	1.91	1.66	1.83
1.96	1.95	2.75	2.26	2.49	2.07	2.46	2.09
2.20	2.35	1.52	1.48	1.87	2.31	2.04	1.59
2.09	1.98	1.70	1.89	2.10	2.76	1.12	1.65
3.09	2.76	2.33	2.07	2.31	2.81	1.86	1.91
2.70	2.10	1.89	1.87	1.43	2.40	1.73	1.29
			Sentence 2				
2.04	3.08	3.45	1.64	2.15	2.08	2.35	2.74
3.71	2.23	3.80	1.92	1.98	2.14	2.74	2.37
3.37	2.25	5.37	1.71	1.88	2.89	2.16	3.08
4.79	2.90	3.69	1.29	2.08	2.42	2.75	3.17
2.49	3.09	3.16	2.98	2.54	3.15	1.95	2.46
3.20	4.34	2.93	2.36	2.05	2.65	2.14	3.38
2.20	2.27	2.85	2.35	2.38	2.72	2.29	2.57
3.17	2.12	2.42	3.76	2.53	2.45	2.21	2.85
3.03	2.34	3.52	1.07	3.07	2.90	1.66	1.90
2.82	2.96	2.69	1.08	3.13	3.37	1.92	2.23
3.38	2.52	2.99	3.03	2.68	3.13	1.83	1.81
3.91	2.50	4.09	2.39	2.75	2.45	2.39	1.79
4.07	5.16	2.35	1.69	1.96	3.05	2.08	1.73
2.37	2.86	1.40	2.35	1.89	4.29	1.30	2.24
4.72	4.21	1.94	3.09	2.51	2.42	1.79	1.69
3.63	3.67	2.02	3.60	2.11	4.80	3.52	1.59
			Sentence 3				
3.01	3.90	3.66	2.00	1.84	3.03	2.54	2.76
5.70	3.26	6.99	2.38	1.01	1.77	2.46	1.34
3.57	3.86	5.98	1.33	1.74	2.12	2.47	3.44
4.14	5.23	5.33	1.62	4.07	2.07	2.33	1.61
3.75	3.31	3.91	4.03	2.82	1.59	1.52	2.71
3.54	3.62	5.89	4.18	1.34	1.87	1.74	2.76
2.66	3.19	4.46	3.88	1.98	1.49	1.50	2.12
3.17	2.92	2.83	4.10	1.91	1.65	1.31	3.03
5.35	2.54	3.71	3.00	4.00	2.20	1.02	1.48
4.52	2.72	4.48	3.16	3.12	2.29	1.57	1.75
5.02	2.39	4.01	3.67	3.05	2.32	1.40	1.26
3.98	2.33	3.92	2.86	2.47	2.40	1.76	1.64
5.36	6.10	3.88	2.92	1.77	2.13	1.11	1.28
3.49	3.54	2.89	4.11	1.22	3.47	1.87	1.41
4.39	5.22	2.72	5.45	2.46	3.35	1.73	1.66
5.04	3.99	2.89	5.55	1.51	4.18	1.85	1.14

Experiment 16 - Subject Data

Continuous				Discontinuous			
OOM		ROOM		OOM		ROOM	
SM Aft	MS Bef	SM Bef	MS Aft	SM Aft	MS Bef	SM Bef	MS Aft
			Sentence 1				
2.45	2.43	2.82	3.87	1.21	1.71	1.54	1.95
3.10	2.46	2.79	2.60	2.60	3.01	2.92	3.08
1.72	1.81	2.52	1.66	1.74	2.05	1.87	1.52
2.79	1.73	2.02	2.18	1.93	1.20	0.90	1.47
1.56	2.39	1.59	1.91	1.60	2.09	1.84	2.09
1.84	2.05	2.21	2.03	1.42	1.99	1.41	1.71
1.44	2.22	1.38	1.77	2.19	3.12	2.82	2.80
1.83	2.31	2.48	1.68	1.58	1.29	1.31	0.82
1.51	1.25	0.82	1.10	1.37	1.69	1.22	1.43
1.81	2.35	2.49	1.62	2.32	1.86	2.25	1.89
3.72	3.13	2.59	4.23	3.70	3.16	4.27	3.96
2.23	2.97	2.24	2.98	1.79	2.21	1.88	1.70
1.65	1.94	1.44	1.93	1.76	1.95	1.76	2.52
2.26	1.42	2.68	2.25	1.05	1.02	1.35	1.20
2.64	2.33	2.81	2.58	3.08	3.03	5.22	3.42
1.09	1.59	1.27	1.28	1.30	1.13	1.85	1.70
0.94	2.61	2.47	2.01	1.78	1.51	1.69	1.30
3.58	3.75	2.64	3.50	2.25	3.06	1.99	3.08
1.56	2.01	2.08	2.77	2.00	1.49	2.22	2.21
1.37	1.36	1.12	1.19	4.03	2.83	3.36	2.74
			Sentence 2				
3.54	2.85	2.51	4.38	1.50	3.10	1.63	1.64
3.86	2.89	2.79	3.43	2.87	3.60	1.68	3.36
4.37	6.63	6.28	7.93	1.28	2.30	1.86	1.42
4.78	3.00	1.98	2.66	2.85	2.18	3.03	1.91
3.38	2.90	2.04	2.50	2.04	2.97	2.46	2.10
3.69	2.49	1.22	2.56	1.77	1.68	1.29	1.30
1.98	2.06	2.13	2.48	2.51	3.04	2.41	3.27
2.25	1.90	1.51	1.40	1.27	1.00	0.99	0.97
1.66	2.01	1.21	1.51	1.70	1.50	1.11	1.32
3.15	1.70	0.91	2.25	2.27	2.13	3.57	2.91
2.85	4.28	2.35	3.19	4.11	4.16	3.56	3.11
2.10	3.64	2.34	2.35	2.50	4.83	3.19	2.94
4.36	3.06	4.63	5.85	2.39	3.28	1.70	2.51
3.69	1.71	1.23	2.61	1.32	1.63	1.07	1.33
4.92	3.39	2.37	3.74	3.74	5.90	3.38	2.54
2.99	2.13	1.08	1.44	1.69	1.45	1.40	1.19
4.44	3.93	3.02	2.35	2.48	2.86	2.16	2.17
4.12	4.30	3.33	3.35	2.36	2.87	2.06	1.86
2.31	3.52	1.17	3.04	2.91	2.81	2.86	2.17
1.71	2.24	1.28	1.68	3.57	5.35	5.60	3.86

Continuous				Discontinuous			
OOM		ROOM		OOM		ROOM	
SM Aft	MS Bef	SM Bef	MS Aft	SM Aft	MS Bef	SM Bef	MS Aft
Sentence 3							
4.40	3.78	3.43	4.09	1.84	1.87	1.89	2.84
4.34	4.91	4.03	5.21	2.34	1.59	1.64	1.37
9.19	9.35	9.43	13.01	1.55	1.61	1.10	1.14
5.32	3.08	2.08	4.81	1.07	1.44	0.83	1.04
3.95	3.09	3.51	3.77	1.18	1.83	1.22	1.32
5.43	3.41	2.37	4.76	1.22	1.94	1.13	1.40
3.32	3.33	2.44	2.69	3.08	3.32	3.01	3.14
2.64	2.33	1.38	2.27	1.59	1.27	1.13	1.85
1.58	1.72	2.35	1.66	0.71	1.17	0.85	0.52
3.61	2.02	1.63	1.84	2.49	2.86	2.69	2.64
3.92	3.92	3.37	4.16	3.95	3.97	3.69	3.54
3.02	3.51	2.19	4.58	3.52	5.33	2.52	1.69
6.74	4.06	10.29	7.98	2.40	1.71	1.79	1.36
4.06	2.87	2.09	4.26	1.38	2.48	0.94	1.22
4.54	3.33	2.83	5.00	4.80	5.80	2.54	2.66
2.54	2.03	2417	1.86	1.62	1.31	1.56	1.87
3.87	3.64	2.18	2.64	4.71	1.66	1.09	1.15
5.41	7.11	5.75	5.28	1.28	2.37	1.27	0.96
2.61	3.64	2.15	2.58	2.42	1.70	2.93	1.78
2.88	1.52	1.36	1.95	2.26	2.16	5.41	1.76

Experiment 16 - Sentence Analysis

	DF	SS	MS	F	PROB
SUBJ	47	62.1356			
Sentence	2	46.3318	23.1659	65.9629	0.00000
	45	15.8038	0.3512		
Continuous/Disc	1	55.2825	55.2825	117.2117	0.00000
Sent v Cont/Disc	2	50.8340	25.4170	53.8898	0.00000
	45	21.2241	0.4716		
OOM v ROOM	1	4.2715	4.2715	5.3529	0.02385
Sent v OOM/ROOM	2	4.6869	2.3434	2.9367	0.06172
	45	35.9091	0.7980		
Clause Order	1	1.1159	1.1159	1.3440	0.25115
Sent v Cl Ord	2	1.3668	0.6834	0.8231	0.55090
	45	37.3614	0.8303		
Cont/Disc v OOM/ROOM	1	0.0963	0.0963	0.2558	0.62132
Sen/con/dis/OOM	2	1.1312	0.5656	1.5031	0.23211
	45	16.9333	0.3763		
Con/Disc v Cl Ord	1	8.3544	8.3544	19.8891	0.00017
Sen/con/dis/Cl Ord	2	3.5809	1.7905	4.2625	0.01970
	45	18.9022	0.4200		
OOM v Cl Ord	1	1.3020	1.3020	2.0612	0.15450
Sen/OOM/Cl Ord	2	0.6163	0.3081	0.4878	0.62274
	45	28.4248	0.6317		
Con/Dis/OOM/Cl Ord	1	0.4227	0.4227	0.5683	0.53873
Sent v Con/Dis v OOM v Cl Order	2	0.1100	0.0550	0.0739	0.92840
	45	33.4668	0.7437		
W	336	325.3930			

Experiment 16 - Subject analysis

SOURCE	DF	SS	MS	F	PROB
SUBJ	59	350.9170			
Sentence	2	57.6925	28.8462	5.6074	0.00622
	57	293.2246	5.1443		
Continuous/Disc	1	68.1089	68.1089	12.4213	0.00118
Sent v Cont/Disc	2	63.0023	31.5011	5.7450	0.00560
	57	312.5439	5.4832		
OOM v ROOM	1	5.6182	5.6182	9.5072	0.00346
Sent v OOM/ROOM	2	5.8433	2.9217	4.9441	0.01047
	57	33.6834	0.5909		
Clause Order	1	1.4312	1.4312	3.2827	0.07177
Sent v Cl Ord	2	1.8980	0.9490	2.1768	0.12078
	57	24.8505	0.4360		
Cont/Disc v OOM/ROOM	1	0.0788	0.0788	0.1316	0.71887
Sen/con/dis/OOM	2	1.3305	0.6652	1.1107	0.33695
	57	34.1392	0.5989		
Con/Disc v Cl Ord	1	10.4932	10.4932	26.5799	0.00004
Sen/con/dis/Cl Ord	2	4.6337	2.3169	5.8687	0.00510
	57	22.5024	0.3948		
OOM v Cl Ord	1	1.6509	1.6509	3.4769	0.06404
Sen/OOM/Cl Ord	2	0.7269	0.3634	0.7654	0.52606
	57	27.0641	0.4748		
Con/Dis/OOM/Cl Ord	1	0.5434	0.5434	1.6469	0.20188
Sent v Con/Dis v OOM v Cl Order	2	0.1679	0.0840	0.2544	0.77944
	57	18.8071	0.3299		
W	420	639.1177			

Material for Experiment 17

NOMINAL - 1 ANTECEDENT

Marcel picked up a rubber.
He threw it at Tom.
Did Marcel pick up a rubber?

Susan received a book.
It was her favourite present.
Did she receive a record?

Liz looked for her book.
It had been left on the table.
Did she want her book?

Peter ate a pie.
It made him feel sick.
Had Peter been hungry?

Joanne posted a letter.
It was a token of sympathy.
Did she post a letter?

Philip swallowed the tablet.
It tasted awful.
Was Philip ill?

Andy sold a chair.
It was an antique.
Was Andy an antique dealer?

Elaine saw a pigeon.
It was soaring high above the trees.
Did Elaine have her eyes closed?

Brian played the recorder.
It was a rather inferior instrument.
Did Brian play the trombone?

Alison had a car.
It was always breaking down.
Could Alison drive?

Peter was given a top.
It broke after a short time.
Did he have a top?

Sue played tennis.
It was her favourite game.
Was Sue lazy?

NOMINAL - 2 ANTECEDENTS

Marcel picked up a pencil and a rubber.
He threw it at Tom.
Did Marcel pick up a rubber?

Susan received a book and a jumper.
It was her favourite present.
Did she receive a record?

Liz looked for the thermos and her book.
It had been left on the table.
Did she want her book?

Peter ate a pie and a chocolate bar.
It made him feel sick.
Had Peter been hungry?

Joanne posted a letter and a card.
It was a token of sympathy.
Did she post a letter?

Philip drank the medicine and swallowed the tablet.
It tasted awful.
Was Philip ill?

Andy sold a chair and a desk.
It was an antique.
Was Andy an antique dealer?

Elaine saw a seagull and a pigeon.
It was soaring high above the trees.
Did Elaine have her eyes closed?

Brian played the recorder and the violin.
It was a rather inferior instrument.
Did Brian play the trombone?

Alison had a motorbike and a car.
It was always breaking down.
Could Alison drive?

Peter was given a top and a jack-in-the-box.
It broke after a short time.
Did he have a top?

Sue played football and tennis.
It was her favourite game.
Was Sue lazy?

TEMPORAL - 1 ANTECEDENT

Paul went to the gallery on Tuesday.
It was a good day.
Did he go to the museum on Wednesday?

Kate knocked down the shed on Sunday.
It was an exhausting day.
Did she work hard?

Sam went to a party at lunchtime.
It was a very boring two hours.
Did Sam enjoy socializing?

Juliet went to the park after lunch.
It was a good two hours.
Did Juliet go to the park in the afternoon?

Louise made a business trip to Paris in July.
It was a successful month.
Did she visit Canada in July?

Dave was filming in Rome all January.
It was a tiring month.
Was Dave a film star?

Sue played in the band on Friday night.
It was an exciting night.
Did Sue play in the band on Tuesday?

John went to a meeting on Tuesday night.
It was a boring night.
Was the meeting boring?

Joan played hockey on Saturday afternoon.
It was an exhausting afternoon.
Did she play hockey on Sunday?

Philip saw the dentist on Friday morning.
It was an unpleasant morning.
Did Philip need treatment?

Linda was in France last week.
It was an interesting week.
Did she visit Scotland last week?

Robert spent this week rock climbing.
It was an enjoyable week.
Was Robert fit?

TEMPORAL - 2 ANTECEDENTS

Paul went to the museum on Tuesday and the gallery on Wednesday.
It was a good day.
Did he go to the museum on Wednesday?

Kate knocked down the shed on Sunday and chopped the wood on Monday.
It was an exhausting day.
Did she work hard?

Sam went to a party at lunchtime and another in the evening.
It was a very boring two hours.
Did Sam enjoy socializing?

Juliet went shopping in the morning and to the park after lunch.
It was a good two hours.
Did Juliet go to the park in the afternoon?

Louise made a business trip to Canada in June and Paris in July.
It was a successful month.
Did she visit Canada in July?

Dave was filming in Rome all January and Milan all March.
It was a tiring month.
Was Dave a film star?

Sue played in the orchestra on Tuesday night and the band on Friday night.
It was an exciting night.
Did Sue play in the band on Tuesday?

John went to a meeting on Tuesday night and a film on Thursday night.
It was a boring night.
Was the meeting boring?

Joan played hockey on Saturday afternoon and squash on Sunday afternoon.
It was an exhausting afternoon.
Did she play hockey on Sunday?

Philip saw the doctor on Monday morning and the dentist on Friday morning.
It was an unpleasant morning.
Did Philip need treatment?

Linda was in France last week and in Scotland this week.
It was an interesting week.
Did she visit Scotland last week?

Robert spent last week working hard and this week rock climbing.
It was an enjoyable week.
Was Robert fit?

Experiment 17 - Sentence Data

Temporal		Nominal	
1 antecedent	2 antecedents	1 antecedent	2 antecedents
6.13	5.13	5.33	5.13
5.11	5.16	4.96	5.48
5.81	5.45	6.82	5.53
5.99	4.96	6.26	7.34
4.78	4.61	5.88	5.88
5.39	5.48	3.94	3.33
5.56	5.03	5.48	3.93
5.94	4.57	5.62	5.54
5.57	4.18	5.18	3.81
5.23	4.13	5.23	4.31
5.61	4.97	5.51	6.60
5.89	4.20	6.21	5.77

Subject Data

Temporal		Nominal	
1 antecedent	2 antecedents	1 antecedent	2 antecedents
3.50	2.87	4.75	4.00
5.95	5.30	5.22	4.93
5.65	5.00	7.17	6.05
5.98	3.18	5.27	4.22
7.00	4.42	8.12	4.87
5.13	1.78	6.40	3.87
5.03	4.77	4.65	4.83
4.47	3.53	4.18	5.40
5.15	5.38	5.63	5.52
9.98	8.63	9.68	9.50
5.62	3.32	5.73	5.88
5.02	4.68	5.32	4.38
2.75	3.12	3.20	2.82
6.95	4.55	5.27	4.78
3.32	4.07	2.85	2.87
7.97	6.18	7.10	5.98
3.32	4.07	3.47	2.95
6.45	6.03	5.58	5.80
6.38	3.93	5.80	5.60
6.10	5.88	6.15	6.08
5.58	4.37	5.22	5.08
6.12	3.77	5.87	5.60
6.73	5.93	5.93	6.78
4.27	4.98	4.93	4.25
4.85	4.60	5.37	5.12
4.97	5.30	4.68	5.13
5.20	5.32	5.03	4.88
5.68	4.97	5.98	5.48
7.73	8.03	6.95	8.00
4.30	5.45	5.37	4.67
6.25	6.07	6.57	4.50
6.38	5.52	6.65	6.75

Experiment 17
Sentence Data

	DF	SS	MS	F	PROB
SUBJ	11	10.7175			
Temporal v Nominal	1	0.3658	0.3658	0.4688	0.51358
	11	8.5828	0.7803		
1 v 2 antecedents	1	3.4723	3.4723	11.0979	0.00672
	11	3.4416	0.3129		
Tem/Nom vs 1/2	1	0.6008	0.6008	2.2814	0.15656
	11	2.8966	0.2633		
W	36	19.3598			

Subject Data

	DF	SS	MS	F	PROB
SUBJ	31	194.1570			
Temporal vs Nominal	1	1.1026	1.1026	2.6127	0.11251
	31	13.0825	0.4220		
1 vs 2 antecedents	1	11.4601	11.4601	14.8865	0.00082
	31	23.8647	0.7698		
Temp/Nom vs 1/2	1	0.9905	0.9905	2.7708	0.10246
	31	11.0822	0.3575		
W	96	61.5826