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An investigation of 'minimalist' and 'constructionist' processing strategies in pronoun comprehension

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<u>An Investigation Of 'Minimalist' And 'Constructionist' Processing Strategies In</u>
<u>Pronoun Comprehension</u>

Garry Wilson

This thesis investigated the use of 'minimal' (gender/number information, linguistic conjunction and thematic role occupancy) and 'non-minimal' information (spatial information and description type - proper name vs. role name i.e. *the waiter*) in the comprehension of pronouns, (McKoon and Ratcliff, 1992).

Fourteen experiments were conducted. Seven experiments measured clause-by-clause reading times; seven measured frequency of reference in sentence continuation tasks. Six reading time experiments used materials pronominally unambiguous on the basis of the gender and number information. Experiments one to twelve also manipulated the spatial location of the characters (together or apart). Experiments five, six, seven, eight, eleven and twelve also manipulated noun phrase conjunction (by the use of '*and*'), proposed to be a cue to plural pronoun use (Hielscher and Musseler, 1990; Sanford and Lockhart 1991). Experiment thirteen was a reading time task using pronominally ambiguous sentences. Characters' thematic roles and description type were manipulated. Experiment fourteen was a sentence continuation task version of experiment thirteen.

For experiments one to twelve, the predictions were that subjects making use of a constructionist processing strategy would read plural references faster when characters were described as being together rather than apart. In continuation tasks, it was predicted that subjects would make more plural references to characters described as being together rather than apart. In experiment thirteen it was predicted that subjects making use of a minimalist strategy would read references faster depending on the character's thematic role occupancy rather than on description type. In experiment fourteen it was predicted that subjects using a minimalist strategy would make more references to characters on the basis of thematic role occupancy rather than description type.

The results did not consistently support either the minimalist or constructionist hypotheses. Subjects appeared instead to be making use of different strategies as a function of task demands. This interpretation is in line with work by Garnham et al (1992), McKoon and Ratcliff (1992), and Oakhill et al (1989).

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Pronoun Comprehension

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Submitted For The Degree Of Ph.D

University Of Durham

Department Of Psychology

1995

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DECLARATION

None of the work carried out in this thesis has been previously submitted for a degree in the University of Durham or in any other institution.

The experimental work undertaken was carried out whilst the author was employed as a half-time research associate by the Anaphora Working Group of the Human Communication Research Centre. This project provided direction for the experimental work carried out, but the design, implementation, data collection, analysis and subsequent interpretation of the findings was carried out solely by the author.

ACKNOWLEDGEMENTS

CHAPTER 1: INTRODUCTION

The overall aim of this thesis is to explore the nature of the representation routinely used to process language. Particularly, the claims of McKoon and Ratcliff's (1992) *minimalist hypothesis* in relation to pronoun comprehension are investigated. The experiments carried out investigate whether comprehension of both singular and plural pronouns takes place in an 'elaborated,' essentially non-linguistic mental model, (Gernsbacher, Goldsmith and Robertson, 1991) or whether pronoun comprehension is carried out using the minimal amount of information (i.e. number and gender) to unambiguously specify a referent (Ehrlich, 1980).

In addition, this thesis also investigates the importance of various sources of information in directing a reader to 'focus' (Sanford and Garrod, 1981; Sidner, 1983) on a particular antecedent or group of antecedents. This is explored in cases where gender/number information is either sufficient or insufficient to unambiguously assign a pronoun to an antecedent.

Again at the specific level, the processes involved in plural pronoun comprehension are scrutinised. The proposed *Common Association Base* (CAB) and other aspects of Eschenbach, Habel, Herweg and Rehkamper's (1989) work will be explored in terms of the minimal/elaborated distinction central to the thesis. Is the CAB constructed primarily on the basis of linguistic (minimal) or non-linguistic (elaborated) sources of information? Some of the questions asked are 'does plural pronoun processing differ from the types of processing carried out on singular pronouns? When are pronouns assigned to antecedents? Are any existing models of language comprehension able to accommodate the results displayed in this thesis and those obtained from previous research?'

In the case of singular pronouns, this work seeks to determine the relative importance of thematic role information, sentence position and type of character description in signalling an antecedent as being the most likely target of a pronominal reference. These sources of information are examined in sentences

where there are no gender cues to help readers assign pronouns. The results of this specific area of research may also serve to illuminate the wider issue under investigation: the specific nature of the representation used to comprehend pronouns (and, by extension, language).

Before reviewing the literature concerning the areas of specific investigation, (plural pronoun comprehension and thematic roles), the minimalist hypothesis will be outlined. An understanding of the basic claims of this hypothesis is necessary because they are central to the manipulations carried out in the experiments detailed in the following chapters. The claims of the minimalist hypothesis are then compared to the findings of other work carried out both in the fields of language comprehension in general, and in pronoun comprehension in particular.

Although principally concerned with pronoun comprehension, the central assumptions of this thesis are related to wider concerns of language processing. As such it is necessary that language comprehension be considered. The mechanisms used to resolve pronoun comprehension are undoubtedly at least partly reliant on the way sentences and texts are represented.

MCKOON AND RATCLIFF'S 'MINIMALIST' HYPOTHESIS

The minimalist hypothesis is a modification of the 'mental model' view of language comprehension (Johnson-Laird 1983; Van Dijk and Kintsch 1983) discussed in detail in following sections. Basically this model was built up from the findings of workers such as Bransford, Barclay and Franks (1972) who discovered that subjects' memory for sentences appeared to contain inferences based on the structure of the situation described rather than the actual words used. Subjects' recall of the sentences they read was not verbatim. Rather their recall contained information that hadn't been explicitly mentioned in the text. Other research (reviewed in detail later) suggested that the representation of the situation described by a sentence or text could contain inferences that are

seemingly incidental to the comprehension of the text, (relatively recent work includes the findings of Gernsbacher, Goldsmith and Robertson, 1991, and Greenspan, 1986). It is against the backdrop of this research (and the work of others, discussed later) that the minimalist hypothesis was proposed. Like many mental model theories (certainly the work of Johnson-Laird, 1983 and van Dijk and Kintsch, 1983), the minimalist hypothesis assumes that comprehension of written material requires the integration of the information stated explicitly in the text with general knowledge about the world. This view of language comprehension is widely held:

> "There is to my knowledge no genuine disagreement in psycholinguistics about what general types of information may contribute to language comprehension. Rather the issue is how the information is used, for what purpose and at what stage of analysis." Frazier (1987) p.561

However, the minimalist hypothesis seeks to distinguish itself from other model theories (termed 'constructionist' theories by McKoon and Ratcliff: I will continue to refer to other mental model theories using this term) in terms of the quantitative and qualitative nature of the inferences drawn during language comprehension. As the work of (amongst many others) Bransford et al (1972), Gernsbacher et al, (1991) and Greenspan (1986) suggested, a key feature of mental models is the inclusion of inferential information. It is the nature of the inferences that are drawn during comprehension that distinguishes between the 'minimalist' and 'constructionist' stances. Specifically they have difficulty with the idea that (they claim) is implicit in all 'constructionist' mental models: that 'non-minimal' or 'elaborated' inferences (McKoon and Ratcliff's terminology) are drawn automatically during comprehension. Problematically, (as will be discussed later), McKoon and Ratcliff hold the view that the 'constructionist' position believes a mental model to be a full representation of the events described by a text. The minimalist hypothesis claims that readers do not automatically construct inferences that fully represent the situation described. Rather it claims that;

"In the absence of specific, goal-directed strategic processes, inferences of only two kinds are constructed: those that establish locally coherent representations of the parts of the text that are processed and those that rely on information that is quickly and easily available." McKoon and Ratcliff, (1992), p.440.

It is this claim that forms the basis of the experiments included in this thesis and the work that provides the link between pronoun processing and language comprehension. According to this hypothesis, subjects will use the least amount of information available in order to process language. McKoon and Ratcliff (1992) support this claim with both experimental evidence and with a reinterpretation of the findings of other researchers.

As mentioned, one of the central claims of the minimalist hypothesis is that an inference is only constructed during reading if the information it is drawn from is readily available, (i.e. in short term memory) or if the text is not locally coherent. A formal definition of local coherence is not yet available. McKoon and Ratcliff make use of a working definition that states that local coherence is a set of two or three sentences that make sense on their own or in combination without the need for the use of information from elsewhere in the discourse.

McKoon and Ratcliff draw heavily from the work of Kintsch and van Dijk (1978). Further implications and a more detailed discussion of their model are discussed in the next section. However, because of the close links between the two theories, the basics of Kintsch and van Dijk's work are outlined here. In the Kintsch and van Dijk model processing occurs in a limited mental environment: short term memory. The information contained within short term memory (STM) during reading is assumed to comprise those words explicitly stated in the text plus the propositions formed from them. Each proposition is composed of a concept represented by a relational term and one or more arguments. For instance in the following example;

1) George hit John.

The propositions that make up sentence 1) may be written in the form of the relational term and the arguments that this relates:

(HIT, GEORGE, JOHN)

The concepts making up the proposition are defined in semantic memory. HIT is defined (according to Kintsch, 1974) by a frame showing the case structure (c.f. Fillmore 1968) appropriate for propositions with HIT as a relation and which contains slots for an agent, object, and an instrument (in the example above the instrument slot is empty). Kintsch (1974) also proposes that the definition of HIT includes the information that if someone is hit they will be hurt, get angry, retaliate etc. This is the sort of information that McKoon and Ratcliff assume is readily available. Thus propositional information is minimal in nature. Although primarily linguistic, the representation of propositions needs to be able to cope with a certain amount of inference generation. Often the links between propositions need to be inferred. An example of this is given in the following sentence (McKoon and Ratcliff, 1992, p.443):

2) The mausoleum that enshrined the czar overlooked the square.

This is suggested to (informally) contain the following two propositions:

(ENSHRINED, MAUSOLEUM CZAR)
and
(OVERLOOKED, MAUSOLEUM SQUARE)

In order to form a locally coherent structure the two propositions need to be linked together. This is achieved in this case by co-reference: in order to build a coherent structure for this sentence one must infer that the mausoleum that overlooked the square and the mausoleum enshrining the czar are in fact the same mausoleum. In Kintsch and van Dijk's (1978) model, co-reference occurs when an argument overlaps two or more propositions. This model assumes that the inferences required to establish argument overlap (and thus local coherence) are

encoded when the propositions are formed. The minimalist hypothesis incorporates this feature in terms of the claim that inferences are only made on the basis of readily available information and in order to achieve local coherence. It is clear from this description that the minimalist hypothesis uses an extremely broad definition of the term inference.

Experimental evidence is available that supports the adoption of Kintsch and van Dijk's (1978) model as an example of minimalism. Ratcliff and McKoon (1978) gave subjects a series of short lists of sentences to study. Each list was followed by a recognition test comprising a list of single words drawn from the sentences seen, plus a number of distractors. Subjects were to decide as quickly as possible whether or not the word had been studied before. Ratcliff and McKoon's findings suggested that target words immediately preceded by a word from the same sentence were responded to faster than targets that were preceded by a word that hadn't appeared in the same sentence. The reduction in response time was found to be greater if the two words were from the same proposition than if they were from the same sentence but from separate propositions. This findings was taken as suggesting that subjects encode information proposition by proposition. Ratcliff and McKoon suggested that this finding provided strong support for the minimalist hypothesis. The evidence for a level of propositional representation in comprehension was further strengthened by the findings of Swinney and Osterhout (1990). In a cross modal lexical decision task, Swinney and Osterhout found that subjects responded faster to decisions about words associated with the target words when the words appeared in the same proposition. For instance in the sentence:

3) The policeman saw the boy that the crowd at the party accused of the crime.

One of the propositions that would presumably be encoded is (ACCUSED, CROWD, BOY). When a lexical decision was made about an associate of *boy* subjects responded faster when the decision concerned the word *accused* rather than the word *party* for instance. The word accused is part of the same proposition as boy whereas party is part of another proposition. As information

that is encoded within a proposition is suggested to be minimal in nature, and as Swinney and Osterhout (1990) found that words in the same proposition are accessed more easily than words in different propositions (as suggested by faster decision times), then this lends some support (although perhaps a little tentative) for the minimalist hypothesis' claims that minimal information is encoded automatically.

These findings are amongst those that led to the formation of the minimalist hypothesis. In addition to this work, findings that could be interpreted as being minimalist have been noted in other areas of language research. In the following section a number of studies will be outlined and their findings discussed in relation to the minimalist hypothesis.

MINIMALISM AND LANGUAGE COMPREHENSION

The minimalist claim is similar in many respects to the underpinnings of research (both early and within the last 15 years) carried out in the field of psycholinguistics. It may be argued that the majority of the work carried out in the area of language comprehension may be crudely categorised as supporting either a minimalist or constructionist view of language. The work of Frazier et al (1982) and Rayner et al (1983) on the minimal attachment strategy is a good example. In this work it is suggested that readers routinely use far less information than is available in a text to guide their processing. This interpretation has been a preoccupation of psycholinguistics. Chomsky's detailed work, although primarily concerned with the structure of language, recognised the interaction of linguistic and non-linguistic factors (1957; 1965; 1980). Chomsky proposed that language and thought are separate but interactive systems. The rules underlying syntactic and semantic constructions form the 'computational' aspects of language. In a sense it is this system that forms the innate (at least in part) aspect of language. The second component involves such concepts as object - reference and thematic relations such as "agent", "goal," "instrument" etc. This

component was named the "conceptual" system by Chomsky (1980) and it was claimed that it should be considered as part of our general cognitive system.

> "We might discover that the computational aspect of language and the conceptual system are quite differently represented in the mind and brain, and perhaps that the latter should not strictly speaking be assigned to the language faculty at all but rather considered as part of some other faculty that provides "common sense understanding" of the world in which we live." Chomsky (1980) p.55.

So even here there appears a form of minimalism, (although rather more minimal than the form proposed by McKoon and Ratcliff). Early work in psycholinguistics tended to concentrate primarily on the structural aspects of language, and thus was implicitly concerned with investigating minimal factors in language comprehension. The importance of syntax in language comprehension was investigated by Epstein (1961) who demonstrated that even meaningless materials are easier to learn if they have some syntactic structure. In a task in which subjects were required to learn nonsense syllables, Epstein found that subjects were able to remember more when they were presented in a sentence structure (example 4) than when they were presented in a list (example 5).

4) The yigs wur vumly rixing hum in jigest miv.

5) The yig wur vum rix hum in jig miv.

As the materials are meaningless, the results of this experiment suggest that subjects are making use of the syntax of the materials organised like the ones in example one to aid their memory. Miller and Isard (1963) also produced results which supported the central role of syntax in comprehending sentences. They presented subjects with strings of words that fell into one of three categories: category 1 consisted of ordinary sentences; category 2 strings were structured but meaningless as a result of swapping words between sentences; category 3 strings used the same words as appeared in category 2 but presented in a random order. Subjects had to report as many of the words in each string as

possible, a task complicated by the simultaneous presentation of noise. Miller and Isard found that subjects reported more words from category 1 strings than from category 2 strings, and more words from category 2 strings than from category 3 strings. However, in a later version of this experiment, Marks and Miller (1964) found that semantic information was of similar use as an aid to comprehension. Using strings with no syntactic cues to understanding but containing semantic information, Marks and Miller found that about as many words from these 'category 4' strings were reported as from category 2 strings. The results of these experiments suggested that no single feature of the 'computational' aspect of language (Chomsky 1980) appeared to carry sentence meaning. Thus researchers were unable to say, for instance, that syntax was of greater importance than semantics in language comprehension. Although the results of these early investigations are hardly surprising (i.e. that readers use their knowledge of syntax AND of semantics when comprehending language) they do illustrate the implicitly stated search for minimal explanations of language comprehension.

Although the data from 'memory-for-sentences' experiments led to a gradual slackening of interest in the role of syntax in language comprehension, work investigating the structure of the language processor still sought to determine what kinds of linguistic and non-linguistic information were used in language comprehension and when. The work of Frazier and her colleagues is outlined next and her results and the results of opponents of Frazier's view are discussed in terms of the minimalist hypothesis.

THE STRUCTURE OF THE LANGUAGE PARSER

The work of Frazier and her colleagues (Frazier 1987; Frazier and Fodor 1978; Frazier and Rayner 1982; Rayner, Carlson and Frazier 1983) and the work answering their findings has gone some considerable way to clarifying the possible structure of the language processing system. Frazier and Fodor (1978) described a modification of the work of Kimball's (1973) surface structure parser

and of Augmented Transition Network models of the kind proposed by Woods (1970). Frazier and Fodor suggested that incoming words are parsed in two stages. The first stage is the analysis carried out by the "Preliminary Phrase Packager" or PPP (affectionately known as "the sausage machine"). The PPP is a limited capacity processing 'window' which is capable of analysing several words at a time. This first stage of the parsing process is relatively insensitive to the larger structure of the sentence. The PPP is decidedly "bottom-up" in its approach, assigning lexical and phrasal nodes to the words in the string undergoing analysis. These initially parsed phrases are then passed on to the second stage processor; the "Sentence Structure Supervisor" or SSS. This part of the parser is essentially the "top-down" part of the process. The SSS;

> "...can survey the whole phrase marker for the sentence as it is computed, and
> it can keep track of the dependencies between items that are widely separated
> in the sentence and of long term structural commitments which are acquired as
> the analysis proceeds." Frazier & Fodor (1978) p.292.

Frazier and Fodor put forward this two stage parser in response to the work on the capacity limitations of working memory (Baddeley & Hitch 1974). Because Frazier and Fodor's model is a two stage parser, they reason that because of the extra processing that has occurred on the input by the SSS (remember that this input will have also been processed by the PPP) the representation of the string will occupy less space in working memory as a result of "chunking" (Miller 1956). This in turn will in theory free processing space.

> "...it is a well-attested (if unexplained) fact about human memory that the more
> structured the material to be stored the smaller the demand it makes on storage
> space." Frazier & Fodor (1978) p. 293

Presumably the processing carried out on incoming sentences is analogous to "chunking"(Miller 1956) in that just as "chunking" is proposed to operate as a result of the creation of meaningful links between stimuli. In Frazier and Fodor's model the meaningful links are those created by the SSS's overview of the structure of the entire sentence.

Evidence that the parser is structured in this way is suggested by the results of a number of studies of 'garden-path' sentences (Frazier and Rayner, 1982; Rayner, Carlson and Frazier, 1983). The parser appears to exhibit preferences for certain interpretations of structurally ambiguous sentences. This supports the two stage "Sausage Machine" model. In each 'garden-path' sentence there exists a point where the parser must make a decision as to how the lexical information in the string undergoing analysis is to be integrated into the phrase structure.

"A word at an ambiguous phrase boundary could be incorporated into a package with the words on its left, or it could become the first word of a new package including the words on its right." Frazier and Fodor (1978) p.303

This model is also able to explain the difficulty associated with processing centre-embedded sentences such as the example below;

6) The woman the man the girl loved met died.

Because the PPP is attempting to package the six words together as a phrase, they could only be interpreted as constituting a conjoined noun phrase. This explanation is supported by Frazier and Fodor by contrasting the sentence above with the sentence below in terms of processing difficulty.

6b) The woman someone I met loved died.

The relative ease of understanding this sentence is explained in terms of the fact that the noun-phrases are not conjoinable. This kind of error is also explainable by Frazier and Fodor's (1978) paper and the subsequent work of Frazier and her colleagues. (Frazier and Rayner 1982; Carlson Rayner and Frazier 1983) The "short sighted" nature of the PPP (its limited capacity processing window) which leads to difficulty in processing "centre-embedded" and "garden-path" sentences, is thought to result in the adoption of a heuristic strategy for sentence processing. This strategy is known as the "minimal-attachment" strategy. Basically the

limited capacity of the PPP and the two stage nature of the parser leads readers to attempt to construct the simplest phrase structure possible. The work of Frazier and Rayner (1982) and Rayner, Carlson and Frazier (1983) suggests that the first analysis of a sentence is conducted on purely syntactic grounds. As outlined above, Frazier suggests that the reader incorporates each word of a sentence into a "constituent structure representation" (Frazier, 1987, pp 561). This occurs roughly as each word is encountered. This is the 'packaging' process carried out by the PPP. At each stage in this process the reader constructs the minimum number of nodes required by the grammar of the language, dependent on the structural assignment given to preceding words, as the example overleaf shows, (from Frazier, 1987, pp. 561-562):

```
a)    S        b)    S        c)      S            d)       S
      /              /              /   \               /    \
     NP            NP            NP   VP            NP    VP
      |            / \            / \   |            / \   / \
     Det          Det N         Det N  V           Det N  V  NP
      |            |  |          |  |   |           |  |  |   \
      |            |  |          |  |   |           |  |  |   Det
      |            |  |          |  |   |           |  |  |    |
     The...       The girl...   The girl knew...    The girl knew the...
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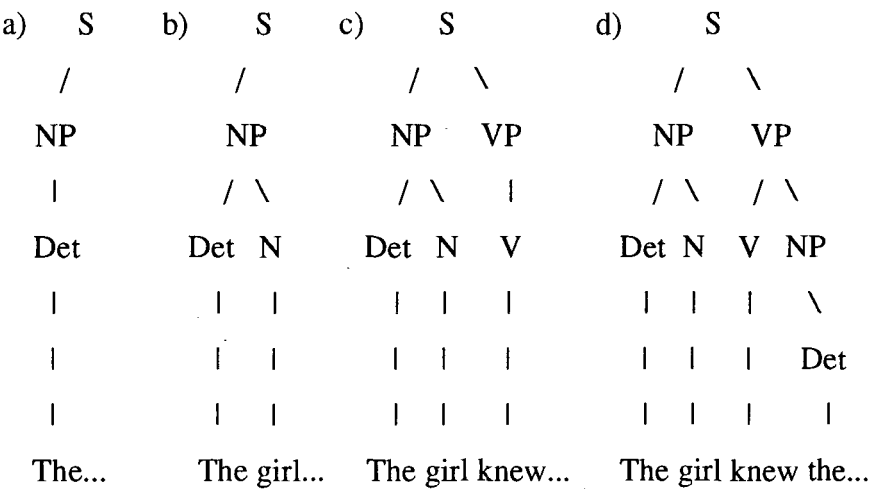
The sentence is processed according to the "minimal attachment" heuristic. This simply refers to the strategy of constructing a representation consisting of the minimum number of nodes possible. A related heuristic proposed by Frazier (1982) is that of 'late closure.' This strategy means simply that where grammatically permissible, subjects attach new items into the clause/phrase currently undergoing processing. Eye movement experiments carried out by Frazier and Rayner (1982) and by Rayner, Carlson and Frazier (1983) confirm that subjects reading behaviour conforms to the minimal attachment strategy's predictions.

The work of Frazier and her colleagues suggests that the human parsing system is modular in form. Even when subjects saw sentences that were preceded by disambiguating contextual information, they still produced eye movements that conformed to the minimal attachment hypothesis (Rayner, Carlson and Frazier 1983). This suggests that subjects were not initially producing a representation that made use of the semantic (in its widest possible sense) information contained within the context sentences. If they had made use of it then one would not have expected the subjects to have been 'garden-pathed'.

These findings have been independently confirmed by a study carried out by Ferreira and Clifton (1986). This study also made use of the eye movement-tracking paradigm. Subjects took part in three experiments. In the first (described below) subjects read sentences like the examples below;

7a) The defendant / examined / by the lawyer / turned out / to be unreliable.

    c - 2   c - 1   c   c + 1   c + 2

7b) The evidence / examined / by the lawyer / turned out / to be unreliable.

    c - 2   c - 1   c   c + 1   c + 2

Sentences 7a & 7b contain points of temporary syntactic ambiguity. The sentences are disambiguated at the point when the word *by* is read. Until that point subjects could expect either an active (Minimal Attachment) reading or a relative clause reading. In the case of subjects taking the minimal attachment reading of the sentence then they would assume that *examined* is the main verb in the sentence. The prediction of the minimal attachment hypothesis is that subjects will take more time to read sections c and c + 1 (as noted above) because they will have to restructure the phrase marker for the sentence. Once they realise that the sentence does not conform to the minimal attachment strategy they will have to accommodate this new information into their phrase structure marker. It is this restructuring that causes the increase in reading time (Ferreira and Clifton 1986, p.352). This effect would presumably not be seen if the parsing modules interact

with one another initially as sentence 7b contains sufficient semantic information to reduce or nullify any possible 'garden-path' effects. The subject of 7a is a potential agent, whereas the subject of 7b (*evidence*) is not. However, if the parser still shows a 'garden-path' effect then this would support the minimal attachment hypothesis and the notion that the parsing system is modular in nature with no (or little) INITIAL interaction between different modules. Otherwise the semantic information supplied by the NP *the evidence* would be sufficient to rule out the active (minimal attachment) reading of the sentence. Ferriera and Clifton's (1986) findings suggested that subjects were not making use of the semantic information supplied by the initial NP to guide their parsing. This result in turn suggests that the parser is indeed organised into modules and that these modules DO NOT initially interact with one another during language comprehension.

This work was further supported by Ferriera and Henderson (1990). The results of their eye-movement experiments suggested that verb information was not made use of to guide the initial syntactic parsing of sentences although it DID aid subsequent reanalyses.

This modular, essentially non-interactive view is at odds with the work of other researchers, such as Crain and Steedman (1985). Their work suggested that syntactic parsing is guided on-line by semantic/pragmatic information. They refer to a series of experiments carried out by Crain (1980). Crain displayed a series of 'garden-path' sentences. Some of these were preceded by a context sentence that semantically biased the interpretation of the sentence, and some by a context sentence that did not semantically bias the sentence. Other sentences were not preceded by a context sentence. Crain's findings were interpreted by Crain and Steedman as supporting an "interactive" model of language processing. If context (semantic information) is enough to rule out or change the syntactic garden-path reading of a sentence then this suggests that semantic information is being used as well as syntax initially upon encountering a word. Thus the phrase structure marker is constructed via an interactive. However, these experiments used grammaticality judgements (and the times required to reach these judgements) rather than eye-movement measurements as used by Frazier and her colleagues

(as outlined earlier). This work was expanded upon by Altman and Steedman (1988). In this paper they proposed a weakly interactive model that operates in parallel rather than as a serial processor.

The fact that actual eye-movements were examined by the supporters of a modular, initially non-interactive processor, lends support to their argument rather than to the supporters of an interactive, parallel language processor. The fact that Frazier and her colleagues, (Frazier and Rayner 1982; Rayner, Carlson and Frazier 1983) and Ferriera and her colleagues (Ferriera and Clifton 1986; Ferriera and Henderson 1990) were able to tell which word the subjects' visual attention was fixated upon lends more credence to their interpretation. In other tasks (such as grammaticality judgements or self paced reading experiments) then reading behaviour is either not directly measured at all or reading time is confounded by the inclusion of reaction times (see Sanford and Garrod, 1989, for a review of the pros and cons of various task types used in language processing).

Whilst the evidence reviewed suggests that the initial representation of a text is based on syntactic (and presumably lexical information), the results of memory-for-sentences experiments (Johnson-Laird and Stevenson, 1970; Sachs, 1967) suggest that this representation is short lived. Subjects faced with a delay of more than a few seconds are unable to reliably recognise sentences on the basis of their structure. They are however, able to discriminate between sentences that have an identical meaning to, and those that differ in meaning from, target sentences (Sachs 1967). Ferriera and Henderson (1990) found that semantic information was made use of in subjects' recovery from 'garden-path' effects. These findings, and those of Altman and Steedman (1988) and Crain and Steedman (1985) suggest that subjects are making use of a representation that consists of both syntactic and semantic (used in its broadest sense) information to guide language comprehension.

Although the claims of Frazier and her colleagues (Frazier and Rayner 1982; Rayner, et al, 1983) differ from the claims made by McKoon and Ratcliff (1992) in many respects, both suggest that readers make use of much less than all

available information at some stage in comprehension. The minimalist hypothesis is however compatible with both the view of language comprehension proposed by Frazier and her opponents Altman and Steedman (1988) and Crain and Steedman (1985). In Frazier's view a syntactic parsing heuristic is initially applied and this heuristic is insensitive to semantic information (hence even semantically biased sentences produce a garden path effect based on the syntactic information rather than semantic information). Subjects are making use of less than minimal information here as comprehension has not occurred. However, Altman and Steedman's (1988) and Crain and Steedman's (1985) findings suggest that semantic information can be used to cause garden path effects. In other words for subjects to 'garden-path' as a result of semantic information requires that this information is processed. However, the methodology used by Crain and Steedman (reading times) is less sensitive than the eye-tracking technique made use of by Frazier and Rayner (1982) and Rayner et al (1983). Ferriera and Henderson's (1990) eye-tracking study suggests however, that subjects use semantic information on the second pass and presumably use this information to correct the initially mistaken parse based on syntactic information. This findings is directly in keeping with the claims of McKoon and Ratcliff (1992). Recall that they suggest that subjects make use of those inferences (the definition is broad enough to encompass any non-explicit link that needs to be made) necessary to allow local coherence (sentence comprehension) to occur. Ferriera and Henderson's (1990) findings provide some support for this interpretation.

The representation of linguistic information appears to be built up in a modular fashion. Eye-tracking studies suggest that the initial analysis of a sentence is based on syntactic information only. However, this syntactic representation is quickly elaborated upon: the second pass of the sentence appears to incorporate semantic information with the syntactic (Ferriera and Henderson, 1990). In addition, work carried out by Johnson-Laird and Stevenson, (1970) and Sachs (1967) suggests that subjects' memory for the syntactic structure (verbatim memory) of sentences is short lived. Subjects appear to remember sentences according to their meaning rather than in terms of the exact words used. This

finding was further investigated by Kintsch and van Dijk and led to the production of the model of propositional representation that was mentioned earlier.

This work will be discussed in more detail in the next section.

PROPOSITIONAL REPRESENTATION AND MINIMALISM

As mentioned in the previous section, subjects initially seem to represent both syntactic and semantic information during language comprehension. The results of memory experiments (such as those carried out by Johnson-Laird and Stevenson, 1970, and Sachs, 1967) suggest that the syntactic components of this representation are relatively short lived. It appears that ultimately it is the 'gist' or the meaning of the information read that is represented. An attempt to obtain an independent estimate of exactly what constitutes gist was carried out by van Dijk (1975). He asked subjects to write a summary statement of a passage (a summary being assumed to be the equivalent of gist in terms of everyday performance). Van Dijk compared the protocols from the summaries obtained with actual recall and found that the summaries contained less information than the recall protocols. However, most of what appeared in the summaries was also found in the recall data, (the additional information tending to be details of various descriptions). These extra details vanished after a short delay between presentation and subsequent recall. More importantly, van Dijk found a fair degree of consensus between subjects concerning what was contained in the summaries and thus the salient features of what makes up the gist of a passage. This was also true of the recall protocols. van Dijk used this correlation as evidence for the view that memory is for gist, and that rules governing 'summarising strategies' are the same as those determining storage and retrieval. Kintsch (1974) and later Kintsch and van Dijk (1978), developed a theory of propositional representation to account for the these findings. Kintsch theorised that the meaning of a text is derived from the sequence of propositions that make it up: its 'text base'. Each of these propositions are composed of concepts

represented by a relational term and one or more arguments, as outlined earlier. Kintsch proposes that propositions may be joined together and used as the arguments of other propositions. For example the sentence;

8) George apologised for hitting John.

May be represented by the following propositional format;

(APOLOGISE, GEORGE, (HIT, GEORGE, JOHN)

The ability of propositions to be embedded within one another and their proposed inferential capacity greatly increases the flexibility of propositional representations as a model of language comprehension. This model may also be used to account for the findings of Johnson-Laird and Stevenson (1970) and Sachs (1967). What subjects are representing is a concept which may be expressed in many ways. For instance the proposition (HIT) maybe expressed in a number of ways (e.g. 'strike' or 'bash'). Thus propositional representations are able to provide an explanation for the features of memory for gist: the proposition is encoded but not the exact expression of the concept. Similar propositional representation systems have been postulated by Norman and Rumelhart (1975) and Anderson and Bower (1973).

Local coherence (as defined by McKoon and Ratcliff) is determined in Kintsch and van Dijk's (1978) model as a result of the construction of the text's 'microstructure'. The microstructure of a text is composed of the meaning of the individual propositions and the referential links between them. This is proposed to be constructed as a result of the operation of a limited capacity processor searching through the current 'chunk' of propositions being processed in its memory buffer. When the processor finds the same argument in both the memory buffer and the chunk being processed, it links them together as co-referential. If there is no common argument then the processor searches through propositions in long term memory or in the text to find a relation between the two. If this search fails an inference needs to be made to create a proposition linking the new

propositions already in memory and the material currently being processed. Because of the way in which co-reference is established in this model (as a result of the common occurrence of the same argument), some arguments appear in more than one processing cycle. According to Kintsch and van Dijk (1978), these should be more memorable as a result of the amount of processing carried out on them.

The operation of these processes are essentially responsible for the construction of inferences required to maintain local coherence. Remember earlier it was mentioned that McKoon and Ratcliff suggested that global inferences were only made to establish local coherence. Searching for arguments that are not in the current chunk of propositions being processed is (in McKoon and Ratcliff's terms) the equivalent of making a global inference in order to maintain local coherence. The construction of the microstructure from the chunk of propositions processed in the memory buffer is the equivalent of McKoon and Ratcliff's criteria for the establishment of local coherence.

Kintsch and van Dijk's model (and McKoon and Ratcliff's, given that their work is based heavily on Kintsch and Van Dijk's model) thus provides an explanation of a number of experimental findings, such as the work of Johnson-Laird and Stevenson (1970). Their subjects mistook sentences with similar meanings, if these sentences also preserved the same relation between the people they featured. For example a subject who saw sentence 9a) would be unable to distinguish it from sentences 9b), 9c) or 9d).

e.g.

> 9a) John liked the painting and he bought it from the duchess.
>
> 9b) John liked the painting and he the duchess sold it to him.
>
> 9c) The painting pleased John and he bought it from the duchess.
>
> 9d) The painting pleased John and the duchess sold it to him.

The concept and relations between the arguments (John and the duchess) remain constant in each of these sentences. As Kintsch and van Dijk claim

that concepts are not exact in their meaning, the differences between *liked* and *pleased by* and the differences between being a 'buyer' and a person 'sold to' could both be captured by some more abstract concept. Remember that Kintsch and van Dijk claimed that concepts may be expressed in more than one way (e.g. (HIT) may be expressed as 'strike' or 'bash'- author's example). Johnson-Laird and Stevenson's subjects mistook sentences of types 9a), 9b), 9c) and 9d) for one another, but not sentences with similar structure but changed meaning. Again these are the results one would expect if subjects were representing the sentences using a propositional representation of the type claimed by Kintsch and van Dijk.

However, the results of the studies described above can also be explained by appealing to the notion of mental models (as shall be discussed in the next section) Furthermore, despite its superficial ability to cope with a range of experimental findings, the propositional representation model of Kintsch and van Dijk (1978) has some severe failings. As mentioned above, the details of how factors affecting global aspects of text comprehension are integrated into the 'macrostructure'(Kintsch and van Dijk's terms for global representations of a text - made up from the microstructure) of a text are very vague. In addition, the handling of co-reference in the model is unsatisfactory. Co-reference is too complex to be accounted for simply as a result of the overlap of arguments (Garnham 1982). In the example of text shown below (taken from Johnson-Laird, 1983, pp 380),

> 10) Roland's wife died in 1928. He married again in 1940. His wife now lives in Spain.

The text contains two propositions about *Roland's wife* but the arguments patently do not refer to the same person, despite the overlap. Similarly, propositional representation fails to capture the fact that propositions with no arguments in common may still refer to the same individual. Much more detail needs to be added to this model in terms of when and how inferential information is added to the representation of the text. These are failings that

are only partially addressed by McKoon and Ratcliff's minimalist hypothesis. As it stands there are a number of other experimental findings that Kintsch and van Dijk's (1978) model is unable to explain. How do propositions account for the findings that seemingly unrelated information about the situation described by the text are available to readers? Information such as the emotional states of individuals appearing in the text (Gernsbacher, Goldsmith, and Robertson 1992) or the location of objects surrounding the main protagonist but not explicitly mentioned (Morrow, Bower, and Greenspan 1989)? The results of studies like these suggest that what is constructed as the result of comprehension of a text is a mental model: A representation of what the world would be like if the information given in the text were true. Kintsch and Van Dijk also came to believe that a propositional representation of text was insufficient to account for the range of findings mentioned above. In 1983 they proposed a further stage to their model of text comprehension; the situational model. This is functionally equivalent to a mental model. The propositional representation is merely the second stage of comprehension in their model. 'Gist' is now widely thought to be memory of the mental model representation of the text. It is here that McKoon and Ratcliff's model differs from constructionist models. McKoon and Ratcliff, it will be recalled, suggest that a more complete representation than the propositional representation is only constructed to satisfy particular goals. For instance the readers in Gernsbacher et al's (1992) study were probed for words describing emotional states that had appeared in sentences. McKoon and Ratcliff's hypothesis would suggest that subjects were not engaging in 'normal' reading behaviour. Rather their goal in reading the texts was to represent the emotional states of characters. In the next section further evidence for the construction of mental models are reviewed along with a discussion of the compatibility of minimalist and constructionist views of mental models.

MENTAL MODELS: ELABORATED OR MINIMALIST?

The studies reviewed in the preceding sections appear to suggest that comprehension occurs as the result of the integration of initially separate sources

of information (Ferriera and Henderson, 1990). This interpretation is compatible with the mental model approach to language comprehension. In two of the most influential models (Johnson-Laird, 1983; Van Dijk and Kintsch, 1983) it is proposed that a mental model is constructed from both a representation of the linguistic information contained within a text/sentence and its integration with information from long term memory (LTM).

The minimalist hypothesis suggests that information is only drawn from LTM under two conditions: if 'global' information is necessary to establish local coherence or if this information is necessary to achieve a specific goal (i.e. subjects are reading a text in order to perform a specific task/extract a particular kind of information). It is in the nature of the specific inferences that are drawn that characterises the main differences between minimalist and constructionist approaches (according to McKoon and Ratcliff, 1992). Alan Garnham (a constructionist in McKoon and Ratcliff's terminology) describes a mental model as follows:

> "...people remember neither the syntax nor the semantics of what they hear, but rather its content, in a more general sense...a representation that is not closely related to any linguistic description of the text and which should not be called a semantic representation." (Garnham, 1985, p.141).

Minimalist mental models are far more closely related to the linguistic information in the text. Inferential information (as described earlier) is based on inferences concerning co-reference of arguments in the minimalist view, whilst inferences in constructionist models appear to be more 'global' in McKoon and Ratcliff's terms. In the following pages studies suggesting the probable nature of mental models will be reviewed. These results will then be evaluated in terms of the support they lend the minimalist and constructionist positions.

As mentioned previously one of the main sources of information supporting the notion that the meaning of a text is represented in the form of a mental model, comes from the findings of studies investigating the encoding of inferential

information. Mental models appear to be characterised by the inclusion of inferences about information that has not been explicitly mentioned in the text.

Experimental evidence supporting this view was provided by Bransford, Barclay and Franks (1972). They showed that subjects' memory for text includes inferences in addition to the linguistic information provided. Bransford et al had subjects listen to one or the other of the following sentences:

> 11a) Three turtles rested beside a floating log and a fish swam beneath them.

Or

> 11b) Three turtles rested on a floating log and a fish swam beneath them.

After a series of such sentences, subjects took part in a recognition task, including test items like the following:

> 11c) Three turtles rested beside a floating log and a fish swam beneath it.

and

> 11d) Three turtles rested on a floating log and a fish swam beneath it.

Subjects previously hearing sentence 11a) realised that 11c) and 11d) hadn't been presented to them before, but subjects hearing 11b) rejected sentence 11c) but not sentence 11d). Bransford et al explain this as a result of 11d) being a correct inference derived from sentence 11b) but not from sentence 11a). Thus the results of Bransford et als' experiment suggest that their subjects are not merely representing the information contained in the sentences they heard. Rather they appear to be augmenting this information with their real-world knowledge: inferences valid in a real-world situation of the type described by the text are also valid inferences of the model. Put more simply, the subjects were representing a situation rather than merely representing the linguistic information they were presented with.

This suggestion was reinforced by the work of Thorndyke (1975b, 1977) and Garnham (1979). Thorndyke had subjects read through passages and then take part in a recognition test containing some sentences that hadn't appeared in the passages, but that were plausible inferences. When a plausible inference was reinforced by a later sentence then it was more likely to be falsely recognised than when it hadn't been reinforced. Garnham's study utilised a cued recall task. His subjects read sentences like:

12) The housewife cooked the chips.

Using materials of this sort, Garnham varied the recall cue presented to his subjects, either 'cooked' or 'fried'. Garnham found that the recall cue 'fried' was more effective in helping subjects to remember the original sentence than the cue 'cooked', even though they had actually read 'cooked' as part of the sentence to be recalled. Garnham explained this finding by saying that sentence (12) above, is understood by the construction of a knowledge-based model of the situation. This model is essentially non-linguistic in nature and because of this, (and the knowledge that one cooks chips by frying them), we find that the cue 'fried' maps onto the situation better than cooked. Both Thorndyke's and Garnham's work provide further support for the notion that the representation of text is a combination of both the information explicitly stated and the inferences needed to understand it.

However it has been suggested that perhaps the fact that these studies employed memory tests may have caused the effects noted. These results are observed only after the readers'/listeners' memories have had a chance to fade. Subjects tend not to confuse sentences until after a delay between presentation and recall (although this may be due to subjects' expectations of a memory test leading them to initially use a linguistic presentation of the sentences, as noted by Johnson-Laird and Stevenson, 1970). Perhaps subjects ARE ordinarily representing information linguistically and the results of Bransford et al and Garnham are merely the result of a fading memory trace or are some artefact of a memory task.

A number of on-line studies suggest that this is not the case and that mental models, (rich in information not explicitly mentioned in the text), are constructed DURING comprehension. This information may be of a number of types ranging from spatial information, (Bryant, Tversky and Franklin, 1992; Glenberg, Meyer and Lindem, 1987; Morrow, Greenspan and Bower, 1987; Morrow, Greenspan and Bower, 1989) to the incidental emotional state of the characters depicted, (Gernsbacher, Goldsmith, and Robertson 1992) and peripheral qualities of concrete nouns (Greenspan, 1986).

Morrow et al (1987, 1989) had subjects learn the spatial layout of an imaginary building and the objects contained in each room. After subjects had learned this layout they read passages describing a character moving around the building. Morrow et al found that subjects answered questions about objects in the target or 'goal' room faster than they responded to questions about objects in the 'source' room. In addition, Morrow et al (1989) found that when the protagonist moved through a 'path' room (a room passed through between the 'source' and the 'goal' rooms) information about the objects in the path room was more accessible than information about objects in either the 'source' or an unrelated room. This was the case even when the 'path' room was implicit as a result of the building's layout rather than being explicitly mentioned in the text. Morrow et al explain their results in terms of readers constructing a mental model of the layout of the building in which they take the perspective of the main character. As the main protagonist was described as moving through the building, subjects found it easier to access information that was more relevant to the protagonist's actions (e.g. rooms that were nearer to the 'goal' room and that the protagonist passed through, were more accessible than rooms that were equidistant but irrelevant to the action).

It is difficult to see how these results could be easily explained by anything other than the construction of a mental model of the text. Knowledge of the objects in the 'path' room is not needed to comprehend the text, nor do they appear to form any logical part of a propositional representation. Presumably if one were to update a propositional representation of a text, then the relevant

information would consist of the change from the 'source' room to the 'goal' room. Unless there were some explicit information concerning events during the move then the information about the actual change of location would be irrelevant.

These results suggest that subjects were instead representing some implicit information about the actual move itself and the route taken. This information was not necessary for comprehension, which suggests that subjects' representations of text are partial models of the real world. If the protagonist had to move through an intervening room to get from room A to room B then this must occur in the model as well. The actual change in location itself isn't all that is represented; the necessarily implied action is also represented.

That this kind of representation isn't some artefact of spatial imagery, but rather that it pervades all aspects of language comprehension, is suggested by the work of Gernsbacher, Goldsmith, and Robertson (1992). In their experiment, subjects were given short passages to read that described a number of various situations. After each passage subjects were presented with a target sentence that contained either an appropriate or inappropriate description of one of the character's emotional states. Although it was not necessary to represent the emotional state of the characters in order to understand each passage, subjects read target sentences containing appropriate emotional states significantly faster than those describing inappropriate emotional states. In a probe task subjects pronounced a word describing an emotional state faster when it matched the expectations of the situation just read about than when a mismatch occurred.

Greenspan, (1986), in a number of tasks (including cued recall, semantic priming and semantic judgement tasks) found that subjects had access to features possessed by entities but not central to their nature. For instance subjects who saw the word piano in a sentence that emphasised its musical qualities still were able to use a peripheral quality of pianos (e.g. that they are heavy) to access the original noun. In each of the three tasks. There is no necessity for subjects to have

represented this information in order to have understood the sentence about the musical qualities of pianos and yet it is still accessible.

Taken together, these studies suggest not only that subjects are constructing mental models during their comprehension of texts, but also that they are doing so routinely, rather than just to accomplish certain tasks. Even when comprehension can be accomplished without them, these inferences are still encoded. In the light of the research reviewed above this suggests that language comprehension results in a mental model of the situation described by the information in the text. This model is constructed as a result of both the linguistic information specified in the text and the reader's general knowledge of the world (Johnson-Laird, 1983; van Dijk and Kintsch, 1983).

Mental models, receiving as they do general knowledge information from semantic memory, seem to be rich in all kinds of information corresponding to the real-world aspects of the described situation. This may include any implied or implicit information about the situation the model is representing. This aspect of mental models suggests that they are decidedly non-minimal in nature.

Mental model theory is capable of explaining many of the problems that dogged the propositional representation model of Kintsch and van Dijk (1978). Indeed they modified their notion of representation to include a further level beyond that of the proposition; a situation model (van Dijk and Kintsch, 1983). Co-reference for instance, which was identified earlier as a potential problem for a system of propositional representation, is handled by the inclusion of a representational token corresponding to each entity in the model. Thus in the example text used earlier;

> 10) Roland's wife died in 1928. He married again in 1940. His wife now lives in Spain.

There is no possibility of a mistaken co-reference between Roland's first and second wife because they are represented by two different tokens in the model. Similarly, Garnham's (1987) findings can be explained in the same way. Garnham's subjects read passages containing sentences like the following.

13) By the window was a man with a martini.

This character was later described as waving to the hostess. Subjects were however unable to remember whether or not they had read 13a) or 13b).

13a) The man with the martini waved to the hostess.
OR
13b) The man by the window waved to the hostess.

This can be explained by the fact that since *the man by the window* and *the man with the martini* refer to the same person, that person will have only one token comprising both these pieces of information. Thus confusion between the two descriptions is likely to occur, because both sentence 12a and 12b refer to the same individual.

Mental models are also able to cope with the findings suggesting that inferential information is stored about the situation described by the text. This is because the mental model is a construction of the world (or part thereof) as it would be if the information given by the text were true, rather than merely being a representation of the information given in the text. As such, if one needs to pass through a room to get to another room in real-life then a character in a mental model will have to do so also (Morrow et al, 1989). Likewise if one would expect someone to feel guilty about stealing from a friend in a real-life situation then a character who is described as stealing from a friend will also be represented as feeling guilty in a model (Gernsbacher et al, 1991).

Sanford and Garrod (1981) propose that world knowledge is accessed via 'scenarios'. These are similar to Minsky's 'frames' (1975) and the 'scripts'

proposed by Schank and Abelson (1977). Basically these are knowledge structures containing information about situations or events. As such they contain information about certain expectations in the form of default items. e.g. in a restaurant scenario unless explicitly stated otherwise, one would expect the presence of certain items and a certain sequence of events (such as waiters, menus, ordering the meal, paying the bill, etc.). The organisation of stereotypical information in this way may account for the inclusion of inferential information in representations of discourse. A situation described by a text would access whatever relevant scenario and the information that it contains in the form of expectations or default values (for a fuller account see Sanford and Garrod, 1981).

An inability to construct an accurate mental model of the situation described by a text seems to result in a reliance on a linguistic representation. This interpretation is supported by the work of Mani and Johnson-Laird (1982). They gave subjects a number of spatial layouts to remember. They found that when subjects were unable to create an unambiguous mental model of a situation. They tended to remember the sentences verbatim. This finding is in line with the proposal that more than one type of representation is used in the construction of a mental model and also provides some explanation of why subjects sometimes appear to be remembering materials verbatim.

The body of work reviewed suggests that the result of comprehension is the construction of a mental model of the events described by the text. The discussion has centred on how mental models may explain many of the aspects of language comprehension that propositional representations cannot account for.

However even though it is generally accepted that mental models are created at some time during comprehension, the exact timing and circumstances leading to their construction is an area of heated discussion. It is in discussing these details that the minimalist and constructionist stances differ most. Minimalism offers a subtly different interpretation of the findings outlined in the preceding pages. The

minimalist hypothesis incorporates aspects of Kintsch and van Dijk's (1978) model of propositional representation. Essentially, the minimalist claim is that 'normal' language comprehension is carried out with only a representation of the information given in a text plus those inferences necessary to achieve local coherence. More global or elaborated inferences will only be drawn in order to achieve specific goals that are required for the task being undertaken. Thus the findings of the experiments detailed earlier can be explained in terms of readers constructing representations that contain information that they will be asked questions about or asked to make decisions about later. In the case of Morrow et al (1987; 1989) McKoon and Ratcliff (1992) suggest that the task subjects performed was not a test of normal reading. Given that subjects were required to learn the layout of a building and its contents it was suggested that the goal of reading the text was to encode spatial locations and relationships. As such it is unsurprising that subjects produced the response times that they did. In addition, McKoon and Ratcliff suggest that constructionist mental model theories are unable to explain a number of findings. Remember that McKoon and Ratcliff assume that all constructionist models make the following claims:

"A situation model is the result of interaction between information given in a text and knowledge about linguistics, pragmatics, and the real world; a situation model can be modified as new information comes in to produce a completely new interpretation of the text; the information in a situation model can be manipulated to produce emergent relations; a situation model is perceptual-like; a situation model guides interpretation of referential terms; and a situation model guides the generation of inferences." Glenberg, Lindem and Meyer, (1987), p.69.

If mental models are such complete representations of the situation described by a text then why is it that some information is encoded and some is not? For instance in an experiment carried out by Dosher and Corbett (1982) the relationship between actions and their implicit instruments was explored. In sentences such as "Mary stirred the coffee" there is an implicit instrument, in this case a spoon. In a Stroop task, Dosher and Corbett showed subjects sentences and lists of

instrumental items. They found that there was no facilitation of reading times for instruments regardless of whether the instrument was the most likely for the action. It would appear from this test that the instruments one would assume would be implied by the action were not activated. This in turn suggests that subjects were not encoding the inference that a particular instrument was involved in the action when they read the sentences. An effect of instrument was only found when subjects were instructed to explicitly guess the instrument used before they received the Stroop task. This is in line with the minimalist hypothesis but goes against the notion that a "life-like" model of the situation is being constructed. Instead the results of Dosher and Corbett suggest that in the absence of any specific reader goals, inferences unnecessary for local coherence are not being constructed. Whilst it may be argued that a Stroop task is not a 'normal' reading activity, Dosher and Corbett's results are line with a number of other studies. McKoon and Ratcliff's (1989e) review of on-line tasks investigating the construction of elaborative inferences supports the minimalist position. In lexical decision tasks and recognition tasks that had a short delay between the presentation of context materials and a test word McKoon (1988) and McKoon and Ratcliff (1989c) found no difference between response times and error rates in control conditions and those judged to predict an inference. When the time between presentation of context materials and test word was increased Potts, Keenan and Golding (1988) found a significant difference between predictive and control conditions in a lexical decision task. Subjects were faster at making the lexical decision when the test word followed a context sentence that strongly predicted the generation of an elaborative inference. McKoon and Ratcliff (1986) carried out a recognition task and found that when the time between presentation of context and test materials was increased, recognition times for words following the 'control' context were significantly faster than times for test words following a 'predictive' context sentence. Taken together the results of the review article and of Dosher and Corbett (1982) suggest that subjects are NOT automatically encoding plausible inferences during comprehension.

The minimalist hypothesis as posed by McKoon and Ratcliff (1992) is presented in opposition to constructionist models. However critics of the minimalist stance have pointed out that the main 'differences' between minimalism and the position of most constructionists are small and may be explained in terms of a number of errors on the part of McKoon and Ratcliff's understanding of the constructionist position.

Garnham (1992), Glenberg and Mathew (1992) Singer (1993) and Zwaan and Graesser (1993), have pointed two main problems with the minimalist stance. These are the somewhat artificial distinction between minimalism and constructionism and the question of automaticity. Given that a mental model is constructed in working memory, there is a very real processing constraint on the amount of information that could be included in a mental model. Thus because of considerations of 'cognitive economy' a mental model could not contain all of the details of a situation described in a text. This limited capacity processor is a feature of a number of mental model theories, (Glenberg, Meyer and Lindem 1987 [ironically]; Garnham, 1987; Garnham Oakhill and Vonk, 1989; Sanford and Garrod 1981) and so at least partially undermines this difference between the two stances. The nature of the constraints imposed by the internal environment in which mental models are constructed, require mental models to be 'minimalist' (if not to the same degree as that proposed by McKoon and Ratcliff). This notion is further supported by the work of Oakhill, Garnham and Vonk (1989). In this paper the authors propose the notion of an incomplete interpretation of a text as an explanation of some of the inconsistencies in findings in the mental models literature. A similar line of reasoning is held by Vonk and Noordman (1989). They claim that the most likely representation is one that falls in between the two extremes. Rather than comprehension resulting in a veridical model of the situation or in a representation that is practically composed only of linguistic information the true nature of the end result of comprehension is probably a compromise. In a sense these papers address the minimalist claims and in effect partially answer the question about the 'veridical' nature of mental models that forms one of the major arguments against constructionism. McKoon and Ratcliff's (mis)understanding of the constructionist position is based apparently

solely upon the work of Bransford et al (1972) and Glenberg et al (1987). They appear to have almost completely ignored the work of European researchers in the area of mental models.

McKoon and Ratcliff also say that it may be necessary to make certain global or strategic inferences in order to understand a text. However if this is the case, then there appears to be no functional difference between minimalism and constructionism. Both theories suggest that inferences are drawn during reading and that these may be in support of comprehension at either a local or a global level. The distinction between global and local inferences is not made clear in McKoon and Ratcliff's paper. As mentioned in the quotation given earlier they suggest that non-minimal inferences can be drawn if they are made on the basis of "information that is quickly and easily available." What is information that is not easily available? The exact nature of this information needs to be made more explicit for the minimalist hypothesis to provide an adequate explanation of language comprehension. For instance, McKoon and Ratcliff suggest that a minimal inference is one that is made to establish local coherence or is made on the basis of "readily available" information. However in their discussion of Bransford, Barclay and Franks (1972) study they suggest that an inference based on a knowledge of spatial relationships (that if turtles are on a log and a fish swims beneath the log it also swims beneath the turtles) is an elaborative inference. This is because this information is not readily available. However without a knowledge of spatial relationships how is one to correctly understand the sentence? In their defence, McKoon and Ratcliff do say that

> "Our goal in establishing the minimalist hypothesis is to stimulate research
> designed to find the principles by which inferences are generated." McKoon
> and Ratcliff, 1992, p.463.

However, as their research and standpoint is based on the distinction between different types of inference, then any lack of clarity concerning these definitions is a serious flaw (a sentiment echoed by Keenan, 1993).

The other point that McKoon and Ratcliff make in their minimalist argument is that only some inferences are constructed automatically. However as Carrieras (1993) points outs there seems to be some confusion on McKoon and Ratcliff's part. Automaticity is not a key feature of mental model theory. Garnham (1992) has taken issue with the claim that any inferences are made automatically in the sense of "not requiring cognitive effort". As Carrieras states;

"...the claim that mental models are built on-line differs from the claim that mental models are built automatically."
Carrieras (1993).

Despite the fact that McKoon and Ratcliff present experimental evidence in support of their claims for a minimalist approach to inference construction, (directly in the form of a number of experiments suggesting that global inferences are not necessarily constructed on-line) there is at least as much evidence in support of the constructionist mental model approach. In fact, as the reviews of McKoon and Ratcliff's (1992) work point out, (Carrieras, 1993; Garnham, 1992; Glenberg and Mathew, 1992; Noordman and Vonk, 1993; Singer, 1992; and Zwaan and Graesser, 1993), the differences between the two approaches are slight and seem to be the result of McKoon and Ratcliff's misconceptions about what mental models actually are.

As well as having been addressed by Oakhill et al (1989) the differences between the minimalist and constructionist positions have also been reviewed recently in a paper by Graesser, Singer and Trabasso (1994). This is an attempt to bring together the results of text comprehension studies (both minimalist and constructionist interpretations) under one framework sufficient to explain both. Graesser et al suggest that McKoon and Ratcliff's (1992) misconceptions about what mental models actually are, result from the shortcomings of early work into this area. Specifically they cite the lack of explicit predictions about the classes of inferences are generated during comprehension. In an attempt to unify these two positions Graesser et al propose that comprehension is best described in terms of

the *Search (or effort) after meaning* principle (p. 371). In simplified terms this principle rests upon three main assumptions:

1. *The reader goal assumption* This rests upon the assumption that reading is directed towards the satisfaction of a particular purpose that the reader has in mind. The representation of the text constructed is thus dependent on the reader's specific goals. Graesser et al suggest that normally representations are at the level of meaning and the referential situational model.

2. *The coherence assumption* This assumption is that the reader will normally attempt to construct a representation that is coherent at both the local, (e.g. the level of adjacent clauses or short sequences of clauses - the level of pronominal reference), and the global level (e.g. the interrelation of local chunks of information to give a higher order level of information). An example of global coherence cited by Graesser et al is the way that local pieces of information may be combined to produce a theme of a particular text, such as the moral or main point of a text.

3. *The explanation assumption* This is concerned with the reader's attempts to provide a reason for why individual events actions etc. are mentioned in a text. These attempts are proposed to "involve naive theories of psychological and physical causality in an effort to achieve coherence in understanding."(p. 372).

Although this model is acknowledged to be limited to narrative texts, it does provide a solid foundation for the development of a more wide ranging theory of language comprehension. One that is able to encompass the constructionist and minimalist standpoints. Essentially it unifies and makes more explicit the points raised in objection to McKoon and Ratcliff's minimalist hypothesis. It does suffer however from a lack of any empirical evidence specifically testing its hypotheses. It does (along with the work of McKoon and Ratcliff, 1992, and Garnham et al 1992) provide possible explanations for the findings of a number of experiments carried out in this thesis. As such all three of these papers are reviewed in more depth in the concluding chapter.

In the review of language comprehension in general, the minimalist and constructionist accounts have been compared. There is evidence to suggest that language comprehension begins with representations making use of much less than all available information (Ferriera and Clifton 1986; Ferriera and Henderson 1990; Frazier and Rayner 1982; Rayner, Carlson and Frazier 1983). This is contrasted with mental model approach to language comprehension, an approach that accommodates these findings in its claim that textual information is integrated with generally known information. Evidence was presented that suggests that a mental model is a representation of a situation, not a representation of the information given in the text. This is assumed as a result of studies suggesting that information is encoded that is not specifically mentioned in a text. This is proposed to be general knowledge. The minimalist position states that this information is an artefact of task demands and does not reflect the true processes involved in reading under "normal" circumstances. The minimalist approach highlights inconsistencies in the constructionist stance. However, in its turn minimalism has a number of flaws, one of which is the lack of clarity of its definitions of the differences between a minimal and an elaborated inference. One area in which the minimalist hypothesis is very clear is in the comprehension of anaphora. Studies carried out in the area of anaphora comprehension by Corbett, (1984), Dell, McKoon and Ratcliff, (1983) and McKoon and Ratcliff, (1980a):

"...support the minimalist hypothesis by showing that the information necessary to establish anaphoric connections is available immediately during reading." McKoon and Ratcliff, 1992, p.444.

In order to produce a more stringent test, McKoon and Ratcliff suggest that a study examining the availability of information and the pronoun resolution is necessary. Pronoun comprehension presents the ideal opportunity to investigate the claims of the minimalist hypothesis using a class of inference that is clearly defined. The next chapter reviews work in the area of pronoun comprehension and relates the findings to the minimalist hypothesis.

CHAPTER 2: PRONOUN ASSIGNMENT AND MINIMALISM.

PRONOUN ASSIGNMENT

Pronouns are anaphoric expressions used to refer to entities which have (usually) previously been introduced into a text or sentence. A pronoun carries very little information on its own - it relies on its antecedent to impart most of its meaning to it. The range of possible referents of a pronoun is constrained by a number of lexical, syntactic, semantic and pragmatic factors. Two of the constraints are specified by the pronoun itself; a pronoun must agree in number and gender with its antecedent (The exceptions to this rule [outlined by Gernsbacher 1991] will be considered later). For instance "he" refers to an animate (usually human), singular, male. Thus in sentence 14);

14) John sold Gail his car because he hated it.

There is no difficulty in assigning the pronoun to the correct antecedent because the pronoun specifies the range of possible antecedents it can refer to. In this case there is only one possible antecedent in the group of animate, singular males specified by the pronoun: John. As Sanford and Garrod (1981) point out, other rules constraining pronoun assignment are more complex. For example, one syntactic rule concerns reflexive pronominalisation. This states that the pronoun must refer back to an ˙antecedent that is the subject of the same clause. Another rule states that backward pronominalisation can only occur when the pronoun is in a subordinate clause preceding the main clause. Thus in sentence (15a) below, backward pronominalisation can occur (the "he" can refer to Fred);

15a) Although he could not swim, Fred jumped in to save Mary.

But in sentence 15b) (overleaf) this rule is violated and so the pronoun cannot refer to Fred.

15b) He jumped in to save Mary, although Fred could not swim.

Thus in a number of cases pronoun resolution may be accomplished using far less than all of the information available (Ehrlich 1980). Instead, linguistic factors (such as lexical and syntactic information) may serve to rule out a large number of potential antecedents. Accordingly, pronoun comprehension affords researchers an excellent opportunity to test the minimalist hypothesis. Pronoun comprehension is widely thought to be a search for the most appropriate referent from a set of candidates. The domain in which this search is proposed to take place is critical in all models of language comprehension. Early models of pronoun assignment tended to assume (either explicitly or implicitly) that a serially or hierarchically ordered search took place through a list of clauses or propositions (Clark and Sengul, 1979; Corbett and Chang, 1983; van Dijk and Kintsch, 1983). As Greene, McKoon and Ratcliff (1993) point out, these early models were based on serial scanning models of memory (c.f. Murdock, 1974; Sternberg, 1966, 1969). As models of memory have tended to move away from serial/hierarchical models to multidimensional parallel search models so models of a pronoun resolution have also changed. Many discourse models now incorporate parallel searches (e.g. Grosz, Joshi, and Weinstein, 1983; Webber, 1983).

Ehrlich (1980) investigated the nature of this search. In her experiment she showed subjects a number of sentences which contained what we may term minimal information and non-minimal information. These sentences were of the following types:

16a) John blamed Bill because he split the coffee.

Or

16b) Jane blamed Bill because he spilt the coffee.

In the case of sentence 16a) the set of possible referents for the pronoun 'he' is equal to all of the entities mentioned by the text (the only people mentioned are singular males). In this case readers need to use their knowledge of the structure of events to infer that the recipient of blame is likely to be a person who spills something: in this case Bill. However in sentence 16b the set of possible referents of the pronoun consists of only one candidate: Bill. Bill is the only entity that possesses the quality of 'maleness' specified by the pronoun. Although pronoun comprehension is straightforward in both cases, sentence 16b does not require the reader to access information that is not included in the sentence. The pronoun is resolvable solely on the basis of the gender cue. This information (lexical information) is apparently either more readily available or allows faster access to the antecedent than the information in sentence 16a. Whether the 'search enhancing' effects of gender cue reflects a serial or a parallel search is not made clear from Ehrlich's experiment. However, according to the minimalist hypothesis subjects should read sentences in which the referent is specified by gender alone, faster than those in which gender cue is insufficient to unambiguously resolve pronoun assignment. This would be expected to occur regardless of whether pronoun resolution is accomplished via a serial or a parallel search. Ehrlich explored the use of gender cue and knowledge of events (causal bias) in pronoun comprehension. Her findings were that subjects were faster at reading sentences in which a referent could be selected on the basis of gender information alone than when reading sentences containing no gender cue. This information can be interpreted as providing support for the minimalist hypothesis. Subjects appear to be making use of the most readily available information to guide their processing of pronouns. In this case the information is at the lexical level.

However, sometimes the gender and number information carried by the pronoun is insufficient to specify who or what the pronoun is referring to. For example in the sentence below;

18) John sold Bill his car because he hated it.

The gender/number information of the pronoun is insufficient by itself to specify whether it is John or Bill who is being referred to. In the case above we may assign the pronoun to John as a result of our knowledge about buying and selling: it is unlikely that Bill would buy a car that he hated so 'he' is assigned to John.

As in the example sentences above, pronoun assignment appears to draw on information from a number of sources. Various factors affecting pronoun assignment have been identified, reflecting the diverse knowledge sources used, including syntactic parallelism (Caramazza, Grober, Garvey and Yates, 1977; Caramazza and Gupta, 1979; Stevenson, Nelson and Stenning 1993), first mention, (Allerton, 1978; Cole, Harbert, Hermon, and Sridhar, 1980; Fletcher, 1984; Gernsbacher and Hargreaves, 1988; Gernsbacher, Hargreaves and Beeman, 1989; Keiras, 1979; 1980; 1981b), the thematic roles of the potential antecedents, (Stevenson, Crawley and Kleinman, 1994), the animacy of the possible antecedents (Bernado, 1980; Clark and Begun, 1971; Fillmore, 1977; Perfetti, 1973; Perfetti and Goldman, 1974; 1975) and verb causality (Brown and Fish, 1983; Garvey and Caramazza, 1974), among others. It is evident then that pronoun assignment may be accomplished on the basis of the operation of a large number of factors.

In order to influence pronoun assignment these factors must be incorporated into a representation of the text. One notion of text processing that attempts to provide an explanation of how these factors may interact are the proposed mechanisms of 'foregrounding', (Chafe, 1972), 'centring'(Gordon, Grosz and Gilliom, 1993; Grosz et al 1983, 1986) or 'focus', (Sanford and Garrod, 1981). Although these terms differ in a number of ways they are similar in a number of central points. They will be assumed to refer to roughly the same process. Chafe coined the term foregrounding to describe the fact that not every entity in a text is equally easy to refer to. Those that are easy to refer to are termed 'foregrounded'. In simple terms this means that they can be referred to using a pronoun. If an antecedent is not foregrounded, using a pronoun will seem odd even if the

pronoun may be assigned unambiguously. For example the following sentence (Sanford and Garrod 1981, p. 135);

19a) The donkey kicked its owner on the leg.

could be followed by either;

19b) Then it ran into the village and hid.

Or

19c) He was extremely annoyed by this aggressive behaviour.

One can equally easily refer to either *"the donkey"* or *"the owner"*, using a pronoun. This is explained by Sanford and Garrod (1981) as a result of both being foregrounded by the explicit mention which occurs in the first sentence. However if the text was structured as follows, then we see that the ease of reference between *"the donkey"* and *"the owner"* changes.

20a) The donkey kicked its owner on the leg.

20b) It ran into the village and hid.

20c) He was extremely annoyed by this aggressive behaviour.

The "He" in sentence, (20c), sounds strange despite the fact that the pronoun may be unambiguously assigned to *"the owner"*. That is because the use of the pronoun serves to continue the foregrounding of *"the donkey"* at the expense of moving *"the owner"* out of the foreground. Sanford and Garrod (1981) extend this notion to include both explicit and implicit foregrounding (which they term 'focus'). They explain pronoun assignment as the result of an individual or object being in explicit focus. Items in explicit focus are those that have been explicitly mentioned in the text. Items in implicit focus are those whose existence is implied by what is in explicit focus. These can then be introduced into the text as definite items (e.g. using 'the' rather than 'a') but not referred to using a pronoun. For example, after reading the sentence below, it would be permissible to refer to the house using a pronoun, but in order to refer to a

specific part of the house (e.g. the lounge), then that part must be brought into explicit focus by being explicitly mentioned.

> e.g.　21a) I looked around the house.
> 21b) It was very spacious.

Thus the 'it' must refer to the house as a whole not a specific part of the house unless that part had been introduced by name.

When there is more than one possible antecedent available for a pronoun to be assigned to, then the actual antecedent chosen may be determined by the relative *'weights'* (Sanford and Garrod's term) of the factors biasing pronoun assignment, (e.g. first mention, parallel function etc.). Thus the 'focus' mechanism proposed by Sanford and Garrod can accommodate the findings of a wide variety of studies, as a result of the different 'weights' assigned to different factors. Their model is not incompatible with a number of other findings suggesting that heuristic strategies are employed in pronoun assignment. Sanford and Garrod's model proposes a limited capacity working memory text processor. This processor assigns pronouns to antecedents as a result of the interplay of the factors outlined above. The various sources of information, (e.g. lexical, syntactic, semantic and general knowledge), being applied at different times during processing.

A number of studies carried out investigating pronoun assignment suggest that general knowledge about the overall meaning of a sentence is not always used before assignment takes place, (Caramazza et al, 1977; Ehrlich, 1980; Springston, 1976). Ehrlich's study involved presenting subjects with sentences like the ones below and asking them to choose which noun phrase a particular pronoun referred to;

> 22a) Steven blamed Frank because he spilled the coffee.
> 22b) Jane blamed Bill because he spilled the coffee.

Ehrlich found that subjects preferred to assign the 'he' to Frank in sentence 22a). This they must do as a result of their knowledge about the situation. Spilling coffee is 'bad' and, as Frank was the person who carried out this 'bad' act, then Steven has a reason to blame him. However, exactly the same rationalisation of the actions applies in sentence 22b), except that the pronoun CANNOT refer to anyone else but Bill, as a result of the constraints imposed on reference by the gender information specified by the pronoun. This is not to say that subjects are making use of a serial processing model of text whereby linguistic then pragmatic constraints are applied in sequence. Ehrlich's findings may also be explained in terms of a parallel processing model of text comprehension, such as that put forward by Mellish, (1981; 1985) and Altman and Steedman (1988). They too represent reference as a process of constraint satisfaction. These constraints may be 'hard' or 'soft.' A hard constraint is a constraint that cannot be violated (such as gender agreement between the pronoun and antecedent). A soft constraint is a general tendency noted in pronoun assignment. For instance the preference for a reader to assign a pronoun to the first mentioned entity, (as noted by Allerton, 1978; Cole, Harbert, Hermon, and Sridhar, 1980; Fletcher, 1984; Gernsbacher and Hargreaves, 1988; Gernsbacher, Hargreaves and Beeman, 1989; Keiras, 1979). A soft constraint MAY be violated. In the constraint satisfaction view, reading through a text confronts a reader with an accumulating number of constraints which a referent must satisfy in order to have a pronoun assigned to it. The reader has a number of representations of 'partly evaluated' referents available to him or her. The reader's task is to decide which members of the set of partly evaluated referents satisfy ALL the available constraints. The set of possible referents becomes more and more refined as analysis proceeds until just one possible candidate remains. Thus both linguistic and pragmatic constraints may single out a referent for pronoun assignment.

The initial set of possible antecedents for the pronoun "he" in sentence 22a) consists of Steve and Frank. Both satisfy the gender constraint imposed by the pronoun so at this point both are possible recipients of the pronoun. When we come upon the pragmatic constraint *"...because he spilled the coffee"* we are able to single out Frank as the most likely candidate for pronoun assignment because

we know that people who spill things are more likely to be blamed than those who do not. It must be noted that this is a 'soft constraint': Steven is still a possible antecedent although an extremely unlikely one. In sentence 22b) the set of possible antecedents (Jane and Bill) is immediately reduced to one because of the 'hard' gender constraint imposed by the pronoun. As there is only one possible referent that satisfies the gender constraint, Jane must have the pronoun assigned to her.

Thus no matter whether processing is accomplished serially or in parallel, gender information in both models is sufficient to accomplish pronoun assignment before pragmatic information. This is not to say however that pragmatic or general knowledge information is not used at all, merely that gender cues appear to speed the process of pronoun assignment (Caramazza et al 1977). It may be that gender cue is a minimal source of information (McKoon and Ratcliff, 1992). However, as Stevenson and Vitkovitch (1986) point out;

> "Given the inherent ambiguity of pronouns, it may be that readers always rely
> on pragmatic information in order to comprehend them." Stevenson and
> Vitkovitch, 1986, p.336.

In earlier sections it has been suggested that comprehension appears to result in the construction of a mental model of the situation described by a text. This model is constructed from one or more linguistic representations (Johnson-Laird 1983; van Dijk and Kintsch, 1983; Tanenhaus, Carlson and Seidenberg 1985), and receives input from the reader/listener's general knowledge. Within this model, pronoun assignment is carried out as a result of the constraints on possible antecedents provided by the presence of linguistic and pragmatic constraints. As mentioned in chapter one, it appears that pronoun assignment is accomplished via a search of a mental model for antecedents, rather than through a search of a linguistic representation of the information contained within text, (Garnham 1982, 1987; Johnson-Laird, 1983). However, it appears from the work of Ehrlich (1980) and Springston (1976) that the 'hard' constraint imposed on the range of possible antecedents resulting from unambiguous gender information specified by

pronouns, is a powerful aid to fast pronoun assignment. So even though pronoun comprehension does appear to take place within a mental model, relatively low-level minimal sources of information do play an important role in comprehension.

The work so far has considered only singular pronouns. The work of a small number of researchers investigating plural pronoun comprehension has revealed some interesting findings that suggest a number of modifications to the assumptions underlying pronoun research. In the next section, some of this work is reviewed in relation to the representational and processing issues discussed previously. How does the work on plural pronouns relate to the minimalist hypothesis and to the suggestion that pronoun resolution is accomplished through the use of a mental model? A major point of discussion is whether plural pronouns are processed in a similar way to singular pronouns.

PLURAL PRONOUNS

There has been comparatively little research into factors affecting the use of plural pronouns. The majority of research into the assignment of pronouns to antecedents has been concerned with those factors resulting in a single individual being selected as the antecedent of a (usually ambiguous) singular pronoun. Similar assignment problems apply to plural pronouns as to singular pronouns: Which entity(ies) are being referred to by the pronoun (i.e. which individual(s) are included in any group/plural or singular reference and which are not). However, plural pronouns also present the interesting problem of WHY does group reference take place at all? What are the factors that increase the likelihood of a plural reference rather than a singular reference taking place? How are groups formed? What factors lead us to cause a number of individuals/objects to be classified together? The factors that may be hypothesised as determining whether or not individuals can be referred to as a group, are undoubtedly dependent on the type of process that is used to comprehend written language. This will depend on what the end stage of comprehension is and also depend on the nature of the process itself. By this it is meant the details of the structure of

the language processing system will affect what type of information is available to be made use of at any specific time during the comprehension process. For instance, different types of information (i.e. linguistic or non-linguistic) will be used at different points during comprehension if the processor is a modular rather than an interactive system (as suggested by the findings of Ferriera and Clifton, 1986; Ferriera and Henderson, 1990; Frazier and Rayner 1982; and Rayner, Frazier and Carlson, 1983). This in turn is dependent on the end-product of processing. For example if the end product of 'normal' comprehension is a propositional representation of the information conveyed in a text (such as the one proposed by Kintsch and Van Dijk in 1978 and McKoon and Ratcliff, 1992) then information drawn from general knowledge about the world will not have a role to play in plural pronoun processing.

As mentioned, relatively little work in the area of language comprehension has been carried out into the mechanisms involved in processing plural pronouns.

> "Most approaches to 'processing reference' are concerned with the case of singular NPs and deal with the complications of plurals only peripherally by remarks of the kind 'The plural case can be considered analogously'." (Habel, 1986 p.1).

Although Habel is suggesting that plural pronouns are a special case of reference, attempts to explain plural reference (references to groups of entities) that have treated plural pronouns (and similar kinds of anaphoric references) in much the same way as singular pronouns, have met with some success. By this it is meant that pronoun resolution is carried out on the basis of satisfying the constraints of number and gender specified by the pronoun. Fraurud (1991) studied a corpus of 85 non-fiction Swedish texts investigating the range of possible antecedents of plural pronouns and their syntactic and semantic features. Fraurud categorised the range of antecedents as belonging to one of six groups:

Simple plural antecedents: These were NPs with a head in the form of a plural pronoun, noun, adjective, participle or count word. e.g. they, some boys, the old (pl.).

Simple singular antecedents: These were NPs with a head in the form of a singular noun. e.g. the family, a group of substances.

Co-ordinate antecedents: These antecedents are NPs containing two or more heads e.g.

$$((John)_{NP1} \text{ and } (Mary)_{NP2})_{NP3} \text{ will come. They...}$$

Split antecedents: These are antecedents whose NPs appear in different constituents of a sentence or in different sentences altogether. e.g.

$$(John)_{NP1} \text{ will come with } (Mary)_{NP2}. \text{ They...}$$

Antecedentless: This classification of antecedent occurs when the text lacks a NP that could be anaphorically related to the plural pronoun. e.g.

> It was different in the peasant society. Then she was the one who
> was the most active in professional life. She had the keys. All that
> <u>they</u> took away from us.

Fraurud classed *cataphoric* references (those that possess a linguistic antecedent in following text) as a subclass of antecedentless pronouns. The distribution of these different antecedent classifications is given overleaf in Table 2.1 (taken from Fraurud, 1991, p.3).

Table 2.1: Distribution of plural pronouns by type of linguistic antecedent

	N	%
Simple plural	474	89.4
Co-ordinate	29	5.5
Simple singular	15	2.8
Antecedentless	7	1.3
Split	4	0.8
Cataphoric	1	0.2
Total	529	100

Fraurud applied an algorithm derived from her 1988 work on singular pronouns to the plural pronouns found in her study of the corpus. She found that in 91% of cases, this algorithm (based on number/gender agreement, recency of mention and a few syntactic constraints and preference rules - see Fraurud 1988 for a fuller description) was sufficient to allow pronoun resolution to take place. However, the findings of Fraurud agree with the point made by Habel (1986): while plural pronouns share many of the same assignment features as singular pronouns (such as the determination of what the pronoun's referent is), there are complications of use that are unique to plural pronouns. As Fraurud's results report, her algorithm was unable to account for nine percent of the pronouns encountered. In addition, Fraurud approached the problem from a computational linguistic stance. As such her algorithm is not based on the actual performance of human readers.

The Hamburg group of researchers suggest that plural pronouns are comprehended differently from singular pronouns because:

> "Compared to the case of singular pronouns, the resolution of anaphoric
> plural pronouns requires an additional step of processing: the sum formation."
> Eschenbach, Habel, Herweg and Rehkamper, (1989) p.161.

This sum formation refers to the means by which a number of individual referents come to be grouped or 'summated', to allow a group reference to take place. Another peculiarity of plural pronouns is their apparent ability to violate a hard constraint: That of agreement in number (Gernsbacher, 1991). She found that certain situations exist in which plural pronouns may not only be used to refer to singular antecedents, but are actually preferred to more linguistically correct usages.

Gernsbacher's work suggests that this violation of number agreement is a result of the nature of pronoun use. Supporting the contention raised in the preceding section, Gernsbacher's work suggests that a pronoun refers to an underlying concept, rather than to a preceding noun phrase. In other words referents are non-linguistic concepts rather than actual linguistic entities such as NPs. This is in line with Garnham's 1982 contention that essentially linguistic representations of text (such as Kintsch and van Dijk's 1978 model of propositional representation) are not sufficient to be able to account for reference. In a reading time task, Gernsbacher's subjects had no difficulty in processing plural references to singular antecedents, and in fact preferred these 'illegal' uses to references that obeyed the 'agreement in number' constraint. Subjects in Gernsbacher's study were apparently making on-line use of their real-world knowledge to understand sentences. In cases like the example below:

23a) I need a plate.

23b) Where do you keep them?

Subjects make use of their knowledge that people usually possess more than one plate in order to interpret the plural pronoun as referring to the concept of 'number of plates that people usually own'. Thus, the plate mentioned in the example above is a non-specific member of the generic set of 'plates that are owned' by the person in question. The antecedent is the concept rather than the NP "a plate".

This finding was largely upheld in three experiments carried out by Oakhill, Garnham, Gernsbacher and Cain (1992). Subjects rated linguistically 'illegal' conceptual anaphors as being as acceptable as 'legal' ones. In a second experiment (measuring acceptability ratings and times), Gernsbacher's conceptual anaphors (as rated in Oakhill et al's first experiment) were rated highly and judgement times were low. A third experiment contrasted references with implicit plural antecedents (conceptual anaphors) with references containing explicit plural antecedents. Oakhill et al (1992) found that reading times for pronouns referring to collective sets (Gernsbacher 1991) were faster than for pronouns that had an explicitly plural antecedent. However, references to generics and to implied multiple items were read faster when there was an explicit plural antecedent than when the plural antecedent was implied. The results of Gernsbacher (1991) and Oakhill et al (1992) provide some support for the view of language comprehension that suggests the end result of understanding a text is the construction of a mental model of the described situation.

The antecedents used in the sentences investigated by Gernsbacher were all examples of either frequently or multiply occurring events; generic types of entities or events (a peculiarity also noted by Fraurud, 1991); or animate members of collective sets. These are already implicitly members of groups. Intuitively it seems likely that this an effect on the interpretation of the plural pronouns. The concept of group membership is obviously an important one in plural pronoun comprehension. A plural reference identifies a number of individuals with some features in common and on this basis excludes other individuals from being identified as part of the group. This idea of group reference is supported in some respects by Gernsbacher's (1991) work. As stated, Gernsbacher's work looked at references to groups that had already been formed. But how does 'on-line' group construction take place? What are the factors that allow us to group together individuals who have previously been introduced separately?

Eschenbach, Habel, Herweg and Rehkamper (1989), suggest that it is the operation of a "Common Association Basis" (CAB) that allows a plural reference to be made. When two entities share features in common then they form a

"complex referential object" (a referent that is composed of the individuals captured by the common association base). Not every possible combination of objects mentioned in a text may be included in the formation of a "complex referential object" and thus referred to using a plural pronoun. The entities need to have some properties in common, but these may be features of the situation such as interaction, the same role, or spatial proximity (Rehkamper, 1990). For example in the following sentences, the "complex object" Michael and Maria is introduced and may be referred to by 'they':

24a)   The children went to the cinema last night.
        They had a great time.

24b)   Michael and Maria went to the cinema last night.
        They had a great time.

24c)   Michael went to the cinema last night with Maria.
        They had a great time.

24d)   Michael met Maria at the cinema last night.
        They had a great time.

The situation and the objects involved are the same in each sentence version: the complex object consisting of Michael and Maria is introduced. The common association basis (CAB) differs in each sentence. In sentence 24a) the CAB is provided by the plural NP "*the children*" and the event, "*going to the cinema*". In 24b) the conjoined NP "*Michael and Maria*" and the event provides the CAB. In 24c) the NP "*Michael*" and the PP "*with Maria*" and the event leads to the formation of a complex object, whereas in 24d) it is the event of "meeting someone" that provides the CAB. Even though the complex object is explicitly named by the plural NP in only one sentence ("*the children*" in 24a)) a plural reference may still be made to the characters appearing in all of the sentences. It is the CAB that provides the basis for the "sum formation" operation proposed to be necessary in order to represent individually introduced characters as a group.

This ties in with Gernsbacher's findings. Her classifications of conceptual anaphors into frequent/multiply occurring events/items, generic types and members of a collective set share similarities across a range of properties. Although not specifically the aspects of shared similarities mentioned in Eschenbach et al's work, their findings do emphasise that similarities such as spatial proximity, or shared action help to form a CAB.

Eschenbach et al (1989) also provide a counter example. In the following sentence, the two entities have no CAB and so the use of a plural reference to them is extremely difficult;

25) Michael and his frisbee were at the park. They...

Even though a conjoined NP is used, no group referent (or complex object) is formed, which leads to difficulty in accepting the use of a plural pronoun. This is because the difference in ontological types between the entities (Michael - human, "*his frisbee*"- inanimate object) rules out a CAB.

What are the factors that lead to the formation of a common association base then? A range of factors have been mentioned. These divide easily into what might be termed 'minimal' (NP conjunction) and 'non-minimal' (spatial proximity) sources. As noted above, the type of linguistic construction used to introduce the characters is hypothesised to affect the strength of the CAB. This hypothesis has been supported by the experimental findings of Hielscher and Musseler (1990) and Sanford and Lockhart (1991). Hielscher and Musseler (1990) investigating the use of the German pronoun 'sie' (which is ambiguous in number until a verb inflection has been read) found evidence suggesting that it was aspects of the pre-pronominal sentence structure that determined whether the characters in the text were represented as a group or as individuals. If the noun phrases of separately introduced characters were conjoined through the use of '*and*', '*as well as*' or '*neither/nor*', or by the preposition '*with*' then subjects showed a preference for referring to both of them as a group rather than as individuals. Conversely, when the characters appeared in sentences in which they

were conjoined using 'without' or 'instead of' then subjects preferred to refer to them as individuals rather than as a group.

In a continuation study (in which subjects were required to complete a sentence fragment), Sanford and Lockhart (1991) also noted that subjects were more likely to use a plural pronoun to refer to characters who had been introduced with NPs conjoined through the use of 'and', than if they occupied a Subject-Verb-Object sentence structure. In addition, Sanford and Lockhart found that characters who were introduced in the same way were more likely to be referred to as a group than characters with differing introduction types, (e.g.. Name/name or role/role pairings were more likely to be referred to using a plural pronoun than name/role or role/name pairings). This finding is in line with earlier work on text processing and scenario dependent characters carried out by Anderson, Garrod, and Sanford (1983), and Sanford, Moar, and Garrod (1988). Sanford and Lockhart explain the introduction type effect as being a special case of ontological type (Herweg, 1988). It thus also suggests that plural pronouns are processed according to the operation of Sanford and Garrod's (1981) 'focus' model of text comprehension. If (as we saw in the last section) one character in a text receives more 'focus' than another then that character will be the one that continues to be explicitly focused. The work of Anderson et al (1983) and Sanford et al (1988) referred to above, suggested that named characters were more likely to remain foregrounded in explicit focus than role-named characters. Thus it may be surmised that the reverse of this situation will result in the formation of a group: when the two characters receive equal amounts of focus then they will both remain in explicit focus and thus facilitate plural references to them. The idea that equal amounts of focus leads to increased ease of use of a plural reference is in line with the proposed CAB of Eschenbach et al, (1989) and is an assumption made implicitly by McKoon Greene and Ratcliff (1993) in the construction of their materials. Equal focus in this case may be seen as being just another form of common association basis.

Thus both Hielscher and Müsseler's results and those of Sanford and Lockhart lend some support for the idea of the Common Association Basis as being

responsible for the construction of group entities from singular entities. Where does the CAB draw most of its information from? Is a group reference primarily determined as the result of linguistic information (such as NP conjunction, Hielscher and Musseler, 1990; Sanford and Lockhart, 1991), or from non-linguistic information such as entities sharing the same situational role and thus receiving the same amount of focus (Sanford and Lockhart, 1991)? This question is of obvious relevance to the general aim of exploring McKoon and Ratcliff's (1992) minimalist hypothesis. If the information used to process plural references is primarily linguistic in nature, then this would lend support for McKoon and Ratcliff. This notion is supported in part by the effectiveness of Fraurud's (1988) algorithm searching for an antecedent that exists as a linguistic entity. Her algorithm (based largely on agreement in number/gender) was 91% successful as a means of explaining plural reference. The results of Hielscher and Musseler's (1990) study suggested that NP conjunction was a powerful means of signalling a plural antecedent. This work was supported by the findings of Sanford and Lockhart (1991). Linguistic information is assumed to be minimalist in nature according to McKoon and Ratcliff's definitions. If one could establish that 'non-minimal' information is used in the comprehension of pronouns resolvable on the basis of minimal sources of information, then this would require a radical re-thinking of McKoon and Ratcliff's minimalist strategy. One of the difficulties is in establishing a non-minimal source of information that is sufficiently non-linguistic to escape the classification of readily available. The lack of any clear definition of minimal and non-minimal information is a serious flaw in the minimalist hypothesis (as pointed out by Keenan 1993). One type of information that McKoon and Ratcliff suggest is non-minimal in nature is spatial information. They specifically cite the findings of Bransford et al's (1972) study as resulting from non-minimal processing. Spatial information has been widely used as an indication of the presence of a mental model, (as evidenced from the number of mental model studies considered in the preceding chapter) and, as it is mentioned as a possible source of information used in the formation of a CAB (Rehkamper, 1990), then it is possible that spatial information is a non-minimal source used in plural pronoun comprehension. If this were the case then the use of non-minimal information (spatial) in plural pronoun comprehension would run counter to the

predictions of the minimalist hypothesis. Work suggesting that spatial information may be used in group formation is discussed in the next section.

SPATIAL INFORMATION AND PLURAL PRONOUNS

Glenberg, Meyer and Lindem (1987) found that subjects were more quickly able to recognise a previously named target object when that object had been described as being spatially close to the main actor of a text. This finding occurred even though the texts were propositionally equivalent and when the target object had never been explicitly 'foregrounded'. This result suggests that even though the target object was not activated through explicit foregrounding or focus its increased availability resulted from its described proximity relative to the main actor. This supports the contention that pronoun comprehension is carried out in a non-minimal mental model of a text. This finding is also in line with the idea of Rehkamper (1990) that spatial proximity is sufficient to form a CAB. For instance in the following sentence Rehkamper proposes that the preferred interpretation of the pronoun 'they' is Peter and Mary.

26) John watched Peter and Mary while they were coming down the

street.

This is proposed to be because the verb '*watched*' provides no CAB for all three individuals as it "expresses no interaction and no spatial nearness." (Rehkamper, 1990).

Glenberg and Langston (1992) suggest that the findings of Glenberg et al (1987) are due to what they term "noticing". They suggest that whenever an update of a mental model occurs (by adding, deleting or moving a representational element) then attention is focused on the element being updated. They follow the 'spotlight' metaphor of attention, and propose that other representational elements that are spatially close to the updated element are caught in this spotlight and so

"noticed". This leads to the representation of the target object's changed relationship with the updated element and presumably accounts for its increased activation. Glenberg has recently changed the criteria which allow noticing to take place. He now states that the target object must be in physical contact with the updated element for it to be activated (personal communication).

Glenberg et al (1987) used sentences varying the distance between the main protagonist and an inanimate object (e.g. John and his sweatshirt). Because only inanimate targets were used the object would necessarily have to be touching the main character in order to remain spatially near to him. It is unclear whether physical contact would be necessary for an update to occur if the target were an animate entity able to move along with the main actor on its own. If this were the case then spatial proximity without physical contact may be enough to update both entities.

The spatial aspects of mental models have been well documented, (Bransford, Barclay and Franks, 1972; Mani and Johnson-Laird, 1982; Glenberg et al, 1987; Morrow et al, 1987, 1989; Bryant et al, 1992; Glenberg, Kruley and Langston, in press; Bryant and Tversky, in press). In many of the studies cited, spatial information appears to be the 'favoured choice' of non-linguistic information for any experiment investigating mental models. The work carried out on the spatial aspects of mental models, (especially the work of Bryant et al 1992), led to Bryant's (1992) proposal that spatial information is represented in its own sub-system of working memory (not unlike the visuo-spatial scratch-pad of Baddeley and Hitch, 1974). This "Spatial Representation System" (SRS) takes the form of a spatial mental model. Objects are represented either egocentrically (from the observer's viewpoint), or allocentrically (from a viewpoint independent of the observer). The representation of objects in the SRS may come from either described or perceived spatial arrays in Bryant's model: the SRS is common to both. Evidence for this view of spatial representation has come from Bryant's own work (Bryant et al, 1992; Bryant and Tversky, in press), and the work of his colleagues (Franklin and Tversky, 1990b), on spatial frameworks, and from independent work carried out by Denis and Cocude (1989) and Denis and

Zimmer (in press). The work of Denis and Cocude on mental scanning of described and observed maps suggests there is no difference between the representations of information derived from these two sources. This, along with the work of Denis and Zimmer (in press) who observed spatial priming effects in recognition of objects in described maps, lends support for a common spatial representation system for both observed and described spatial arrays.

Glenberg and Mathew (1992), reporting on Glenberg et al (in press), propose that mental models are constructed;

> "...using pointers arrayed in a spatial working memory. Distances between pointers are representationally meaningful in that distance in the model has an analogical correspondence to distances being described...".

Thus there is considerable reason to expect that spatial information will be used to group together characters who have been introduced separately into a text. The notion proposed by Eschenbach et al (1989), that groups are formed as a result of the construction of a Common Association Basis from a variety of information sources (one of which is spatial information), has been reviewed. We have also looked at experimental evidence presented by Glenberg, Lindem and Meyer (1987) which suggests the spatial proximity of entities in a mental model leads to them being treated similarly when updates of a mental model occur (i.e. they are treated as a group). Whether this is due to the effect of a "spotlight" mechanism of attention (Glenberg and Langston, 1992), or due to the spatial nature of mental models constructed from texts (Bryant et al, 1992; Glenberg et al, in press), is not yet clear. One common feature however is that all of this work assumes that comprehension of spatial information takes place in a mental model. Furthermore that this mental model is nearer to the constructionist rather than the minimalist view of mental models. Spatial information is not necessary for routine comprehension of language according to McKoon and Ratcliff.

The CAB of Eschenbach et al (1989) is a process which specifies which entities are likely to be able to grouped and which are not. As such the CAB is thought to

be an integral part of the processing of pronouns. Eschenbach et al (1989) and Hielscher and Musseler (1990) suggest that readers begin to represent entities as either 'atomic' (individual) referents or 'complex' (group) referents as soon as they are encountered. This is thought to be carried out on the basis of common similarities. As well as ontological type, and spatial information, another basis for the construction of 'atomic/complex' referents mentioned by Eschenbach et al (1989) is verb information. Different verbs appear (to a greater or lesser extent) to specify which individuals are most likely to be able to be grouped (e.g. *'meet'* is a stronger cue than *'watched'*). As such, then it would suggest that verb information plays an important part in specifying whether an entity is represented in an 'atomic' (individual) or 'complex' (group) form.

According to Eschenbach's proposals, verb information is an obviously important area for language comprehension. This is a view that has been echoed in other fields of language research. The information carried by verbs appears to cut across all levels of representation (lexical to non-linguistic). There is evidence to suggest that verb information is amongst those factors that increase/decrease the likelihood of an antecedent being assigned a pronoun. The next section discusses a range of theoretical perspectives and experimental evidence examining the role of verbs in pronoun comprehension.

THEMATIC ROLES

Thematic roles or thematic relations, (Jackendoff, 1987) are similar to the case roles proposed by Fillmore (1968). A thematic role is occupied by those NPs that are the arguments of a verb. The exact thematic role played by an argument is dependent on the meaning of the verb it is related to (and the range of possible thematic roles is a matter for debate). Although related to the meaning of verbs (suggesting perhaps a primarily semantic function), thematic roles have been proposed to be primarily syntactic in nature, (Chomsky included θ theory in his 1981 Government Binding (GB) theory). In GB the function of thematic roles was perceived to be one of providing an additional

set of constraints on the structural interpretation of sentences. However, whilst acknowledging that thematic roles may have a syntactic function, most current interest outside of structural linguistics tends to emphasise the semantic/conceptual aspects of thematic roles and their function (Carlson and Tanenhaus, 1988; Ladusaw and Dowty, 1988; Rayner, Carlson and Frazier, 1983).

> "...the assumption that thematic roles have an independent status in linguistic theory comparable to categories or grammatical functions must be examined carefully. Often the phenomenon...may be better explained by generalisations about the entailments and presuppositions of verbs and reasoning from general principles of human action." (Ladusaw and Dowty, 1988, p.61).

The area of thematic role research is thus a problematic one. As illustrated above, there seems to be a great deal of doubt as to what thematic roles actually are and to which domain of linguistic information they more properly belong. Jackendoff (1987) proposed that a grammatical theory may not be the best way of characterising the function of thematic roles. In the sentences shown below (modified from Jackendoff, 1987, p. 369) "control" of the sentence part enclosed in square brackets, (i.e. who is leaving) cannot be inferred from the structure of the sentence;

(27a) John gave Sue orders [PRO to leave].
      SOURCE   GOAL

(27b) John got from Sue orders [PRO to leave].
      GOAL   SOURCE

(27c) John gave Sue a promise [PRO to leave].
      SOURCE   GOAL

(27d) John got from Sue a promise [PRO to leave].
      GOAL   SOURCE

The reason that structure cannot be used to infer control is that each sentence is - "structurally identical in the relevant respects..." (Jackendoff, 1987, p.369). There must therefore be some other factor at work that predicts the control of the bracketed section of the sentence. Jackendoff suggests that the thematic roles of the NPs in each sentence are a better indicator of the pattern that control takes (GOAL and SOURCE thematic roles in this case). The thematic roles occupied by the NPs appearing in each sentence are thought by Jackendoff to be specified by the verb. In the case of sentences containing the verb *order*, part of the meaning of the verb is that the occupant of the GOAL thematic role is under some obligation to perform the action described, whilst in the case or the verb *promise* the occupant of the SOURCE role is obligated (Jackendoff, 1987, p.369), and thus control goes to the occupant of the SOURCE role. Because of their close relationship to the actual meaning of verbs, Jackendoff further argues that thematic roles are part of a semantic/conceptual language processing structure NOT part of syntax. In simplified terms, Jackendoff suggests in his "Semantics and Cognition" theory (1983) that the conceptual structure contains a number of primitive conceptual categories such as OBJECT/THING, EVENT, STATE, ACTION, PLACE, PATH, PROPERTY and AMOUNT. Jackendoff suggests that these primitives can be broken down into even more basic categories: for instance, EVENTS can be broken down into GO and STAY, whilst STATE can be reduced to BE and ORIENT. Thematic roles are theorised to cut across these categories (features of which are possessed by verbs) and form a link between syntax and semantics/concepts in language processing. Jackendoff gives as an example of this, Gruber's (1965) intuitive definition of THEME: the object in motion or being located. This thematic role may therefore possess primitive attributes of OBJECT, EVENT, STATE, ACTION and PROPERTY depending on the verb it is associated with.

Thematic roles have been proposed to be organised in a hierarchical form by Nishigauchi (1984). Nishigauchi proposes that control goes to argument highest on this hierarchy, (shown overleaf):

THEME → GOAL → LOCATION/SOURCE → AGENT

The hierarchical view of thematic roles is a derivation of the work of Fillmore's (1968) work on case roles and Jackendoff's (1972) work on thematic relations. This view assumes that each argument cannot have more than one thematic role assigned to it, that each argument receives a role and that there are a small number of discrete roles. It must be stressed that this view of thematic roles is highly contentious. The number of thematic roles has been proposed to range anywhere from individual roles for each verb, (Marantz, 1984; van Riemsdijk and Williams 1986), to the view held by Dowty (1991), that thematic role occupancy varies across a continuum, rather than a hierarchy. Dowty suggests that the end points of this continuum two "cluster concepts": *PROTO-AGENT* and *PROTO-PATIENT*. Dowty also suggests that an argument of a verb may bear either of these two "proto-roles" or both, depending on the number of entailments that the particular verb gives to the associated arguments. As Dowty discusses thematic roles from a model-theoretic semantics standpoint, the entailments he mentioned are entailments in the formal sense of the word: they are formulae which entail one another if, in every possible situation (in every model) in which the first is true then the second is true also. An illustrative example of the features of an agent role used by Dowty is the subject argument of the two place predicate *x murders y*. Suggested entailments of this verb are that *x* carries out a volitional act (thus volition is one of the entailments of murder and help specify the differences between similar verbs: volition is not an entailment of kill because one can kill by accident), that *x* intends this to be the kind of act specified by the verb (i.e. 'to cause to die'), and that *x* causes some event to take place involving *y* (i.e. *y* dies). An agent is so defined because it is the subject argument of verbs that contain proto-agent entailments. This notion is a more useful one than the 'one role for each verb' suggestions of Marantz, (1984) and van Riemsdijk and Williams, (1986) in terms of its predictive qualities. Dowty's notion also has the advantage of offering an explanation for the evidence both for and against a

hierarchical organisation of thematic roles. It is possible that verbs of similar types (e.g. verbs of transfer such as *give* or *sell*) and containing similar entailments may end up being placed in the same categories. The arguments of these similar verbs, (similar because they share many of the same entailments), could be easily mistaken for discrete thematic roles. Thus it is possible for Dowty's 'proto-roles' hypothesis to explain the organisation of thematic roles into discrete categories. In addition, Dowty's ideas can also provide some explanation for the observed difficulties with a thematic hierarchy. Engdahl (1990) for instance, suggests that the interpretation of bound anaphora and of reflexives in terms of thematic roles, requires different hierarchies for different aspects of their interpretation. If one abandons the notion of a hierarchical structure in favour of a continuum then one has the benefits of the flexibility of Marantz and van Riemsdijk and Williams' approaches whilst still retaining some predictive qualities.

The direction taken by linguistic research from the grammatical to the more conceptual aspects of thematic roles has been paralleled in some respects by psycholinguistic investigations of the effects of verb information on language comprehension. This work is discussed in the next section.

VERB BIAS AND IMPLICIT CAUSALITY

The work in this area has been concerned with the apparent consistent biases noticed when assigning the causes of particular events to antecedents. This bias has been attributed to the causal information implicit in many verbs, (Brown and Fish, 1983; Caramazza, Grober, Garvey and Yates, 1977; Caramazza and Gupta, 1979; Garnham Oakhill and Cruttendon, 1992; Garvey and Caramazza, 1974; Garvey, Caramazza and Yates, 1975; McKoon, Greene and Ratcliff, 1993). In the following two sentences (from Grober et al, 1978), although the pronoun can refer to either NP, subjects appear to favour particular readings (the preferred antecedent in each sentence is underlined):

28a) <u>George</u> telephoned Walter because <u>he</u> wanted some information.

28b) George criticised <u>Walter</u> because <u>he</u> misplaced the file

This is referred to as the verb's "causal bias" and Garvey and Caramazza (1974) suggest that direction of causality is involved in pronoun assignment. This assertion is supported by the results of a sentence completion task carried out by Garvey et al, (1975). Their findings were interpreted in terms of the reader's knowledge of the meaning of the verbs. For instance in the case of the verb *apologise*, it is part of our knowledge of the verb's meaning that the motivation to carry out the verb comes primarily from within the person doing the apologising. In an active sentence this verb's causal bias would lead, according to Grober et al (1978), to an increased number of references to the first NP. Similar findings were noticed by Garnham et al (1992) in three experiments measuring the time taken to make grammaticality judgements. Time taken to make grammaticality judgements increased when sentences violated the causal bias of the verb.

Garnham et al (1992), Garvey et al (1975) and Grober et al (1978) suggest that the causal bias of the verbs they used accounted for the preference for particular referents. To return to the earlier example, the causal bias of *apologise* is thought to occur because of our knowledge of the verb's meaning suggests that the motivation to apologise (in the absence of other information is generated 'within' the person apologising rather than from within the person being apologised to. In other words there is some feature of a person who apologises that biases readers to refer to him. In many respects this is similar to Dowty's (1991) notion of verb entailments specifying the thematic role occupancy of a verb's arguments. Dowty's (1991) classification of Proto-Agent included arguments occupying a role with entailments such as *volition, sentience/perception, causation, movement* and *independent existence* (p.572-573). Given that Dowty's concept of Agent specifies causality as a defining feature (a feature also suggested in Jackendoff's 1985 definition of agent) then

it seems possible that 'implicit causality' is not the best way of characterising the pattern of reference noted by Garnham et al (1992), Garvey et al (1975) and Grober et al (1978). It seems possible that an explanation in terms of thematic role occupancy may fit Garnham et al (1992), Garvey et al (1975), Grober et al (1978) and Stevenson et al's (1994) data better than an explanation based on implicit causality.

Work bringing together these two aspects of verb information (thematic role and implicit causality) was carried out by Stevenson et al (1994). In two sentence completion/continuation tasks Stevenson et al noted a distinct preference for subjects to refer to those NPs occupying particular thematic roles. However, the pattern of thematic role preference was NOT in accordance with Nishigauchi's thematic hierarchy (1984). Stevenson et al interpreted this pattern of results as being more in keeping with Dowty's (1991) proto-roles than with a hierarchical view of thematic role preferences. Stevenson et al interpreted these results as suggesting subject's were focusing on the results of an action. 'Agents' cause changes to the states of 'patients': subjects preferred to refer to 'patients' in their continuations rather than 'agents'. Likewise 'goals' were preferred to 'sources' and 'experiencers' rather than 'stimuli.' In both of these cases the action ends up with the 'goal' and the 'experiencer' respectively. This interpretation was supported by the findings of Stevenson et al's third experiment which manipulated the connective used to link the first and second clauses. Clauses were linked using either the connective *so* or *because*. It was found that subjects preferred to refer to 'goal', 'experiencer' and 'patient' antecedents when sentences were connected by *so*, rather than by *because*. Stevenson et al interpret their findings (like Carlson and Tanenhaus, 1988, and Rayner, Carlson and Frazier, 1984) as suggesting that thematic roles provide a mechanism for linking grammatical information, real world knowledge and the mental model used to mediate between these two sources. They provide a basis for representing events. Thematic roles will ordinarily focus the reader's attention on the consequences of an event. Stevenson et al reconcile their findings with the earlier work on

causal bias (a focus on the causes of an event) with the results of their third experiment. They manipulated the connective used to join the two clauses. When they used *because* as a connective, the focusing effects of thematic role on the outcomes of an event were attenuated. In the work of ; Caramazza, et al, (1977) and Caramazza and Gupta, (1979) which also used *because* as a connective, they found that their results conformed to this pattern. The focus on the structure of an event is in keeping with the work of Garnham and Oakhill (1992), and Oakhill, Garnham and Vonk (1989). In both papers the authors talk about a mapping of the characters appearing in a text onto the roles they play in the events described. This is obviously similar to the work of Sanford and his colleagues (Anderson et al, 1984; Garrod and Sanford, 1990; Sanford and Garrod, 1981; Sanford et al 1988) who investigated the mapping of characters onto situational roles they were playing. Garnham and Oakhill and Oakhill et al suggest that the effect of the causal bias of verbs is in part due to the actual role of the individual in an event rather like the notion proposed by Marantz, (1984) and van Riemsdijk and Williams, (1986). Thus there seems to be a general agreement about the interpretation placed on the findings of Stevenson et al.

Thematic roles then, seem to be able to be classed in (at least) three different ways: in terms of their syntactic function (Chomsky 1981), their semantic features (Jackendoff, 1987; Nishigauchi, 1984), and in terms of their role in the structure of events, (Stevenson et al, 1994). Perhaps because of their apparent ubiquity, Stevenson et al have sketched a possible outline of the underlying function of thematic roles: their ability to provide the link between syntactic, semantic and discourse levels of representation. Whilst the concept of thematic roles as a link between different levels of representation has been raised before, (Jackendoff, 1987), Stevenson et al provide a possible explanation that is backed up by empirical evidence. Starting from a view of mental models that is similar to Johnson-Laird, (1983) and Van Dijk and Kintsch, (1983), they suggest that thematic roles provide the links between linguistic and non-linguistic information that contribute to the formation of a mental model. This

view of mental model formation suggests that a linguistic representation of text is initially constructed. This linguistic representation reflects the syntactic and semantic structure of a sentence. Inferential information based on real world knowledge may be This information may be added to this representation forming a mental model of a text. This is essentially non-linguistic in nature, resembling more closely the structure of a situation rather than the structure of a sentence. The question is how this information is integrated. Stevenson et al point out that the common element is conceptual. The content words of the linguistic input are represented in terms of the roles they play in terms of their syntactic function, the semantic role and the real world role . It is suggested that this link is provided by thematic roles, because they possess features that overlap all three of these domains. This idea is not only intuitively appealing, but it would also help to explain why thematic roles (or their equivalents) have appeared in so many studies of language.

A specification of the exact nature of thematic role information and its function is beyond the scope of this thesis. Stevenson et al have however provided some evidence suggesting that they play an important role in pronoun comprehension, one that is related not only to the specific goals of this study (an investigation of those factors involved in pronoun comprehension) but also to the wider goals of the nature of the representation routinely used in pronoun comprehension.

Given that thematic roles may be involved in pronoun comprehension, and that the information provided by thematic roles seems to be such a central part of understanding a situation (as suggested by the evidence reviewed above), thematic role information may provide an excellent opportunity to test out the minimalist hypothesis. If thematic role information cuts across many different types of representation, as proposed by Jackendoff, (1987) and Stevenson et al (1994), then it seems reasonable to assume it plays a central role in language comprehension. Such an information source would appear to conform to the definition of minimalist put forward by McKoon and Ratcliff (1992). As such

then the use of thematic role information in preference to more 'global' information would indicate the presence of minimalist processing.

SUMMARY

In the last two chapters evidence has been reviewed that suggests a mental model (made up from linguistic representation(s) of a text and aspects of general knowledge about the world: Garnham, 1982, 1987a; Johnson-Laird, 1983; van Dijk and Kintsch, 1983) best characterises language comprehension. However, counter evidence has been examined which suggests that this mental model is 'minimal' in nature and that in most cases comprehension requires only that readers represent the linguistic information contained within a text and those inferences based on world knowledge necessary for local coherence (McKoon and Ratcliff 1992). The apparent widespread use of heuristic strategies that process language on the basis of a representation making use of far less than all available information about a situation, (Ferriera and Clifton 1987; Ferriera and Henderson, 1990; Frazier and Rayner 1982; Rayner et al 1983) lends some support to this hypothesis. Factors affecting pronoun resolution are obviously reliant on the representation in which language comprehension occurs. Findings indicate that in the case of singular pronouns, pronominal reference is accomplished faster using lexical/linguistic information, (Ehrlich, 1980). Subjects appear to use the number/gender information specified by a pronoun to guide or speed their search for a pronoun's antecedent. If more than one antecedent is still available after the pronoun is read then pronoun resolution takes place on the basis of information about the world (essentially non-linguistic information. The processes involved in pronoun resolution may be explained in terms of the operation of a 'focusing' (Sanford and Garrod, 1981), or 'foregrounding' (Chafe, 1972), mechanism. This mechanism takes into account factors such as first mention, parallel function, thematic roles etc. Each of which have a 'weight' which draws the comprehender's attention to the focused entity. Once this entity has become 'focused/foregrounded' all further pronominal references are assigned to it until another object is focused.

Plural pronouns have been proposed by Eschenbach et al (1989) to be a special case. The mechanisms concerning their use appear to be different from the ones proposed to handle singular pronouns in a small number of cases (Fraurud 1991). In certain cases plural pronouns can even be used to refer to singular noun phrases (Gernsbacher, 1991) violating the number/gender agreement constraint on assignment (Ehrlich, 1979; Mellish, 1981, 1985; Altman and Steedman, 1988). Gernsbacher (1991) suggests that these irregularities occur because pronouns refer to non-linguistic concepts rather than to linguistic structures such as noun phrases. Therefore plural pronoun resolution cannot be carried out without the use of non-linguistic information. Information of this kind is widely assumed to indicate the construction of a mental model.

Eschenbach et al (1989) propose that plural pronoun resolution involves a step not necessary in singular pronoun resolution. This step involves the construction of a group (or complex referential object) from the individuals appearing in a text or sentence. Inclusion in a group is carried out as a result of the construction of a Common Association Base (CAB) between the members of the group (Eschenbach et al, 1989). Many factors are proposed to contribute to the formation of the Common Association Basis, both linguistic and non-linguistic in nature. However, little experimental work has been carried out to examine these proposals. Results suggest that linguistic factors such as noun phrase conjunction are important in promoting group formation, (Hielscher and Musseler, 1990), as is non-linguistic information, such as name vs. role-name contrasts, (Sanford and Lockhart, 1991). As such a minimalist/constructionist opposition becomes apparent in plural pronoun comprehension as well as in more general aspects of language comprehension.

The role of verb information in the form of thematic role information has also been considered. Thematic role information is difficult to classify as "belonging" to one domain of knowledge or another. However thematic role information is undoubtedly minimalist in nature according to McKoon and Ratcliff's (1992) criteria.

This experiments described in the following chapters aim to examine whether or not non-minimal information (in the form of spatial information and information about the roles entities play in real world situations) is used in preference to minimal information (in the form of gender cues, noun-phrase conjunction and thematic role information) in singular and plural pronoun resolution. The investigation of these aims (it is hoped) will also help to specify the relative importance of linguistic and non-linguistic information in pronoun resolution in particular and language processing in general.

The next chapter is the first experimental chapter. It examines the role of spatial information in the on-line construction of a group referent. It also examines the use of minimal (gender/number) information specified by the pronoun versus non-minimal information (spatial).

CHAPTER 3: SPATIAL INFORMATION AS A CUE TO GROUP FORMATION

INTRODUCTION

The experiments in this chapter are intended to bridge the gap between work on the role of spatial information in text processing and the work on plural pronoun processing. The study carried out by Glenberg et al (1987) suggested that spatial proximity between two entities leads to the increased activation of both, even when only one is 'foregrounded' (Chafe, 1972) or 'focused'(Sanford and Garrod, 1981). The intuitions of Eschenbach et al (1989) and Rehkamper (1990) on the operation of the "Common Association Basis" (CAB) suggest that spatial information may be sufficient to set up a CAB and thus cause two spatially close entities to be classed as a group (allowing the use of a plural pronoun to refer to them). These two studies suggest that spatial information may be used to cue the formation of a group referent from the separate individuals appearing in the text, a process which Eschenbach et al (1990) suggest is necessary for plural reference to occur. On a more general level this chapter seeks to test the minimalist hypothesis of McKoon and Ratcliff (1992). This approach makes predictions that are similar to the findings of Ehrlich (1980). Work on (singular) pronoun assignment she showed subjects sentences containing a pronominal reference that was resolvable on the basis of either pragmatic information or on the basis of the gender cue supplied by the pronoun. She interpreted her results as suggesting that subjects make use of the constraints on possible antecedents specified by the gender (and also presumably the number) information of the pronoun, in preference to pragmatic information. The minimalist hypothesis also suggests that subjects will carry out those inferences necessary for local coherence on the basis of readily available information in preference to inferences based on more 'global' knowledge.

By varying the spatial information specified by each sentence and by making each pronominal reference unambiguously resolvable using nothing more than the number/gender information specified by the pronoun, it is possible to infer what

kinds of representations are being made use of in pronoun resolution. If subjects make use of spatial information when processing plural pronouns, then it may be inferred that they are making use of a mental model of the situation to guide their processing. This would also suggest that plural pronoun resolution does not occur at the earliest possible time during processing. If this were the case then subjects would be expected to make use of the gender/number information of the pronoun to guide pronoun resolution, and not to make use of the spatial information. This would lend some support to the minimalist hypothesis.

The experiments in this chapter are of two types. Experiments one and three are reading time tasks. It was decided to make use of this task because, (short of eye-tracking studies), it is the most direct measure of the comprehension of written language. If a fast reading time indicates ease of comprehension, then if subjects read a sentence describing two people as being close together and then read a plural reference faster than a singular reference, then it may be inferred that the faster reading time reflects the use of the spatial information to form a group referent. At the time of writing no other researchers have made use of this task in investigating on-line group formation (although Hielscher and Musseler made use of an on-line semantic decision task in their 1990 study of NP conjunction and group formation).

Experiments two and four are sentence completion tasks. This task type is included to attempt to establish subjects' underlying preferences in pronoun comprehension. This type of task has been used both by Hielscher and Musseler (1990) and by Sanford and Lockhart (1991). Effects of both linguistic information (NP conjunction) and non-linguistic information (same method of description e.g. Name or role name vs. different introduction types) have been found in sentence completion tasks. Again it would be inferred (as supported by Sanford and Lockhart and Hielscher and Musseler's work) that increased use of plural reference indicates the presence of a representation of the individuals as a group.

By making use of both of these methodologies it is hoped to firstly establish whether spatial information is used as a cue to group formation and secondly if there are any differences in pronoun use between the two tasks. This would help to establish when different information sources are made use of, and provide indicators to the type of representation being used to process pronominal reference. If spatial information is used in both reading time and sentence completion tasks, it may be inferred that subjects are making use of a mental model, even when pronouns are able to be resolved on the basis of linguistic (lexical) information alone. The minimalist position predicts that no difference will be found between conditions regardless of the spatial manipulation, as pronoun resolution is unambiguously resolvable on the basis of gender/number information specified by the pronoun.

EXPERIMENT 1

The studies carried out by Hielscher and Musseler (1990) and Sanford and Lockhart (1991) suggest that both linguistic and non-linguistic information plays a role in cueing group formation from individuals introduced separately into a text. Other work has suggested that spatial information may have a role to play in group formation (Glenberg et al, 1987; Eschenbach et al, 1989). This experiment is designed to test whether or not subjects use a mental model of the situation portrayed in a sentence (as indicated by the use of spatial information) as a guide to the assignment of plural pronouns to antecedents. The experimental sentences featured two individuals, one male and one female. Therefore there was no ambiguity as to who the pronouns ('he', 'she' and 'they') referred to. This allowed subjects to assign the pronouns using only linguistic cues (Ehrlich, 1980). The spatial proximity of the individuals was manipulated by having each sentence describe the characters as moving either towards or away from one another.

In a self-paced reading time task containing two individuals of similar ontological type - i.e. two humans rather than say, a human and a dog or inanimate object

(Herweg, 1988) - and description type (Sanford and Lockhart, 1991) the prediction would be that subjects reading first clauses describing these individuals as being spatially close together, would read target clauses containing a plural pronoun faster than if the individuals had previously been described as being spatially separate. This would support the notion that a mental model, which makes use of spatial information, is being used to resolve plural pronoun assignment (in McKoon and Ratcliff's terminology a 'constructionist' rather than a minimalist model).

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham and all were naive as to the aims of the experiment.

MATERIALS

There were six lists of experimental materials each containing eighteen experimental sentences. Each sentence consisted of two clauses. Clause one introduced two people (both identified by their first name) one male and one female, who were described as moving either towards one another (the 'together' condition) or away from one another (the 'apart' condition). Clause two (the target clause) contained a pronominal reference to either the first mentioned, second mentioned or both people (these made up the three 'antecedent' conditions). This clause was always six words in length. An example of each condition is shown in table 3.1, overleaf:

Table 3.1: Example of sentences in each condition

APART CONDITION

1st Clause: Paul moved away from Fiona and

2nd Clause:

      Antecedent   =1st: he was pleased to do so.

                           =2nd: she heaved a sigh of relief.

                           =Both: they parted the best of friends.

TOGETHER CONDITION

1st Clause: Paul moved towards Fiona and

2nd Clause:

      Antecedent   =1st: he tripped up on the way.

                           =2nd: she was surprised and moved away.

                           =Both: they walked away under the trees.

(See appendix 1 for a full list of experimental materials)

The combination of location (apart or together) and antecedent referred to in the target clause (1st mentioned, 2nd mentioned or both) results in six different versions of each sentence. In addition to the eighteen experimental sentences, subjects also saw eighteen filler sentences. These filler sentences were split into two clauses and described one male and one female in various situations.

        e.g.   Andrew and Kate were both at Durham and

                  they graduated last year.

Subjects also saw six practice experimental sentences and six practice filler sentences before the main experimental block began. These practice materials

were of exactly the same format as the ones described above. The results of these practice trials were not recorded.

DESIGN & PROCEDURE

This was a self-paced reading time task. Subjects were required to read sentences presented to them on the VDU of a BBC model B microcomputer. The materials manipulated situational structure (apart and together descriptions) and antecedent referred to (1st mentioned, 2nd mentioned or both). The various combinations of these factors yield six different versions of each sentence.

A repeated measures Latin square design was used with each subject seeing three sentences in each condition. The presentation order of the sentences was randomised within each list and across subjects. The time taken for subjects to read the target clause was recorded in each case.

Subjects were required to press the space bar to begin each trial (prompted by the computer). This delivered the first clause. After having read and understood the first clause, subjects pressed the space bar again. This removed the first clause from the screen and displayed the target clause. Subjects again read the clause and when they had comprehended it, pressed the space bar. Timing started when the target clause appeared on the screen and ended when the subject pressed the space bar. Subjects repeated the 'read and respond' procedure for each sentence. One in four trials were followed by a yes/no question to encourage comprehension.

      e.g.   Roger limped away from Charlotte and
                  she stared horrified at the wound.
                  Was Roger injured?

Halfway through the main experimental block there was a one minute rest period.

Subjects were required to complete a short series of practice trials to familiarise themselves with the procedure before starting the experiment. The practice consisted of 6 filler sentences and 6 experimental sentences. The reading times for these sentences were not recorded.

RESULTS

It was found on closer examination of the materials, that there were imbalances in the number of sentences appearing in each condition. Instead of there being eighteen sentences in each of the six conditions across the six lists, this number varied +/- 2. The mean reading times for each subject and each sentence were therefore based on unequal numbers of data points.

Reading times were calculated for the target clause in each sentence. Reading times of less than 350 milliseconds were excluded from the analysis. There were two such trials discarded, which formed 0.3% of the total number. The reading times for target clauses referring to either the first or second mentioned individuals were combined to give an average reading time for references to singular antecedents versus plural antecedents. These are displayed in table 3.2;

Table 3.2: Mean reading times for target clauses containing singular
or plural reference by described location

	ANTECEDENT		
DESCRIPTION	Singular	Plural	Means
Apart	1593.2	1812.4	1702.8
Together	1679.3	1655.8	1667.6
Means	1636.3	1734.1	

An analysis of variance of the reading times in table 3.2, (all ANOVAs treated subjects and sentences as random variables c.f. Clark 1973), revealed a main effect of antecedent which was only marginally significant on the F2 analysis (F1= 5.218, df = 1,35, P<0.03; F2= 3.542, df = 1,17, P<0.08). Subjects read target clauses containing singular pronouns faster than clauses containing plural pronouns. Analysis also revealed an interaction between situational description and antecedent, although again this interaction was only marginally significant on F2, (F1= 5.906, df = 1,35, P<0.02; F2= 3.459, df = 1,17, P<0.08). Subjects were significantly faster at reading target clauses containing singular references when they followed an apart description rather than a together description (see figure 3.1).

Figure 3.1: Graph showing interaction between spatial description and antecedent referred to
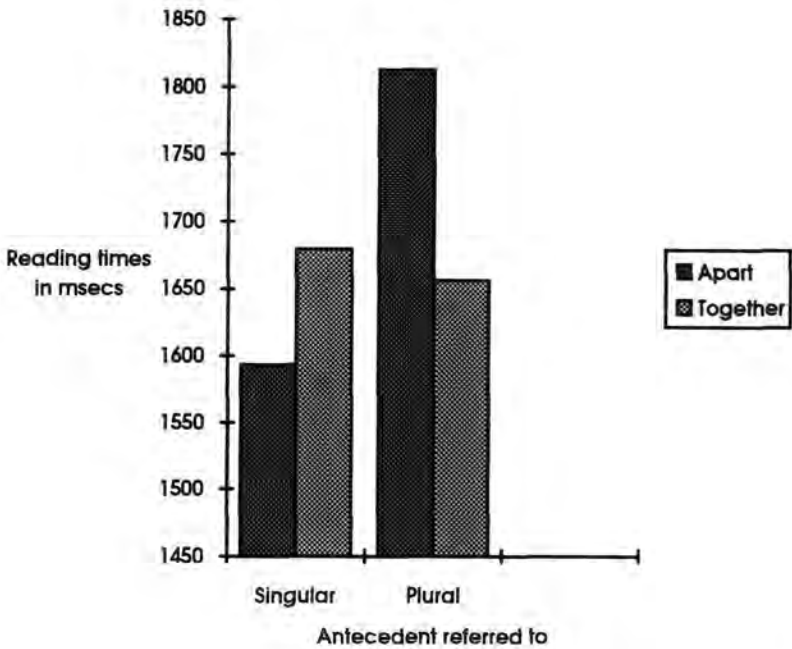
The mean reading times for first and second mentioned antecedents (which were combined to give mean reading times for singular antecedents) are displayed in table 3.3 (overleaf).

Table 3.3: Mean reading times for target clauses containing references to first and second mentioned antecedents and to both antecedents

	ANTECEDENT			
DESCRIPTION	First	Second	Both	Means
Apart	1536.5	1720.1	1851.8	1702.8
Together	1614.3	1846.1	1709.2	1723.2
Means	1575.4	1783.1	1780.5	

Analysis of variance carried out on the mean scores in table 3.2 revealed a significant main effect of antecedent ($F1 = 11.893$, $df = 2,70$, $P<0.0002$, $F2 = 5.148$, $df = 2,34$, $P<0.012$). Subjects read target clauses referring back to the first mentioned person significantly faster than those referring to either the second mentioned person or both. No other effects were noted that were significant on both F1 and F2.

It was decided to re-analyse the mean reading times contained in table 3.2, this time excluding the reading times for references to the first mentioned antecedent. It was thought that the significant first-mention effect might be 'swamping' an interaction between description and second/both antecedents. This possibility is suggested by the mean reading times for the apart/together descriptions of second mentioned singular pronouns and plural pronouns.

Analysis of variance revealed a significant interaction between situational structure and antecedent ($F1 = 6.239$, $df = 1,35$, $P<0.02$, $F2 = 4.749$, $df = 1,17$, $P<0.05$). Subjects read plural references faster than references to the second mentioned person when they followed a together description, and references to the second mentioned person faster than plural references when they followed an apart description (see figure 3.2 overleaf). No other significant effects were noted on either F1 or F2 analyses.

Figure 3.2: Graph showing interaction in reading times between spatial description and antecedent referred to (excluding reading times for 1st mentioned antecedent)
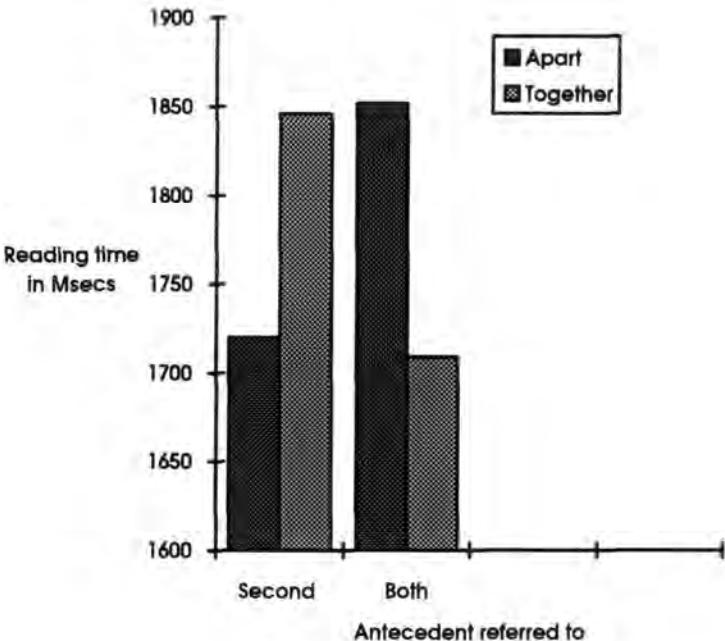
DISCUSSION

These findings are partially in accordance with the results predicted and may suggest that subjects are making use of a 'constructionist' mental model type representation when processing text. Subjects read clauses containing plural pronouns faster when the clause followed a 'together' description than when it followed an 'apart' description. Conversely, subjects read clauses containing second mentioned singular pronouns faster when the clause followed an 'apart' description than when it followed a 'together' description. Although these findings were only marginally significant on the F2 analysis, they suggest that the relative spatial locations of the people described are being used to cue the formation of a group referent or 'complex referential object', or as two 'atomic' referential objects (representation of the characters as individuals) depending on

the description types. In addition to the trend just described, it was found that plural pronouns following together descriptions were read significantly faster than second mentioned singular pronouns. Conversely, second mentioned singular pronouns following apart descriptions were read significantly faster than plural pronouns.

These results may be interpreted as suggesting that 'together' descriptions appear to cue the formation of groups while 'apart' descriptions appear to cue the formation of 'atomic' or individual representations. That non-linguistic information is being used to cue the type of representation of the characters appearing in each sentence, suggests that a mental model is used to process even referentially unambiguous sentences. The pattern of results obtained lends some tentative support for the contention that plural pronoun assignment takes place AFTER non-linguistic information (spatial in this case) has been processed. This suggests that a mental model of the situation has been constructed. If this were not the case then it would have been expected that there would be no effect of spatial information on subjects' reading times for the target clauses. This is because there is sufficient information conveyed by the pronoun in terms of number and gender information to allow unambiguous pronoun assignment to occur. Ehrlich's (1980) work suggests that in such cases pronoun assignment should be unaffected by non-linguistic information (either because of gender information being processed first or because it is processed faster than non-linguistic information (Mellish 1981; 1985)). The findings of this experiment directly contradict McKoon and Ratcliff's proposal that language comprehension proceeds on minimalist grounds (1992).

In terms of plural pronoun processing, if Eschenbach et al's (1989) theory concerning group reference is correct, (that the in order to be able to refer to a group then the individuals must be somehow constructed/represented in a new form - a complex referential object), then this would account for the differences in reading times observed for plural and singular pronouns. It may be that the 'sum formation' (the process by which individuals are re-constructed as a group) operation is what accounts for the increased reading times of plural pronouns.

The operation of the sum formation was suggested by Eschenbach et al (1989) and by Hielscher and Musseler (1991) was proposed to be an extra processing step and as a result would require extra processing time. However as this finding was only marginally significant on the F2 analysis, the support it lends to Eschenbach et al's hypothesis must remain tentative.

In addition to the spatial proximity/plural pronoun effect, it was also found that references to the first mentioned person were read significantly faster than references to either the second mentioned person or to both as a group. This 'first mention effect' is both widely documented and a relatively robust effect (Kieras, 1980; Gernsbacher and Hargreaves, 1988; Gernsbacher, Hargreaves and Beeman, 1989) so it is unsurprising that it should also be found in this experiment. However, if Hielscher and Musseler (1990) are correct in their reasoning then a first mention effect should have been found for apart descriptions only. They argued that the construction of a representation of two individuals occurs BEFORE any disambiguating information is read. If apart descriptions cue the formation of a representation of the antecedents as individuals rather than as a group then it would be expected that those processes documented as affecting singular pronoun assignment (such as first mention) would come into play, but the first mention effect should be absent from together conditions. This should occur as a result of the operation of the focusing mechanism suggested to account for pronoun assignment. In terms of Sanford and Garrod's (1981) focus model, the first mention effect may be seen as focusing the reader on one particular entity. Presumably then, groups (or complex referential objects) receive equal amounts of focus. Both entities are in focus thus allowing them to be referred to as a group. However, before discounting Hielscher and Musseler's proposal it may be that the materials used did not cue the relative locations of the antecedents strongly enough to overcome the first mention effect. The materials used allowed considerable leeway in the interpretation of the finishing location of the individuals described.

> e.g.   Paul moved away from Fiona and
> he was glad to do so.

In the above example there is little information available to discriminate whether Paul has finished moving away from Fiona, has just started or is in the middle of the activity. The temporal cues implied by verbs in spatial descriptions was found to be of importance in cueing the distance between two entities by Morrow and Clark (1988). As such, this information may be of importance to this study. If the interpretation of spatial information cannot be fully constrained then its effects in cueing the construction of a group referent cannot be adequately assessed.

The possibility that a more precise description of the relative location of the antecedents might result in a reduction or absence of the first mention effect is tested in experiment three.

EXPERIMENT 2

This experiment was a sentence completion version of experiment one, included to determine whether the results obtained in experiment one were dependent on task type. As the tasks used in this experiment and in experiment one are different, the possibility exists that the findings may be affected by the manner of processing used by subjects. When reading, subjects are required only to comprehend the information given in each sentence, whereas in a sentence completion task, subjects have not only to comprehend the sentence fragment but also to elaborate on the information given. As such this task may be open to influence from a number of different sources. For instance subjects may use their knowledge of typical situations to guide what they write and map the situation given onto an appropriate 'script' or 'scenario' (Sanford and Garrod 1981; Schank, 1985). Thus in this experiment (which is less constrained in the information available for use by subjects), it may be possible to have a crude index of how strong a grouping cue spatial information is compared with the range of other background information subjects may use in processing. The inclusion of this task type may also provide another clue as to the type of

processing that is routinely used in language processing. The minimalist hypothesis suggests that without a specific reading goal then subjects will process language using a representation of the information contained within a text. This task is asking subjects to read each sentence fragment and produce a continuation of the fragment. This is in contrast to the reading time task. In this task subjects are required only to read and understand the material in each sentence. There is no goal in the reading time task beyond what McKoon and Ratcliff term 'local coherence' (understanding the text). Thus differences between the two task types may provide very coarse indicators of the type of representation that subjects are making use of: minimalist or 'constructionist'.

The completion task used in this experiment required subjects to read a booklet of sentence fragments each describing two people (one of each gender) and to write a few words completing each fragment. The predictions are similar to the predictions of experiment one: if subjects construct a mental model to process sentences, then they will write significantly more completions containing plural references when the characters are described as being together, rather than apart.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham. All subjects were naive as to the purposes of the experiment.

MATERIALS

The materials used in this experiment were modified versions of the ones used in experiment one. Each trial consisted of an incomplete sentence (the first clause of the materials used in experiment one). Each sentence fragment introduced two named people (one male, one female) and varied the

situational description (the two people were described as being either together or apart). An example of the sentences used in each condition is given in table 3.4 below.

Table 3.4: Example of sentence fragments in each condition

APART CONDITION
Paul moved away from Fiona and
TOGETHER CONDITION
Paul moved towards Fiona and

(see appendix 2 for a full list of experimental materials).

There were two conditions: together descriptions and apart descriptions. There were two lists of 18 sentences and each list contained one of the two versions of each sentence. Each subject received a booklet containing a different list and there were nine sentences in each condition in each list.

DESIGN & PROCEDURE

Subjects were required to read each sentence fragment and complete it. The materials manipulated the situational structure (together and apart descriptions of the character's location). A repeated measures, Latin square design was used. Each subject received nine sentence fragments in each condition. The order of sentence fragments was randomised within each booklet and across all subjects. The antecedent referred to in each completion was recorded.

Subjects were instructed to regard each trial as being entirely separate from the rest and therefore not to try and complete each sentence fragment in such a way as link it with the others.

Subjects were instructed to finish each trial before moving on to the next. Subjects were allowed to complete the booklet in their own time and were tested individually.

RESULTS

Each completed sentence was scored by noting who the subject referred to in the completion (either the first mentioned, second mentioned or both people). References to people or events not featured in the text were not included in the analysis. There were forty-six such completions, which formed 7.1% of the total number. The number of references made in the completions to the first and second mentioned individuals were combined to give an average score for singular references (shown below in table 3.5).

Table 3.5: Mean number of singular and plural references

	ANTECEDENT		
DESCRIPTION	Singular	Plural	Means
Apart	4.181	0.028	2.105
Together	4.167	0.000	2.084
Means	4.174	0.014	

Analysis of variance (in which subjects and sentences were treated as random variables) revealed a significant main effect of antecedent (F1= 778.117, df =

1,35, P<0.00001; F2= 20957.055, df = 1,17, P<0.000001). Subjects made significantly more singular references in their completions than plural references. No other significant effects were noted on either F1 or F2. The number of references made to first mentioned, second mentioned and both people are shown in table 3.6 below:

Table 3.6: Mean number of references made to first mentioned, second mentioned or both antecedents

| | ANTECEDENT | | | |
DESCRIPTION	First	Second	Both	Means
Apart	7.753	0.583	0.028	2.788
Together	7.556	0.778	0.000	2.778
Means	7.655	0.681	0.014	

Analysis of variance revealed a significant main effect of antecedent (F1= 261.051, df = 2,70, P<0.00001; F2= 2242.421, df = 2,34, P<0.000001). Subjects made significantly more references to the first mentioned person than to either the second mentioned or both people. No other significant results were noted on either F1 or F2.

DISCUSSION

As in experiment one, an overwhelming preference for subjects to refer to the first mentioned person is seen. This effect is even more strongly marked in this experiment than it was in experiment one, although this may be a result of subjects being able to choose the antecedent themselves, rather than merely

having to read information contained in the sentence presented. There is no evidence of an interaction between situational structure and the choice of antecedent, which runs counter to predictions. It was expected that subjects would have made more references to both characters when they had been described as being together rather than apart.

There was only one plural reference made in the whole experiment and this followed an apart description. However, the failure to obtain the results predicted may be due to the overwhelming use of verb phrase ellipsis by the subjects.

e.g. Simon ran towards Julia and gave her a hug.

This was by far the most common completion method employed and, as this always referred to the first mentioned person (the one moving towards or away from the second mentioned person), then this would explain why there is no effect of description type. Subjects were apparently making use of this heuristic regardless of the information contained in the sentence. It is possible that this is the result of the possibility (discussed in experiment one) that the materials used did not cue the location of the individuals strongly enough. It was proposed by Hielscher and Musseler (1990) that in sentences containing two individuals, cues will lead either to the formation of a group referent or to a representation of two individuals. It may be that the lack of cueing of the exact position of the individuals resulted in the formation of this atomic representation, which in turn led to the choice of the first mentioned person as antecedent.

This possibility is tested in experiment four by the use of a more highly defined description of the relative locations of the characters.

EXPERIMENT 3

This experiment was a modified replication of the reading time task used in experiment one using re-worked materials. It was thought that the materials used

in experiment one may not have cued the spatial location of the two characters strongly enough, and the sentences used in this experiment were designed to overcome this. The increased spatial cueing of these materials was accomplished by a general decrease in the number of motion verbs used and by an increase in the use of static descriptions, (which would help eliminate any temporal ambiguities about WHEN the individuals were in the positions described - a point raised by Morrow and Clark 1988).

This experiment used the same self-paced reading time task as the one used in the first experiment and featured sentences containing one male and one female, who were described as being either together or apart.

The predictions were that if subjects construct a mental model to process sentences then they would read plural pronouns following a together description faster than those following an apart description. It was also predict that singular pronouns would be read faster when they followed an apart description than when they followed a together description.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham. Subjects had no prior knowledge of the aims of the experiment.

MATERIALS

There were six lists of experimental materials, each containing eighteen experimental sentences. Each sentence consisted of two clauses. Clause one introduced two people (both identified by name), one of each gender, who were described as being either apart or together. Clause two (which was the target

clause) contained a pronominal reference to either the first mentioned, second mentioned or both people. This clause was always six words long. An example of the materials used in each condition can be seen in table 3.7, overleaf.

The combination of location (apart or together) and antecedent referred to in the target clause (1st mentioned, 2nd mentioned, or both) gives six different sentence conditions.

Table 3.7: Example of sentences in each condition

APART CONDITION	
1st Clause:	Len sat apart from Maisie and
2nd Clause: Antecedent	=1st : he waited to see the doctor.
	=2nd : she waited to see the doctor.
	=Both: they waited to see the doctor.
TOGETHER CONDITION	
1st Clause:	Len sat beside Maisie and
2nd Clause: Antecedent	=1st : he tried to start a conversation.
	=2nd : she tried to start a conversation.
	=Both: they had a nice long chat.

(See appendix 3 for a full list of experimental materials)

In addition to the eighteen experimental sentences, subjects also saw seventy filler sentences. These filler materials consisted of two sentences followed by

a question. The first sentence contained two quantifiers and the second referred to one of the quantified noun phrases.

> e.g. Susan gave some friends a recipe.
> The recipe was for Hungarian goulash.
> Was Susan a cook?

Subjects also saw six practice experimental texts and fourteen practice filler texts. These practice materials were of exactly the same format as the experimental and filler sentences previously described. The reading times for these practice trials were not recorded.

DESIGN & PROCEDURE

This was a self-paced reading task. Subjects were required to read sentences presented to them on the VDU of a BBC model B microcomputer. The materials manipulated situational structure ('apart' and 'together' descriptions) and antecedent referred to (1st mentioned, 2nd mentioned or both). The various combinations of these factors yield six different conditions.

A repeated measures, Latin square design was used. Subjects saw three sentences in each experimental condition. The presentation order of the sentences was randomised within each list and across subjects. The time taken for subjects to read the target clause was recorded in each case.

Subjects were required to press the space bar to begin each trial (prompted by the computer). This delivered the first clause. After having read this and understood the first clause subjects pressed the space bar again. This removed the first clause from the screen and displayed the target clause. Subjects again read the clause and when they had comprehended it, pressed the space bar. Timing started when the target clause appeared on the screen and ended when the subject pressed the space bar. Subjects repeated the read and respond procedure for each sentence. One in

four trials were followed by a yes/no question included to encourage comprehension.

> e.g.   Roger waited in the next room to Charlotte and
>   she tried to read a magazine.
>   Was Roger waiting?

Halfway through the main experimental block there was a one minute rest period.

Subjects were required to complete a short series of practice trials to familiarise themselves with the procedure before starting the experiment. The practice consisted of 6 practice experimental sentences and 14 practice filler sentences. The reading times for these sentences were not recorded.

RESULTS

Reading times were calculated for the target clause in each sentence. Reading times of less than 350 seconds were excluded from the analysis. There was only one such reading time, which made up 0.15% of the total. The reading times for target clauses referring to the first and second mentioned individuals were combined to give an average for references to singular antecedents. These are displayed in table 3.8, below.

Table 3.8: Mean reading times for target clauses containing singular
or plural pronouns

	PRONOUN		
DESCRIPTION	Singular	Plural	Means
Apart	1408.8	1453.7	1431.3
Together	1504.3	1536.1	1520.2
Means	1456.6	1494.9	

Analysis of variance of the reading times in table 3.1 revealed no significant main effects or interactions on either F1 or F2.

The mean reading times for first and second mentioned antecedents (which were combined to give mean reading time for singular pronouns in the previous table) are displayed in table 3.9, below;

Table 3.9: Mean reading times for target clauses containing references to first mentioned, second mentioned or both antecedents by described location

		ANTECEDENT			
DESCRIPTION	First	Second		Both	Means
Apart	1403.2	1414.3		1455.9	1424.5
Together	1473.1	1530.9		1536.1	1513.4
Means	1438.2	1472.6		1496.0	

Analysis of variance of the reading times in table 2.9 (treating subjects and sentences as random variables) revealed a main effect of situational structure that was significant on F1 only (F1= 4.599, df = 1,35, P<0.04; F2= 1.678, df = 1,17, P<0.22). Subjects were faster at reading target clauses following apart descriptions than target clauses following together descriptions. No other effects were noted that were significant on either F1 or F2.

DISCUSSION

These results do not follow the predictions made. Instead of finding that plural references are read significantly faster when they follow together descriptions and that singular pronouns are read faster when they follow apart descriptions, no significantly reliable differences between reading times were found in any of the conditions. The effect of type of antecedent (singular or plural) lends some tentative support for Eschenbach et al's (1989) proposal that plural reference requires an additional step the sum formation. However, as this effect was only significant on the F1 analysis, this interpretation must be regarded with caution.

This experiment was designed to explore the first mention effect obtained in experiment one by attempting to cue the relative locations of the two people in each sentence more strongly. The change in the materials did knock out the first mention effect, but it seems to have also negated the cueing effects of the spatial information given.

One possible explanation for the difference in results between experiments one, two and three is that spatial information plays no part in cueing the formation of either group or individual referential objects. While an effect of spatial information was noted in experiment one, it was not replicated in either experiment two or experiment three.

It is possible that the information in the second clause of the materials used in experiment one caused the interaction between spatial information and the ease of use of plural and singular pronouns. This would explain why the same results were not obtained in experiments two and three: if the second clauses contained the information that was causing the effects attributed to spatial information, then changing the second clauses (as was the case in experiment three), or removing them altogether (as occurred in experiment two) would be sufficient to remove the effect.

It is thus possible that the changes in materials (resulting in the sentences used in experiment three) had the effect of reducing the spatial information in some way. However, this latter possibility seems unlikely as the materials used in experiments one and three differed only in the use of more static descriptions of the location of the characters. There may be more overlap between spatial relationships and interaction than had been previously considered. Herskovits (1986) points out that the spatial relationship between two entities may imply more than just their distance. For example if someone stands at a sink or sits at a desk one is usually assumed to be carrying out an action that is associated with that object (such as writing at a desk or washing at a sink). Thus in the case of certain entities, actions are constrained by their function. Also because of the range of possible interaction, the distance between the two entities is also specified. Thus one has a very clear picture of the actual distances involved in the sentence;

Bob was standing at the sink.

Although there is much more freedom of action when one considers interaction between two animate entities there may be similar implied "spheres of interaction" (Morrow and Clark 1988). This may have accounted for the lack of findings in this experiment. For instance in the clause (used in experiment one;

Paul moved towards Fiona and...

The action may imply that Paul is moving towards Fiona in order to interact in some manner with her. Conversely, reading that;

Roger sat in the same room as Charlotte and...

does not as readily suggest that the two may be interacting. They may be sitting in a room together merely as a result of chance, for instance in a doctors surgery.

A large use of ellipsis was noted in completions produced by subjects in experiment two. This might explain the lack of a spatial information effect.

Subjects may have been writing continuations featuring ellipsis because it allowed them to complete the continuations faster. This would lend some support for the minimalist interpretation. However as this stance would predict no effect of spatial information there is a difficulty in knowing whether or not the null effect was caused by the manipulation of the materials as described above or whether it occurred as a result of the operation of a minimalist strategy. Before accepting the minimalist interpretation, the other possibilities must first be discounted.

These possibilities are examined in experiment four, a sentence completion task using the same materials as those used in the first clause of the materials used in experiment three.

EXPERIMENT 4

This experiment was a sentence completion task version of experiment three. The materials used were designed to give a strong cue to spatial location. As in the preceding three studies this experiment investigates the role of spatial information in the processing of pronouns. Specifically the effect that spatial information has on the representation of characters appearing in sentences. According to the work of Eschenbach et al (1989) and Sanford and Lockhart (1991) characters will be represented by readers as either 'atomic' or 'complex' referential objects. This experiments manipulates descriptions of the spatial proximity of these characters in an attempt to explore the effects this information has on subjects' use of singular and plural pronouns.

This experiment used the same sentence completion task as the one used in experiment two: each sentence fragment featured two people (a male and a female) who were described as being either together or apart.

The predictions are also identical to those of experiment two: if subjects routinely make use of a mental model process sentences, then they will make use

of the spatial information given in the sentence fragments to cue the formation of group or singular referents. This would result in more plural references being made in sentence completions following a together description rather than an apart description. Conversely if subjects are making use of a minimalist representation (McKoon and Ratcliff 1992) or of linguistic information to cue group formation then it would be expected that the spatial description of the characters would have no effect on the number of plural references made.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham. Participants were unaware of the experimental hypothesis.

MATERIALS

The materials used in this experiment were modified versions of the ones used in experiment three. Each trial consisted of an incomplete sentence (the first clause of the sentences used in experiment three). Each sentence fragment introduced two named people (one male and one female) and varied the situational description (the two people were described as being either together or apart). Examples of the sentence fragments used are given overleaf in table 3.10 (See Appendix 4 for a full list of experimental materials)

There were two lists of eighteen sentences, each list containing one of the two versions of each sentence. Each subject received a booklet containing a different list and there were nine sentences in each condition in each list.

Table 3.10: Example of sentence fragments in both conditions

APART CONDITION
Len sat apart from Maisie and

TOGETHER CONDITION
Len sat beside Maisie and

DESIGN & PROCEDURE

The design and procedure used in this experiment were exactly the same as the ones used in experiment two. Only the materials used differed, as outlined above.

RESULTS

Each completed sentence was scored by noting who the subject referred to in the completion (either the first mentioned, second mentioned or both people). References to people or events not featured in the text were not included in the analysis. There were eighteen such completions, which formed 2.8% of the total number. The number of references made in the completions to the first and second mentioned people were combined to give an average score for singular references (shown in table 3.11, overleaf).

Analysis of variance (treating subjects and sentences as random variables) carried out on the scores contained in table 3.11 revealed a main effect of spatial location, although this finding was not significant on F2 (F1= 9.692, df = 1,35, P<0.004; F2= 2.911, df = 1,17, P<0.11). In their completions subjects made more references in the together condition than in the apart condition.

Table 3.11: Mean number of singular and plural references

| | PRONOUN | | |
DESCRIPTION	Singular	Plural	Means
Apart	4.347	0.167	2.257
Together	3.569	1.444	2.507
Means	3.958	0.806	

Analysis also revealed a significant main effect of pronoun ($F1= 223.512$, df = 1,35, $P<0.00001$; $F2= 230.618$, df = 1,17, $P<0.00001$). Subjects made significantly more references to singular antecedents than to plural antecedents. Analysis also revealed an interaction between spatial location and antecedent referred to ($F1= 21.348$, df = 1,35, $P<0.0002$; $F2= 25.074$, df = 1,17, $P<0.0003$). Subjects made significantly more plural references when the individuals introduced in the sentence fragment had been described as being together rather than apart. This interaction is displayed in figure 3.3 (below):

Figure 3.3: Mean number of singular and plural references
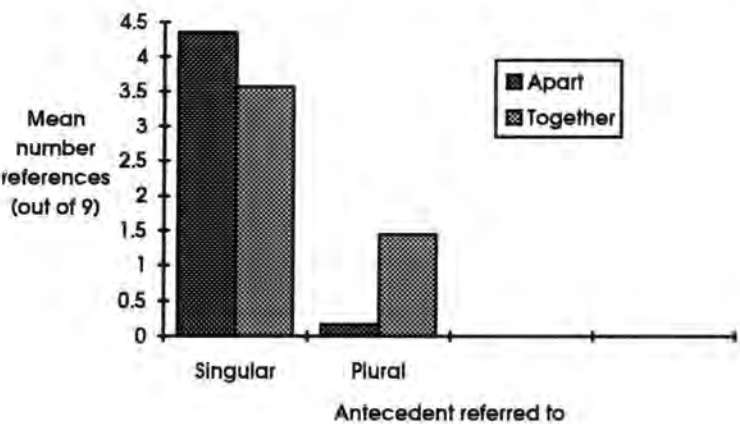
The mean number of references made to first mentioned, second mentioned and both individuals in each condition are shown in table 3.12, below.

Table 3.12: Mean number of references made to first mentioned, second mentioned or both antecedents

	ANTECEDENT			
DESCRIPTION	First	Second	Both	Means
Apart	7.750	0.972	0.139	2.954
Together	6.611	0.333	1.611	2.852
Means	7.181	0.653	0.875	

Analysis of variance carried out on the mean scores in table 3.12 revealed a significant main effect of antecedent referred to (F1= 279.121, df = 2,70, P<0.00001; F2= 518.845, df = 2,34, P<0.00001). Subjects made significantly more references to the first mentioned person than to either the second mentioned or both individuals. Analysis also revealed a significant interaction between antecedent referred to and spatial location (F1= 9.346, df = 2,70, P<0.0005; F2= 12.141, df = 2,34, P<0.0003). Subjects made significantly more plural references than singular references following a together description. Analysis of the mean number of 2nd mentioned singular pronouns and plural pronouns (excluding the mean number of first mentioned singular pronouns) revealed an interesting finding. When sentence fragments were in the together condition, subjects made significantly more references to both individuals than to the second mentioned individual. However, when the fragment described the people as being apart, then subjects made significantly more references to the second mentioned individual than to both (F1= 22.989, df = 1,35, P<0.0002; F2= 14.634, df = 1,17, P<0.002) as shown in figure 3.4 (overleaf).
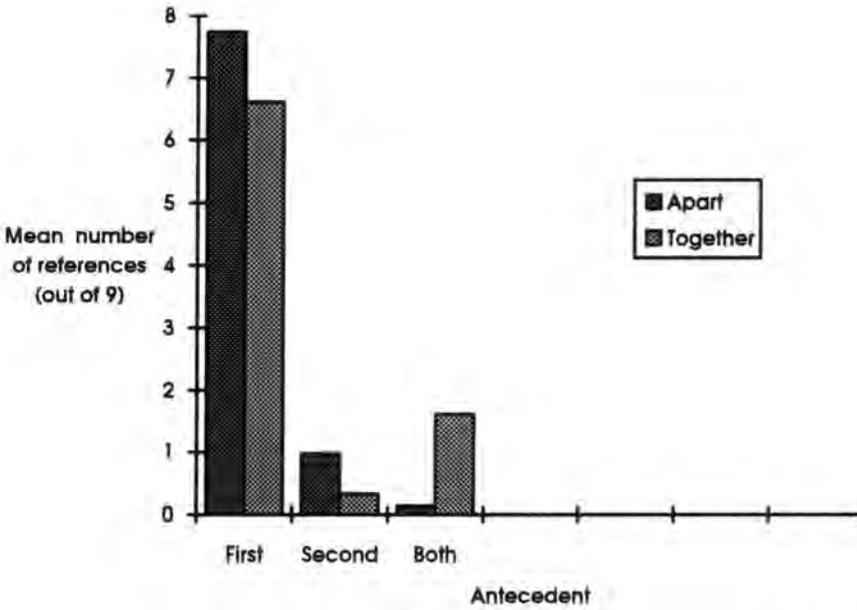
No other effects were noted that were significant on F1 and F2.

DISCUSSION

These findings are the ones that were predicted would occur if subjects were
making use of a mental model (in other words a 'non-minimalist' representation)
to process sentences. The pattern of results matches those obtained in
experiment one. Subjects made significantly more plural references when the
individuals had previously been described as being together rather than apart, and
more references to the second mentioned person than to both when the
individuals were described as being apart. It therefore seems unlikely that the
lack of a together description/increase in plural reference found in experiment
two was due to the spatial description being insufficient to cue the appropriate
representation of the individuals (either as group or individual referents).

It also seems unlikely that insufficient spatial information was the cause of the lack of results in experiment three. If the information given in experiment three was insufficient to cue the formation of group/individual referents then it would be expected that there would be no difference between that experiment and this one, given that both used the same spatial descriptions. It is thus possible that the difference in findings is due to the different task types used.

Perhaps the greater degree of processing required to carry out the completion experiment (comprehension of the sentence fragment and subsequent elaboration of it) required the use of a mental model, whereas in the simpler "comprehension only" reading time task, there was no need to construct a mental model. This interpretation would support McKoon and Ratcliff's minimalist hypothesis (1992). While possible, this explanation is also unlikely. If the different task types reflected uses of different types of information, then there should be no difference in the results obtained between experiments one and three and between two and four. There should have been no effect of spatial information in experiments one and three and an effect of spatial information in both experiments two and four. Instead it was found that both experiments one and four produced similar results. Thus it seems unlikely that the results obtained are entirely dependent on task type.

Another possibility is that the results obtained from experiment one were the result, not of the spatial information given, but of some uncontrolled information causing the effect. This would explain why no effect was found of facilitation of plural pronoun use following a together description in experiments two and three. The removal of the second clause in experiment two and changing of the second clause in experiment three would have the effect of removing the cueing information and thus negating the effect. However this is again unlikely to be the single cause of the pattern of results obtained. This experiment was also devoid of second clause information. It also used materials that were different from the ones used in experiment one (the only similarity being the spatial descriptions). Therefore if the effect found in experiment one was the result of the information

given in the second clause, then one would have expected to have found no effect in this experiment either.

As the results of experiment one were replicated, here it suggests that mental models ARE being used to process sentences in which pronoun assignment can be accomplished unambiguously and that spatial information is used as a cue when representing characters appearing in short texts/sentences: when the characters are together, they are more easily grouped together; when apart they are more easily represented as individuals.

GENERAL DISCUSSION

Overall, the results of these experiments can be taken as supporting the hypothesis that when processing pronouns, subjects are making use of non-linguistic information even when linguistic information is sufficient for unambiguous pronoun assignment. Experiments one and four showed significant interactions between spatial description and subsequent pronoun use. These experiments support the assertion of Hielscher and Musseler (1990) that cueing information contributes either to the formation of a group referent or ('complex referential object') or to the construction of individual referents (or 'atomic referential objects'). Although their findings were concerned only with NP conjunction, it must be noted that both sets of findings are in accordance with the notion of the Common Association Base proposed by Eschenbach et al (1989). In Eschenbach et al's theory spatial information is proposed as another source of information which helps to establish a CAB.

The interpretation of these results refutes Ehrlich's (1980) assertion that readers primarily make use of pronominal gender constraints placed on possible antecedents during pronoun assignment. (It is assumed here that a pronoun's 'number' information acts as a constraint in a similar way as its gender information). If this were the case then the interactive effect of singular pronoun use and spatial information would not have been expected to have occurred. If

there can be only one referent for a pronoun (specified by gender agreement between possible antecedents and the pronoun), then spatial information should play no part in the resolution process. Thus, as all of the sentences used in the experiments described in this chapter were unambiguously assignable to antecedents as a result of the number/gender information specified by the pronoun, then there should have been no effect of spatial location on the subsequent processing of pronouns. This null effect is the effect proposed by McKoon and Ratcliff (1992). The minimal amount of information required to process the pronouns in these experiments is the gender number information specified by the pronouns themselves. Thus for local coherence this information is sufficient. Spatial information is redundant. As there were effects of spatial information then the minimalist hypothesis cannot be whole accepted wholeheartedly.

It is suggested that the lack of supporting evidence obtained in experiment two was the result of a combination of a general preference of subjects to refer to the first mentioned entity in a sentence and the ease of use of verb phrase ellipsis in completing a continuation task. The first mention effect was noticed in experiments one, two and four, and is in line with the findings of those workers mentioned earlier (Allerton, 1978: Cole, Harbert, Hermon and Sridhar, 1980; Fletcher, 1984; Gernsbacher and Hargreaves, 1988; Gernsbacher, Hargreaves and Beeman, 1989; Keiras, 1979). The use of verb phrase ellipsis in completions allowed subjects a saving of time when completing each sentence due to the omission of the verb phrase.

The results of experiment three are more difficult to explain however. The fact that experiment three produced different results from experiment one (which used a similar task and manipulated the same variables) and experiment four (which used similar materials but a different task) suggests that the lack of effect noted was specific to experiment three. However, upon examination of the materials used in experiment three there appear to be no pieces of second clause information that would interfere with or countermand the spatial information contained in the first clause.

Possible reasons for the failure of experiment three to produce any significant results (such as strategies induced by task demands as mentioned by Garnham Oakhill and Cruttenden 1992, and McKoon and Ratcliff 1992) will be addressed at more length in the concluding comments in chapter seven.

Taking the results of these experiments to support the contention that spatial information IS used as a grouping cue, then it seems reasonable to suggest that subjects are routinely constructing a mental model of the situation described by the text when processing plural pronouns. However, this suggestion must be regarded as tentative due to the lack of supporting results obtained in experiments two and three.

In the next chapter the relative strength of spatial information as a cue to group formation, will be investigated by contrasting it with an effect observed by Hielscher and Musseler (1990) and Sanford and Lockhart (1991): that of noun phrase conjunction.

CHAPTER 4: SPATIAL INFORMATION VS. LINGUISTIC CONJUNCTION

INTRODUCTION

The results of the experiments carried out in chapter three tentatively suggested that spatial information is used during processing as a cue to the formation of group referents from characters previously introduced as individuals. The use of spatial information suggests that readers routinely construct a mental model of a sentence or text during reading and use this to guide the assignment of pronouns to their antecedents. This interpretation was suggested because subjects read sentences containing pronoun assignments resolvable on the basis of pronominal gender/number information, faster when the characters were described as being together rather than apart. This finding is in opposition to the minimalist hypothesis of McKoon and Ratcliff (1992) and the experimental findings of Ehrlich (1980). These studies suggested that subjects do not make use of general knowledge (or that this information is accessed more slowly) when pronouns are unambiguously resolvable on the basis of gender (and presumably number) cues specified by the pronoun. Other experimental studies have suggested that linguistic (and presumably minimal) information (as well as the non-linguistic information found in experiments one and four) is an important cue to group formation (Hielscher and Musseler, 1990; Sanford and Lockhart, 1991).

In two studies investigating the use of the German pronoun 'sie' (ambiguous in number until a verb inflection is read), Hielscher and Musseler (1990) found that noun phrase conjunction using 'and', 'as well as', 'neither/nor' and the preposition 'with' led to an increased frequency of the plural interpretation of the pronoun. Singular interpretation of 'sie' was found when the noun phrases (NPs) occurred joined by the prepositions 'without' and 'instead of'. Sanford and Lockhart (1991) also found an increased use of plural reference to refer back to individuals introduced with NPs conjoined by the use of 'and'.

NP conjunction is an example of information proposed to be used in the formation of a Common Association Base (CAB). This is the relation suggested

by Eschenbach et al (1989) to be responsible for the formation of a group referent (or 'complex referential object') from individuals/objects introduced separately in a text. Following on from the results obtained by Glenberg et al (1987) and the spatial cueing effects noted in chapter three it is suggested here that spatial proximity is also a possible source of information used in the formation of a CAB (as suggested by Rehkamper 1990).

The experiments in this chapter are designed to pit NP conjunction against spatial proximity in an attempt to ascertain which is the more potent cue to group referent formation. The results of these experiments are also hoped to make clearer what kind of representation is being made use of when processing plural pronouns. If subjects make use of NP conjunction to cue the formation of group referents but not spatial information, then it may be concluded that they primarily make use of linguistic structure to guide plural pronoun assignment. This finding would suggest that subjects are ordinarily making use of a 'minimal' representation of the text to guide pronoun resolution. If however subjects make use of both types of information then we may conclude that they are using a 'constructionist' mental model of the situation. This is in line with the view of Johnson-Laird (1983) and van Dijk and Kintsch (1983) that a mental model is built up from a linguistic representation of the text combined with knowledge about the real world.

EXPERIMENT 5

This experiment is an investigation of the relative importance of linguistic and non-linguistic information in cueing the formation of a group referent or 'complex referential object' (Eschenbach et al 1989; Sanford and Lockhart, 1991; Rehkamper, 1990) from characters previously introduced as individuals.

A number of studies have shown findings that linguistic conjunction plays an important role in the formation of group referents or 'complex referential objects' (Hielscher and Musseler, 1990; Sanford and Lockhart, 1991).The

findings in chapter three cautiously suggest that subjects are making use of spatial information as a cue to the formation of complex referential objects. Thus it was decided to investigate both of these factors together.

This self-paced reading time experiment manipulated linguistic structure (Conjoined NPs or Subject-Predicate structure), situational structure (individuals described as being either together or apart) and antecedent referred to (first mentioned person, second mentioned person or both).

The predictions are that if subjects primarily use linguistic (and therefore minimal) information as a cue to the formation of a group referent (or 'complex referential object') then they will read plural pronouns faster than singular pronouns when the plural antecedents occur in conjoined noun phrase sentences. If subjects primarily make use of non-linguistic information to cue group referent formation (i.e. constructing a mental model), then it would be expected that plural pronouns would be read faster than singular pronouns when they are described as being together rather than apart in the situational manipulation.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham. Subjects were unaware of the experimental hypotheses being tested.

MATERIALS

Twelve lists of experimental materials were used in this experiment, each containing twenty-four texts. Each text consisted of three sentences; two context sentences and a target sentence. The target sentence varied according to the linguistic structure of the first clause and the antecedent referred to in the second

clause (which was always six words long). In addition, the first context sentence varied according to whether the two antecedents were together or apart in the described situation. The second context sentence provided elaborative information about the scene set in sentence one and was included to prevent the topicalisation of one of the antecedents (Hornby, 1972; Sanford and Garrod, 1981). This sentence did not refer to either of the named people (one male, one female) introduced in the first sentence. The manipulation of linguistic structure (conjoined or unconjoined), spatial structure (together or apart descriptions), and the antecedent referred to (first or second mentioned antecedent or both antecedents) yields twelve sentence conditions. An example of the sentences appearing in each condition is given overleaf in table 4.1.

In addition to the 24 experimental texts, subjects also saw 70 filler texts. These filler materials consisted of two sentences followed by a question. The first sentence contained two quantifiers and the second referred to one of the quantified noun phrases.

> e.g. Susan gave some friends a recipe.
> The recipe was for Hungarian goulash.
> Was Susan a cook?

Subjects also saw eight experimental texts and fourteen filler practice texts. These practice materials were of exactly the same format as the ones described above and in table 4.1.

Table 4.1: Example of sentences in each condition

TOGETHER CONDITION

John and Karen were in the science lab when the new equipment arrived.
It was very tightly packed and very hard to assemble.

CONJOINED NPs: John and Karen read the instructions and

SUBJ.-PRED. : John read the instructions to Karen and

ANTECEDENT =1ST: he was even more confused afterwards.

=2ND: she was even more confused afterwards.

=BOTH: they were even more confused afterwards.

APART CONDITION

John was in the lab and Karen in the equipment room when the new
equipment arrived. It was very tightly packed and very hard to
assemble.

CONJOINED NPs: John and Karen read the instructions and

SUBJ.-PRED. : John phoned Karen about the instructions and

ANTECEDENT =1ST: he was even more confused afterwards.

=2ND: she was even more confused afterwards.

=BOTH: they were even more confused afterwards.

(see appendix 5 for a full list of experimental materials)

DESIGN & PROCEDURE

This was a self-paced reading time task. Subjects were required to read sentences presented to them on a VDU by a BBC model B microcomputer. The materials manipulated situational structure (together and apart descriptions), linguistic structure (conjoined NPs or subject-predicate sentences), and the antecedent referred to (first mentioned, second mentioned or both people). The various combinations of these three factors yield a total of twelve different versions of each text as illustrated below.

Situational Structure	Together						Apart					
Sentence Structure	Conj. NPs			Subj. Pred.			Conj. NPs			Subj. Pred.		
Antecedent	1st	2nd	Both	1st	2nd	Both	1st	2nd	Both	1st	2nd	Both
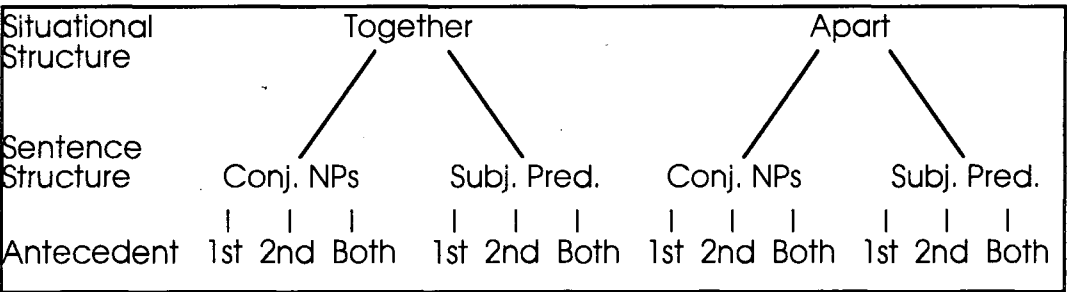
A repeated measures, Latin square design was used with each subject seeing 2 texts in each condition. Trial order was randomised across subjects and within each stimuli list. The time taken for each subject to read the target clause of sentence three was recorded.

Subjects were required to press a key to begin each trial (prompted by the computer). This delivered the first sentence. After having read and comprehended the sentence, subjects pressed the response key a second time. This removed the first sentence and delivered the second sentence. After having read and understood this sentence, subjects again pressed the response key. If the sentence was a filler sentence, a question answerable using Yes/No keys was presented. If the sentence was an experimental sentence then the first clause of the third sentence was delivered. Subjects were once again required to read the clause and press the space bar when they had understood it. Timing started when the sentence was presented and ended when subjects pressed the response key.

Subjects repeated the read and respond procedure. One in four experimental trials were followed by a yes/no question about the text.

Subjects were required to complete a short series of practice trials to familiarise themselves with the procedure before starting the experiment. The practice consisted of eight practice experimental text and fourteen practice filler texts. The reading times for these practice texts were not recorded.

RESULTS

Reading times were calculated for the target clause in each trial. Target clause reading times of less than 350 milliseconds were not included in the analysis. There was only one such reading time, which made up 0.1% of the total number of trials. The reading times for first and second mentioned antecedents were combined in each condition to produce an average reading time for singular pronouns. Mean reading times for each condition are shown overleaf in table 4.2.

Analyses of variance (treating subjects and sentences as random variables) were carried out on the results in table 4.2 (overleaf). A main effect of antecedent referred to was noted which was significant on F1 only (F1 = 4.0256, df = 1,35 P<0.05, F2 = 3.614, df = 1,24 P<0.10). Plural pronouns, were read faster than singular pronouns. Analysis also revealed a significant interaction between linguistic structure and antecedent referred to (F1 = 4.8434, df = 1,35 P<0.05, F2 = 7.334, df = 1,24, P<0.05). This interaction is shown in figure 4.1 (on page 102). Target clauses containing plural pronouns were read significantly faster when they followed a clause containing a conjoined noun phrase structure than when they followed a subject-predicate structure. No other significant effects were noted on either F1 or F2.

ANTECEDENT

DESCRIPTION	Singular	Plural	Means
TOGETHER	1323.452	1201.722	1262.587
Conjoined-NPs	1352.917	1137.972	1245.445
Subj.- Pred	1293.986	1265.472	1279.729
APART	1358.816	1262.042	1310.429
Conjoined-NPs	1385.458	1209.611	1297.535
Subj.- Pred	1332.174	1314.472	1323.323
CONJ. NPs	1369.188	1173.792	1271.490
SUBJ. - PRED	1313.080	1289.972	1301.526

Mean reading times for pronouns referring to each antecedent are displayed in Table 4.3 (overleaf).

Figure 4.1: Graph showing interaction between linguistic structure and antecedent
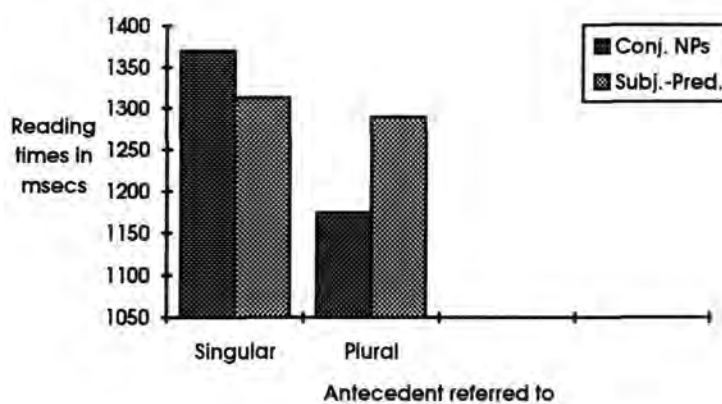
Analyses of variance (treating subjects and sentences as random variables) were carried out on the results in table 4.3. A main effect of antecedent referred to was noted which was significant on F1 only (F1 = 4.426, df = 1,35 P<0.02, F2 = 2.567, df = 1,24 P<0.10). Plural pronouns were read faster than singular pronouns.

Analysis also revealed a significant interaction between linguistic structure and antecedent referred to (F1 = 5.165, df = 1,35 P<0.01, F2 = 3.466, df = 1,24, P<0.04). This interaction is shown in figure 4.2 (overleaf). Target clauses containing plural pronouns were read significantly faster when they followed a clause containing a conjoined noun-phrase structure than when they followed a subject-predicate structure. No other significant effects were noted on either F1 or F2.

Table 4.3: Mean reading times for target clauses by condition

	ANTECEDENT			
DESCRIPTION	First	Second	Both	MEANS
TOGETHER	1276.084	1371.834	1202.236	1283.384
Conjoined NPs	1316.500	1390.278	1138.500	1281.759
Subj.- Pred	1235.667	1353.389	1265.972	1285.009
APART	1332.250	1396.859	1287.042	1338.750
Conjoined NPs	1381.639	1411.111	1210.083	1334.278
Subj.- Pred	1282.861	1382.806	1364.000	1343.222
CONJ. NPs	1349.070	1400.695	1174.292	1308.019
SUBJ. - PRED	1259.264	1368.098	1314.986	1314.116

Figure 4.2: Graph showing interaction between linguistic structure and antecedent
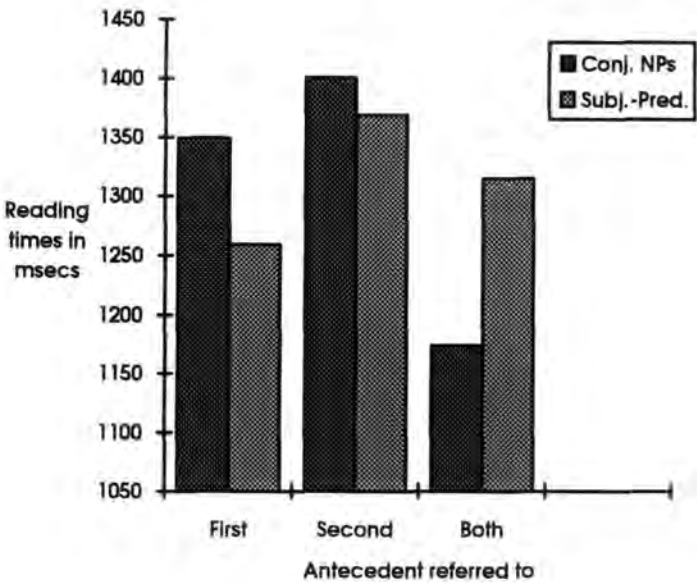
DISCUSSION

The results obtained are those predicted if subjects were primarily relying on linguistic information to cue the formation of group referents. Subjects read target clauses containing a plural pronoun faster when the target clause followed conjoined noun-phrase structured sentences than when they followed subject-predicate structured sentences. There was no significant finding of an effect of situational information in the reading times for plural pronouns. This finding is at odds with the findings of experiments one and four, where it was found that plural pronouns were read significantly faster when they followed a together description than when they followed an apart description. In this experiment, the findings followed the trend of results obtained in experiment one. Taken in conjunction with the findings from the experiments in chapter three, this suggests that there may be competition between cues to the formation of group referents. By this it is meant that the linguistic (NP conjunction) and spatial cues do not interact. It would appear that one or the other is made use of, but not both (a similar finding to that of Ehrlich, 1980). If both were made use of then one

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would expect to find the fastest reading times occurring following sentences with a conjoined NP structure and featuring a together description. This is not the case.

The model of text processing proposed by Johnson-Laird (1983) and by van Dijk and Kintsch (1983), suggests that a mental model is constructed from the input of both a linguistic representation of the information given in the text and of our general knowledge about the world. It may be that in the case of plural pronoun processing, the linguistic cues to group formation may take precedence over the non-linguistic cues. It may be that as a linguistic representation is constructed earlier than a mental model in text processing (as suggested by Frazier 1987; Frazier and Rayner 1982), linguistic information which may contribute to the formation of a "Common Association Base" (Eschenbach et al 1989) may be incorporated into the representation at this stage in processing. In such a case, NP conjunction would appear to be such a strong cue that it negates the effects of spatial information as a cue to the formation of a group referent. This would explain why there was no effect of spatial information in this experiment. It may be that only in the absence of linguistic cueing information are non-linguistic information sources analysed. This would explain the earlier results in experiments one and four. In these sentences subjects had no structural cues (of a linguistic nature) to group formation and thus relied more heavily on the spatial description to cue the formation of a group referent. This interpretation would support the minimalist hypothesis. Subjects are able to resolve plural pronominal references on the basis of the number information specified by the pronoun. There are only two entities in the sentence, so any reference is likely to refer to them. If, as Eschenbach et al (1989) propose, a CAB must exist before entities can be referred to using a plural pronoun, then the NP conjunction and spatial information provides the basis for the sum formation. Subjects do not make use of the spatial information although the NP conjunction does effect faster reading times for plural pronouns. This suggests that the subjects are making use of minimal information (in the form of linguistic information) rather than non-minimal information in the form of spatial information to guide their processing

of plural pronouns. This suggests that a minimal representation is used where possible and supports McKoon and Ratcliff's (1992) minimalist hypothesis.

It is possible that a simpler explanation of the disparity between the results of experiment one and this experiment presents itself. In the materials used in experiment five, the first line of the text described the situation. This was followed by a distracter sentence included to reduce any topicalisation of one individual over another (Hornby, 1972; Sanford and Garrod, 1981). This sentence was followed by a clause containing the two individuals in either a conjoined noun-phrase or subject-predicate sentence structure, followed by the target clause. The distance between the situational description and the pronoun may have reduced the cueing efficiency of the spatial cue, which would have accounted for the difference in findings between experiments one and four and this one. This factor (distance between pronoun and antecedent) was found to affect the activation of spatially close but non-foregrounded target items in Glenberg et al's (1987) recognition task. Similar effects were noted by Ehrlich and Rayner (1983) in their eye-tracking study. This possibility is tested in experiment seven.

EXPERIMENT 6

This experiment is a continuation task version of experiment five. It was decided to run a continuation task as well as the reading task used in experiment five in order to see if situational information was made use of differently in 'on-line' and 'off-line' tasks. This it was thought would provide a crude indication of the effects of task on the representation used to process the same types of information. If a difference was noted then this would provide some tentative support for the minimalist hypothesis. McKoon and Ratcliff (1992) suggest that subjects would construct a minimal representation of a text in the absence of any specific task demands that would require them to do otherwise. Even though the results of experiment five concur with the findings of Hielscher and Musseler (1990), in that linguistic conjunction appears to play an important role in cueing

group referent formation, our own findings in experiments one and four suggest that information other than the purely linguistic plays a part in the formation of group referents.

This continuation task experiment manipulates linguistic structure (Conjoined NPs or Subject-Predicate structure), and situational structure (individuals described as being either together or apart). The predictions are as in experiment 5: if subjects primarily use linguistic (minimal) information as a cue to the formation of group referents, then they will produce significantly more continuations containing plural references when the antecedents occurred in conjoined noun phrase structured sentences than when they occurred in subject-predicate structured sentences. If subjects primarily make use of non-linguistic information to cue complex referential object formation (indicating the construction of a mental model) then we would predict that more continuations containing plural references would be made when the individuals were described as being together than when they were described as being apart.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham. Subjects were naive as to the purpose of the experiment.

MATERIALS

The materials used in this experiment were modified versions of the ones used in experiment five (see table 4.1 for an example of sentences used). Each text consisted of three sentences. Sentence one introduced two named people (one male, one female) and varied the situational description (the people were described as being either together or apart). The second sentence provided elaborative information about the situation described in sentence one and was

included to prevent either one of the two people introduced in sentence one from being topicalised (Sanford and Garrod 1981). The third sentence varied the linguistic structure the individuals appeared in (conjoined noun phrases or subject-predicate sentences). See appendix 6 for a full list of experimental materials.

There were thus four possible combinations of each sentence: together description/conjoined noun phrases; together description/subject-predicate structure; apart description/conjoined noun phrases; apart description/subject-predicate structure.

There were four lists of twenty-four sentences, each list containing a different version of each sentence. Each subject received a booklet containing a different list and there were six sentences in each condition in each list.

DESIGN & PROCEDURE

This was a sentence continuation task. Subjects were required to read each text and write a short sentence about the situation they had just read. The materials manipulated situational structure (together and apart descriptions) and linguistic structure (conjoined NPs and subject predicate structures). The combinations of these factors yield four different versions of each text corresponding to the design outlined

A repeated measures, Latin square design was used with subjects receiving 6 sentence fragments in each condition. The order of texts was randomised within each booklet and across subjects. The antecedent referred to in each continuation sentence was recorded.

Subjects were instructed to regard each trial as being entirely separate from the rest and therefore not to try to continue each text in such a way as to link it with the other texts. Subjects were instructed to finish each trial before moving on to

the next. Subjects were allowed to complete the booklet in their own time and were tested individually.

RESULTS

Each booklet was scored by noting who the subjects referred to in their continuation sentences (first mentioned person, second mentioned person or both). References to people or events not featured in the text were not included in the analysis. There were 87 such continuations, accounting for 10.07% of all continuations made. The number of assignments made to first and second mentioned entities in each condition were added together and divided by two to give a mean singular reference score for each condition (shown below in table 4.4).

Table 4.4: Mean number of assignments made in each condition
to singular/plural antecedents

LINGUISTIC STRUCTURE

	Conjoined NPs		Subject/Predicate		
DESCRIPTION	Singular	Plural	Singular	Plural	Means
Together	0.431	2.181	1.972	0.722	1.327
Apart	0.694	2.042	2.139	0.625	1.375
Means	0.563	2.112	2.056	0.674	
		1.338		2.730	

Analyses of variance (treating subjects and sentences as random variables) revealed no significant main effects, but there was a significant interaction

between linguistic structure and antecedent (F1= 156.989, df = 1,35, P<0.00001, F2= 128.878, df = 1,23, P<0.00001). Subjects made significantly more continuations containing plural references than singular references when the antecedents appeared with conjoined NPs and more singular references than plural references when the antecedents appeared in subject-predicate sentences (see figure 4.3 below). No other effects significant on both F1 and F2 were noted.

Figure 4.3: Graph showing mean number of references made to singular/plural antecedents by linguistic structure
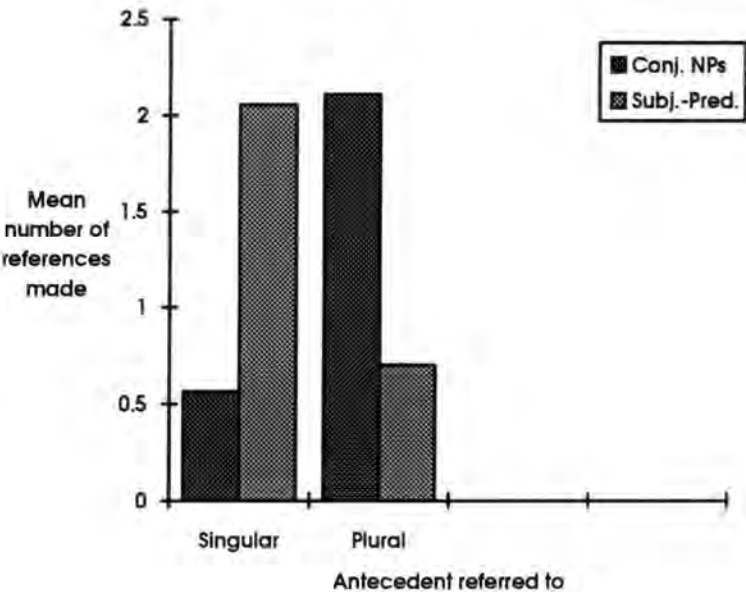
The number of continuations made to first and second mentioned antecedents was also calculated. These are displayed in table 4.5 (overleaf).

Analyses of variance (treating subjects and sentences as random variables) revealed a significant main effect of antecedent (F1= 48.736, df = 1,35 P<0.00001, F2= 24.173, df = 2,46, P<0.00001). More continuations were made referring to both individuals than to either the first or the second mentioned individual.

Table 4.5: Mean number of assignments made in each condition to each antecedent by sentence position and number

	ANTECEDENT			
DESCRIPTION	First	Second	Both	Means
TOGETHER	1.014	1.389	2.889	1.764
Conjoined NPs	0.389	0.472	4.361	1.741
Subj. - Pred.	1.639	2.306	1.417	1.787
APART	1.362	1.472	2.820	1.885
Conjoined NPs	0.806	0.583	4.361	1.917
Subj. - Pred.	1.917	2.361	1.278	1.852
CONJ. NPs	0.598	0.528	4.361	1.829
SUBJ. - PRED.	1.778	2.334	1.348	1.820

Analysis also revealed a significant interaction between linguistic structure and antecedent (F1= 91.826, df = 2,70 P<0.00001; F2= 84.419, df = 2,46 P<0.00001). Significantly more continuations referred to both individuals rather than to either the first or second mentioned individual when they appeared in conjoined NP sentence structures (see figure 4.4 overleaf). No other effects significant on F1 and F2 were noted.

DISCUSSION

The findings of this experiment are partially in line with the predictions made earlier. Subjects were significantly more likely to write a continuation sentence containing a plural reference if it followed a conjoined NP structured sentence. This suggests that subjects are primarily making use of linguistic information (noun-phrase conjunction) to cue the formation of groups or 'complex referential objects'. This is in line with the results of the on-line reading time task used in experiment five and the findings of Hielscher and Musseler (1990). It is also in agreement with the predictions made by the minimalist hypothesis.

However, despite the support for the minimalist hypothesis, it may be that the distance between a cue and reading a pronoun (as discussed in experiment five and suggested by Glenberg et al 1987) or writing a continuation sentence has an effect on the strength of the information's power to cue a complex referential object's formation. Situational and linguistic structures were manipulated in this

experiment, but the situational information was always further away from the pronoun/continuation sentence than the linguistic information. Thus the formation of complex referential objects may be determined by the last source of cueing information encountered. This possibility is tested in experiments seven and eight.

EXPERIMENT 7

This was a modified replication of experiment five, testing the relative strengths of linguistic conjunction and situational structure as cues to the formation of complex referential objects. The materials used in this experiment were modified versions of the ones used in experiment five. It was thought that perhaps the materials used in that experiment may have artificially reduced the cueing effects of the spatial information because of the distance between the spatial information and the pronoun. In experiment five the distance between the spatial description and the pronoun was one and a half sentences. It is possible that this distance may have reduced the cueing strength of the situational information resulting in the lack of an interaction between situational information and the antecedent referred to. To test this possibility the number of context sentences used in each text was reduced to two (the second sentence used in experiment five being removed). Originally this second context sentence had been included to try and prevent topicalisation of one or both entities from occurring (Hornby, 1972; Sanford and Garrod, 1981). However, given the lack of effect of spatial information noted in experiments five and six, it was surmised that perhaps the intervening second context sentence used may have attenuated the effects of the spatial information. This possibility is in accordance with the proposed working of Sanford and Garrod's (1981) model of text processing and is supported by the findings of Ehrlich and Rayner (1983) and Glenberg et al (1987). This takes place in a limited memory environment. It may be that the delay between presenting the spatial information and referring back to the entities mentioned caused by the intervening filler sentence reduced the importance of the spatial information.

In this self-paced reading task it is predicted that if subjects primarily make use of linguistic information (indicating a minimal representation) to process plural pronouns, then they will read plural references faster than singular references when the antecedents appear with conjoined NPs, rather than in subject-predicate sentence structures. If subjects primarily make use of situational information as a cue to the formation of complex referential objects then it is predicted that plural references would be read faster than singular references when the antecedents are described as being together rather than apart.

METHOD

SUBJECTS

48 unpaid volunteers served as subjects. All were students or staff of the University of Durham, and were unaware of the aims of the experiment.

MATERIALS

There were twelve lists of experimental materials, each containing twenty four experimental texts, each of which was composed of two sentences. The first sentence introduced one male and one female by name, and varied the sentence structure they appeared in (conjoined NPs or subject-predicate), and the situational structure (whether they were described as being 'together' or 'apart'). The second sentence (the target sentence), varied which antecedent was referred to (either the first mentioned person, the second mentioned person or both). Table 4.5 (overleaf) contains an example of the sentences appearing in each condition.

Table 4.5: Example of sentences in each condition

TOGETHER CONDITION

CONJOINED NPs:

John and Karen were in the science lab when the new equipment arrived.

SUBJ.-PRED. :

John was in the lab and so was Karen when the new equipment arrived.

ANTECEDENT =1ST: He found it difficult to assemble.

=2ND: She found it difficult to assemble.

=BOTH: They found it difficult to assemble.

APART CONDITION

CONJOINED NPs:

John and Karen were in different parts of the building when the new
equipment arrived.

SUBJ.-PRED.:

John was in a different part of the building from Karen when the new
equipment arrived.

ANTECEDENT =1ST: He found it difficult to assemble.

=2ND: She found it difficult to assemble.

=BOTH: They found it difficult to assemble.

(see appendix 7 for a full list of experimental materials)

The combination of location in the situation (together or apart description), and
linguistic structure (conjoined NPs or subject-predicate) in sentence one, and
antecedent referred to (first mentioned, second mentioned or both) in sentence
two, results in twelve text conditions.

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In addition to the twenty four experimental texts, subjects also saw forty eight, three-sentence filler texts. These texts introduced three individuals and described their actions. The texts varied whether the antecedents were conjoined or whether they appeared in subject-predicate sentences and whether the antecedents appeared in the same or different sentences.

Table 4.6: Example filler text

> e.g.   John and Sammy were playing in the garden.
>   Ellen watched their game with interest.
>   John pushed Sammy and Ellen kicked him.

Subjects also saw eight experimental and eight filler practice texts. These practice materials were of exactly the same format as the ones described above.

DESIGN & PROCEDURE

This was a self-paced reading time experiment similar to the one used in experiment five. Subjects were required to read sentences presented to them on a VDU by a BBC model B microcomputer. The materials were of exactly the same design as the ones used in experiment five, although they varied in specific details as described in the materials section above.

A repeated measures, Latin square design was again used. Trial order was randomised across subjects and within each stimuli list. The time taken for each subject to read the target sentence was measured. Subjects were required to press the space bar to begin each trial (prompted by the computer). This delivered the first sentence. After having read and comprehended the sentence, subjects pressed the space bar a second time. This removed the first sentence and delivered the target sentence. After having read and understood this sentence,

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subjects again pressed the response key. This removed the target sentence and delivered a yes/no question. Timing of the target sentence began when the sentence was presented to subjects and ended when they pressed the space bar to indicate that they had understood the sentence. Subjects repeated the read and respond procedure. Each trial was followed by a question, and the responses to these questions were recorded.

Subjects were required to complete a short series of practice trials to familiarise themselves with the procedure before starting the experiment. The reading times for these practice texts were not recorded.

RESULTS

Reading times were calculated for the target sentence (sentence two) for each trial. Reading times of less than 350 milliseconds were not included in the analysis. There were 15 such trials which made up 1.3% of the total number. The reading times for first and second mentioned antecedents were combined for each condition to produce an average reading time for singular pronouns. These reading times are displayed in table 4.7 overleaf;

Analyses of variance (treating subjects and sentences as random variables) of the reading times displayed in table 4.7 revealed no main effects or interactions that were significant on either F1 or F2.

The mean reading times for target sentences containing references to the first mentioned, second mentioned and both antecedents are shown in table 4.8 (overleaf).

Table 4.7: Mean reading times for target sentences containing singular or plural references

ANTECEDENT

DESCRIPTION	Singular	Plural	Means
TOGETHER	1345.04	1285.61	1315.32
Conjoined NPs	1335.32	1282.00	1308.66
Subj.-Pred.	1354.75	1289.21	1321.98
APART	1351.21	1349.95	1350.58
Conjoined NPs	1373.64	1372.04	1372.84
Subj.-Pred.	1328.78	1327.85	1328.32
CONJ. NPs	1354.48	1327.02	1340.75
SUBJ. - PRED.	1341.77	1308.53	1325.15

Table 4.8: Mean reading times for target sentences containing references to first mentioned, second mentioned or both antecedents

ANTECEDENT

DESCRIPTION	First	Second	Both	Means
TOGETHER	1327.40	1362.79	1285.61	1345.36
Conjoined NPs	1317.10	1353.77	1282.00	1317.62
Subj.-Pred.	1337.69	1371.81	1289.21	1332.90
APART	1356.98	1345.43	1349.95	1350.78
Conjoined NPs	1417.98	1329.27	1372.04	1373.09
Subj.-Pred.	1295.98	1361.58	1327.85	1328.47
CONJ. NPs	1367.54	1341.52	1372.02	1325.26
SUBJ. - PRED.	1316.84	1366.70	1308.53	1330.69

Analyses of the mean reading times shown in table 4.8 revealed no significant main effects or interactions on either F1 or F2.

DISCUSSION

These findings are not in accordance with those predicted earlier. Subjects appear to be using neither situational nor linguistic information to cue the formation of group referents. The modification of the materials used in experiment five for use in this experiment (the removal of the second sentence) appears to have 'knocked out' the cueing effect of the linguistic information. Unlike experiment five, in this study there is no effect of linguistic conjunction on the reading times for plural pronouns. Neither is there an effect of situational description on the reading times for plural pronouns, as was found in experiment one.

Although no significant effects were noted, an examination of the mean reading times displayed in tables 4.7 and 4.8 reveals that reading times do follow the trends obtained in experiment five and the results obtained in experiment one. Tables 4.7 and 4.8 show that plural references following together descriptions are read 64 milliseconds faster than plural references following apart descriptions. The differences between reading times for plural pronouns appearing in conjoined NP vs. subject - predicate structured sentences are very small: only 9 milliseconds.

The lack of significant findings obtained in this experiment is puzzling. One possibility is that the cueing information given in the first sentence and the first clause of the second sentence was in some way attenuated by the information contained in the target clause. However if this is the case then one would expect that in a continuation task (involving the removal of the target clause) subjects would make use of one or both of the sources of cueing information and that this would affect the frequency with which plural references occur. This possibility is tested in experiment eight.

EXPERIMENT 8

Experiment eight is a continuation task version of experiment seven. It is included to determine whether task type has any effect on the results obtained in experiment seven. It was suggested in experiment six that the fact that there were two sentences of context in the text to be continued may have reduced the effect of the spatial cue in some way. This possibility is tested in this experiment by having only one context sentence.

In addition, it was suggested in experiment seven that the information given in the target clause may have attenuated the situational and linguistic information in some way. This would account for the lack of cueing effects found in experiment seven. If subjects use situational or linguistic information to cue the formation of complex referential objects in this experiment then it is possible that the lack of significant findings obtained in experiment seven was indeed due to the information in the target clause.

This study manipulated situational and linguistic structure in the same way as in experiments five, six and seven. Subjects were required to write a continuation elaborating on some aspect of the situation or entities described.

The predictions are that subjects will write more continuations featuring references to both antecedents when they are described as being together than when they are described as being apart. In addition, it would also be expected that subjects will make more references to both antecedents when they previously appear in conjoined NP sentence structures than when they appear in subject-predicate structured sentences. If subjects make use of linguistic information but not spatial information then this would suggest that subjects are making use of a representation based on linguistic (minimal) information to process plural pronouns.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students and staff of the University of Durham. Subjects were not informed of the experimental hypotheses being tested.

MATERIALS

The materials used in this experiment were the first sentences of the texts used in experiment seven (see table 4.5 for an example of the texts used in each condition). Each sentence introduced two named people (one male, one female) and varied the linguistic structure they appeared in (conjoined NPs or subject-predicate sentence structures), and the situational structure (the two people were described as being either together or apart). See appendix 8 for a full list of experimental materials.

There were four lists of twenty four sentences, each list containing one of the four versions of each sentence. Each subject received a booklet containing a different list and there were four sentences in each condition in each list.

DESIGN & PROCEDURE

This was a sentence continuation task. Subjects were required to read each sentence and write a sentence about the situation they had just read. The materials manipulated linguistic situational structure (together and apart descriptions) and linguistic structure (conjoined NPs and subject predicate structures).

A repeated measures, Latin square design was used. The order of sentences was randomised in each booklet and across subjects. The antecedent referred to in

each continuation sentence was recorded. Subjects were instructed to regard each trial as being entirely separate from the rest and therefore not to try and continue each sentence in such a way as to link it with the other texts. Subjects were instructed to finish each trial before moving on to the next one. Subjects were allowed to complete the booklet in their own time and were tested individually.

RESULTS

Each booklet was scored by noting which antecedent subjects referred to in their continuation sentences. References to individuals or events not featured in the sentence were not included in the analysis. There were 101 such continuations, which formed 11.7% of the total number. The number of references made in the continuations to the first and second mentioned antecedents were combined to give an average score for singular references (shown in table 4.9 below).

Table 4.9: Mean number of singular and plural references made in each condition

ANTECEDENT

DESCRIPTION	Singular	Plural	Means
TOGETHER	1.014	3.153	2.084
Conjoined NPs	0.694	3.639	2.167
Subj. - Pred.	1.333	2.667	2.000
APART	1.396	2.611	2.004
Conjoined NPs	1.028	3.333	2.181
Subj. - Pred.	1.764	1.889	1.827
CONJ. NPs	0.861	3.486	2.174
SUBJ. - PRED.	1.549	2.278	1.914

Analyses of variance (treating subjects and sentences as random variables) of the mean scores displayed in table 4.9 revealed a significant main effect of linguistic structure (F1= 12.998, df = 1,35, P<0.0013; F2= 10.238, df = 1,23, P<0.005). Subjects wrote significantly more continuation sentences referring to one or both of the individuals in the first sentence when this sentence contained conjoined NPs rather than subject-predicate structures. There was also a significant main effect of antecedent (F1= 50.573, df = 1,35, P<0.0000; F2= 83.024, df = 1,23, P<0.0000). Subjects made significantly more plural references than singular references in their continuation sentences. Analysis also revealed a significant interaction between situational structure and antecedent referred to (F1= 9.179, df = 1,35, P<0.005; F2= 8.343, df = 1,23, P<0.009). Subjects made significantly more plural references when the antecedents were described as being together rather than apart. This interaction is shown in figure 4.5 (below).

Figure 4.5: Graph showing mean number of references made to singular/plural antecedents by situational structure
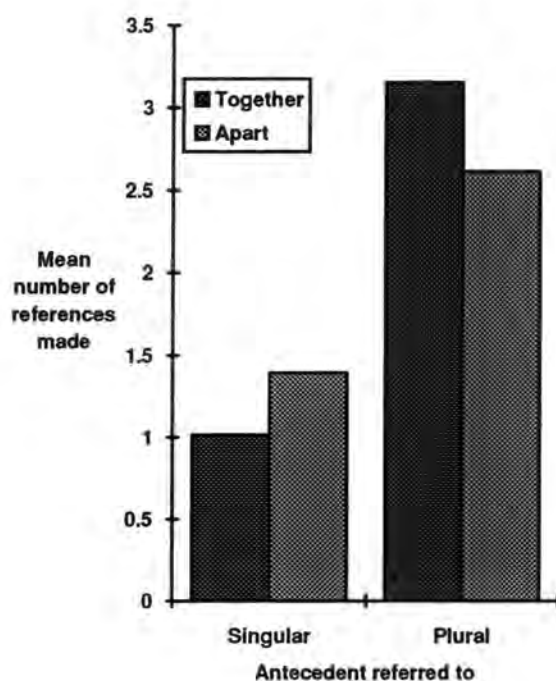
Analyses of variance (treating subjects and sentences as random variables) also revealed a significant interaction between linguistic structure and antecedent (F1= 47.836, df = 1,35, P<0.0000; F2= 47.675, df = 1,23, P<0.00002). Subjects made significantly more plural references when the antecedents appeared in a conjoined NPs sentence structure than when they appeared in subject-predicate sentence structures (shown in figure 4.6 below).

Figure 4.6: Graph showing mean number of references made to singular/plural antecedents by linguistic structure
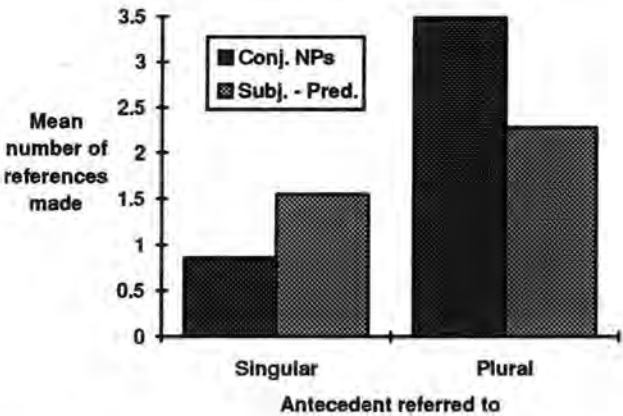
There were no other significant effects on either F1 or F2.

The mean number of references made to the first mentioned, second mentioned or both antecedents are shown in table 4.10 overleaf.

Analyses of variance (treating subjects and sentences as random variables) performed on the mean scores in table 4.10 revealed a significant main effect of antecedent referred to (F1= 43.261, df = 2,70, P<0.00001; F2= 48.915, df = 2,46, P<0.00001). Subjects made significantly more plural references to both antecedents than to either first or second mentioned antecedents.

Table 4.10: Mean number of references made to first mentioned, second mentioned or both antecedents in each condition

ANTECEDENT

DESCRIPTION	First	Second	Both	Means
TOGETHER	1.028	1.000	3.153	1.727
Conjoined Nps	0.694	0.694	3.639	1.676
Subj. - Pred.	1.361	1.306	2.667	1.778
APART	1.834	0.959	2.611	1.801
Conjoined Nps	1.417	0.639	3.333	1.796
Subj. - Pred.	2.250	1.278	1.889	1.806
CONJ. NPs	1.056	0.667	3.486	1.736
SUBJ. - PRED.	1.806	1.292	2.278	1.792

Analysis also revealed a significant interaction between situational structure and antecedent ($F1 = 7.432$, $df = 2,70$, $P<0.002$; $F2 = 8.844$, $df = 2,46$, $P<0.0009$). When the antecedents were described as being together subjects made significantly more references to both antecedents than to either the first or second mentioned antecedents. This interaction is shown in figure 4.7 (overleaf).

Analysis also revealed a significant interaction between linguistic structure and antecedent ($F1 = 28.452$, $df = 2,70$, $P<0.00001$; $F2 = 28.569$, $df = 2,46$, $P<0.00001$). When the antecedents appeared with conjoined NPs, subjects made significantly more references to both antecedents than to either first or second mentioned antecedents. This interaction is shown in figure 4.8 (overleaf).

Figure 4.7: Graph showing the mean number of references made to either first mentioned, second mentioned or both antecedents by situational structure
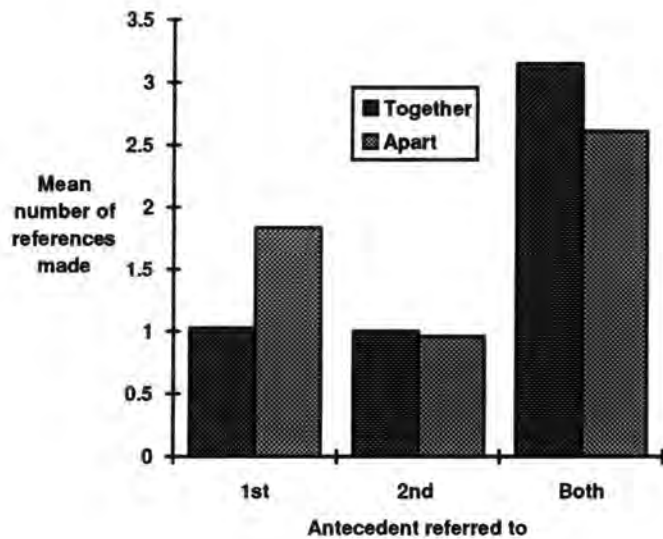
Figure 4.8: Graph showing the mean number of references made to first mentioned, second mentioned or both antecedents by linguistic structure
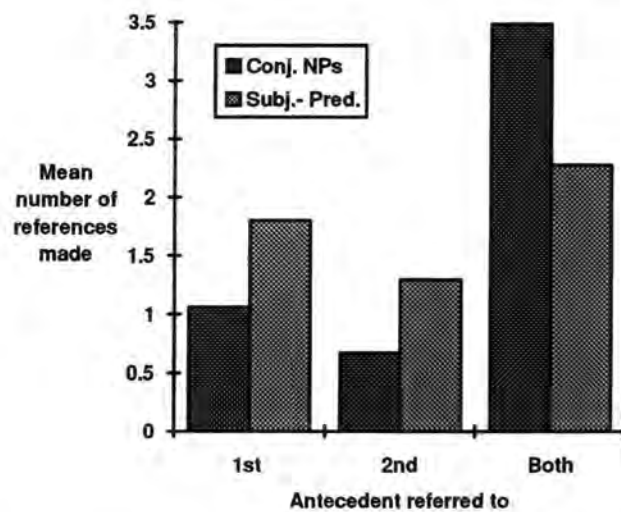
There were no other effects significant on either F1 or F2.

DISCUSSION

These results are those predicted. Subjects appeared to be making use of both linguistic and situational information when forming complex referential objects. These findings agree with the notion that subjects routinely make use a mental model of a situation. Johnson-Laird (1983) and Van Dijk and Kintsch (1983) suggest that a mental model is made up of both linguistic and non-linguistic information. This is in line with the findings of experiment 8 when subjects appeared to be using both linguistic and non-linguistic information to guide plural pronoun comprehension. The findings of this experiment also lends support for the assertion that spatial proximity IS a cue to the formation of complex referential objects.

There does not appear to be an interactive effect of cueing strength when conjunction and spatial proximity are both present. There is no finding that subjects write more references to both antecedents when they are described as being together AND when they appear in a conjoined NP sentence structure. This lends some tentative support for the idea that there is competition between sources of cueing information; subjects appear to be using one source or the other to cue the formation of complex referential objects but not both.

It is possible that the information in the target clause of the materials used in experiment seven WAS the cause of the lack of results obtained in that study. When this information was absent (in this experiment), then subjects used the situational and linguistic information present in the first sentence to cue the formation of a group referent. However it must be stressed that this possibility should be regarded as tentative only as experiments seven and eight used different tasks.

GENERAL DISCUSSION

The results of the experiments described in this chapter suggest that linguistic structure plays a more important role in cueing the formation of group and individual referents than does spatial information. This was suggested by the results of experiments five, six and eight. In experiment five subjects read plural references faster when the individuals had appeared with conjoined noun phrases than when they had appeared in subject-predicate structured sentences. There were no significant effects of situational structure on the reading times for plural pronouns although it was noticed that plurals were read faster following a together description rather than an apart description. Although not significant, the direction of the trend of results is in line with the predictions.

A similar finding was obtained in experiment six. Subjects made significantly more continuations containing a plural reference when the entities appeared with conjoined NPs rather than in subject-predicate structured sentences. Again there was no significant effect of situational structure, but it was found that slightly more plural references were made when the entities were described as being together than when they were described as being apart. Although these findings are in line with the minimalist hypothesis (McKoon and Ratcliff 1992), it was surmised that the lack of interaction between of situational structure and pronoun used may also have been dependent on the point at which a continuation was required to be written. The distance between cueing information and the point at which it needs to be acted upon, (e.g. on encountering a pronoun) is in line with the findings of Glenberg et al (1987). Using a word recognition task they found that the activating effects of spatial proximity on a non-foregrounded object were reduced with the number of intervening sentences between the spatial description and the place in the text where the probe word appeared. In an eye tracking study Ehrlich and Rayner (1983) found an effect of distance between antecedent and pronoun of fixation times in the region of the pronoun.

Experiments seven and eight tested this hypothesis. The materials in these two studies had the situational description appearing in the same sentence that featured the linguistic manipulation. No significant effects were obtained from experiment seven but experiment eight revealed significant interactions between both situational structure and linguistic structure on the frequency of plural pronoun use. The results of experiment eight lend tentative support for the assumption that increased distance between cueing information and pronoun was sufficient to attenuate the effects of the cue. However, this suggestion would have been considerably strengthened by obtaining similar results in experiment seven. The lack of significant results obtained in experiment seven is puzzling. One would have expected to have replicated the findings of experiment eight, or, if the use of spatial information is limited to 'off-line' tasks (such as continuation tasks), to have found a replication of the results obtained in experiment five.

It is possible that some aspect of the material presented in the target sentence of experiment seven attenuated the situational and linguistic cueing information. On examination of the results of experiment seven it is found that even though there were no significant effects, the trends shown by the reading times are in the direction we predicted for situational information: plural references following together descriptions were read 64 milliseconds faster than those following apart descriptions. There was some facilitation of plural processing following together descriptions albeit a very small one.

The idea that information contained in the target sentence attenuated the situational information would account for the findings of experiment eight. When the second clause information was omitted (forming the materials used in experiment eight) the predicted situational and linguistic effects on plural pronoun use were obtained. An examination of the materials used in experiments seven and eight however, reveals no obvious information that could lead to an attenuation of the spatial/linguistic cueing information. Also the fact that experiments seven and eight used different tasks cannot be overlooked. Thus the presence of attenuating information accounting for the difference in results of experiments seven and eight is a tentative suggestion.

The results of experiment eight alone are not enough to draw any firm conclusions about the relative importance of linguistic conjunction and spatial description as cues to the formation of group referents. As a result of the experiments carried out so far, it was decided to re-run experiments one and two and experiments seven and eight in chapter five. The experiments carried out in chapter three suggested that spatial information was used to cue the formation of group referents in both on-line and off-line tasks. The experiments run in this chapter suggested that spatial information and linguistic information were not interactive in the formation of group referents. Subjects appeared to be making use of either linguistic OR situational information to cue the formation of group referents but not both (experiment eight). Furthermore it would appear that linguistic information is a more important cue to group referent formation than situational information (experiments five, six and eight; Sanford and Lockhart 1991). However the relative cueing strengths of linguistic and non-linguistic information as indicated by the results of experiments five, six and eight are tentative suggestions only. This is a result of the possibility in experiments five and six, that the distance between spatial information and pronoun/continuation sentence may have attenuated the strength of the spatial cue (Ehrlich and Rayner, 1983; Glenberg et al, 1987). In order to make these results clearer and also to test further the relative strengths of linguistic/non-linguistic cues to group referent formation, it was decided to re-run experiments three and four and experiments seven and eight. This time the materials would contain information that was as purely spatial as possible. This was decided upon in an attempt to control for the possible attenuating information proposed to have caused the lack of results in experiment 8. This was in order to test whether the nature of the task type played any role in the nature of the processing carried out on the materials. For instance would more spatial materials lead to a concentration on the spatial aspects of the task at the expense of the linguistic information? If so then it would be expected that spatial information would become the primary cue to group formation. These possibilities are tested in chapter five.

CHAPTER 5: PURELY SPATIAL INFORMATION AND PLURAL PRONOUNS

INTRODUCTION

The findings of the experimental work carried out in chapter four were insufficient to show conclusively whether linguistic information was a more important cue to the formation of group referents than non-linguistic information. As such it is not possible to make more than suggestions about the nature of the representation used to routinely process pronouns. The experiments in this chapter are intended to replicate and extend experiments one and two and experiments seven and eight. By carrying out a replication it is hoped that the relative strengths of linguistic conjunction and spatial information as cues to the formation of group referents will be indicated. As noted in chapter three, the distance between the spatial information and the pronoun may have been enough to reduce its effectiveness as a cue (see experiment five). In experiment seven (which used materials designed to overcome this problem) the results were not significant. However the trend was in the direction predicted.

Experiment eight DID produce significant interactions of the types predicted: together descriptions produced greater use of plural pronouns than apart descriptions, whilst linguistic conjunction led to increased plural use than subject-predicate sentence structures. This result, and the trend noticed in experiment seven, cautiously suggests that the reasoning behind the failure of experiments seven and eight to support the predictions, was correct. In order to further test this, experiments seven and eight are replicated (in a modified form) in experiments eleven and twelve.

In addition to replicating experiments seven and eight the experiments in this chapter are intended to once again further investigate the nature of the representation being used to process plural pronouns. Are subjects making use of a mental model of a text when processing unambiguous references to individuals introduced separately? If so then it would be expected that subjects

would read faster/make more plural references when the individuals are described together then when they are described as being apart. Conversely the minimalist hypothesis predicts that spatial information will not be made use of if pronouns are unambiguously resolvable on the basis of gender/number cues. If subjects are making use of a mental model (suggested by the results of experiments one, four and eight), then the experiments in this chapter are designed to convey the importance of linguistic (noun-phrase conjunction) and non-linguistic (spatial description) information as cues to the formation of group referents.

In order to test this possibility materials were used that contained information that was as purely spatial in nature as possible. The reasoning behind the use of this type of information was to test whether subjects were in fact making use of purely spatial information when processing plural pronouns rather than some other uncontrolled aspect of the situation that the materials used had captured (such as grouping information as a result of shared activity a notion suggested by the work of Herskovits, 1986, and Morrow and Clark 1988).

The experiments in this chapter again consist of two task types: reading time and sentence continuation/completion experiments. Results from the reading time experiments indicating that subjects read plural references faster following together rather than apart descriptions would suggest that subjects are making use of a mental model of the situation. Subjects reading plural references following noun-phrase conjunction faster than subject-predicate structured sentences (regardless of description type) would suggest that subjects are making use of linguistic information to guide the construction of group referents. When both factors are present, a comparison of reading times for plural references following together descriptions or NP conjunction will provide a crude indication of which factor is most important in cueing the formation of a group referent. The same predictions hold true for the completion tasks except that the number of plural references made by subjects will be the indicator of the relative importance of linguistic and non-linguistic cueing factors. Subjects using spatial information to help guide their processing of plural pronouns would suggest that people

ordinarily make use of a mental model of the situation rather than a minimalist representation (as suggested by McKoon and Ratcliff, 1992).

EXPERIMENT 9

This experiment was a modification of the reading time task used in experiments one and three using re-worked materials. The materials were constructed to contain as much spatial and as little other information as possible. The materials used the present tense and specified the individuals' positions as being static relative to one another. The results of the reading time tasks used in experiments three and seven suggested that the information given in the target clause with the pronoun may have in some way reduced the cueing effectiveness of the situational/linguistic manipulations. This interpretation was suggested because although experiment one produced an effect of faster reading times a modification of the materials resulted in no significant interactions being observed (see experiment three). A similar modification of the materials used in experiment seven resulted in a similar lack of findings. The current experiment was designed to see whether purely spatial materials would orient the subjects' attention towards the situational cues. If this were the case then this result would suggest that the lack of an interaction between situational structure and pronoun use in experiments three and seven may have been due to interference from other knowledge sources (such as scenario information for instance Sanford and Garrod 1981) cued by the information given in the target clause, or of some other feature of interaction other than spatial proximity.

This experiment used the same design and procedure as the ones used in experiments one and three and again featured one male and one female who were described as being either together or apart. The materials differed from the ones used in experiments one and three in that these materials were designed to contain information that was as purely spatial as possible. Predictions were that if subjects make use of a mental model constructed using spatial information when processing sentences, then they would read target clauses containing plural

pronouns faster if the antecedents had been described as being together rather than apart.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham. Subjects were not informed of the experimental hypotheses.

MATERIALS

Six lists of experimental materials were used each containing eighteen experimental sentences. Each sentence consisted of two clauses. Clause one introduced two people (one male, one female) both of who were mentioned by name and described as being either together or apart. Clause two was the target clause and contained a pronominal reference to either the first mentioned, second mentioned or both antecedents. The target clause was always eight words in length. An example of the materials used in each condition is shown in table 5.1, overleaf.

The combination of location (apart or together) and antecedent referred to in the target clause (1st mentioned, 2nd mentioned or both) resulted in six sentence conditions.

In addition to the eighteen experimental sentences, subjects also saw eighteen filler sentences. These filler sentences were split into two clauses and described the location of named people in relation to inanimate objects.

> e.g.   Andrew was standing next to a tree and
>   he was in front of a small rise.

Table 5.1: Example of sentences in each condition

APART CONDITION

1st Clause: Paul is far away from Fiona and

2nd Clause:

Antecedent   =1st : he is next to a fast flowing river.

              =2nd : she is next to a fast flowing river.

              =Both: they are next to a fast flowing river.

TOGETHER CONDITION

1st Clause: Paul is beside Fiona and

2nd Clause:

Antecedent   =1st : he is next to a fast flowing river.

              =2nd : she is next to a fast flowing river.

              =Both: they are next to a fast flowing river.

(See appendix 9 for a full list of experimental materials).

In addition to the experimental and filler materials described, subjects also saw six practice experimental sentences and six practice filler sentences. These followed the same format as the ones described above. The reading times for these practice trials were not recorded.

DESIGN & PROCEDURE

This was a self-paced reading time task. Subjects were required to read sentences presented to them from the VDU of a BBC model B microcomputer. The

materials manipulated situational structure (apart and together descriptions) and antecedent referred to (1st mentioned, 2nd mentioned or both).

A repeated measures Latin square design was used with each subject receiving three sentences in each experimental condition. The presentation order of the sentences was randomised within each list and across subjects. The time taken for subjects to read the target clause was recorded in each case.

Subjects were required to press the space bar to begin each trial (prompted by the computer). This delivered the first clause. After having read and understood the first clause, subjects pressed the space bar again. This removed the first clause from the screen and displayed the target clause. Subjects read the clause and when they had comprehended it, pressed the space bar. Timing started when the target clause appeared on the screen and ended when the subject pressed the space bar. After each trial subjects received a yes/no answerable question about the sentence they had just read in order to encourage comprehension.

> e.g.   Paul is far away from Fiona and
>   he is next to a fast flowing stream.
>   Is Paul with Fiona?

Subjects repeated the read and respond procedure for each sentence. Halfway through the main experimental block there was a one minute rest period. Subjects were required to complete a short series of practice trials to familiarise themselves with the procedure before starting the experiment. The practice consisted of 6 practice experimental sentences and 6 practice filler sentences. The reading times for these sentences were not recorded.

RESULTS

Reading times were calculated for the target clause in each sentence. Reading times of less than 350 milliseconds or greater than 9.5 seconds were not included in the analysis. There were 2 such reading times, which made up 0.3% of the

total. The reading times of target clauses referring to the first and second mentioned individuals were combined to give an average reading time for references to singular antecedents. These are displayed in table 5.2 below.

Table 5.2: Mean reading times for target clauses by description and antecedent

	ANTECEDENT		
DESCRIPTION	Singular	Plural	Means
Apart	2202.4	2185.4	2193.9
Together	2093.2	2035.9	2064.6
Means	2147.8	2110.7	

Analyses of variance (treating subjects and sentences as random variables) of the reading times in table 5.2 revealed a main effect of description type that was significant on F1 only (F1= 4.128, df = 1,35, P<0.05; F2= 0.934, df = 1,17, P<0.66). Subjects read target clauses significantly faster when they followed together rather than apart descriptions. There were no other main effects or interactions significant on either F1 or F2.

The mean reading times for first and second mentioned antecedents (which were combined in table 5.2 to give mean reading times for singular antecedents) are displayed overleaf in table 5.3.

Table 5.3: Mean reading times for target clauses by description and antecedent

ANTECEDENT

DESCRIPTION	First	Second	Both	Means
Apart	2133.1	2271.5	2185.4	2196.7
Together	2120.5	2065.9	2035.8	2074.1
Means	2126.8	2168.7	2110.7	

Analyses of variance (treating subjects and sentences as random variables) carried out on the reading times displayed in table 5.3 revealed no significant main effects or interactions on either F1 or F2.

DISCUSSION

These results do not conform to the predictions stated earlier. Although the trend of results are in the direction predicted (plural references are read faster when they follow together rather than apart descriptions) the differences in reading times are not significant. Using materials containing very little information other than spatial information appears to have little effect in cueing the formation of group referent in reading time tasks. The fact that spatial proximity conferred a processing advantage on plural pronouns (decreased reading times in experiment one, and increased frequency of use) in experiments one, four and eight, suggests that the lack of significant findings in this experiment may be due to some facet of the task or materials employed rather than a lack of cueing efficacy in spatial information itself. However this must remain a very tentative conclusion given the lack of consistency of findings. The results of this experiment conform to the predictions of the minimalist hypothesis in that McKoon and Ratcliff suggest that as the sentences are pronominally unambiguous then spatial information will not be incorporated into the representation of the text and therefore there will be no

effect of spatial description on reading times. However, this interpretation cannot be automatically accepted. McKoon and Ratcliff (1992) predict a null result. In order to accept this hypothesis one must first eliminate all other possible causes of the null result.

In the light of earlier findings (experiments one, four and eight) it would appear that spatial information IS used as a cue to the formation of group referents. Therefore the lack of results in this case may be due to problems with the materials or possibly as a result of the task employed.

If it IS the case that it is task type that determines whether or not spatial information is made use of when processing plural pronouns then one would expect to find different results (following the predictions made earlier) in a continuation task version of this experiment. This possibility is tested in experiment ten.

EXPERIMENT 10

This experiment is a continuation task version of experiment nine and a modified replication of experiments two and four. The experiment was designed to test whether subjects would make use of purely spatial information to cue the formation of group referents. If this were the case then this would suggest that the lack of findings in experiment nine was not due to the fact that spatial information does not cue the formation of group referents. Rather it would suggest that the two task types (reading time and completion/continuation) are in some way responsible for the different results obtained (e.g. the information given in the target clause of the reading time experiments may somehow have attenuated the spatial information).

The continuation task used in this experiment required subjects to read a booklet of sentences describing two people (one of each gender) and to write a continuation sentence about the sentence they had just read.

The predictions are that if subjects are constructing a mental model to process sentences containing unambiguously assignable pronouns then they will write significantly more continuation sentences containing plural references following together rather than apart descriptions.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham. Subjects were naive as to the aims of the experiment.

MATERIALS

The materials used in this experiment were modified versions of the ones used in experiment nine. The materials used were designed to contain information that was as purely spatial as possible. Each trial consisted of a sentence (the first clause of the materials used in experiment nine closed before the 'and' by a full stop) introducing two named people, one of each gender. This sentence varied the situational description (the two people were described as being either 'together' or 'apart').

There were thus two possible combinations: 'together' descriptions and 'apart' descriptions. There were two lists of eighteen sentences, each list containing one of the two versions of each sentence. Each subject received a booklet containing a different list and there were nine sentences in each condition in each list.

Table 5.4: Example of sentences in both conditions

APART CONDITION

Paul is far away from Fiona.

TOGETHER CONDITION

Paul is beside Fiona.

(see appendix 10 for a full list of experimental materials)

DESIGN & PROCEDURE

This was a sentence continuation task. Subjects were required to read each sentence and write a sentence that continued the situation described in some way. The materials manipulated the situational structure ('together' and 'apart' descriptions of the people's location). A repeated measures, Latin square design was used. The order of sentences was randomised within each booklet and across subjects. The antecedent referred to in each continuation was recorded.

Subjects were instructed to regard each trial as being entirely separate from the rest and therefore not to try and continue each sentence in such a way as to link it with the others. Subjects were instructed to finish each trial before moving on to the next. Subjects were required to complete the experiment within fifteen minutes and were tested as a group. No conferring was allowed while completing the experiment.

RESULTS

Each completed trial was scored by noting who the subject referred to in the continuation sentence (either the first mentioned, second mentioned, or both

antecedents). References to people or events not mentioned in the first sentence were not included in the analysis. There were 34 such trials which made up 5.2% of the total number. The number of references made in continuations to the first and second mentioned individuals were combined to give an average singular reference score (shown below in table 5.5).

Table 5.5: Mean number of singular and plural references

	ANTECEDENT		
DESCRIPTION	Singular	Plural	Means
Apart	5.056	1.361	3.209
Together	4.028	2.444	3.236
Means	4.542	1.903	

Analyses of variance (treating subjects and sentences as random variables) of the scores displayed in table 5.5 revealed a main effect of situational structure, although this was only marginally significant on F2 (F1= 9.376, df= 1,35, P<0.005; F2= 3.716, df= 1,17, P<0.07). Subjects made significantly more references to individuals appearing in the first sentence when they were described as being together rather than apart.

Analysis also revealed a significant main effect of antecedent (F1= 14.149, df= 1,35, P<0.0001; F2= 8.920, df= 1,17, P<0.009). Subjects produced more singular than plural pronouns in their continuations. In addition, analysis showed a significant interaction between situational structure and antecedent, (F1= 9.939, df= 1,35, P<0.004; F2= 5.845, df= 1,17, P<0.03). Subjects produced more plural pronouns in continuations to 'together' fragments and more singular pronouns in continuations to 'apart' fragments. This interaction is displayed in figure 5.1, overleaf.

Figure 5.1: Graph showing the mean number of references made to
singular/plural antecedents
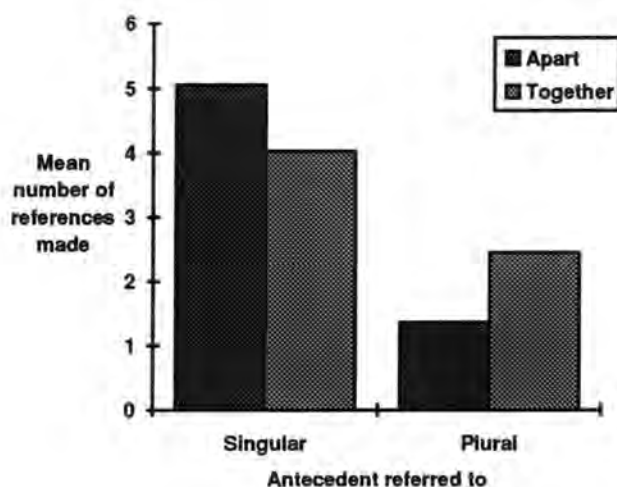
The mean number of references made to first mentioned, second mentioned and both antecedents are shown overleaf in table 5.6.

Analyses of variance (treating subjects and sentences as random effects) carried out on the mean scores in table 5.6 revealed a significant main effect of antecedent referred to (F1=15.609, df = 2,70, P<0.00004; F2= 25.563, df = 2,34, P<0.00002). Subjects produced significantly more references to the second mentioned antecedent than to either the first antecedent or to both antecedents as a group.

Analysis also revealed a significant interaction between situational structure and antecedent (F1= 7.448, df = 2,70, P<0.002; F2= 4.284, df = 2,34, P<0.03). Subjects produced significantly more plural pronouns in continuations of 'together' fragments, and significantly more singular pronouns in continuations of 'apart' fragments. This significant interaction is shown overleaf in figure 5.2. There were no other effects that were significant on either F1 or F2.

Table 5.6: Mean number of references made to first mentioned, second mentioned and both antecedents)

ANTECEDENT

DESCRIPTION	First	Second	Both	Means
Apart	1.972	5.056	1.361	2.796
Together	1.972	4.028	2.444	2.815
Means	1.972	4.542	1.903	2.806

Figure 5.2: Graph showing the mean number of references made to 1st mentioned, 2nd mentioned or both antecedents
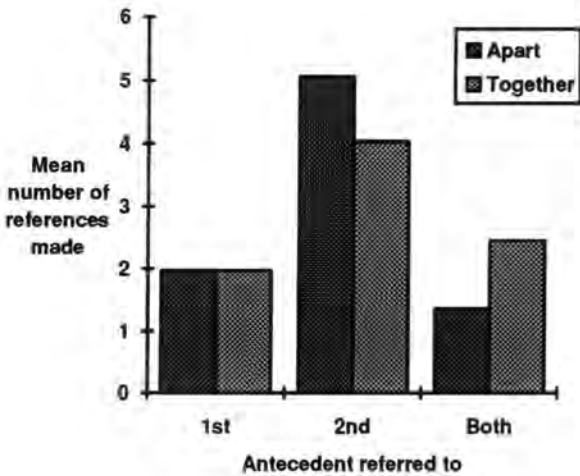
DISCUSSION

This finding is in line with the stated predictions. Subjects appear to be using spatial information as a cue to the formation of group referents, a finding which replicates the findings obtained from experiment four. This finding lends additional support for the hypothesis that a mental model is used to process even unambiguous sentences. The results of this experiment also lend some support to the supposition that the information in the target clause of the reading time

experiments was responsible for attenuating the spatial information. When this information was removed (as in this experiment) then spatial information was used to cue the formation of complex referential objects. Again this suggestion must be made cautiously as the two tasks used are different.

This experiment appears to suggest that spatial description IS a valid cue to the formation of group referents. As such it was decided to modify experiments seven and eight (which manipulated linguistic structure as well as situational structure) using more spatial materials. In conjunction with the findings of the earlier series of experiments it was hoped that this would (albeit) crudely illustrate the relative cueing strengths of purely spatial information and noun-phrase conjunction in the construction of group referents.

The testing of the strengths of these two sources of cueing information is carried out in experiment eleven.

EXPERIMENT 11

This experiment is a modification of experiment seven. It was designed to investigate the use of a linguistic cue (conjoined NPs) and a non-linguistic cue (purely spatial information) in processing plural reference. In both design and procedure the experiment was identical to experiment seven. The only difference between this experiment and experiment seven lay in the spatial information conveyed by the materials used.

This self-paced reading time experiment manipulated linguistic structure (Conjoined NPs or Subject-Predicate structure), situational structure (entities described as being either together or apart), and antecedent referred to (first or second mentioned entity or both). Predictions were that if subjects were primarily using linguistic information as a cue to the formation of group referents then they would read plural pronouns faster than singular pronouns when the plural antecedents occurred in conjoined NP sentence structures. If subjects were

primarily making use of non-linguistic information to cue group referent formation (i.e. constructing a mental model) then it would be predicted that plural pronouns would be read faster than singular pronouns when the antecedents were together rather than apart in the situational description.

METHOD

SUBJECTS

48 unpaid volunteers served as subjects. All were students or staff of the University of Durham. Subjects had no prior knowledge of the aims of the experiment.

MATERIALS

Twelve lists of experimental materials were used in this experiment each containing twenty-four sentences. Each sentence contained two clauses. The first clause varied according to the linguistic structure (either conjoined NPs or subject-predicate structure and the situational structure (people were described as being either apart or together). The target clause varied the antecedent referred to (first or second mentioned individual or both) and was always eight words long. Examples of sentences appearing in each condition are given overleaf in table 5.7.

The combination of linguistic structure (conjoined NPs or subject-predicate structure) and situational structure (apart or together descriptions) in the first clause, and the antecedent referred to (first mentioned, second mentioned or both) in the target clause, results in twelve different sentence conditions.

Table 5.7: Example of sentences in each condition

CONJOINED NPS/APART DESCRIPTION

Paul and Fiona are far away from one another and

ANTECEDENT = 1ST: he is next to a fast flowing river.

= 2ND: she is next to a fast flowing river.

= BOTH: they are next to a fast flowing river.

CONJOINED NPS/TOGETHER DESCRIPTION

Paul and Fiona are beside one another and

ANTECEDENT = 1ST: he is next to a fast flowing river.

= 2ND: she is next to a fast flowing river.

= BOTH: they are next to a fast flowing river.

SUBJECT-PREDICATE/APART DESCRIPTION

Paul is far away from Fiona and

ANTECEDENT = 1ST: he is next to a fast flowing river.

= 2ND: she is next to a fast flowing river.

= BOTH: they are next to a fast flowing river.

SUBJECT-PREDICATE/TOGETHER DESCRIPTION

Paul is beside Fiona and

ANTECEDENT = 1ST: he is next to a fast flowing river.

= 2ND: she is next to a fast flowing river.

= BOTH: they are next to a fast flowing river.

(see appendix 11 for a full set of experimental materials)

In addition to the experimental and filler materials described, subjects also saw 16 practice filler sentences and 12 practice experimental sentences. These practice materials were of the same format as those outlined earlier. The results of these practice trials were not recorded.

DESIGN & PROCEDURE

This was a self-paced reading time task. Subjects were required to read sentences presented to them on the VDU of a BBC model B microcomputer. The materials manipulated linguistic structure (conjoined NPs or subject-predicate sentences) situational structure (people were described as being either together or apart) and antecedent referred to (first mentioned, second mentioned or both). The various combinations of these factors yield a total of twelve different versions of each text corresponding to the design outlined below:

Situational Structure		Together			Apart	
Sentence Structure	Conj. NPs	Subj. Pred.		Conj. NPs	Subj. Pred.
Antecedent	1st 2nd Both	1st 2nd Both		1st 2nd Both	1st 2nd Both
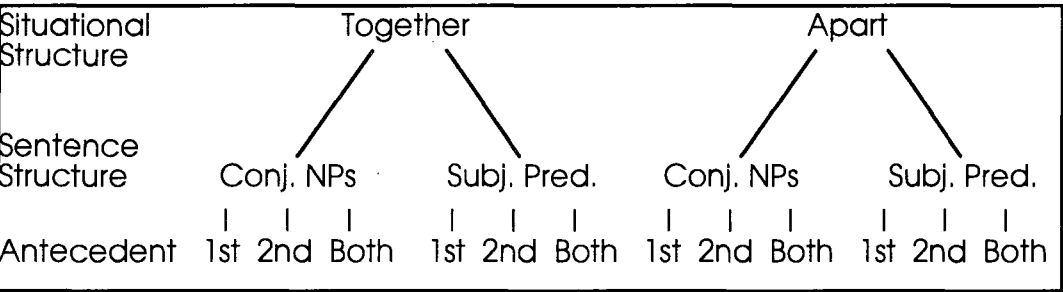
A repeated measures, Latin square design was used, with each subject receiving two sentences in each condition. Sentence order was randomised across subjects and within each stimuli list. The time taken for each subject to read the target clause of each sentence was recorded.

Subjects were required to press a key to begin each trial (prompted by the computer). This delivered the first clause. After having read and comprehended the clause, subjects pressed the response key a second time. This removed the first clause and delivered the target clause. After having read and understood this, subjects again pressed the response key. This removed the target clause and

delivered a question, (answerable using Yes/No keys). Responding to the question removed it and presented the signal, "press space for next trial". The response was recorded. Timing of the target clause started when the clause was presented and ended when subjects pressed the response key.

Subjects repeated the read and respond procedure for each sentence. Every sentence was followed by a question. Subjects were required to complete a short series of practice trials to familiarise themselves with the procedure before starting the experiment. The practice consisted of 12 experimental sentences and 16 filler texts. The reading times for these practice texts were not recorded.

RESULTS

Mean reading times were calculated for each target clause in each condition. Reading times of less than 350 milliseconds were not included in the analysis. There were 5 such reading times which made up 0.4% of the total.

The reading times for clauses referring to first mentioned and second mentioned antecedents were combined to give reading times for singular antecedents. These reading times are displayed in table 5.8 overleaf.

Analyses of variance (treating subjects and sentences as random variables) carried out on the data in table 5.8 revealed a significant interaction between situational structure and antecedent type (F_1= 14.3771, df = 1,35 $P<0.0009$, F_2= 6.0985, df = 1,23 $P<0.03$). Subjects read target clauses containing a plural pronoun faster when the antecedents had been described as being together, than when antecedents were described as being apart. This interaction is depicted in figure 5.3 overleaf 164. No other effects that were significant on both F_1 and F_2 were noted.

Table 5.8: Mean reading times for target clauses by condition
(Singular and plural antecedents)

ANTECEDENT

DESCRIPTION	Singular	Plural	Means
TOGETHER	2025.417	1723.070	1942.410
Conjoined NPs	1974.944	1768.083	1871.514
Subj. - Pred.	2075.889	1678.056	1876.973
APART	1859.531	1859.403	1791.005
Conjoined NPs	1818.069	1799.639	1808.854
Subj. - Pred.	1909.792	1919.167	1914.480
CONJ. NPs	1896.507	1783.861	1840.184
SUBJ. - PRED.	1992.841	1798.612	1895.727

Figure 5.3: Graph showing mean reading times for target clauses containing
singular/plural references by description type
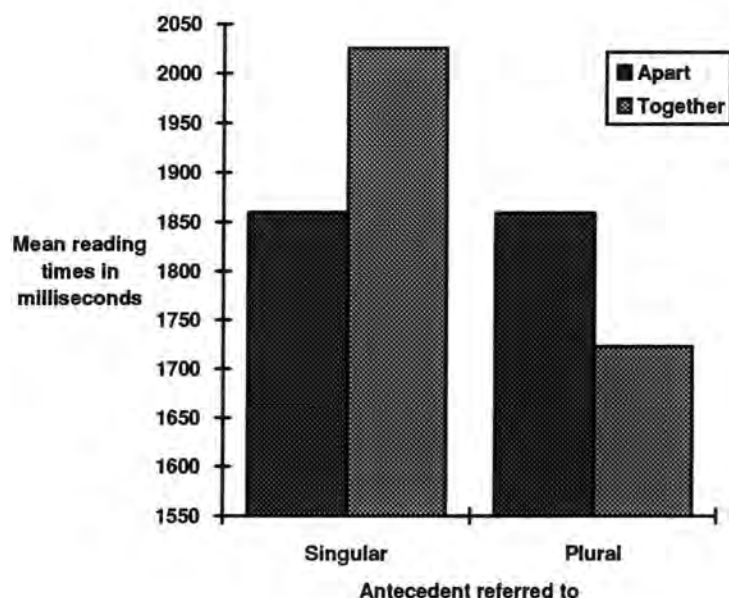
The mean reading times for target clauses in which the antecedent was the first mentioned, second mentioned, or both people are displayed in table 5.9 overleaf.

Analysis of variance carried out on the results in table 5.9 revealed a significant interaction between situational structure and antecedent, although this was only marginal on F1 (F1= 2.0610, df = 2,70 P<0.10, F2= 3.2224, df = 2,46 P<0.05). Subjects were faster at reading plural pronouns when they followed a 'together' description than when they followed an 'apart' description.

Analysis also revealed a significant three way interaction between, linguistic structure, situational structure and antecedent, although this effect was only marginal on F2 (F1= 4.5421, df = 2,70 P<0.02, F2= 3.0764, df = 2,46 P<0.06). Subjects were faster at reading plural pronouns when they followed a together description and a subject-predicate linguistic structure. This interaction is displayed in figure 5.4 overleaf. No other effects were noted that were significant on either F1 or F2.

Table 5.9: Mean target clause reading times by condition

ANTECEDENT

DESCRIPTION	First	Second	Both	Means
TOGETHER	1996.85	2054.13	1723.07	1924.68
Conjoined NPs	2103.06	1847.11	1768.08	1906.08
Subj.-Pred.	1890.64	2261.14	1678.06	1943.28
APART	1842.45	1885.42	1859.41	1862.43
Conjoined NPs	1725.75	1910.39	1799.64	1811.93
Subj.-Pred.	1959.14	1860.44	1919.17	1912.92
CONJ. NPs	1914.41	1878.75	1783.86	1859.01
SUBJ. - PRED.	1924.89	2060.79	1798.62	1928.10

Figure 5.4: Graph showing mean reading times for target clauses by pronoun type (singular/plural) situational structure (together/apart) and linguistic structure (conjoined NPs/Subject-Predicate structure)
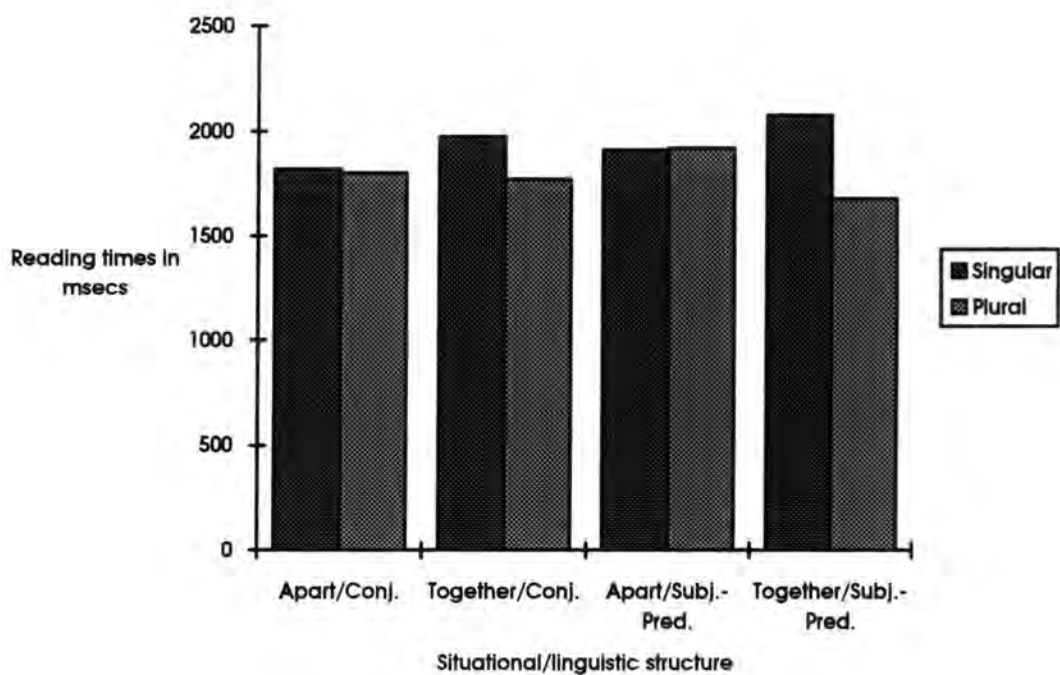
DISCUSSION

These findings conform to those predicted if subjects are constructing mental models to process sentences. The fact that each pronominal reference can be resolved without recourse to non-linguistic information (using gender/number information supplied by the pronoun) suggests that subjects are routinely constructing a mental model during the processing of sentences. If subjects were not using mental models to process sentences, then one would not have expected to find target clauses containing plural pronouns to be read faster following together descriptions. As spatial information appears to be a feature of mental models (Bransford, Barclay and Franks 1972; Glenberg, Meyer and Lindem, 1987; Mani and Johnson-Laird 1982; Morrow, Bower and Greenspan, 1989) the effect of spatial information on reading times of plural pronouns appears to indicate that a mental model is being constructed to handle sentence processing. The fact that these sentences are referentially unambiguous suggests that mental

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models are being routinely constructed when processing language. This finding runs counter to the suggestion of McKoon and Ratcliff (1992) that mental models are constructed only in special circumstances and for the global coherence of texts. This conclusion is suggested because the pronominal references are unambiguous in gender and number. Only two people were mentioned one of each gender. According to McKoon and Ratcliff, this situation does not require the construction of a mental model.

It was found that subjects read plural pronouns significantly faster when they followed a together rather than an apart description. The lack of an effect of NP conjunction in this study is puzzling. One would have expected to have replicated the results of experiment five here, finding that subjects read plural references significantly faster following conjoined NP structured sentences rather than subject predicate structured sentences. Instead no significant interactions were found between linguistic structure and subsequent reading times for pronominal reference. The materials used in this experiment, consisting of information as purely spatial as possible, may have accounted for this finding. It is a possibility that strongly spatial information may serve to "activate" the Spatial Representation System proposed by Bryant (1992). The level of spatial information may have been sufficient in this experiment to have caused the sentences to have been processed using this proposed specialised sub-system. In such a case it is possible that the linguistic cueing information may have been overridden by the spatial information given. The three way interaction (not significant on the F2 analysis of the data) is also puzzling. Subjects read references to both antecedents faster when they were described as together rather than apart. This is in line with predictions and the results of Glenberg, Meyer and Lindem's experiment (1989). However the three way interaction suggested that subjects read plural references faster still when the together description appeared in a subject - predicate structured sentence. The results of Hielscher and Musseler's (1990) and Sanford and Lockhart's (1991) experiments suggested that NP conjunction was a powerful cue to group referent formation. Thus logically a three way interaction would be expected to have been composed of the cueing effects of spatial proximity and NP conjunction. Possibly this may have been due

to the materials used. This may become clearer after the results of experiment twelve have been analysed. As experiment twelve uses the same first clauses as this study, a replication of this finding would suggest that some facet of the materials is causing this anomalous result. It must be stressed that caution needs to be exercised in interpreting the results in this way as different tasks were involved.

These results suggest that spatial information is of greater importance in the association of entities appearing in sentences (and thus the formation of group referents) than linguistic conjunction. The findings of this experiment are compatible with those of Glenberg et al (1987). They found that non-foregrounded objects were more accessible to subjects when they were spatially associated with a foregrounded individual than when they were disassociated. Glenberg and Langston's (in press) proposed "noticing" mechanism would account for Glenberg et al's results and those obtained here. They suggest a spotlight metaphor of attention, and that this spotlight is directed at a particular element when an update of the mental model occurs. They also suggest that other representational elements in the spatial vicinity of the updated element are "noticed", and that the relationship between the updated element and the "noticed" element is also updated.

These results will be discussed in relation to the results of the other experiments carried out in this chapter in the general discussion following experiment twelve.

EXPERIMENT 12

This experiment is a continuation task version of experiment eleven and utilised a modified set of the materials used in that experiment. It was decided to run a continuation version of experiment eleven in order to see if situational information was made use of in an "off-line" task as well as in the reading-time task employed in experiment eleven. The results of experiment eleven suggested that subjects primarily use situational information to cue the formation

of group referents rather than linguistic information. This runs contrary to the findings of Hielscher and Musseler (1990) who found that linguistic conjunction was the main cue to the formation of referentially complex objects. Instead, earlier results suggest that mental models making use of non-linguistic information are used to process even referentially unambiguous sentences.

This continuation task manipulated linguistic structure (conjoined NPs or Subject-Predicate structures) and situational structure (together or apart descriptions).

The predictions were those of the previous eleven experiments: if subjects primarily make use of situational information to cue the formation of group referents then they will produce significantly more continuations containing plural references when the people in the sentence are described as being together rather than apart. If subjects primarily make use of linguistic information as a cue to the formation of group referents,(suggesting the use of a minimalist representation), then the prediction would be that more continuations containing plural references would be made when the people described occur with conjoined NPs, rather than in subject-predicate sentences. An interaction between spatial information and antecedent referred to would suggest that subjects are constructing a mental model of the situation read about. The presence of an interaction between situational information and antecedent referred to would also suggest that a mental model is being used to process pronoun assignment.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects in this experiment. All were students of the University of Durham. Subjects had no initial knowledge of the experimental aims.

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MATERIALS

The materials used in this study consisted of a modified set of the sentences used in experiment eleven. Each of the sentences in experiment eleven consisted of two clauses conjoined by 'and'. The materials used in this experiment were simply the first clause of the ones used in experiment eleven, closed before the 'and' by a full stop.

e.g.   Paul and Fiona are far away from/beside one another and...

became

Paul and Fiona are far away from/beside one another.

See table 5.7 on page 157 for an example of the first clauses occurring in each condition, and appendix 12 for a full list of experimental materials.

Each sentence contained two named people (one male, one female) and was manipulated in terms of linguistic structure (conjoined NPs or subject-predicate) and situational structure (the people were described as being either together or apart). There were thus four sentence conditions: conjoined NPs/together description; conjoined NPs/apart description; subject-predicate/together description; subject-predicate/apart description. There were four lists of twenty-four sentences, with each list containing a different version of each sentence. Each subject received a booklet containing a different list and there were six sentences in each condition in each list.

DESIGN & PROCEDURE

This was a continuation task. Subjects were required to read each sentence and write a short sentence about the situation they had just read. The materials manipulated linguistic structure (conjoined NPs and subject predicate

structures) and situational structure (together and apart descriptions). The various combinations of these four factors yield four different versions of each sentence.

A repeated measures, Latin square design was used. The order of sentences was randomised within each booklet and across subjects. The antecedent referred to in each continuation sentence was recorded.

Subjects were instructed to regard each trial as being entirely separate from the rest, and therefore not to try to continue each sentence in such a way as to link it with the others. Subjects were instructed to finish each trial before moving on to the next. Subjects were allowed to complete the booklet in their own time and were tested as a group. Subjects were not allowed to confer while completing the booklets.

RESULTS

Each booklet was scored by noting who the subjects referred to in their continuations (first mentioned person, second mentioned person or both. References to events or people other than those appearing in the sentence being continued were not included in the analysis. There were 79 such continuations, which made up 9.1% of the total number of trials.

The mean number of continuations referring to first and second mentioned individuals were combined and averaged for each trial to give a mean score for singular and plural antecedents. These scores are given in table 5.10 overleaf.

Table 5.10 Mean number of continuations referring to singular/plural antecedents

	ANTECEDENT		
DESCRIPTION	Singular	Plural	Means
TOGETHER	1.146	3.014	3.042
Conjoined NPs	0.694	3.778	2.236
Subj. - Pred.	1.597	2.250	3.847
APART	1.507	2.584	2.962
Conjoined NPs	1.042	3.472	2.257
Subj.- Pred.	1.972	1.694	3.666 .
CONJ. NPs	0.868	3.625	2.247
SUBJ.- PRED.	1.785	1.972	1.879

Analyses of variance (treating subjects and sentences as random variables) of the scores displayed in table 5.10 revealed a significant main effect of linguistic structure ($F1= 26.651$, $df= 1,35$, $P<0.00007$; $F2= 57.5$, $df= 1,23$, $P<0.00002$). Subjects were significantly more likely to write a continuation referring to the individuals appearing in the first sentence if they had appeared with conjoined NPs than if they had appeared in subject-predicate sentences. Analysis also revealed a significant main effect of antecedent ($F1= 28.917$, $df= 1,35$, $P<0.00005$; $F2= 82.057$, $df= 1,23$, $P<0.00001$). Subjects were significantly more likely to write a continuation referring to both antecedents than to a single antecedent.

Analysis of variance revealed a significant interaction between linguistic structure and antecedent ($F1= 70.526$, $df = 1,35$ $P<0.00001$; $F2= 61.633$, $df = 1,23$ $P<0.00001$). Subjects wrote significantly more continuations containing plural references when the individuals appeared with conjoined NPs structures

than when they appeared in subject-predicate sentences. In addition, significantly more singular references were produced when the individuals appeared in subject-predicate sentences than when they appeared with conjoined NPs (shown in figure 5.5, below).

Figure 5.5: Graph showing interaction between linguistic structure and number of references made
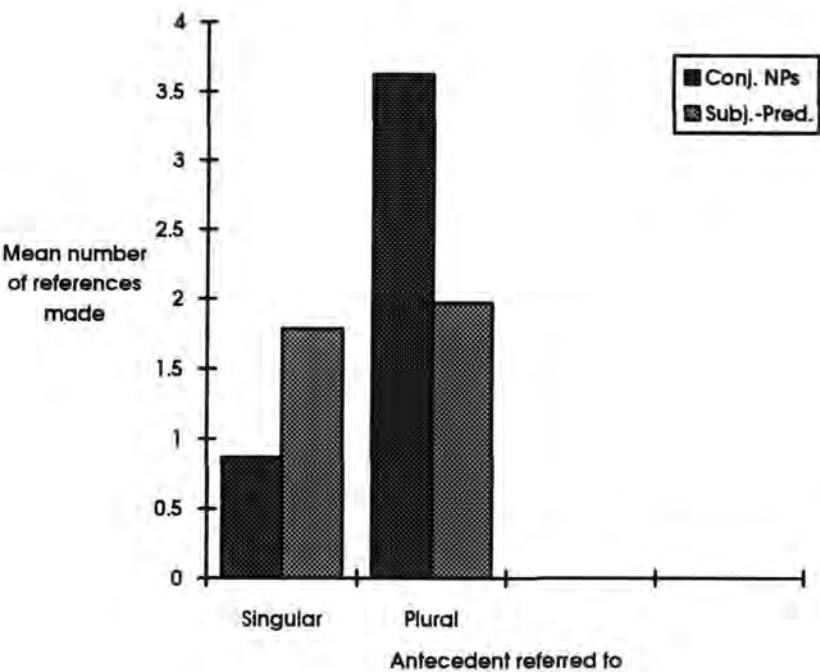
Analysis also revealed a significant interaction between situational structure and antecedent, although this effect was only marginally significant on F2 (F1= 7.534, df = 1,35 P<0.01; F2= 3.767, df = 1,23, P<0.062). Subjects produced significantly more sentences containing plural references when the individuals had been described as being together than when they were described as being apart (as shown in figure 5.6 overleaf).

Figure 5.6: Graph showing interaction between situational structure and number of references made
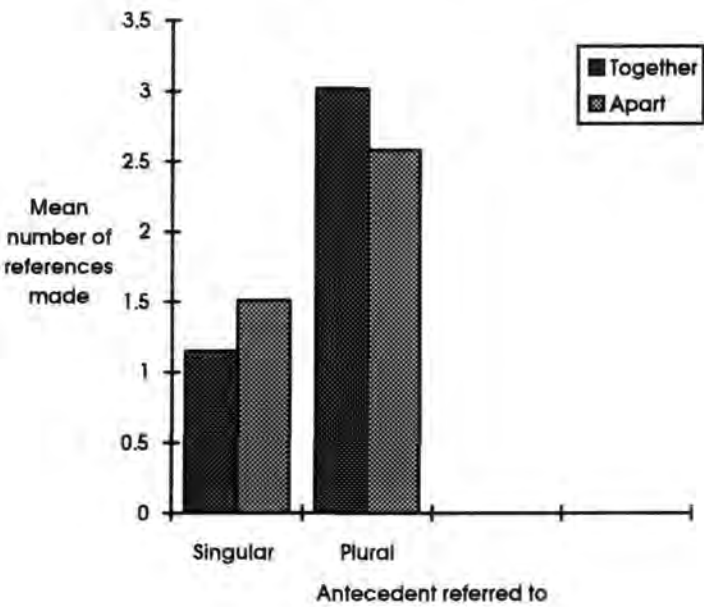
The mean number of continuations containing references to the first and second mentioned antecedents (combined into a singular antecedent score in table 5.10) are displayed in table 5.11 overleaf.

Analysis of variance (treating subjects and sentences as random effects) carried out on the mean scores displayed in table 5.11 revealed a significant main effect of antecedent ($F1= 24.315$, df $= 2,70$ $P<0.00001$; $F2= 44.678$, df $= 2,46$ $P<0.00001$). Subjects wrote significantly more continuations referring to both people than to either the first or second mentioned person. Analysis also revealed a significant interaction between linguistic structure and antecedent ($F1= 37.617$, df $= 2,70$ $P<0.00001$; $F2= 39.0651$, df $= 2,46$ $P<0.00001$). Subjects wrote significantly more continuations containing references to both individuals when they appeared with conjoined NPs than when they appeared in subject-predicate sentences and more singular continuations when the antecedents appeared in subject-predicate sentences than when they appeared with conjoined NPs.(see figure 5.7 overleaf).

Table 5.11: Mean number of references to first mentioned, second mentioned or both antecedents

ANTECEDENT

DESCRIPTION	First	Second	Both	Means
TOGETHER	2.021	1.563	4.521	2.702
Conjoined NPs	1.292	0.750	5.750	2.597
Subj. - Pred.	2.750	2.375	3.292	2.806
APART	2.771	1.604	3.854	2.744
Conjoined NPs	1.792	1.292	5.292	2.792
Subj. - Pred.	3.750	1.917	2.417	2.695
CONJ. NPs	1.542	1.021	5.521	2.695
SUBJ.- PRED.	3.250	2.146	2.855	2.751

Figure 5.7: Graph showing the interaction between linguistic structure and antecedent referred to
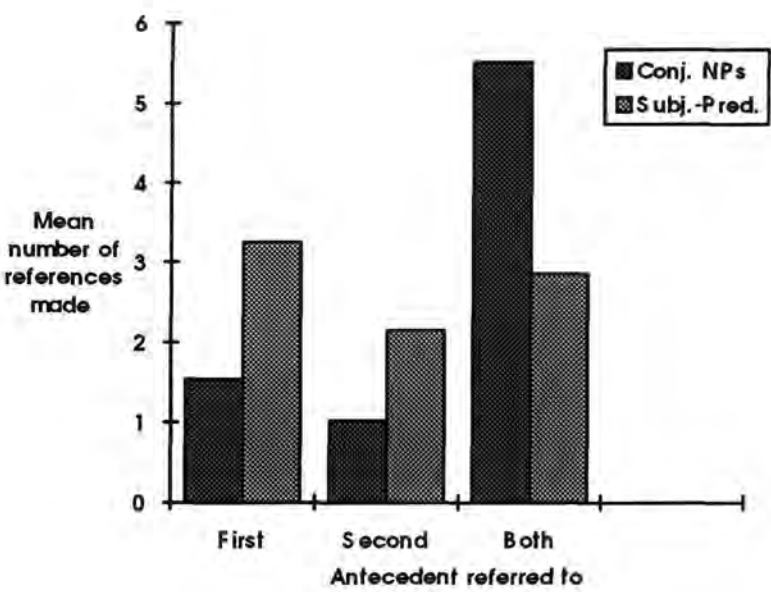
Analysis also revealed a significant interaction between situational structure and antecedent, although this was only marginal on F2 (F1= 5.699, df = 2,70 P<0.006; F2= 3.143, df = 2,46 P<0.052). Subjects wrote more continuations containing plural references when they were described as being together than when they were described as being apart and more singular references when they were described as being apart than when they were described as being together (see figure 5.8, below).

Figure 5.8: Graph showing the interaction between situational structure and antecedent referred to
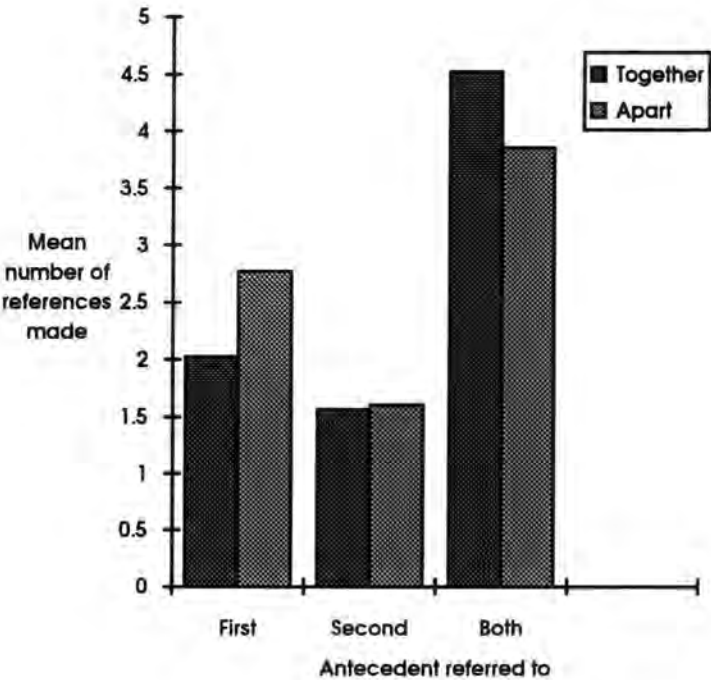
There were no other effects that were significant on both F1 and F2.

DISCUSSION

These findings are in line with the proposals of Johnson-Laird (1983) and van Dijk and Kintsch (1983) concerning the nature of mental model construction. It

was proposed that mental models constructed from information drawn from both linguistic and non-linguistic sources, a proposal in line with the findings obtained in this experiment (albeit the situational effect was only marginally significant on the F2 analysis). Also of interest is the finding of linguistic structure from the analysis of the singular versus plural antecedents (shown clearly in figure 5.5). It can be seen that there appears to be a relationship between NP conjunction and subsequent plural reference, and between subject-predicate sentences and subsequent singular reference. This evidence is compatible with the findings of Hielscher and Musseler (1990), who suggested that linguistic conjunction was of importance as a cue to the formation of group referents: conjoined noun phrases cueing group formation and non-conjoined NPs resulting in the entities being represented as individuals.

These findings are also in line with the proposal of Hielscher and Musseler that complex referential objects are formed BEFORE the pronoun is read. The finding that conjunction leads to a greater incidence of the use of plural pronouns, and that non-conjunction biases readers towards the use of singular pronouns is supportive of their hypothesis. They propose that subjects have already constructed the complex referential object before they write their continuation, hence the increased number of plural references. Likewise the interpretation of the sentence as containing two individuals also appears to occur before the sentence is written, resulting in an increase in the number of singular references. Thus the suggestion is that the formation of a group referent is cued by the sentence structure, before the actual pronoun is encountered. Thus, seeing conjoined noun phrases cues the formation of a group referent while a subject-predicate sentence structure sets the reader up to expect the individuals in the text to remain as individuals. However, it must be noted that the measurements obtained from the tasks used in these experiments are not sensitive enough to confirm or disconfirm this claim.

These findings were not noted in the reading time task used in experiment eleven, as one would expect. However the two task types ARE different, and the reference was within sentences in the case of the reading time task and between

sentences in the continuation task. A reading time task seems intuitively to demand less of the subject than a continuation task. In reading time tasks a subject merely has to comprehend the sentence, while in a continuation task the subject must comprehend the situation AND go on to elaborate on it. Again intuitively one would expect this to make more use of non-linguistic sources of information and thus to require the construction of a mental model type representation. If this is so then the reduced effect of situational information in cueing the construction of a group referent seems puzzling. If one considers that elaborative inferences are characteristic of (constructionist) mental models (at least according to McKoon and Ratcliff, 1992) then these findings in a task that asks subjects to elaborate on the information given, seem doubly curious.

One possible interpretation of the results of experiment eleven and those obtained in this study, may be that the results obtained in experiment eleven were caused by the reference occurring WITHIN the sentence. Here the reference is between sentences. It may be that situational factors play more of a role in the cueing of complex referential objects within sentences than do linguistic factors. This possibility is not contradicted by the results of Hielscher and Musseler's experiments, as they used between sentence materials in their continuation task. Their continuation sentences all began with the pronoun 'sie', which at that point was ambiguous (being either singular feminine or plural). However as there was no spatial manipulation in their study this possibility must remain as speculation. However Stevenson, Crawley and Kleinman, (1994) found a difference in the patterns of pronoun assignment between within-sentence reference and between-sentence references.

The possibility that it is non-linguistic information that primarily cues the formation of group referents in within - sentence references, and linguistic information that primarily cues complex referential object formation between sentences, does run contrary to what one would expect. One would intuitively expect linguistic factors to have a greater cueing effect within sentences, and non-linguistic information (presumably in the form of an ongoing mental model) to be of more use as a cue between sentences. "Real-world" information

intuitively being used in the processing of the larger amounts of information conveyed in texts. One would expect this to occur because of the proposed nature of mental models: they receive input from both linguistic and non-linguistic sources. However, because the linguistic information provides the "baseline information" from which the mental model is elaborated, it may be the case that the importance of linguistic information in mental model construction was misjudged.

It is also possible that the second clause used in experiment eleven (the one containing the pronoun) may have weighted the spatial cueing in some way. Usually this clause related the positions of the two individuals, or the group, to a further inanimate object. Thus this extra spatial information may have oriented the subjects to pay more attention to the spatial aspects of the sentence than they would ordinarily have done. This would be in line with the minimalist hypothesis. McKoon and Ratcliff (1992) suggested that readers are sensitive to the goals of reading. Thus when asked about the spatial locations of the characters in the questions following the target clauses, subjects may have been intentionally representing spatial information in order to answer the expected questions more easily.

GENERAL DISCUSSION

The majority of the results obtained from the experiments comprising this chapter agree with the author's earlier predictions. Readers do appear to be constructing a mental model of the situation described by a text to guide their processing of plural pronouns. Experiment ten replicated the findings of experiment four. This, along with the results obtained from experiments eleven and twelve suggest also that subjects are making use of spatial information as a cue to the formation of group referents. This suggests that readers are routinely constructing a mental model even when pronoun assignment can be unambiguously accomplished as a result of the assignment constraints imposed by the gender/number information carried by the pronoun itself. Thus

the results seem to indicate that mental models are not necessarily only required to handle texts which require the integration of material in order to give a text global coherence (McKoon and Ratcliff, 1992).

The findings of experiment eleven suggested that spatial information was a more effective cue to the formation of group referents than linguistic information. However, this finding was not upheld in experiment twelve. The use of purely spatial materials in this chapter appears to have made little difference to the results obtained. No consistent evidence is found suggesting that a special "Spatial Representation System" is used in processing spatial material (Bryant 1992).

The effect of spatial information as a cue to the formation of group referents appears to be a stronger effect in continuation tasks than in reading time tasks. This suggests a difference in processing strategies used in these two tasks. This suggestion is supported by the experimental work carried out in chapters three and four. In these chapters a difference was noted between the findings of experiments one and two, three and four, and seven and eight. This, along with other factors common to the findings of all three experimental chapters will be discussed in more detail in the final chapter.

CHAPTER 6: THEMATIC ROLE INFORMATION AND PRONOMINAL REFERENCE

INTRODUCTION

On a general level, the experiments in this chapter, (like the experiments carried out in the previous experimental chapters), are designed to explore whether subjects are constructing a representation based on the minimum amount of information to allow pronouns assignment to take place (McKoon and Ratcliff, 1992), or whether a more elaborate representation is being made use of (as suggested by the findings of Gernsbacher, Goldsmith and Robertson, 1992). The experiments also investigate the effects of thematic role on subjects' choice of antecedent. Will subjects prefer to assign pronouns to antecedents according to Nishigauchi's hierarchy of roles? or will the pattern of assignment be best described in terms of some other theory (such as Dowty's 1991 notion of 'proto-roles' or Stevenson et al's 1994 'event hypothesis')?

The two experiments described in this chapter are based on Stevenson et al's (1994) thematic role study. Experiment thirteen uses a clause by clause reading time task, whilst experiment fourteen is a sentence completion task. These two tasks are used to determine whether task type plays a part in subjects' use of thematic role information in their pronoun assignment and to test whether Stevenson et al's results reflect on-line processing. However in order to test the general aims of the thesis, the thematic role information used by Stevenson et al is pitted against introduction type (Anderson, Sanford and Garrod, 1983; Sanford and Lockhart, 1991; Sanford, Moar and Garrod 1988). Thus the experiments test thematic role information (information derived from the relation of the arguments to the verb - classed as minimal information by the author) versus the method of introduction (proper name or 'scenario-role' name: classed as non-minimal information by the author and believed by Sanford and his colleagues to be important in determining how focused the entity is). These two factors (thematic role information versus type of introduction) may be conceptualised as being examples of minimal versus elaborative information (McKoon and Ratcliff 1992).

Verb information (thematic role information) is undoubtedly linguistic information (however thematic roles may fulfil a non-linguistic function as well, as suggested by Jackendoff 1972, 1983 and 1987; Ladusaw & Dowty, 1988; Stevenson et al 1994 and alluded to by Dowty 1991) whilst the type of introduction is primarily of importance in longer texts, and shifts in scenario (although Sanford and Lockhart, 1991, tested and found a significant effect of type of introduction in single sentences) suggesting that its function is one of 'global' importance linked to the establishment and maintenance of a main character (Anderson, Sanford and Garrod 1983). Factors involved in global coherence (such as the functions described by Sanford and his colleagues) are thought by McKoon and Ratcliff (1992) to be less minimal than those factors necessary for local sentence level coherence. They say of 'global inferences' (they classify any non-explicit information as an inference):

"From the minimalist point of view, these inferences should not be automatically constructed during reading. They are usually not required to establish local coherence and they are not usually supported by well-known information." McKoon and Ratcliff, 1992, p. 445

It is clear from this quotation that in McKoon and Ratcliff's terms the use of names or role-names as used by Sanford and his colleagues (Anderson et al, 1983; Sanford and Lockhart, 1991; Sanford et al, 1988) is not a prerequisite for sentence comprehension. In fact, as Sanford et al's studies have necessarily had to counter- balance names and role names, the comprehensibility of their materials is not dependent on the method of introduction of the characters appearing. In such a case it would be fair to conclude that method of introduction is not necessary for local coherence and therefore not minimal information. Although McKoon and Ratcliff concede that there may be situations which require access to 'global factors' in order to achieve 'local' coherence, it is reasonable to assume that if one can understand the sentences used in the following experiments without having to relate them to a particular scenario (i.e. that they are

understandable regardless of whether the NPs are named or role-named) then the name/role-name distinction should be irrelevant (as far as comprehension is concerned) and therefore could be classed as non-minimal information. Thematic role information on the other hand, is vital to sentence comprehension. As thematic roles are concerned with the relationship of arguments to verbs, and this knowledge is necessary to understand what is occurring in a sentence then it seems justifiable to assume that thematic role can be classed as minimal information, (again in terms of McKoon and Ratcliff's 1992 minimalist hypothesis).

Experiments thirteen and fourteen investigate whether the thematic role effects noted by Stevenson et al's (1994) sentence continuation task are made on-line. This is explored by making experiment thirteen a reading time task and experiment fourteen a sentence completion task. Reading time tasks and sentence completion tasks have been used in the work of Sanford and his colleagues and sentence completion/continuation tasks were used by Stevenson et al (1994). By including both tasks, a crude 'on-line' vs. 'off-line' distinction can be made concerning when minimal (thematic role) and non-minimal (method of introduction) sources of information are used.

EXPERIMENT 13

The findings of Stevenson et al (1994) suggest that thematic role information is an important determiner of 'focus' (Sanford and Garrod 1981): i.e. which NP in a sentence is most likely to be the recipient of a pronominal reference. Stevenson et al suggest that thematic roles aid in focusing the reader's attention on a particular NP as a result of their role in language processing. Jackendoff (1972) and Nishigauchi (1984), suggest that thematic roles provide the best explanation of the phenomenon of 'control' in infinitival relatives, purpose clauses and infinitival indirect questions (explained in more detail in the introductory chapter in the section on thematic roles). The process of control is similar in some respects to anaphoric reference in that later information is linked with an entity

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that has been mentioned earlier. Jackendoff and Nishigauchi suggest that there are a small number of thematic roles and that these discrete roles are arranged in a hierarchy. It is this hierarchical arrangement that determines which NP is assigned control: the higher the role on the hierarchy occupied by a particular NP then the more likely it is that the NP will be assigned control. This notion of control was originally based on syntactic grounds. Thematic roles were conceived of primarily in terms of the constraints they placed on syntactic processing (Chomsky 1981). An alternative view is suggested by Jackendoff's later work (1983;1987), and by Dowty's (1989; 1991) work. These two approaches emphasise the more semantic/conceptual nature of thematic roles and suggest that thematic roles may provide a link between syntax, semantics and general knowledge. Dowty (1991) prefers to conceptualise thematic roles as belonging to one of two categories: *proto-agent* and *proto-patient*. These "proto-" roles are simply clusters of the entailments specified by verbs. The argument accumulating the greatest number of *proto-agent* features results in that argument becoming the subject (and assigned the role agent) whilst the argument with the greatest number of *proto-patient* features becomes the object (and is assigned the role patient). In either case, thematic role in this view should be a powerful indicator of the salience of a particular entity (according to the work of Allerton, 1978; Cole et al, 1980; Fletcher, 1984; Halliday, 1970; Hornby, 1972, which investigated the effects of subjecthood on saliency). Stevenson et al tested this in three experiments manipulating the thematic roles of the characters. In sentence completion/continuation tasks featuring pronoun assignment, (via underlining of the referred to antecedent) Stevenson et al found that subjects displayed definite preferences to refer to entities occupying specific thematic role types. However, they explained their findings in terms of subjects interpreting the sentences and thematic roles in terms of the structure of the events depicted by the sentences. Thus thematic role information supplies information necessary for the correct construction of the actions described.

The work of Sanford and his colleagues, (Anderson et al, 1983; Sanford and Garrod, 1981; Sanford and Lockhart, 1991; Sanford et al, 1988) suggests that the method of introduction used is also a potent focusing device. Characters

introduced by a proper name are more likely to have a pronoun assigned to them than characters introduced by their role name. Garrod, Freudenthal and Boyle (1994) and Sanford and Garrod (1981) explain this in terms of the structure of the language processor. Sanford and Garrod (1981) share a similar view of the language processor's structure to that of Johnson-Laird (1983) and Van Dijk and Kintsch (1983). They propose that linguistic information (of whatever sort) interacts with the reader's general knowledge:

> "On the page before the reader is a linguistic object, be it a single sentence or a larger piece of discourse; and in the mind of the reader reside knowledge structures of various kinds. By reading, the words and sentences somehow manipulate these knowledge structures in order to produce a unique configuration, which is the representation of the meaning of the discourse."
> Sanford and Garrod (1981) p.38.

The medium in which this manipulation occurs is a mental model. Sanford and Garrod suggest that the knowledge structures referred to above are organised in the form of large units of information such as *scripts* (Schank and Abelson, 1977) *frames* (Minsky, 1975) or in their own terms *scenarios*, (Sanford and Garrod, 1981). When a role name (such as waiter) is encountered the reader accesses the information associated with a particular scenario and is able to draw inferences/has expectations set up related to the NP's function within that particular situation. For instance in the sentences below, (taken from Sanford and Garrod, 1981, p.54), the NPs in sentence 29b) are referred to using the definite article even though they hadn't been introduced into the text explicitly. In terms of the work of Halliday (1967a & b) and Haviland and Clark (1974) the waiter and the menu are "given" information as opposed to "new" information. This is because intuitively one would expect to find waiters and menus in a restaurant. Thus our representation of restaurants includes stereotypical expectations of waiters and menus. They are in a sense 'implicitly focused' when a restaurant is mentioned (Sanford and Garrod, 1981, p.153).

29a) Feeling hungry, John went into a restaurant.
29b) The waiter brought him the menu.

Anderson et al (1983) and Sanford et al (1988) provide experimental evidence supporting this interpretation. In a continuation experiment Anderson et al found that characters introduced by a proper name were referred to more often in continuations than characters introduced by a role name(e.g. waiter). These results were replicated in a reading time study: pronominal references to 'named' characters were read faster than references to 'role-named' characters. Anderson et al explained these results in terms of the 'topicalising' effects of type of introduction. This was further supported by another finding of their reading time experiment: reading times for references to role-named characters were further increased when the character was referred to after a shift in scene (i.e. in an inappropriate scenario). References to named characters were not adversely affected. Sanford et al (1988) found similar findings in a study incorporating continuation and reading time tasks. Characters introduced by a proper name were referred to significantly more often than role-named characters. This finding was echoed in a reading time task that used pronominal references to refer back to the characters. References to named individuals were read faster than references to individuals introduced by role name.

Stevenson et al's 1994 study suggests that thematic role information is of importance in determining the suitability of a NP as the recipient of a pronominal reference. As thematic roles are thought to be specified by the relationship between arguments and a specific verb then it is possible to conceive of this information as being "minimal" in nature (c.f. McKoon and Ratcliff 1992). The naming effect noted by Sanford and his colleagues may arguably be thought of as being non-minimal in nature. It is related to topicalisation and the access of larger units of information (scenarios). Experiment thirteen therefore investigates not only the relative importance of thematic role and method of introduction as indicating a NP as being the most suitable recipient of a pronominal reference, it also examines the wider processes at work. If minimal information is made use of (in this context thematic role information) rather than non-minimal information (introduction type) then this would lend support for McKoon and Ratcliff's (1992) minimalism hypothesis. If both types of information are used then this

would suggest that more elaborate representations are being made use of during pronoun comprehension.

METHOD

SUBJECTS

36 unpaid volunteers served as subjects. All were students or staff of the University of Durham and naive as to the purpose of the experiment.

MATERIALS

There were 12 lists of experimental materials each of which contained 48 experimental sentences. These sentences consisted of three sub-groups of 16 sentences. These sub-groups varied according to the thematic role relations specified by the verb that was used. Sentences 1-16 contained verbs specifying Goal and Source roles; sentences 17-32 contained Experiencer - Stimulus verbs; sentences 33-48 contained Agent-Patient verbs. The verbs and thematic roles used were chosen according to the criteria laid down in Stevenson et al's 1994 paper (this is reproduced in appendix 13.1). The initial list of sentences were judged in terms of the classifications of roles and plausibility of reference by a group of five postgraduates/staff conducting research in the field of psycholinguistics. Sentences were revised until unanimous agreement was reached. Each sentence consisted of two clauses. Clause one introduced two people. These people were of the same gender and were introduced either by a gender specific proper name or by a gender implicit/explicit role-name. The second clause referred back to either the first or the second mentioned individual using a singular pronoun. The information contained in the second clause was sufficient (confirmed by five independent judges) to specify one individual as being the intended antecedent of the pronoun. The second clause was always six words in length. In order to avoid the widely documented "first mention effect" (Gernsbacher et al 1989) sentences were counterbalanced in terms of the order in which each thematic role appeared.

This ensured that any effects noted were the results of thematic role preferences rather than order effects. An example of a sentence used in each condition is shown in table 6.1 below and overleaf.

Table 6.1: Example of sentences used in each condition

GOAL-SOURCE THEMATIC ROLES

Colin/The fullback caught the ball from Gary/the forward and
    GOAL   SOURCE
he kicked it over the line.

Colin/The fullback caught the ball from Gary/the forward and
    GOAL   SOURCE
he was jealous of the catch.

Colin/The fullback threw the ball to Gary/the forward and
    SOURCE   GOAL
he picked up another practice ball.

Colin/The fullback threw the ball to Gary/the forward and
    SOURCE   GOAL
he caught it with one hand.

EXPERIENCER-STIMULUS THEMATIC ROLES

Darren /The foreman disliked Martin/the welder and
   EXPERIENCER   STIMULUS
he made it clear to everyone.

Darren /The foreman disliked Martin/the welder and
   EXPERIENCER   STIMULUS
he reciprocated the ill will entirely.

Darren/The foreman annoyed Martin/the welder and
   STIMULUS   EXPERIENCER
he regretted it later that evening.

Darren/The foreman annoyed Martin/the welder and
   STIMULUS   EXPERIENCER
he stormed out of the room.

AGENT-PATIENT THEMATIC ROLES

Joseph/The teacher hit Patrick/the pupil and
    AGENT   PATIENT
he made sure that it hurt.

Joseph/The teacher hit Patrick/the pupil and
    AGENT   PATIENT
he began to cry very loudly.

Patrick/The pupil was hit by Joseph/the teacher and
   PATIENT   AGENT
he began to cry very loudly.

Patrick/The pupil was hit by Joseph/the teacher and
   PATIENT   AGENT
he made sure that it hurt.

(See Appendix 13 for a full list of experimental materials).

The combination of thematic role pairs used (Goal-Source, Experiencer-Stimulus and Agent-Patient), type of introduction used in each sentence (name/name, role-name/role-name, name/role-name and role-name/name) and the antecedent's position in the sentence (first or second mentioned individual) resulted in 48 different sentence versions (sixteen versions of each sentence for each type of thematic role pair). In addition to the forty eight experimental sentences subjects also saw 48 filler sentences. These sentences featured two individuals in a variety of sentence structures and with varying word lengths. The second clause of each sentence was joined to the first by the use of 'and'.

> e.g.   Burglary had upset the lives of Anthony and Hamish and
>   the police said there was little they could do.

DESIGN & PROCEDURE

Each subjects was tested individually in this self-paced reading time task. Subjects were required to read sentences presented to them on the VDU of a BBC model B microcomputer. The materials featured sentences containing two individuals of the same gender and manipulated the thematic role they occupied (goal-source, experiencer-stimulus or agent-patient), the method of introduction used for the individuals (name/name, role-name/role-name, name/role-name or role-name/name) and their position in the sentence (first or second mentioned). The various combinations of these factors yield forty-eight sentence conditions, sixteen occurring within each thematic role pair.

A repeated measures, Latin square design was used, with every subject seeing two sentences in each condition. The presentation order of the sentences was randomised within each stimulus list and across subjects. The time taken for subjects to read the target clause (clause two) was recorded in each case.

Subjects were required to press the space bar to begin each trial (prompted by the computer). This delivered the first clause. After having read and understood the first clause, subjects pressed the space bar again. This removed the first clause from the screen and displayed the target clause. Subjects again read the clause and when they had comprehended it, pressed the space bar. Timing started when the target clause appeared on the screen and ended when the subject pressed the space bar. Subjects repeated the read and respond procedure for each sentence. One in four trials was followed by a yes/no question to encourage comprehension. Subjects also saw 8 practice experimental and 8 practice filler sentences before the main experimental block began. The format of these practice materials was exactly the same as the sentences described above. The results of these practice trials were not recorded.

Halfway through the main experimental block there was a one minute rest period.

RESULTS

Reading times were calculated for the target clause in each sentence. The means of these reading times are displayed for each thematic role pairing in the following pages. Analysis of variance (treating subjects and sentences as random variables) carried out on the reading times for the target clauses revealed a significant main effect of thematic role (F1= 6.75, df=5, 55, P<0.0001, F2= 6.55, df=5, 75, P<0.0001) as displayed overleaf in figure 6.1. Subjects' reading times varied according to the thematic role of the antecedent.

Figure 6.1: Graph showing the mean target clause reading times by thematic role of antecedent
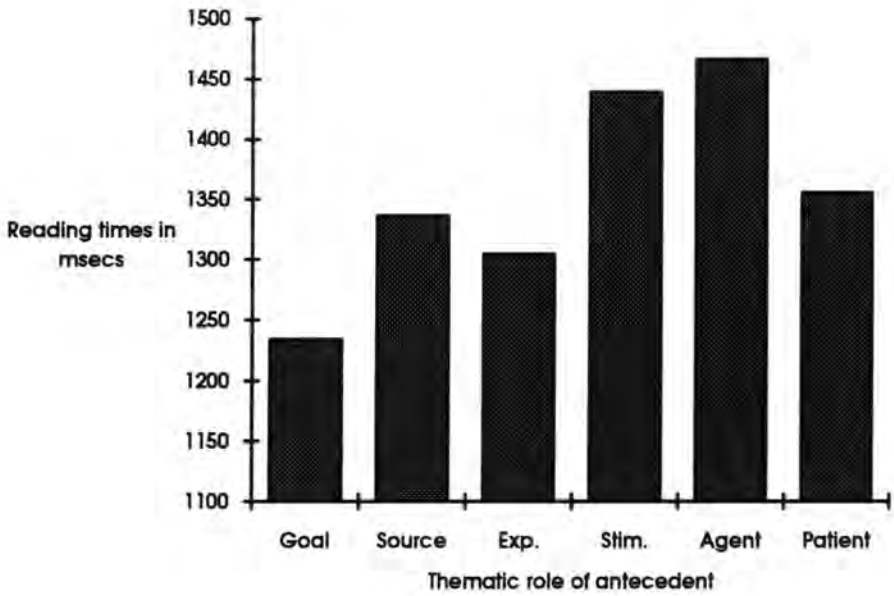
Further analysis was carried out on each set of thematic role pairs in order to determine which thematic roles were the preferred antecedents in terms of reading times.

Goal-Source Sentences

Subjects saw sixteen sentences featuring goal and source thematic roles. The mean reading times for these sentences are displayed in table 6.2 (overleaf).

Analysis of variance carried out on these reading times revealed a main effect significant on the F1 analysis only (F1= 5.62, df= 1,31, P<0.03, F2= 3.55, df= 1,15, P<0.08) although the F2 value was approaching significance. Subjects read clauses referring to the NP occupying the GOAL thematic role faster than clauses referring to the source. No other effects were noted that were significant on both F1 and F2. This main effect is displayed in figure 6.2, overleaf.

Table 6.2: Mean Reading Times For Target Clauses By Condition

| | GOAL | | SOURCE | | |
	1st Mention	2nd Mention	1st Mention	2nd Mention	Mean
Name-Name	1244.78	1120.69	1543.22	1452.19	1340.22
Role-Role	1222.91	1215.69	1344.31	1294.41	1269.38
Name-Role	1277.66	1331.16	1354.59	1268.06	1307.87
Role-Name	1245.38	1216.22	1167.03	1266.34	1223.74
Means	1247.68	1220.99	1352.29	1320.25	
		1234.34		1336.27	

Figure 6.2: Graph showing mean reading times of target clauses by thematic role

of antecedent
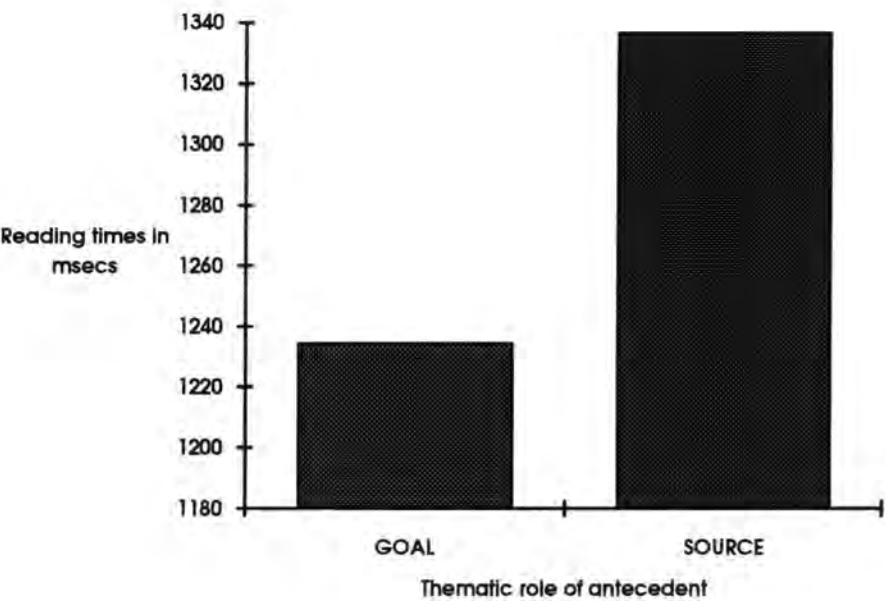
Experiencer-Stimulus Sentences

Subjects saw sixteen sentences featuring experiencer and stimulus thematic roles.
Mean reading times for the target clauses of these sentences are displayed in table
6.3 (overleaf).

Table 6.3: Mean Reading Times For Target Clauses By Condition

| | EXPERIENCER | | STIMULUS | | |
	1st Mention	2nd Mention	1st Mention	2nd Mention	Mean
Name-Name	1258.38	1299.91	1565.13	1428.16	1387.90
Role-Role	1233.25	1306.66	1433.34	1400.03	1343.32
Name-Role	1323.66	1491.38	1407.41	1248.94	1367.85
Role-Name	1286.09	1237.88	1725.00	1305.94	1388.73
Mean	1275.35	1333.96	1532.72	1345.74	
		1304.65		1439.24	

Analyses of variance (treating subjects and sentences as random variables) carried out on these reading times revealed a main effect of thematic role ($F_1 = 4.55$, df=1,31, $P < 0.042$, $F_2 = 6.97$, df=1,15, $P < 0.02$) as shown in figure 6.3, overleaf. Subjects read clauses referring to antecedents occupying the experiencer role significantly faster than references to stimulus antecedents. No other effects were noted that were significant on both F_1 and F_2.

Figure 6.3: Graph showing mean reading time of target clauses by thematic role of antecedent
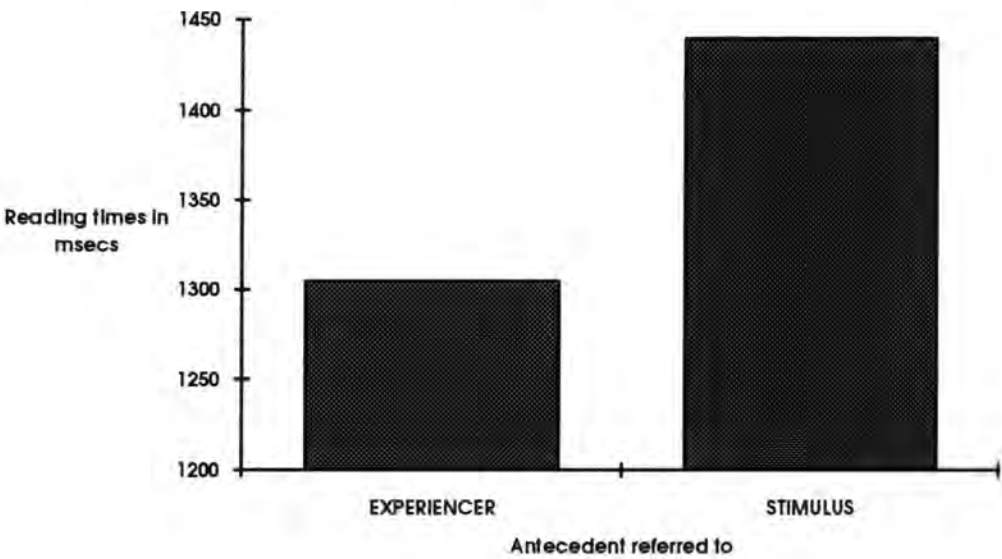
<u>Agent-Patient sentences</u>

Subjects saw sixteen sentences featuring agent and patient thematic roles. Mean reading times for the second clause of these sentences are displayed below in table 6.4.

<u>Table 6.4: Mean Reading Times For Target Clauses By Condition</u>

	AGENT		PATIENT		
	1st Mention	2nd Mention	1st Mention	2nd Mention	Mean
Name-Name	1543.47	1476.94	1339.56	1355.27	1428.81
Role-Role	1527.00	1414.19	1323.56	1396.91	1415.42
Name-Role	1399.19	1426.66	1372.66	1337.53	1384.01
Role-Name	1478.87	1464.97	1393.63	1324.78	1415.56
Mean	1487.13	1445.69	1357.35	1353.62	
	1466.41		1355.49		

Analyses of variance (treating subjects and sentences as random variables) carried out on these reading times revealed a main effect of thematic role ($F1= 6.85$, $df=1,31$, $P<0.015$, $F2= 4.98$, $df=1,15$, $P<0.042$) as shown in figure 6.4 (below). Subjects read target clauses referring to antecedents occupying the patient role significantly faster than target clauses referring to agent antecedents. No other effects were noted that were significant on both F1 and F2.

Figure 6.4: Graph showing mean reading times for target clauses by thematic role of antecedent
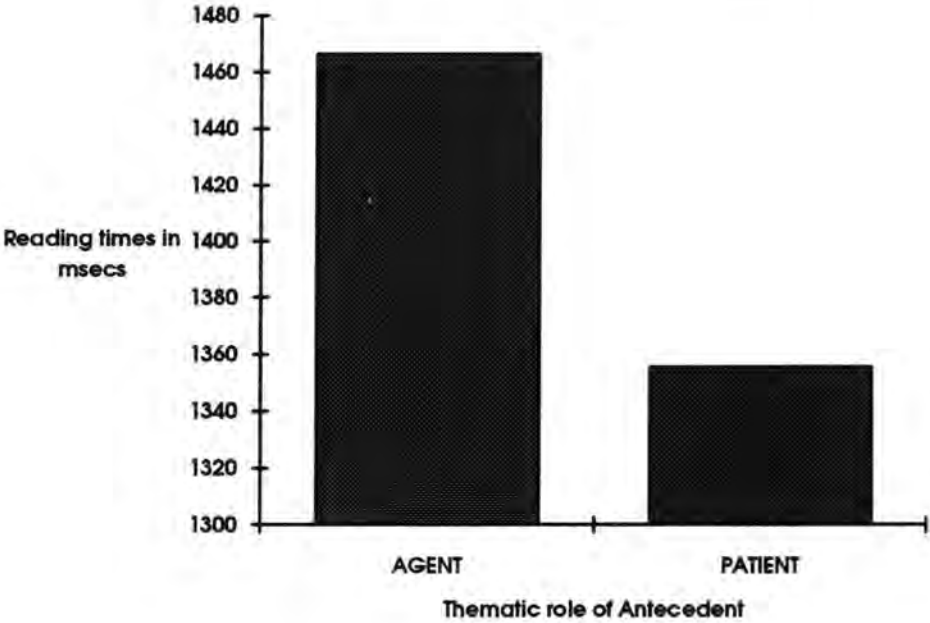
DISCUSSION

The results obtained are those predicted if subjects are resolving pronoun assignment on the basis of minimal information, as suggested by McKoon and Ratcliff's (1992) study. There are no significant effects of introduction type on the reading times for target clauses. The results obtained replicate the pattern of preferences (for GOAL rather than SOURCE, EXPERIENCER rather than STIMULUS and PATIENT rather than AGENT) found by Stevenson et al (1994). However, in this experiment the reading times for clauses referring to the GOAL were only marginally significant. It appears that the preference for referring to antecedents occupying certain roles is not limited to just sentence completion/continuation tasks as the results of this experiment suggest. Subjects read references to NPs occupying the GOAL, EXPERIENCER and PATIENT roles faster than references to SOURCE, STIMULUS and AGENT roles. The results of this experiment suggest (like Stevenson et al's findings) that subjects do not appear to prefer antecedents occupying the hierarchy of roles proposed by

Nishigauchi (1984). However this experiment utilised a reading time task rather than a sentence completion/continuation task. It may be that the results would have been different if the same task had been used.

This possibility is explored in experiment fourteen, a sentence completion task version of this experiment.

EXPERIMENT 14

The predicted results are similar to those expected in experiment thirteen: according to the minimalist hypothesis, subjects will make use of the minimal amount of information in order to assign pronouns to their antecedents. Therefore the minimalist hypothesis will be supported if subjects make use of thematic role information rather than the type of introduction (name or role name: Anderson et al 1983; Sanford et al 1988) as the basis of their pronoun assignment in this sentence completion task version of experiment thirteen.

METHOD

SUBJECTS

32 unpaid volunteers served as subjects. All were students or staff of the University of Durham. Subjects were naive as to the hypotheses being tested.

MATERIALS

The materials used in this experiment were modified versions of the ones used in experiment thirteen. Each trial consisted of an incomplete sentence (the first clause of the materials used in experiment thirteen, plus a singular pronoun). Each sentence fragment introduced two people (using either a name or a role-name; sentences thus varied according to whether they contained name/name, role-

name/role-name, name/role-name or role-name/name introduction types) and varied the thematic role that each occupied (one of the roles from the following pairs; goal-source, experiencer-stimulus, or agent-patient) and the position that the individuals appeared in the sentence (either first or second mentioned) as shown in table 6.5, below and overleaf.

Table 6.5: Example of sentence fragments used in each condition

GOAL-SOURCE THEMATIC ROLES

Colin/The fullback caught the ball from Gary/the forward and he
      GOAL   SOURCE

Colin/The fullback threw the ball to Gary/the forward and he
    SOURCE   GOAL

EXPERIENCER-STIMULUS THEMATIC ROLES

Darren /The foreman disliked Martin/the welder and he
  EXPERIENCER   STIMULUS

Darren/The foreman annoyed Martin/the welder and he
  STIMULUS   EXPERIENCER

AGENT-PATIENT THEMATIC ROLES

Joseph/The teacher hit Patrick/the pupil and he
    AGENT   PATIENT

Patrick/The pupil was hit by Joseph/the teacher and he
  PATIENT   AGENT

(See Appendix 14 for a full list of materials).

This resulted in twenty four possible conditions for each sentence: Sentences differed in the thematic role pairs they featured (goal-source, experiencer-stimulus or agent-patient), the method used to introduce the characters featured in each sentence, (name/name, role-name/role-name, name/role-name or role-name/name), and the order the individuals appeared in the sentences (first or second mentioned position). There were twenty four lists of 48 sentences. Each list containing two sentences in each condition.

DESIGN & PROCEDURE

Subjects were required to read each sentence fragment and complete it. The materials manipulated the thematic role occupied by the characters in the sentence (goal-source, experiencer-stimulus or agent-patient), the method used to introduce each character, (name/name, role-name/role-name, name/role-name or role-name/name), and their sentence position (first or second mentioned). A repeated measures, Latin square design was used. The order of sentence fragments was randomised within each booklet and across subjects. The antecedent referred to in each completion was recorded.

Subjects were instructed to regard each trial as being entirely separate from the rest and therefore not to try and complete each sentence fragment in such a way as to link it with the others. Subjects were also instructed to finish each trial before moving on to the next. Subjects were allowed to complete the booklet in their own time and were tested individually. After finishing the entire booklet subjects were instructed to underline the antecedent they had referred to in each completion.

RESULTS

Booklets were scored by noting the antecedent referred (the person who was underlined) in each sentence completion. Analyses of variance (treating subjects

and sentences as random variables) carried out on the number of references made to each antecedent revealed a significant main effect of thematic role (F_1= 77.72, df= 5,155, P<0.001, F_2= 88.55, df= 5,75, P<0.001), as displayed in figure 6.5 below. Analysis also revealed an effect of sentence position that was only marginally significant on the F_1 analysis (F_1= 3.34, df= 1,31, P<0.078, F_2= 10.79, df= 1,15, P<0.006) as shown in figure 6.6 overleaf.

Figure 6.5: Graph showing mean number of continuations by antecedents' thematic role
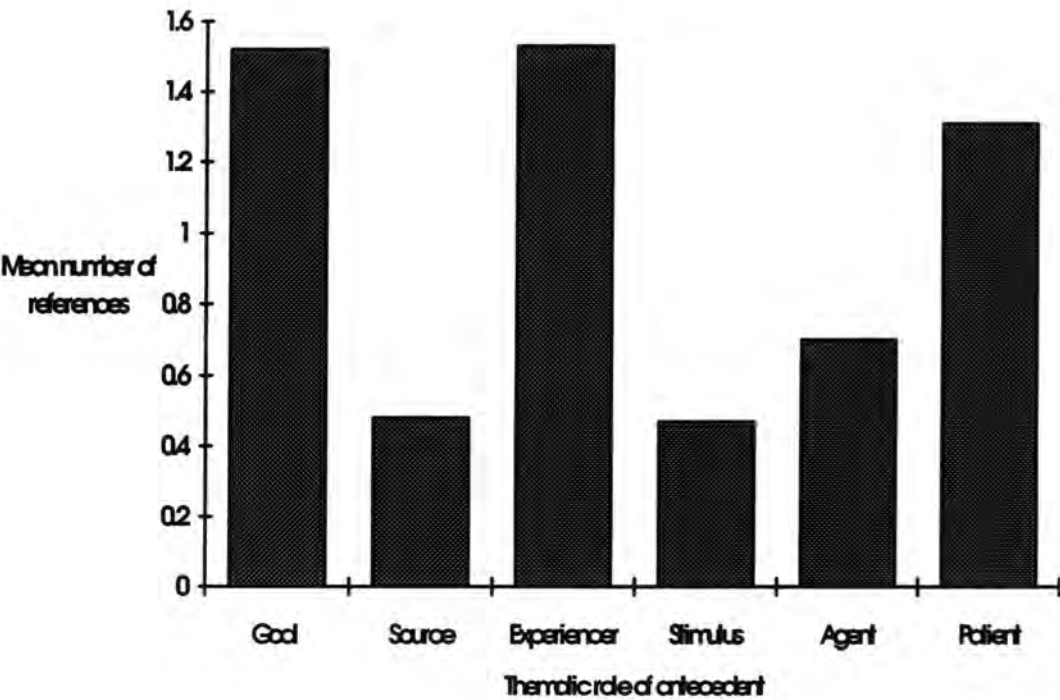
Figure 6.6: Graph showing mean number of references by sentence position of antecedents
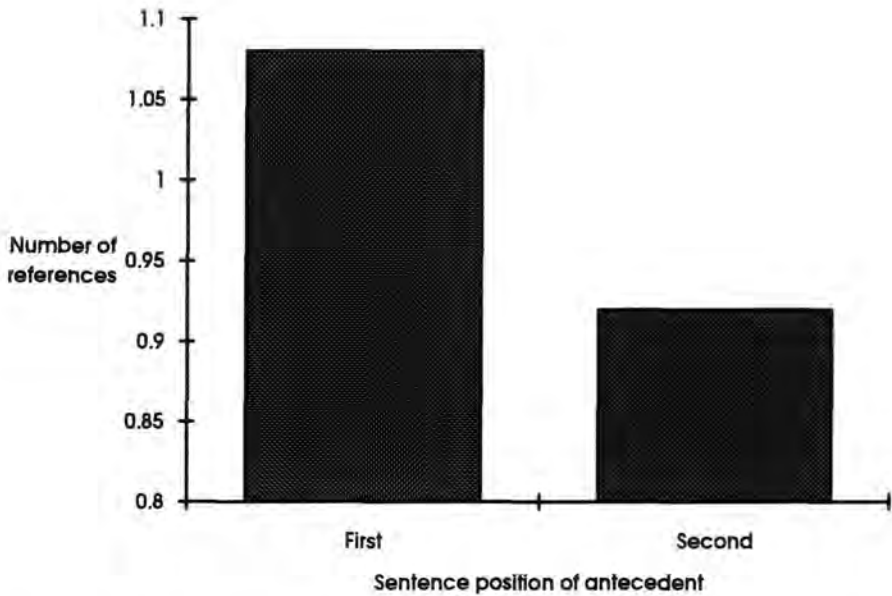
Subjects made more references to the first mentioned NP than to the second mentioned.

In addition to the main effects noted above, analysis also revealed significant interactions between thematic role and sentence position (F_1= 4.79, df=5,155, P<0.001, F_2= 2.82, df=5,75, P<0.023: see figure 6.7 overleaf). Subjects made more references to the first mentioned entity than the second mentioned entity in sentences containing AGENT-PATIENT role pairings. Analysis of variance also revealed an interaction between sentence position and description type (F_1= 11.48, df=3,93 P<0.001, F_2= 6.78 df=3,45, P<0.001: See figure 6.8 overleaf). Subjects made significantly more references to the first mentioned entity when it was introduced with a proper name rather than a role name.

Figure 6.7: Graph showing mean number of references by thematic role and sentence position of antecedent
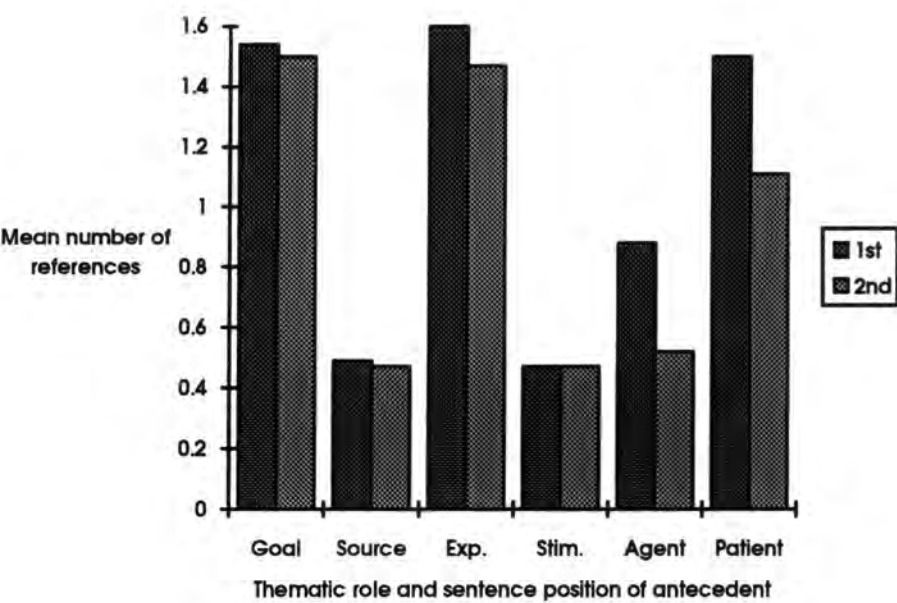
Figure 6.8: Graph showing mean number of references by antecedents' sentence position and description type
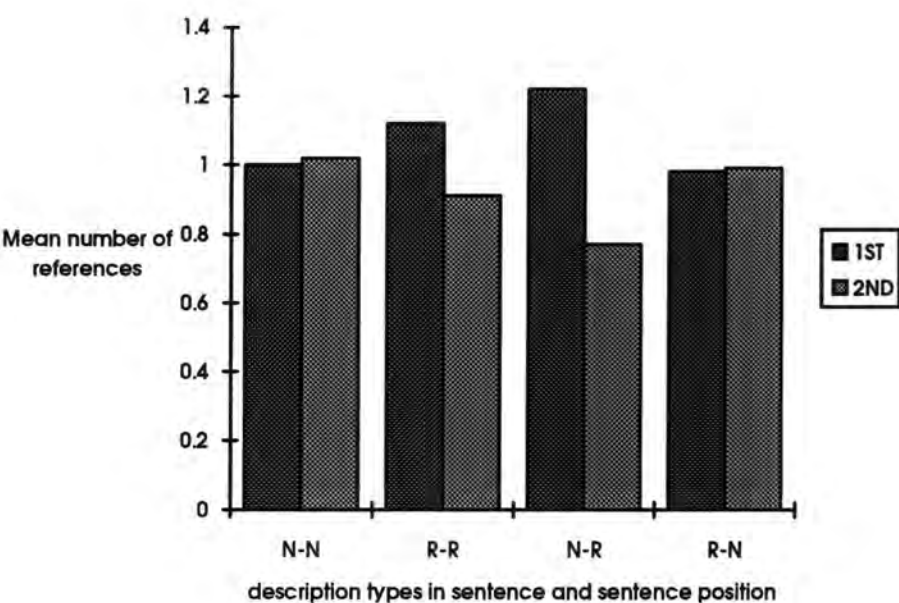
In order to see preferences for individual thematic roles, the sentences containing each thematic role pair had analyses of variance carried out on them separately.

Goal-Source Sentences

The mean number of references made in GOAL - SOURCE thematic role pair sentences are displayed in table 6.6 below.

Table 6.6: Mean number of continuations made to each antecedent by thematic role

| | GOAL | | SOURCE | | |
	1st Mention	2nd Mention	1st Mention	2nd Mention	Mean
Name-Name	1.58	1.64	0.39	0.48	1.02
Role-Role	1.64	1.42	0.55	0.33	0.99
Name-Role	1.67	1.42	0.55	0.39	1.02
Role-Name	1.27	1.48	0.48	0.67	0.98
Mean	1.54	1.50	0.49	0.47	
	1.52		0.48		

Analysis of variance of the sixteen sentences containing goal and source thematic roles revealed a significant main effect of thematic role (F1= 143.2, df=1,31, P<0.001, F2= 79.67, df=1,15, P<0.001). Subjects made more references to the antecedent occupying the goal rather than the source thematic role. This effect is displayed in figure 6.9, overleaf.

Figure 6.9: Graph showing mean number of references made by antecedent's thematic role
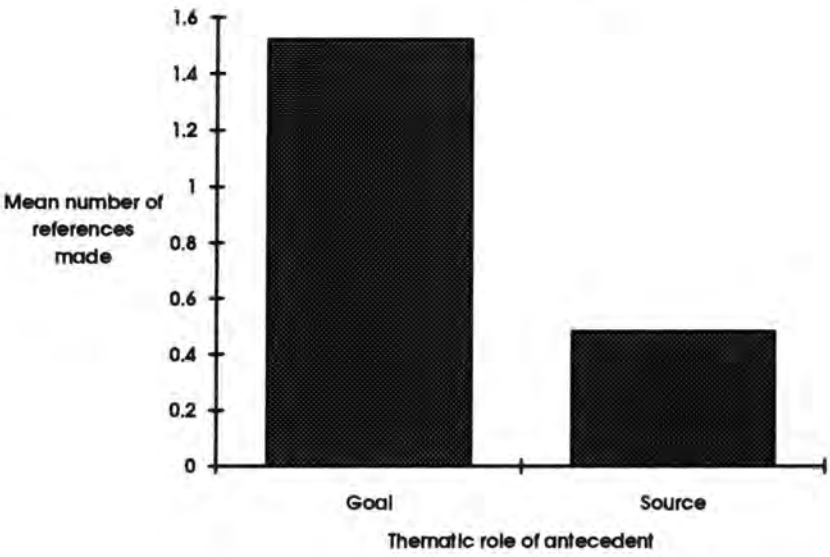
Analysis also revealed an interaction between sentence position and description type that was significant on F1 only (F1= 3.32, df=3,93, P<0.024, F2=2.42, df=3,45, P<0.079). This interaction is shown in figure 6.10.

Figure 6.10: Graph showing the mean number of references made by antecedent's sentence position and description type
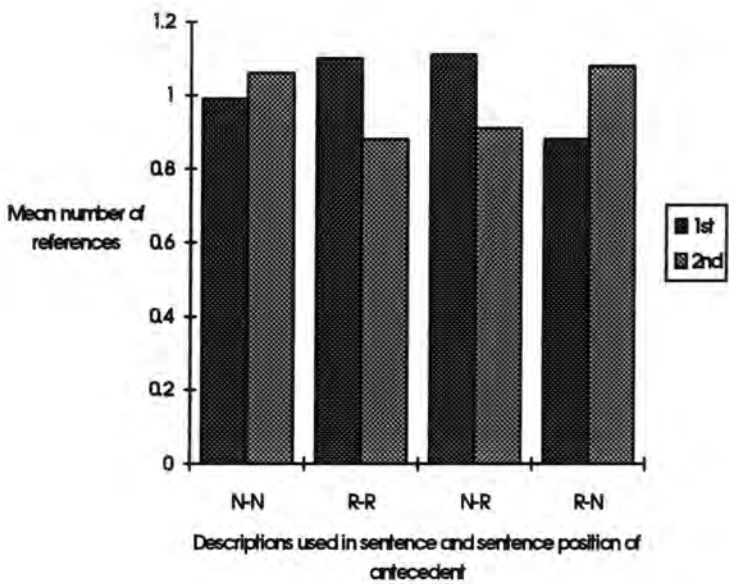
<u>Experiencer-Stimulus Sentences</u>

Analysis of variance was carried out on the sixteen sentences that contained experiencer-stimulus thematic role pairs. The mean number of references made in each condition is shown in table 6.11 below.

Analysis of variance of the means in table 6.11 revealed a significant main effect of thematic role (F1= 173.66, df=1,31, P<0.001, F2= 300.96, df=1,15, P<0.001). Subjects made significantly more references to antecedents occupying experiencer rather than stimulus roles as shown in figure 6.12 overleaf. No other main effects or interactions were noted that were significant on both F1 and F2 analyses.

<u>Table 6.11: Mean number of continuations made to each antecedent by thematic role, sentence position and descriptions used in each sentence</u>

| | EXPERIENCER | | STIMULUS | | |
	1st Mention	2nd Mention	1st Mention	2nd Mention	Mean
Name-Name	1.45	1.58	0.42	0.58	1.01
Role-Role	1.64	1.42	0.45	0.67	1.05
Name-Role	1.82	1.18	0.79	0.18	0.99
Role-Name	1.48	1.70	0.21	0.45	0.96
Mean	1.60	1.47	0.47	0.47	
		1.53		0.47	
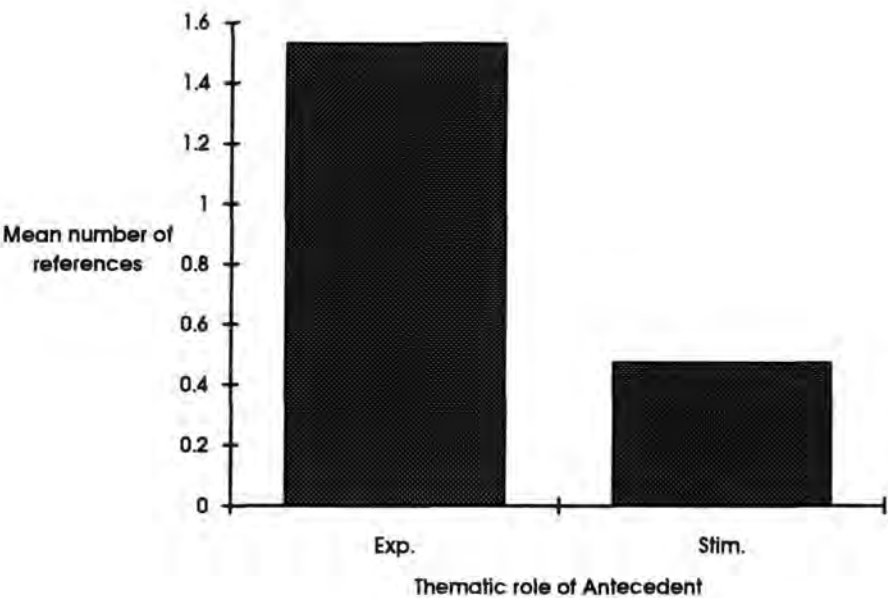
Agent-Patient Sentences

Table 6.12: Mean number of continuations made to each antecedent by thematic role, sentence position and descriptions used in each sentence

	AGENT		PATIENT		
	1st Mention	2nd Mention	1st Mention	2nd Mention	Mean
Name-Name	0.79	0.67	1.36	1.15	0.99
Role-Role	0.94	0.55	1.52	1.09	1.03
Name-Role	0.94	0.39	1.55	1.03	0.98
Role-Name	0.85	0.45	1.58	1.18	1.02
Mean	0.88	0.52	1.50	1.11	
		0.70		1.31	

Analysis of variance of the mean scores displayed in table 6.12 (above) revealed significant main effects of thematic role (F1= 18.73, df=1,31, P<0.001, F2= 41.08, df=1,15, P<0.001) and sentence position, (F1= 10.40, df= 1,31, P<0.004,

F2= 15.43, df=1,15, P<0.001). Subjects made significantly more references to antecedents occupying the patient rather than the agent role. This effect is displayed in figure 6.13 below.

Figure 6.13: Graph showing the mean number of references made by antecedents' thematic role
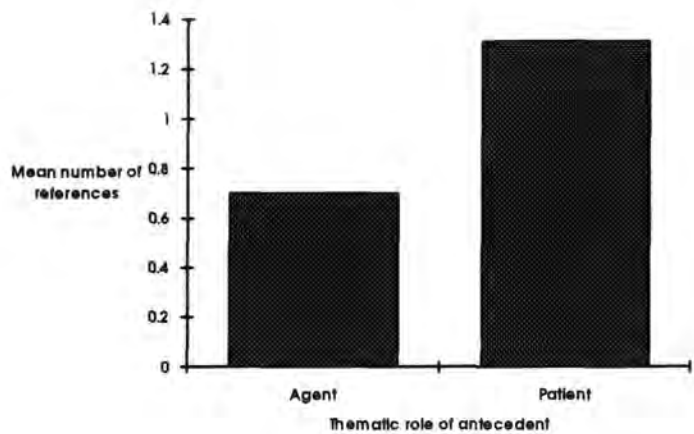
In addition to the effect of thematic role, subjects also made significantly more references to antecedents in the first mentioned sentence position rather than the second mentioned sentence position. This effect is displayed in Figure 6.14, below.

Figure 6.14: Graph showing the mean number of references made by antecedents' sentence position
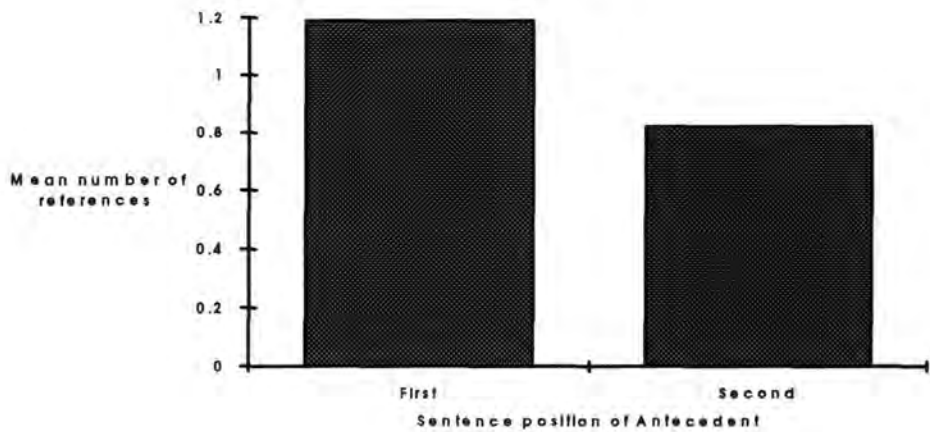
No other effects or interactions were noted that were significant on both F1 and F2 analyses.

DISCUSSION

These results are generally those predicted to occur if subjects were making use of minimal amounts of information to guide their pronoun assignment. The pattern of thematic role preferences obtained is similar to those obtained by Stevenson et al (1994). They too found a preference for subjects to refer to NPs occupying GOAL rather than SOURCE, EXPERIENCER rather than STIMULUS, and PATIENT rather than AGENT roles. In addition to the main effect(s) of thematic role there was an effect of order of mention. Although only marginally significant on the F1 analysis of the overall results, this finding was significant on both Fs in the separate analysis of the Agent-Patient sentences. Subjects preferred to refer to the first mentioned rather than the second mentioned NP. The first mention effect is well documented (Allerton, 1978; Cole et al, 1980; Fletcher, 1984; Gernsbacher, 1989; Gernsbacher and Hargreaves, 1988; Gernsbacher, Hargreaves and Beeman 1989; Halliday, 1970; Hornby, 1972) and the materials in this experiment were counter-balanced to take this factor into consideration. The reasoning behind the occurrence of this effect has been proposed to be the result of the operation of a number of different strategies, both those that may be termed minimal (Hobbs, 1976) and those that suggest the effect occurs as a the result of a the building of a detailed mental model of a text (Gernsbacher, 1989). Because of the conflicting interpretations of the first mention effect and the fact that it was not a factor being specifically manipulated, first mention will not be discussed any further as a main effect at this point. As well as effects of thematic role and order effects, a number of significant interactions were found. Subjects produced more references to the first mentioned entity when in sentences featuring AGENT-PATIENT thematic role pairs than in sentences featuring either GOAL-SOURCE or EXPERIENCER-STIMULUS role pairings. It is unclear why this should have occurred. The work on order effects

(specifically first mention effects) was linked to subjecthood, (Fletcher, 1984; Kieras, 1979; Perfetti and Goldman, 1975), agency, and animacy (Clark and Begun, 1971; Fillmore 1977; Keenan, 1976 and Perfetti, 1973) amongst others. However the first mention effect was noted regardless of whether the antecedent occupied the AGENT or the PATIENT role. This would effectively rule out the "agentive" qualities of the first mention effect as agency was one of the factors being manipulated. Animacy can also be ruled out because all of the characters that appeared in the sentences (regardless of the thematic roles they played) were human and the interaction wasn't noted for sentences other than those containing AGENT-PATIENT role pairs. The interaction suggests that some factor of the agent-patient sentences was linking with the first mention effect. The only way that these sentences differed from the Goal-Source and Experiencer stimulus sentences was in the verbs used to form the agent patient roles and the actual structure of the sentences. Counterbalancing for order effects was carried out by passivising the sentences. This didn't occur in the goal source sentences or the experiencer stimulus sentences. Counter balancing in these sentences was carried out by varying the verbs. It may be that the structural differences between goal-source, experiencer-stimulus and agent-patient sentences caused the effect (i.e. the marked passive construction). However it is again unclear why this might occur. Johnson Laird (1968a & b) noted that passivisation has the effect of "highlighting" the subject (the second mentioned individual). Therefore "saliency" is increased for the second mentioned individual. However, how would this explain the interaction between agent-patient sentences and first mention? Surely Johnson-Laird's findings would suggest a second mention rather than a first mention effect.

Another interaction that was noted in the overall analysis was that of order of mention and the description of the entity (proper name or role name). The interaction was noted for those sentences containing a proper-named entity in the first mention position and a role named entity in the second mentioned position. This effectively links the work of Sanford and his colleagues (Anderson et al, 1983; Sanford and Garrod, 1981; Sanford et al, 1988), with the work of those proposing that first mention is an indicator of topicalisation (in one of its many

forms e.g. Gernsbacher, 1989; Kieras, 1980; 1981b). This work states that first mention is important in signalling what a discourse is about. This is very close to the view held by Sanford and his colleagues concerning the role of naming in discourse comprehension. One would expect an interaction between two types of information that essentially perform the same function: in this case signalling who/what a discourse is about. However this finding conflicts with McKoon and Ratcliff's (1992) minimalist hypothesis, as far as the predictions of this experiment are concerned. mentioned in the introduction.

It is unusual that the first mention effect was noted as occurring in interactions with both 'minimal' (thematic role) and 'non-minimal' (method of introduction) information. Essentially this suggests that the first mention effect operates both 'early' and 'late' in the language comprehension process. There are a number of possible explanations for these findings. One possibility is that the effects noted by other researchers and termed the 'first mention' effect is a term covering the operation of a number of different factors. As mentioned earlier the first mention effect has been explained in terms of various, closely related processes.

This possibility is consistent with the findings of Stevenson, Nelson and Stenning (1993) who present evidence suggesting that the first mention effect is the result of the first noun phrase being the favoured antecedent in a number of heuristic strategies (subject assignment, parallel function and parallel order of mention). Although speculative, the idea that "first mention" is the common point in a number of pronoun assignment strategies, would explain why the first mention effect has proved to be so robust, and why it has been found to be such a powerful cue.

Another simpler explanation for the interactions between first mention/thematic role and first mention/method of introduction, is that the author's original classification of thematic role as 'minimal' information and method of introduction as 'non-minimal' information was mistaken. Perhaps introduction type is a more immediate source of saliency cueing than was first thought (see the

study carried out by Garrod, Freudenthal and Sanford, 1994 , and discussed at more length in the concluding chapter).

However if this is the case then surely one would have expected to have found a main effect of method of introduction. This was not however the case. Thematic role information was used as a cue to pronoun assignment both on its own and as part of an interaction with first mention. Method of introduction however was found to be used as a cue only in conjunction with first mention. As a result of this whilst the interactions noted are unexpected and deserving of further research, they do not seriously challenge the assumptions underpinning this experiment (i.e. that thematic role and method of introduction are minimal and non-minimal cues respectively). The results obtained in this experiment will be discussed in relation to the results of experiment thirteen in the next section.

GENERAL DISCUSSION

As discussed earlier, experiments thirteen and fourteen reproduce the findings of Stevenson et al (1994). The same patterns of thematic role preference are noted ('Goal' rather than 'source', 'experiencer' rather than 'stimulus', 'patient' rather than 'agent') were found in terms of both faster reading times and numbers of references made. Like Stevenson et al's interpretation this contradicts the notion of a hierarchy of thematic role preferences (Nishigauchi, 1984). Instead it lends more support for Dowty's 1991 'proto-role hypothesis'. However as this hypothesis is still in the development stage (no data has as yet attempted to formally specify which clusters of entailments could account for the previous classifications of experiencer theme etc.) any support for Dowty must remain tentative.

Given that a preference for thematic role information was shown in both on-line (the reading time task) and off-line (the sentence completion task) studies, this suggests that thematic role information is a powerful and relatively immediate cue to pronoun resolution. This view is further supported by the lack of significant

main effects of method of introduction (name vs. role name: Anderson et al 1983; Sanford et al, 1988) noted in either study. If subjects were constructing a full representation of the event then (drawing on non-minimal sources of information) then one would have expected to have obtained findings of method of introduction similar to those found by Anderson et al (1983) and Sanford et al (1988).

The findings of this chapter tend to support McKoon and Ratcliff's (1992) "minimalist hypothesis" rather than the implications of Gernsbacher et al's (1992) paper that suggests that subjects are routinely constructing a mental model containing more elaborated information (i.e. information that is unnecessary for comprehension to take place).

These findings will be discussed further in the concluding chapter, which will draw together the findings of all four experimental chapters and relate their findings back to previous research into pronoun comprehension in particular and language comprehension in general.

CHAPTER 7: CONCLUDING REMARKS

SUMMARY OF RESULTS

One of the stated aims of this thesis was to investigate the claims of the minimalist hypothesis. One of the ways of investigating this was the use of two different task types. McKoon and Ratcliff's (1992) minimalist hypothesis states that subjects' performance on reading tasks will differ depending on the goals of the task. This aspect of minimalism will be examined by a comparison of the performance of subjects in reading time and continuation tasks. In order to show up any patterns in the results obtained in these two task types the results from each will be initially considered separately and compared afterwards.

READING TIME TASKS

In experiment one (manipulating situational structure and antecedent referred to) a significant interaction between situational structure and antecedent referred to was found. Subjects read target clauses referring to both entities faster when they followed a together description rather than an apart description. In addition subjects read target clauses containing a reference to the second mentioned entity significantly faster when this followed an apart rather than a together description. There was also a significant main effect of antecedent. Subjects read target clauses referring to the first mentioned antecedent faster than those referring to either the second mentioned or both individuals. The pronominal references made in this experiment were within rather than between sentences.

Experiment three again manipulated situational structure and antecedent referred to. This experiment however, used more static descriptions of the entities. No significant interactions or main effects were noted. Again this experiment featured within-sentence references.

Experiment five once more manipulated situational structure. In addition this experiment also manipulated linguistic structure and antecedent referred to. A significant interaction between linguistic structure and antecedent was obtained: subjects read target clauses containing a plural reference faster when the antecedents appeared in a conjoined NP structured sentence rather a subject-predicate structured sentence. Like experiments one and three, the pronominal references made in this experiment occurred within the same sentence.

Experiment seven also manipulated situational and linguistic structures and the antecedent referred to. However the materials used in this experiment differed from those used in experiment five in that the distance between linguistic and situational information and the subsequent pronoun was the same. No significant main effects or interactions were noted. Unlike experiments one, three and five, this experiment used between sentence references: the pronoun was in a different sentence from the antecedents.

Experiment nine was a modified replication of experiments one and three. Situational structure was manipulated, but the materials used contained information as purely spatial in nature as possible. There were no findings in this experiment that were significant on both F1 and F2 analyses. There was a finding that target clauses were read faster following together rather than apart descriptions, but this was significant only on the F1 analysis. The pronominal references in this task were once more within the same sentence as the antecedents.

Experiment eleven was a modified replication of experiments five and seven. This experiment manipulated situational and linguistic structures as well as the antecedent referred to. This experiment also used materials designed to be as purely spatial in nature as possible. Analysis revealed a significant interaction between situational structure and antecedent referred to. Subjects read target clauses containing plural pronouns faster when they followed a together rather than an apart description. There was also a three way interaction that was significant on F1 only: subjects read target clauses containing a plural pronoun

faster when the antecedents had been described as together in a subject - predicate structured sentence. Reference in this experiment took place within the same sentence.

Experiment thirteen pitted thematic role information against method of introduction (e.g. "John" vs. "the waiter"). A significant main effect of thematic role was obtained: subjects' reading times for target clauses varied according to the thematic role played by the antecedent. Further analysis revealed that subjects preferred (as indicated by reduced reading times) to refer to antecedents who were 'goals' rather than 'sources' (this effect was only marginal on the F2 analysis), 'experiencer' rather than 'stimulus', and 'patient' rather than 'agent'. All references took place within sentences. In addition the references in these experiments were not unambiguously resolvable on the basis of gender information (unlike experiments one to eleven, which were referentially unambiguous on the basis of gender/number). No significant interactions were noted.

INTERPRETATION OF READING TIME RESULTS

The results of experiments one and eleven suggest that spatial information (and thus an essentially non-linguistic mental model) is being used by subjects to process plural and singular pronouns even when pronoun assignment can be accomplished unambiguously. The results of these two experiments suggest that pronoun resolution is carried out using a ('constructionist') mental model of the text rather than only occurring under certain circumstances (McKoon and Ratcliff 1992).

These results also support the suggestion of Rehkamper (1990) that spatial information plays a part in the formation of "complex referential objects", and is part of the "Common Association Base" regulating sum formation suggested by Eschenbach et al (1989). Despite the fact that experiments one and eleven suggest that subjects are routinely making use of a mental model to process plural

pronouns, this interpretation must remain tentative. If subjects are processing pronouns in this way then why were similar results not found in all of the reading time experiments?

Situational information was present in every reading time study carried out and linguistic information was present in experiments five, seven and eleven. In spite of the presence of this information, significant effects of spatial description on reading times appear in only two experiments. The results of Glenberg et al (1987) and the work of Eschenbach et al (1989) and Rehkamper (1990) suggested that spatial information would play a role in linking entities as a group even when they had been introduced into a text separately. The null results obtained in experiments three, five and nine suggest that caution must be exercised in attributing the interaction solely to the spatial manipulations carried out. Otherwise each experiment would presumably have results similar to those noted in experiments one and eleven.

In experiment five, subjects were shown materials which featured a linguistic as well as a situational manipulation. It was noted that subjects read plural pronouns faster than singular pronouns when they followed a sentence in which the antecedents occupied a conjoined NP structure. The lack of an effect of situational structure in this experiment may be the result of the presence of linguistic information. It may be that linguistic information is such a powerful grouping cue that it is used to cue group formation in preference to/or much faster than, non-linguistic information. This hypothesis is similar to Ehrlich's (1980) finding that gender information appeared to attenuate verb bias. This supposition is supported by the results of Sanford and Lockhart's (1991) study. They noticed that linguistic information (the presence or absence of the conjunction 'and') had a more pronounced effect on the number of plural references made than did non-linguistic information. The effectiveness of NP conjunction as a grouping cue was also noted by Hielscher and Musseler (1990). However, in experiment five there was some concern that the distance between the situational description and the pronoun may have caused this effect. Distance between pronoun and antecedent has been shown to increase fixation times in the region of a pronoun

(Ehrlich and Rayner 1983) and clause reading times (Glenberg et al 1987). The linguistic information in experiment five was presented in the clause immediately preceding the pronoun, while the situational description was presented two sentences before the pronoun was encountered. In experiment seven, which manipulated linguistic structure and situational structure, no effects of either linguistic or non-linguistic information on the reading times for singular/plural pronouns were found. In experiment eleven, an effect of spatial description was found but no effect of linguistic conjunction. This would tend to tentatively suggest (albeit very tentatively) that it is possible that the distance between spatial cueing information and pronoun had attenuated the effect of spatial information as a cue. This may have led to subjects making use of linguistic conjunction as a cue. However in this experiment, materials designed to be as purely spatial as possible were used. It is possible that this strongly spatial information may have in its turn attenuated the effects of linguistic conjunction. Again the results are inconclusive. It is not possible to say with any surety whether linguistic or non-linguistic information provides the most potent cue to group formation across experiments.

Why did experiments three, seven and nine fail to produce results in line with experiments one and eleven? They were modified replications of experiments that had earlier produced significant effects. It is possible that McKoon and Ratcliff's minimalist hypothesis is correct. The minimalist prediction is that there will be no difference in reading times and the majority of reading time experiments support this hypothesis.

As can be seen, the findings of the reading time experiments do not present a very clear pattern of results. Effects of spatial information are found in only two of the six experiments carried out. Effects of linguistic conjunction on reading times for plural pronouns are only found in experiment five. Experiments three, seven and nine do not yield any significant effects at all.

Experiment thirteen, although investigating thematic roles, reveals significant preferences for information proposed to be minimal rather than non-minimal.

This finding obviously supports the minimalist hypothesis. McKoon and Ratcliff would predict no effect of spatial information if subjects were making use of a minimal representation to guide pronoun resolution. However, the greatest difficulty in accepting this interpretation is that McKoon and Ratcliff are basing their prediction on a null result. As such, in order to accept that null findings reflect the operation of a minimalist strategy, one must verify that there can be no other interpretation of the results. This is of course, extremely difficult to do. As noted, two out of three of the significant effects obtained in the experiments investigating plural pronouns are effects of non-linguistic information. Why is it that in similar experiments no effect of spatial information is found? The minimalist hypothesis is able to explain this by suggesting that readers will adopt a representational strategy that helps them achieve the goals of reading. In the case of the effects of spatial information (noted in experiments one and eleven), then it is possible that subjects were picking up on the spatial information contained in each sentence and essentially producing a "minimal-plus-spatial" representation of the text. This would certainly make sense in terms of experiment eleven. This experiment, it will be recalled, used sentences that were constructed in order to be as purely spatial as possible. The questions asked of subjects in this experiment were ones that could plausibly have oriented them towards the spatial information in the sentences. A question asking about the locations of the characters appeared after each trial. In experiment one however, the questions asked (after every fourth trial) required answers that were inferences about the current state of either one or both of the characters. For instance "Was Roger injured?" following a trial describing someone limping or "Were Tracy and Peter friends?" following a trial in which the characters had been described as arguing. As mentioned in chapter three however, the materials used in experiment one were not thought to be particularly spatial in nature, in that they all described actions (movement) that resulted in changes in spatial proximity. Even so, and without the proposed orienting effect of questions that asked about the spatial location of the characters, an interaction between spatial information and antecedent was noted. It may be argued that the more purely spatial materials used in experiment eleven served in some way to reinforce the spatial effects noted in experiment one. However, if this were the case then one would have

expected to obtain similar results in experiment nine. This was also a reading time task, and also used purely spatial information. In addition to these two similarities, this experiment also featured questions asking about the relative location of the characters. Given the very obvious similarities (between experiments nine and eleven) one would have expected to have obtained similar results. However, no significant effects were obtained in experiment nine. Whilst these results do not appear to suggest that subjects are always picking up on the non-linguistic information appearing in sentences, neither do they consistently support McKoon and Ratcliff's minimalist hypothesis. It appears rather that subjects are making use of different strategies in different experiments. While the minimalist hypothesis is able to explain this apparent inconsistency, it is due to vagueness rather than any predictive power of the hypothesis. McKoon and Ratcliff (1992) suggest that:

> "For different readers, minimalist processing with little strategic processing will occur in different situations. For some readers it may be a rare occurrence; for others, it might happen in such situations as reading a magazine on an airplane, reading the morning newspaper through the morning fog over breakfast, or reading texts in a psychology experiment. However, more often that not, readers do have specific goals, especially when learning new information from texts and so they often engage in strategic processes designed to achieve these goals." McKoon and Ratcliff, 1992, p.440

Given McKoon and Ratcliff's lack of specific examples, it is possible that some of the reading time experiments included in this thesis induced subjects to engage in strategic processing of spatial information or NP conjunction whilst others did not.

These possible explanations will be re-assessed after the findings of the sentence continuation/completion tasks have been summarised.

SENTENCE CONTINUATION/COMPLETION TASKS

The first completion experiment carried out (experiment two), manipulated situational structure. Sentence fragments contained a description of the entities placing them either together or apart. Pronominal reference was within the same sentence as the one containing the antecedents. Analysis revealed a significant main effect of antecedent; subjects showed an overwhelming preference to write continuations featuring references to the first mentioned antecedent rather than to either the first mentioned or both antecedents. This effect was thought to be the result of subjects making almost exclusive use of verb phrase ellipsis in their completion sentences.

Experiment four was a modified replication of the within-sentence reference completion task used in experiment two. This experiment made use of a modified set of materials (entities were described as being together or apart using more static descriptions). Analysis revealed a significant preference for subjects to write completions featuring reference to the first mentioned individual rather than to either the second mentioned or both individuals. Analysis also revealed a significant interaction between situational structure and antecedent. Subjects wrote significantly more singular references following apart rather than together descriptions.

Experiment six manipulated situational and linguistic structure. This task also featured reference between-sentences. Analysis of variance revealed a significant interaction between linguistic structure and antecedent. Subjects wrote significantly more plural references when the antecedents appeared in conjoined NP structured sentences rather than subject-predicate structured sentences. Subjects also wrote significantly more references to either the first or second mentioned antecedent when they appeared in subject-predicate rather than conjoined NP structured sentences. In addition to this interaction, a significant main effect of antecedent was noted. Subjects wrote more continuations containing plural references than singular references.

Experiment eight was a modified replication of experiment six. It featured the same between-sentences reference, and manipulated the same variables. The materials used differed from those used in experiment six in that the situational and linguistic information occurred in the same sentence. Analysis revealed a significant interaction between linguistic structure and antecedent. Subjects wrote significantly more plural references when the antecedents had appeared in a conjoined NP rather than a subject-predicate structured sentence. Analysis also revealed a significant interaction between situational structure and antecedent. Subjects made significantly more plural references when antecedents were described as together rather than apart. Analysis also revealed a significant main effect of antecedent. Subjects made significantly more references to both antecedents than to either the first or second mentioned antecedents as individuals.

Experiment ten was a modified replication of experiments two and four. It manipulated situational structure as in the earlier experiments but used materials that were as purely spatial as possible. Unlike the experiments it was replicating, it used a between-sentence reference task. Analysis revealed a significant interaction between situational structure and antecedent. Subjects made significantly more plural references when the antecedents were described as being together rather than apart. In addition to this interaction there was also a significant main effect of antecedent. Subjects made significantly more references to the 2nd mentioned antecedent than to either the first mentioned antecedent or to both as a group.

Experiment twelve was a modified replication of experiments six and eight. It manipulated both situational and linguistic structures and the materials made use of were as purely spatial in nature as possible. Analysis revealed a significant interaction between linguistic structure and antecedent. Subjects made significantly more references to both antecedents when they appeared with conjoined NPs rather than in subject-predicate structured sentences. An interaction between situational structure and antecedent was also noted, but this

effect was only marginally significant on F2. Subjects made more references to both antecedents when they were described as being together rather than apart. A main effect of antecedent was also noted. Subjects made significantly more continuations referring to both antecedents as a group than to singular antecedents.

Experiment fourteen manipulated the thematic role of the characters and whether they were introduced using a proper name or a role-name (e.g. waiter). Significant main effects were found for thematic role. Subjects produced significantly more continuations containing references to characters occupying goal (rather than source), experiencer (rather than stimulus) and patient (rather than agent). In addition a main effect of sentence position was obtained (although this effect was only marginal on the F1 analysis); first mentioned characters were referred to more often than second mentioned antecedents. As well as these main effects, two significant interactions were obtained. Subjects referred to antecedents that were introduced by a proper name significantly more often if the antecedent also occupied the first mention position in a sentence.

Unlike the results obtained from the reading time experiments, the findings of the continuation/completion studies are fairly consistent. Spatial information appears to be used as a cue to group referent formation in experiments four, eight, ten and (marginally) twelve. This is in line with the predictions made if subjects were routinely making use of a mental model to handle pronoun assignment. There are three experiments that do not follow this pattern. In experiment six, subjects made use of linguistic rather than situational information to cue the formation of group referents. This suggests that subjects are primarily relying on the use of non-linguistic information (in the form of noun-phrase conjunction) to cue the formation of group referents. However, as mentioned in the discussion of this finding, this result could be due to the distance between the presentation of spatial information and the start of the continuation sentence. This explanation receives some support from the results of experiment eight. When spatial information occurred in the same sentence as linguistic information (noun-phrase conjunction), such as in experiments eight and twelve, spatial information had an

effect on the number of plural references made. If the supposition about the composition of the materials had been incorrect, then it would have been expected that there would be no difference between the results obtained from experiments six and eight. As the results show, when spatial and linguistic information were included in the same sentence, an effect of spatial information was obtained

Whilst acknowledging the effect that the widely researched first mention effect must have had on the findings (Allerton, 1978; Cole et al, 1980; Fletcher, 1984; Gernsbacher and Hargreaves, 1988; Gernsbacher et al, 1989; Kieras, 1979), obtained in experiments two, and fourteen, it is proposed that the lack of an effect of situational information in experiment two was largely the result of the subjects' overwhelming use of verb phrase ellipsis as a strategy for completing each sentence. This strategy reduces the amount of writing that the subjects must carry out in order to complete the experiment, therefore making the task less time consuming. It is therefore possible that this "energy-saving" factor was at least as important to the subjects as any preference for referring to the first mentioned individual. The results of the other continuation/completion experiments uphold this idea. Although a first mention effect was noted in experiments four and fourteen, this was only as part of an interaction between situational structure and sentence position (in the case of experiment four), and as part of an interaction between thematic role and sentence position (in experiment fourteen). The main effect of sentence position obtained in experiment fourteen was not significant on the F1 analysis.

The differences in findings that occurred between the findings of experiments two and four, may have been due to the modification made to experiment two's materials in order to use them in experiment four. The removal of many of the motion verbs may have had the effect of making a verb phrase ellipsis seem less obvious. However, the use of VP ellipsis is certainly possible with the materials used in experiment four. Alternatively the difference in results may have been due to some factor of the motion verbs themselves. It is possible that the thematic roles of the entities (Stevenson et al 1994) may have played a role in the overwhelming preference for the first mentioned individual in experiment two.

In each case the first mentioned person was always an agent and the second mentioned individual was always either goal or source. In experiment four the individuals' thematic roles were not so clear cut. In a spatial description such as the one below;

Leo waited at the station with Laura and...

Leo and Laura are both performing the same action. It is thus possible that the thematic role occupied by the antecedents was cueing the formation of group or individual referents. As the results of experiment fourteen show, thematic role appears to influence pronoun assignment. It is possible that this accounts for the massive effect of first mention in experiment two. It is of course also possible that spatial information plays no part in group referent formation. This would also explain the results of experiment two, but this explanation seems unlikely in the light of the results from experiments four, eight, ten and (tentatively) twelve. If spatial information was not used as a cue to the formation of group referents, then presumably it would not have occurred so consistently throughout the completion task experiments.

The presence of only a marginal effect of situational structure on frequency of use of a plural pronoun in experiment twelve is unexpected, especially since this experiment made use of purely spatial materials. It would appear that this result was merely an anomaly.

Whilst the sentence completion experiments present quite a clear pattern of results suggesting that subjects make use of a non-linguistic representation of the text, the results of experiment fourteen tend to support a more minimalist interpretation. In this study subjects appeared to be making far more use of thematic role information than the more 'global information' (description type). Although, as discussed in chapters two and six, there remains some doubt as to how thematic role information should be classified, in the experimental manipulations carried out in this thesis (and according to the specifications laid out by McKoon and Ratcliff, 1992), thematic role information is 'more minimal'

in nature than type of description. The very different patterns of results obtained from the two task types will be discussed in the next section.

READING TIME VS. CONTINUATION STUDIES

Even though the continuation studies and reading time studies in this thesis used very similar materials, different patterns of results were found to occur between the two task types. Of the experiments run, four out of seven of the continuation and only two of the seven reading time experiments suggested that subjects were making use of a mental model to process even referentially unambiguous sentences. The findings of experiments two, five and six have already been discussed in some depth, and it is possible that the findings obtained in these experiments were due to the composition of the materials. The results of the other experiments suggest that the task subjects carry out affects the type of processing they employ. From the results of continuation experiments four, eight, ten and twelve (cautiously) it would appear probable that subjects are making use of spatial information to cue the formation of group referents. This finding is in line with the findings of Glenberg et al (1987) and the proposals of Eschenbach et al (1989) and Rehkamper (1990) concerning the processes used to allow group reference to take place.

The data obtained from the reading time tasks allow considerably less confidence in interpreting their results. All they suggest is that in some cases subjects are able to make on-line use of non-linguistic information. The results obtained are not sufficient to determine whether this use of mental models (as suggested by the use of non-linguistic information) is carried out routinely or only in special processing cases. The fact that very similar reading time tasks using similar materials failed to produce an effect of spatial information on reading times for plural/singular pronouns in three experiments, would suggest that spatial information (and thus a mental model) is not routinely used for on line pronoun resolution. This interpretation is very similar to the minimalist strategy proposed by McKoon and Ratcliff (1992) to account for on-line processing of text. It will

be recalled that their proposal suggests that subjects construct mental models of texts only under special circumstances. Their claim is that a minimalist strategy is used in "normal" reading i.e. reading with no explicit goal other than comprehension. In the case of reading with a specific goal in mind (an example might be answering questions about specific aspects of a text) then readers will represent minimal information plus the information necessary to satisfy the reader's goals. The specific example that they give of this is subjects' inclusion of inferential information in Bransford Barclay and Franks, (1972) recognition experiment.

As mentioned in chapter one, the minimalist hypothesis is able to explain many of the apparent inconsistencies in research into mental models. For instance the Bransford et al (1972) study found effects of the inclusion of spatial information unnecessary for the comprehension of the sentences used whilst other work, such as Zwaan and Oostendorp (1993) found no apparent effects of encoded spatial inferences in the absence of specific instructions to do so. This is explainable in terms of the goals of the readers. In the Zwaan and Oostendorp study subjects encoded spatial information when specifically asked to do so. Subjects apparently did not in the absence of these instructions. It may be surmised that the subjects instructed to pay particular attention to the spatial information would construct some kind of spatial representation in order to satisfy the task demands. The subjects who did not receive these instructions (and thus who had no spatial reading goal) apparently did not construct spatial information. In the case of the Bransford et al (1972) study, then it may again be the case that subjects were representing the spatial information as a goal of their reading. Although not explicitly instructed to do so it may be that in order to aid their performance on the recognition test, subjects were deliberately attempting to memorise the spatial information contained in the sentences.

This explanation may be extended to other studies. For instance the findings of Gernsbacher et al (1992) that subjects appear to be encoding information about the emotional states of characters appearing in texts. In their study Gernsbacher et al had subjects read through a number of texts describing various events.

Subjects were required to read sentences containing either an appropriate or inappropriate emotion word. These findings were reinforced in a variant of the reading task using words of the appropriate emotional valence and in a task in which subjects were required to pronounce the emotion word. Inappropriate emotion words were processed slower than appropriate words. Subjects in these experiments were not asked to represent the emotional states of the characters. However, the minimalist hypothesis would explain these findings in terms of readers picking up on the emotional content of the stories and representing this information. Thus subjects would be representing minimal information plus the emotional information contained within each text. This interpretation whilst possible is speculative. Caution must be exercised in interpreting this possibility too strongly as a result of the ad hoc nature of the speculation and as a result of the vagueness inherent in McKoon and Ratcliff's (1992) paper.

The subjects in the reading time experiments conducted in this thesis were asked to read the sentences for comprehension. They received no direction to pay attention to specific details of the text and exactly what was meant by "comprehension" was not spelled out to them. However subjects were required to answer questions about the sentences at least every one in four trials. In addition, each reading time experiment contained a number of filler sentences that were at least equal in number to the experimental sentences. In order for McKoon and Ratcliff's 'goal directed' reading to have taken place, the subjects would have had to have deduced for themselves which sentences were the experimental sentences, and what information they should have represented in the case of the five reading time experiments whose questions did not ask about spatial information. Again in this case there are anomalies: Why didn't subjects use spatial information in experiment nine? This experiment featured sentences that were as purely spatial in nature as possible and questions that asked about the spatial locations of the characters?

Whilst there are difficulties in accepting this explanation of the different results obtained from the reading time tasks, it is possible that McKoon and Ratcliff's (1992) notion of goal directed reading might be able to account for the task

differences. This interpretation has been discussed at some length in the recent literature, most notably by Garnham and his colleagues (Garnham and Oakhill, 1992; Oakhill, Garnham and Vonk, 1989; Garnham Oakhill and Cruttenden, 1992; Vonk and Noordman, 1989) although it forms an important part of the models proposed by Graesser et al (1994) and by McKoon and Ratcliff (1992). Their work (which will be discussed in the next section), may provide more detail as to how and why goal directed reading occurs.

GOAL-DIRECTED READING

Garnham and Oakhill, in their 1992 paper, highlight a number of different themes in language research that have emerged recently. One of these themes is related to the notion of 'goal-directed' reading outlined very briefly in McKoon and Ratcliff's (1992) paper. Garnham and Oakhill suggest that this aspect of language processing, this flexibility, is best explained from a mental model framework:

> "Mental models are representations of the world constructed for specific
> purposes, and the model constructed, whether it be from perception, reasoning
> or language processing, should be the one that is most appropriate for the task
> in hand." Garnham and Oakhill, 1992, p.202.

Garnham Oakhill and Cruttenden (1992), Oakhill et al (1989), and Vonk and Noordman (1990) all provide evidence that may be interpreted as backing up this claim. Oakhill et al suggest that the particular task performed by subjects may be sufficient to explain different patterns of results obtained in similar experiments carried out by Garnham and Oakhill (1985) and Vonk (1984;1985a & b). Garnham and Oakhill's subjects read sentences similar to those used by Ehrlich (1980) in that they manipulated verb bias (in the sense of the term used by Caramazza and his colleagues: Caramazza, Grober, Garvey and Yates, 1977;

Caramazza and Gupta, 1979; Garvey and Caramazza, 1974; Garvey, Caramazza and Yates, 1975) such as:

> Max confessed to Bill because he wanted a reduced sentence.
> Max confessed to Bill because he offered a reduced sentence.

In addition to varying the verb bias of the sentence other manipulations included the presence or absence of a gender cue to the referent. Sentences were presented clause by clause with the break occurring at the point of *'because'*. In two experiments subjects were required to complete other tasks in addition to reading the pronoun. One experiment required subjects to answer yes/no questions resolving who the antecedent of the pronoun was. In the other experiment, subjects were asked questions about which character a description fitted. Garnham and Oakhill found effects of a gender cue on the second clause reading times and on the question-answering/name selection times. No effects of congruity were found on both F1 and F2 analyses. Vonk (1984, 1985a & b) however, using similar materials, found effects of congruity but not gender cue on reading times and effects of congruity and gender cue on naming and verification response times. Oakhill et al 1989 suggest that these differences occurred as a result of the subjects' perceptions of their task. Vonk's materials they report contained large numbers of filler items such as;

> Mary had finished the soup before Anna came to the table.
> (Verification task: Anna was eating first)

Oakhill et al suggest that it was possible that Vonk's subjects did not perceive their task as involving them working out the names of the people to whom the pronouns referred. Garnham and Oakhill's subjects however, were required to perform tasks based on who it was that the pronouns referred to. Oakhill et al suggest that these differences in findings are explainable in terms of the operation of two strategies: *role-to-role* mapping and *role-to-name* mapping. The two strategies are similar in some ways in their implications to McKoon and Ratcliff's (1992) minimalist hypothesis. They are examples of the "incompleteness" of

mental models (Oakhill et al 1989). Role-to-role mapping is suggested to occur when a reader focuses on *what* is occurring in a sentence rather than upon *who* is doing it. In the example given above *"Max confessed to Bill"* a reader engaged in role -to-role mapping would represent the roles that are played in the sentence not necessarily the name of the person playing that role. Oakhill et al suggest that when a sentence is presented out of context then the names are more or less meaningless labels. In order to understand the sentence all that is required is the knowledge that someone confessed to someone else. In contrast role-to-name mapping is the representation of a particular name linked to the role that the person is performing.

These two strategies are suggested by Oakhill et al as being responsible for the differences in findings obtained by Garnham and Oakhill (1985) and Vonk (1984; 1985a & b). Garnham and Oakhill's tasks required subjects to carry out role-to-name mapping in order to perform the tasks (which asked about named persons). Vonk's tasks however did not require subjects to answer questions about the particular antecedents as they related to the actions they were performing. As such it is suggested by Oakhill et al that Vonk's subjects may have been carrying out role-to-role mapping. This explanation would be sufficient to account for the differences in findings because of the relation proposed to exist between verb bias and gender cues and the two strategies outlined. Oakhill et al claim that a gender cue is of more use to a subject engaged in role-to-name mapping because it is related to the person carrying out an act and presumably their features. A task that requires a role-to-name representation would be aided if there was only one possible antecedent (the other being ruled out as a result of incompatible gender). On the other hand, gender cues would not be of as much use when the focus of the task was on the events themselves. In such a case one would expect inferences based on the likely causes of events described (in other words the implicit verb bias) would be used because of their greater use in signalling the roles played.

Further evidence supporting this interpretation comes from the study carried out by Garnham, Oakhill and Cruttenden (1992). In a series of experiments that

again manipulated verb bias and gender cue, Garnham et al found that subjects' use of gender cue as an aid to pronoun comprehension was dependent on the task performed subsequent to reading the sentences and the filler materials that were presented with the experimental materials. Garnham et al gave one group of subjects sentences which required them to resolve pronouns (using role-to-name mapping) in order to answer questions following each trial, whilst another group had to read another type of sentence and answer a different type of questions on half of the trials. Subjects required to answer questions concerning pronoun resolution on every trial were found to read target clauses containing gender cues significantly faster than subjects who only had to answer questions requiring pronoun resolution on 50% of trials. This findings suggests that subjects' use of gender cues is determined by strategic processes. However this finding is also in line with the claims of McKoon and Ratcliff's minimalist hypothesis. Presumably the role-to-name mapping strategy suggested by Oakhill et al requires subjects to first carry out role to role mapping. In this respect the strategy making use of role to role mapping could very easily be classified as a form of minimalist processing. Likewise the use of gender cue as an aid to the processing of information that requires knowledge of pronoun assignment may also be classified as minimalist. Subjects are only making representing that information necessary for local coherence and those global aspects of the task. Although true to the spirit of the minimalist hypothesis, this interpretation is certainly not true to its letter.

In addition to these findings, further experimental evidence in support of the 'strategic processing' hypothesis proposal by Oakhill et al (1989) comes from the work of Vonk and Noordman (1989). Vonk and Noordman are concerned with the factors that lead to inference generation. They suggest that the number of inferences generated on-line falls into a middle ground between a minimalist hypothesis and what McKoon and Ratcliff (1992) term a constructionist account in which all inferences are generated. They discuss the notion of necessity in inference making. One of the main problems that they highlight is that "Comprehension is not a monolithic notion but a graded concept." (Page 448). Taking a text-analytic view they suggest that necessary inferences are those that

are easily deducible from the text. Examples of necessary inferences in this case become presupposition, entailments, conventional implications (similar to McKoon and Ratcliff's statement that inferences will be constructed from readily available information), and transitive inferences. However, Vonk and Noordman;

> "...do not like to claim that comprehension requires the construction of a coherent representation: It is an empirical question how coherent a representation one constructs in reading a text." Vonk and Noordman, 1989, p.450

Their experiments set out to empirically investigate which classes of inferences are made on-line and what the role of the readers' goals played in on-line inference generation. Their results suggested that inferences related to the purpose of the reading time tasks are constructed on line. This was measured in terms of reading times for target clauses. Vonk and Noordman's results provide further evidence that the type of representation and thus the information made use of during reading is determined not by the information contained within the text but rather by the reader's goals.

However, although these results are persuasive a possible alternative explanation may exist. In a similar experiment carried out by Zwaan and Oostendorp (1993) investigating spatial information, they found that subjects reading times increased when they were instructed to read texts for their spatial information but subjects' subsequent recall for the spatial information was not improved. This suggests that subjects may be 'over-processing'. In other words reading more than they need to. Again however, this leads back to the question of what constitutes comprehension of a particular text. The findings does however provide further support for the claim that reading processes are strongly affected by the perceived goal of the reader.

The evidence described above may appears to provide an explanation of why the pattern of results obtained was not consistent across all experiments. In the continuation studies subjects goals were to provide a continuation of the sentence

fragment they read. The goal was the same in each case. It may be hypothesised that this standardisation of goal is sufficient to explain the general similarity of results obtained (subjects produced the predicted results in six out of seven experiments). It may be that the standardisation of the goal in each of these tasks, and the nature of the task itself (to elaborate upon a sentence fragment) is such that subjects make use of a constructionist mental model (as suggested by the use of non-minimalist sources of information in theses experiments).

In the case of the reading time experiments, this hypothesised 'standardised goal' was absent. Subjects were instructed to read the sentences that appeared on the VDU and when they had understood the sentence to press the space-bar. Subjects were informed that their reading times were being measured and that they should attempt to press the space-bar as quickly as possible whilst still allowing enough time to comprehend each sentence (a speed accuracy trade-off). As mentioned, the notion of comprehension is a vague one. It may have been that subjects were measuring their comprehension in terms of their ability to successfully answer the questions following trials. Whilst providing a possible explanation for the results obtained in these experiments, caution in accepting Oakhill et al's notion of goal directed reading must still be exercised. This explanation is after all ad-hoc. Before being able to accept it more wholeheartedly, the materials used in the preceding four chapters would have to be manipulated in terms of the goals readers were set as opposed to being allowed to set their own goals.

The specific implications of minimalism and Oakhill et al's role-to-role and role-to-name mapping strategy are examined in more detail in the following sections.

THEMATIC ROLE INFORMATION AND ROLE-TO-ROLE/NAME MAPPING

Oakhill et al's proposed mapping strategies are particularly useful in explaining the results of experiments thirteen and fourteen. Although these results are explainable in terms of Stevenson et al's (1994) work, their study is also

compatible with Oakhill et al's hypothesis. Experiments thirteen and fourteen produced strong effects of thematic role, but only one effect of introduction type and that was part of an interaction between sentence position and introduction. These findings were interpreted as providing further support for the contention put forward by Stevenson et al, that thematic role is a cue to pronoun resolution. Stevenson's work went on to test the preferences for thematic role as a function of the connectives used to link first and second clauses. Their findings suggested that subjects were shifting their focus on either the causes or the outcomes of situations depending on the type of connective. Stevenson et al's findings and the findings obtained in experiments thirteen and fourteen may also be interpreted in terms of Oakhill et al's role-to-role and role-to-name mapping hypothesis. In experiment thirteen subjects were making use of thematic role information to guide their pronoun assignment. In essence they were making use of who was performing what role in the events described. Subjects did not appear to be making very extensive use of the actual names of the individuals that were carrying out these actions. This conclusion can be drawn because of the lack of effect of introduction type. It will be recalled that Anderson et al, (1983), Sanford and Lockhart, (1991) and Sanford et al (1988) proposed that subjects attach characters introduced by their role name (e.g. waiter) to a particular scenario. These characters are in essence not as important as characters introduced by a proper name ('unbound' characters). These named characters are seen as the main protagonists of texts.

Subjects in experiment thirteen did not make use of the method of introduction to guide their reading of these sentences. In Oakhill et al's terms they did not appear to be mapping the roles (in terms of actions rather than scenarios) the characters were playing onto their names or scenario-role names. This suggests that subjects weren't carrying out role-to-name mapping. This interpretation is strengthened further as a result of the strong effects of thematic role information. This may be the equivalent of subjects carrying out a role-to-role strategy. This interpretation is also compatible with the minimalist hypothesis (McKoon and Ratcliff, 1992) as outlined above. Subjects appear to be carrying out the smallest amount of processing necessary for comprehension. In experiment fourteen (the sentence

completion task), subjects appear to once again be making use of thematic role information. Once again subjects did not appear to be making extensive use type of description. There was only one effect of description type and this was as part of an interaction with sentence position. Subjects made more references to characters introduced by name rather than by role name when they occupied the first mention position. Whilst these findings are compatible with the explanation of results put forward by Oakhill et al, they do stand in contrast to the majority of the continuation task results. It will be recalled that the majority of the continuation studies produced significant effects of non-minimalist information (spatial) suggesting the use of a (constructionist) mental model of the situation described by the text. Here however, information that appears to be minimalist in nature is being made use of whilst more global, (and therefore non-minimal) information (scenario dependency) is not being made extensive use of. It is possible that scenario dependency is requires more background or the presence of a larger text rather than the single sentences used in experiment thirteen. However, Sanford and Lockhart (1991) found effects of introduction type in a continuation study they carried out using single sentences.

Thematic role information was only one of the specific aims investigated in this thesis, however. The wider issues of strategies used to process pronouns have been discussed at length. Aspects of these processes have been seen to be able to account for the findings of the thematic role experiments (thirteen and fourteen) and possible for the effects obtained in experiments one to twelve. However, what of the use of spatial information in mental models? What are the implications for the CAB proposed by Eschenbach et al (1989)? These aspects of the thesis will be discussed in the following sections.

SPATIAL INFORMATION AND PRONOUN ASSIGNMENT

The findings of Glenberg et al (1987), who found that described spatial proximity to a foregrounded character made non-foregrounded target objects easier to respond to in a word recognition task, have already been mentioned. This

suggests that spatial proximity might make objects easier to associate. Thus it was thought likely that this factor might play a role in plural pronoun use, especially as it had been proposed by Eschenbach et al (1989) and Rehkamper, (1990) as being involved in the formation of a "Common Association Base" (CAB). The findings of experiments one, four, eight, ten, eleven and twelve all support this notion. All of these experiments reported findings of spatial information leading to either reduced reading times or increased frequency of reference. This suggests that subjects are making use of spatial information as a cue to the formation of group referents. However the question of whether this is 'routine' or not must remain unanswered, given the possibility that subjects may have been engaged in the construction of specific representations based on their perceptions of the task. This interpretation appears all the more likely if one remembers that only two of the reading time experiments produced significant interactions between spatial proximity and reduced reading times for references containing plural antecedents. One of these experiments contained materials designed to be as purely spatial as possible.

The notion of 'goal directed' reading has implications for Bryant's (1992) "Spatial Representation System" (SRS), which was touched upon briefly in chapter two. Oakhill et al's findings would suggest that Bryant's SRS is NOT a separate cognitive system. This interpretation can be argued by examining the relevant literature. Bryant's SRS is based on the finding that subjects appear to represent spatial information in the same kinds of ways regardless of the source of the information (perceptual or linguistic).

> "Space can be understood through perception and language, but are the mental
> representations of space the same in both cases?...I...argue that they are."
> Bryant, 1992.

The characteristics of the proposed SRS are not limited to common memory storage. As mentioned in chapter two, Glenberg et al (1987), found priming effects of spatial distance between two objects. McNamara (1986) also found that proximity between objects in a physical environment influenced the extent of

object name priming in a verbal recognition test. This spatial proximity/priming effect was also noted by Denis and Zimmer (in press).

Other examples of work supporting the notion of an SRS common to both perceptual and linguistic input include the work of Sadalla and Magel (1980) and Sadalla and Staplin (1980). Their work on the representation of distance in a route subjects walked, and the work of Thorndyke (1981) on representation of distance in maps, have produced similar results. People appear to represent the information from these two diverse sources of spatial information in the same way: Both are influenced by the number of turns and points along the route. Franklin (1991) reports of finding similar results using a verbal task. Subjects read narratives describing a route and were asked to route statements such as "From A to B involves going by way of C". Franklin's subjects took longer to respond for routes that involved greater distances and which contained a greater number of turns and intervening locations. The results of these three different task types suggest that a single representation of spatial information is used regardless of the source of information. Further work also suggests the existence of an SRS. Easton and Bentzen (1987) found that both sighted and congenitally blind subjects took longer on a finger-maze tracing task and made more errors when simultaneously verifying spatial statements. This finding suggests that both spatio-motor skills and mental, spatial skills are utilising some common spatial processing resource. Otherwise one would not expect the two tasks to interfere with one another. Similarly Oakhill and Johnson-Laird (1984) found that performing a visuospatial tracking task interfered with a person's ability to form a coherent spatial model from a verbal description. This finding also suggests that interpreting verbal spatial material and performing spatial tasks leads to competition for the resources of the same system. This spatial processing system has been proposed as a sub-system of working memory by Baddeley and Hitch (1974). They termed this slave system "the visuo-spatial scratchpad".

Bryant's argument is that spatial information appears to be made use of in a spatial mental model. This model is a separate subsystem (SRS) devoted only to spatial processing. However in terms of cognitive economy one may argue that a

more flexible mental model (possibly one organised around minimalist principles) would make more sense. Indeed, upon examination of the findings that Bryant used to support the SRS it is just as easy to claim that spatial information, along with other types of information, are handled in a more general mental model. This interpretation is more compatible with Oakhill et al's (1989) work on the flexibility of the language processing system.

In summary, although work exists that suggests that spatial information from separate sources (e.g. perceptual and linguistic) is represented in a common representation, the evidence is not conclusive that this is a separate Spatial representation system. The results obtained from experiments one to twelve also support this interpretation. If a spatial representation system is used to process spatial information then why were differential effects of spatial information found in different tasks? One would expect that there would have been a certain amount of uniformity across results.

However, the lack of a three way interaction between situational and linguistic structure and antecedent suggests that it may be possible to tentatively state that Bryant's claim that spatial information is special may have some truth in it. Situational information and linguistic information do not appear to be processed together. This was one of Bryant's (1992) claims. He suggested that spatial information would be dealt with separately from linguistic information.

Although spatial information use seems to be dependent on task type, subjects do appear to use spatial information to representation groups. The implications of the experimental work carried out will be discussed in relation to plural pronouns in the following section.

CABS PLURAL PRONOUNS AND SPATIAL INFORMATION

It will be recalled from the discussion in chapter two, that a Common Association Base (CAB) was proposed as a means of explaining how two or more entities

introduced separately into a text could be referred to as a group using a plural pronoun (Eschenbach et 1989). Basically the CAB is an index of how "alike" along a variety of continua, the individuals in a text are.

Grouping appears to be dependent on features of the entities and features of the situation in which they occur (Eschenbach et al, 1989; Rehkamper, 1990). Thus the CAB is a direct result of the properties of the entities and situation. If a CAB is formed as a result of an overlap of similar properties possessed by two entities then the entities will be more likely to be represented as a group. If not, then they will be represented as individuals. Group formation is proposed to require an additional step from the representation of entities as individuals.

Spatial proximity (Eschenbach et al 1989; Rehkamper 1990) and linguistic conjunction (Eschenbach et al 1989; Fraurud 1991; Hielscher and Musseler, 1990 Sanford and Lockhart, 1991) were proposed to be factors that facilitated sum formation. These factors were manipulated in twelve of the fourteen experiments carried out. Their findings will be discussed in terms of how strongly they provide evidence supporting the notion of a CAB.

EVIDENCE FOR THE CAB

Eschenbach et al (1989) propose that the construction of a CAB is guided by a variety of factors. Each of the factors involved in sum formation adds to the strength of the CAB. If these factors provide a strong enough association between the entities described, then they may be represented as a group and thus referred to using a plural pronoun. If the association between them is weak, then they are more likely to be represented as individuals (c.f. Herweg's, 1988, "principle of connectedness"). The results of experiments one, and eleven (reading time experiments) suggested that subjects were making use of spatial information to cue the formation of group referents/individuals. Experiment five found an interaction between sentence structure and reading times for antecedents. Plural references to antecedents with conjoined NPs were read faster

than those to antecedents in a subject-predicate sentence structure. Conversely, singular references to antecedents in subject-predicate sentence structures were read faster than references to antecedents with conjoined NPs. These findings are those predicted by Eschenbach et al (1989) and also partly follow the predictions of Hielscher and Musseler (1990). They suggested that subjects would either represent entities as individuals or as a group, and this is in line with the findings obtained. These findings suggest that the representation of entities as groups or as individuals occurs on-line rather than being an effect caused by retrieval or as a result of task demands. It also suggests that in some cases at least that subjects are using a mental model of the situation to process the information that is included in a CAB. These findings are supported by the continuation experiments. Subjects appeared to be making use of spatial proximity as a cue to the formation of groups/individuals in experiments four, eight, ten and twelve (marginally). Subjects used NP conjunction/separation as a cue in experiments six, eight and twelve. Noun phrase conjunction was made use of as a cue to group formation in four out of a possible six experiments, and this reinforces its importance as a cue to group formation. However, although these findings support the notion that spatial proximity and linguistic conjunction are cues to the formation of groups (in-line with the predictions) there are a number of anomalies. Effects of either linguistic or spatial information were absent from experiments two three seven and nine. It is possible however, to explain these results in terms of Oakhill et al's (1989) suggestions about pronominal reference being under the control of strategic processes. If subjects did not perceive their task as being one of the representation of pronouns then this would explain why these two important cues (spatial proximity and NP conjunction) were not made use of in experiments two, three, seven and nine. It may be that (as discussed earlier) subjects were not employing a strategy that required them to carry out pronoun assignment. However, it would appear that Eschenbach et al's' (1989) proposals concerning the use of a CAB are valid ones, but that the use of a CAB is dependent upon subjects employing a pronoun assignment strategy.

The CAB notion was strongly linked to Sanford and Garrod's (1981) focus model. Given the interpretation of the results in terms of Oakhill et al's (1989)

and Garnham et al's' (1992) claims of 'strategic processing', how well does this model fit the results obtained? This question will be discussed in the next section.

SANFORD AND GARROD'S FOCUS MODEL

In summary, Sanford and Garrod's model proposes that reference to discourse entities is accomplished as a result of the operation of a focus mechanism (a similar process has been proposed by Gordon, Grosz and Gilliom, 1993; Grosz and Sidner, 1986). The focus mechanism was proposed in order to attempt to explain the finding that some entities appearing in a text were preferred as antecedents for anaphoric references. This was characterised by Sanford and Garrod's model to be a problem of retrieval from memory. This retrieval process is constrained by three factors:

1) The domain to be searched.

2) A given partial description of the referent to be found (e.g. "he" "she", and "they").

3) The type of information to be returned (the identity of the referent).

In the case of pronoun assignment, the domain of search must be restricted or the partial description of the referent would return every entity in any of the memory stores that fitted the gender/number information specified by the pronoun. Thus, in pronominal reference, searches for a referent take place within the domain of explicit focus. This domain contains specific tokens representing things mentioned in the discourse. Thus when a new entity is mentioned a new token is constructed for it in explicit focus. When a reference is being resolved a search of the tokens in explicit focus is made and the information returned is a note that a token matches the partial description provided by the pronoun.

According to this model, the most foregrounded entity in explicit focus matching the partial description supplied by the pronoun, is the one chosen as the antecedent of the pronoun. As mentioned in chapter two there are a multitude of factors of varying "weights" the interplay between which singles out one particular entity as the antecedent of a pronoun. It is evident that this system has the potential to explain the resolution of plural as well as singular pronouns. The difference in the amount of foregrounding between two possible entities matching the partial description provided by a pronoun appears to be the factor that singles one of them out as the antecedent. Conversely, one would expect entities with very little or no difference in the amount of foregrounding they receive to be more easily grouped together than entities receiving different amounts of foregrounding. The case of plural reference is not incompatible with this model (although some modification is necessary, c.f. Rehkamper 1990 and the findings of Gernsbacher 1991 that suggest that entities in implicit focus can be referred to using a pronoun). Plural reference, it has been proposed (Eschenbach et al, 1989; Herweg, 1988; Rehkamper, 1990), may be accomplished as a result of the similarity (both linguistic and non-linguistic factors) between entities. This may be seen as being the opposite of the focus mechanism: an individual entity is focused upon as a result of the differences in weights assigned to it and other entities. A plural reference on the other hand may be conceived of as being the result of both entities receiving the same amount of focus. However it is probably more useful to think of plural and singular reference as being two sides of the same coin. The same mechanism may be sufficient to account for both plural and singular references. All that the Sanford and Garrod model requires is the addition of the CAB and sum formation process. Both the CAB and the focus model operate on the basis of the interaction of a number of factors of varying importance, that essentially lead to the foregrounding of an entity or entities based on their similarity or lack thereof. It is thus possible that Sanford and Garrod's model could, with modifications to the process by which entities are introduced into explicit and implicit focus, (and the addition of the CAB) be sufficient to account for both plural and singular pronominal reference. The findings of Sanford and Lockhart (1991) represent the first steps in extending the focus model to include plural pronouns.

The findings obtained in the experiments carried out in this thesis may also be explained in terms of the focus model. The use of linguistic and spatial information appears to be made use of as a cue to the representation of entities as either individual or group referents, as specified by the intuitions of Eschenbach et al (1989), Rehkamper, (1990) and on the basis of results of priming studies, (Glenberg et al, 1987; McNamara 1986).

However, although Sanford and Garrod's model may be able to account for the findings obtained in experiments one to fourteen, it is not the only model to be able to do so. Gernsbacher's (1989) paper also provides an explanation for the results obtained. Gernsbacher suggests that the process that governs referential access is best explained in terms of the enhancement of the level of activation of a particular discourse entity, and the suppression of others. Whilst this may seem on the face of it to be simply another way of expressing the focus model outlined by Sanford and Garrod, (replace the term *weight* with *activation* and they are very similar), the addition of the enhancement/suppression feature provides a better fit for the results obtained. It will be recalled that a common finding (noticed in experiments one, five, six, eight eleven and twelve) was that when subjects used either NP conjunction or spatial proximity as a cue to the representation of characters as a group, then the opposite effect was often noted (e.g. subject-predicate structures or spatial distance tended to cue the representation of characters as individuals). This finding is compatible with the notion of enhancement/suppression respectively of the opposite cue. As such Gernsbacher's (1989) model may be a better explanation of the results obtained in experiments one to twelve than Sanford and Garrod's model. However, it must be remembered that in order to accept this interpretation with any confidence the results obtained would have to have been consistent. This was not the case. In experiments two, three, four, seven, nine, and ten, the proposed suppression/enhancement pattern of results, were not obtained.

Although both models provide partial explanations for the results found in experiments one to twelve (fourteen), neither provides a complete explanation of

the results. Gernsbacher's model would need to be extended to provide an explanation of the operation of subjects' goal-directed reading strategies as suggested by the findings of Oakhill et al, (1989) and Garnham et al, 1992). Whilst it may be argued that Sanford and Garrod's model includes an expectation that readers' goals will play a role in the interpretation of pronouns and other references, (point three mentioned above on page 217) this is not a central feature of their model. There is no detailed specification of how readers select between possible different levels of mapping (such as the role-to-role and role-to-name mapping strategies suggested by Oakhill et al, 1989, and Garnham et al, 1992).

In short, although the results suggest that some kind of focusing mechanism is being made use of to process pronominal reference, neither Sanford and Garrod's model nor Gernsbacher's model of pronominal reference can completely account for the results obtained. A model capable of explaining the results obtained in this thesis would have to synthesise the features of both models, the work of Eschenbach et al (1989) and also incorporate the claims of Oakhill et al (1989) and Garnham et al (1992) concerning strategic processes involved in pronoun comprehension. At present there does not seem to any single detailed model that provides an explanation of all of these processes and their integration. As mentioned in chapter one, however, a framework has been presented by Graesser et al (1994) attempting to reconcile the vast body of work on text comprehension with the more recent suppositions that reading may be more goal directed in nature than has been previously assumed. Although not explicitly being able to account for all of the findings in this thesis, (there is no mention of plural pronoun reference, for instance) Graesser et al's model is the best currently available.

GRAESSER SINGER AND TRABASSO'S "SEARCH AFTER MEANING" MODEL

In this model the reader's goals are the starting point for the type of representation that is constructed. The model it will be recalled, rests on three

fundamental assumptions concerning the inferences generated during text comprehension:

1) *The reader goal assumption* (Readers construct meaningful representations based on their reading goals)

2) *The coherence assumption* (The representation constructed is coherent at both local and global levels)

3) *The explanation assumption* (Readers representations attempt to explain why actions, events and states are mentioned in the text)

Graesser et al (1994) suggest that their framework is an advantage over existing models of language comprehension because, unlike existing models, it accounts for the three points outlined above. Other models, Graesser et al claim, have explicitly or implicitly incorporated one or more of these points but have failed to address all three. This model is able to explain why readers are able to produce seemingly veridical models of text and also why at other times very minimalist representations seem to be constructed. Although the model goes into a detailed literature review, many of the areas described are beyond the scope of this thesis. Therefore only those areas of direct relevance to the factors tested in this thesis will be detailed.

The main advantages of Graesser et al's model over other models lie in its recognition of the role of reader goals. The three representational features outlined above are considered to be abandoned if one or more of the three cases following occur:

a) The reader is convinced that a text lacks global coherence and a message.

b) The reader lacks the background knowledge to establish explanations and global coherence for the information occurring within the text.

c) The reader's goals do not require the construction of a meaningful situation model (e.g. proof reading for spelling errors).

If one compares these three special cases with the experimental situations that occurred in this thesis, then it is evident that in terms of Graesser et al's model that subjects would not attempt to construct meaningful representations ('elaborate' mental models). Subjects received either single sentences or at most short texts of three sentences in length. This invalidates the materials in terms of point a) above. Materials used lacked any global coherence: they were instead, isolated sentences. The materials may arguably have also violated point c). In terms of Graesser et al's model, subjects would not have had to construct detailed or involved representations in order to process the information contained in the sentences used in experiments one to fourteen. The materials used in these experiments would not be classed as "ordinary texts" by Graesser et al. Graesser et al suggest that any model of text comprehension should use these as the base-line texts for comprehension because they correspond closely to humans' everyday experiences.

> "Both narrative texts and everyday experiences involve people performing actions in pursuit of goals, the occurrence of obstacles to goals, and emotional reactions to events...The inferencing mechanisms and world knowledge structures that are tapped during the comprehension of everyday experiences are also likely to be tapped during the comprehension of narratives; there is no justifiable reason to believe that readers would turn off these pervasive interpretive mechanisms during reading." Graesser, Singer and Trabasso, 1994, p.372

As a result of this, although acknowledging that their model is limited to answering questions about narrative comprehension, Graesser et al are suggesting that this is not necessarily a drawback given the 'ecological validity' of narratives due to their prevalence as a written form.

As mentioned, this model essentially provides a framework for future research. At the time of writing this model suffers from a lack of empirical evidence designed to specifically test its claims. However, it makes the same points as the other models considered. It also has the advantage of bringing together the evidence from mainstream studies into text processing and the points raised by Garnham et al (1992) Oakhill et al (1989) and McKoon and Ratcliff (1992) concerning reader goals.

FUTURE RESEARCH

Given the apparent ability of Graesser et al's model to draw together minimalist and constructionist processes and the work on reader goals it would seem necessary that its claims be tested empirically. The main drawback with Graesser et al's model at the moment is that it remains a theoretical work. Whilst exhaustive in its review of the literature, there have been to date no empirical studies published that specifically test its claims. Future research therefore needs to test the validity of the "search after meaning" model. In terms of the work conducted in this thesis, a number of both theoretical and methodological issues raised in the discussion of the results suggest future research directions. The role of reader goals needs to be manipulated in any further experiments. Possibly this question could be answered through the replication of existing experiments, with the additional manipulation of specification of reader goals. Graesser et al state explicitly that spatial information is not used routinely in comprehension:

"...the theory predicts that readers do not normally construct inferences that forecast future episodes in the plot and inferences that track the spatial locations of objects within a spatial region." Graesser et al, 1994, p.372

This is at odds with the findings obtained from experiments one, four, eight, ten eleven and twelve. Whilst it may be possible to explain some of these findings in terms of task demands/differences, (Garnham et al, 1992; Oakhill et al, 1989) these claims need to be tested. It seems unlikely that the naive readers used in experiments one to twelve, would be able to infer that the task they were performing during the reading time experiments, was investigating the role of spatial information as a cue to the formation of group referents. However, as stated above this issue needs to be tested in terms of explicit vs. implicit reader goals. One possibility perhaps, is an experiment using similar materials to the ones in experiments one and eleven, but which requires one group of readers to concentrate on spatial information whilst another group are required to concentrate on pronoun comprehension. This may be enough to determine whether the effects obtained in experiments one and eleven were due to readers' processing of spatial information per se, or whether they were using spatial information as a cue to group formation.

Another implication of Graesser et al's model is the use of isolated sentences versus short texts. Graesser et al are very specific in their reasons for making use of narrative texts rather than sentences. Although posing a number of difficulties in terms of controlling for the types of information included in a text whilst making it long enough to be valid, the possibility exists that the use of spatial information in sentences could be compared with its use in longer texts.

Spatial information need not, however, remain the major focus of any further research following on from the work carried out in this thesis. Spatial information and NP conjunction appear to be cues to the formation of groups and individuals. The integration of the work on plurals and the work on thematic role carried out in experiments thirteen and fourteen is an obvious area of further research. Eschenbach et al, (1989) and Rehkamper (1990) suggested that some

verbs cue group formation more readily than others. As thematic role may be considered verb information, then the implications of thematic role as a factor in the formation of groups is an obvious direction for future research. Spatial information, has also been implicated in a number of studies concerned with interaction (notably Herskovits, 1986; Morrow and Clark, 1988). An interesting experiment would perhaps investigate whether spatial proximity or the action that individuals are performing (in the form of the thematic role occupied by the characters) is of more use as a grouping cue.

Further investigations of the nature of thematic role information are a possibility. As mentioned in chapter two, there is considerable doubt as to what thematic roles actually are. The experiments carried out in this thesis have suggested that thematic role is a more immediately available source of information than the role characters play in real world situations. This needs to be investigated further, possibly in terms of the goals that readers have. An obvious choice for initial research would be to investigate Oakhill et al's role-to-role and role-to-name strategies. This would shed some light on the interplay between comprehension driven by the information contained within texts versus comprehension driven by the reader's goals.

IN CONCLUSION

The results of the experiments carried out in this thesis were not sufficient to determine with any confidence whether readers routinely make use of minimal or constructionist processes when comprehending pronouns. The results instead seemed to suggest that the type of task carried out had more effect on the type of information used to resolve pronoun assignment (and thus indicate which general strategy was used -minimal or constructionist). This finding is in line with recent research (Garnham et al 1992, Graesser et al 1994; McKoon and Ratcliff, 1992; Oakhill et al, 1989; Vonk and Noordman 1989) suggesting that:

"Reader goals must be carefully analysed in experiments conducted in discourse processing. The task demand constrain the goals that readers adopt and therefore the inferences they construct." Graesser et al, 1994, p.377

The results obtained may be interpreted as suggesting that subjects were adopting different processing strategies depending on the goals of the task, either the explicit demands of the task or implicit goals set up by themselves. However, despite the difficulty in interpreting the results in terms of the strategic processes used in pronoun comprehension, the results were easier to interpret in terms of the specific goals of the thesis.

The results suggest that both spatial information and the type of sentence structure that characters appear in (in terms of the conjunction used) may be a cue to the construction of 'group referents' from characters introduced individually in sentences/short texts. These findings are in line with the predictions of Eschenbach et al (1989), Rehkamper (1990) and Sanford and Lockhart (1991).

The results of the experiments investigating the use of thematic role as a cue to the resolution of ambiguous singular pronouns, suggest that thematic role is made use of in preference to information about the roles played by the characters in real world situations. This supports the findings of Stevenson et al (1994) who also found that thematic role was used as a cue to pronoun assignment.

The findings of the use of spatial information/linguistic conjunction and thematic role information may be explained in terms of the operation of a focus/activation mechanism. The differences in results occurring between task types may be explained in terms of Graesser et al's (1994) "search-after-meaning" model.

The findings overall seem to emphasise the need for a change of focus in language research. The role played by the McKoon and Ratcliff paper (1992) in highlighting this need must be acknowledged. Although the minimalist hypothesis was undoubtedly flawed, possibly its greatest contribution to the language comprehension literature was in the way it focused attention on research

on the fundamental assumptions made in psycholinguistic research. As Keenan (1993) pointed out:

"It is a call to researchers to revise our intuitions about reading so as to be more in line with the data...At the same time, it is a call to perhaps revise the data base." Keenan, J.M., 1993.

It may be that the trends noted by Garnham and Oakhill (1992) in recent language research reflect this view. The move towards emphasising the role of the reader in language processing (Garnham et al, 1992; Graesser et al, 1994; McKoon and Ratcliff, 1992; Oakhill et al, 1989; Vonk and Noordman, 1989) appears to suggest that future research in psycholinguistics will reflect a more equal distribution of 'psychological' and 'linguistic' input. Instead of research assuming that comprehension is driven by the information being processed, it is possible that a more 'reader-centred' approach may be taken in future.

APPENDIX 1: MATERIALS USED IN EXPERIMENT 1

Sentence conditions as follows:

a) Apart description/reference to 1st mentioned individual.

b) Apart description/reference to 2nd mentioned individual.

c) Apart description/reference to both individuals.

d) Together description/reference to 1st mentioned individual.

e) Together description/reference to 1st mentioned individual.

f) Together description/reference to 1st mentioned individual.

1a) Paul moved away from Fiona and/he was pleased to do so.

b) Paul moved away from Fiona and/she heaved a sigh of relief.

c) Paul moved away from Fiona and/they parted the best of friends.

d) Paul moved towards Fiona and/he tripped up on the way.

e) Paul moved towards Fiona and/she was surprised and moved away.

f) Paul moved towards Fiona and/they walked away under the trees.

2a) Len drove away from Maisie and/he crashed into a brick wall.

b) Len drove away from Maisie and/she waved at the disappearing car.

c) Len drove away from Maisie and/they were not to meet again.

d) Len drove towards Maisie and/he braked at the last minute.

e) Len drove towards Maisie and/she jumped out of the way.

f) Len drove towards Maisie and/they went out for a meal.

3a) Ted swam away from Ruth and/he did not come back again.

b) Ted swam away from Ruth and/she followed as fast as possible.

c) Ted swam away from Ruth and/they played tag in the pool.

d) Ted swam towards Ruth and/he covered the distance very rapidly.

e) Ted swam towards Ruth and/she swam away at top speed.

f) Ted swam towards Ruth and/they stood talking in the water.

4a) Roger limped away from Charlotte and/he looked around for a bandage.

b) Roger limped away from Charlotte and/she stared horrified at the wound.

c) Roger limped away from Charlotte and/they sadly waved a final goodbye.

d) Roger limped towards Charlotte and/he cried out with the pain.

e) Roger limped towards Charlotte and/she followed to offer some help.

f) Roger limped towards Charlotte and/they called out for some help.

5a) Simon ran away from Julia and/he fell over on the way.

b) Simon ran away from Julia and/she soon followed at great speed.

c) Simon ran away from Julia and/they didn't intend to meet again.

d) Simon ran towards Julia and/he tripped up on the way.

e) Simon ran towards Julia and/she was frightened and moved away.

f) Simon ran towards Julia and/they were glad to meet up again.

6a) Leo walked away from Laura and/he refused to go back again.

b) Leo walked away from Laura and/she stood watching in the rain.

c) Leo walked away from Laura and/they met later at the car.

d) Leo walked towards Laura and/he fell over on the way.

e) Leo walked towards Laura and/she turned and walked quickly away.

f) Leo walked towards Laura and/they sauntered away hand in hand.

7a) George strolled away from Katie and/he suddenly turned and came back.

b) George strolled away from Katie and/she wondered whether to follow behind.

c) George strolled away from Katie and/they were sad about the parting.

d) George strolled towards Katie and/he whistled cheerfully on the way.

e) George strolled towards Katie and/she walked quickly the other way.

f) George strolled towards Katie and/they made friends in no time.

8a) Steve strode away from Shirley and/he almost broke into a run.

b) Steve strode away from Shirley and/she heaved a sigh of relief.

c) Steve strode away from Shirley and/they were undoubtedly no longer friends.

d) Steve strode towards Shirley and/he was obviously very angry indeed.

e) Steve strode towards Shirley and/she stood still trembling with fear.

f) Steve strode towards Shirley and/they immediately began to argue heatedly.

9a) Karen tiptoed away from Jim and/he was completely unaware of it.

b) Karen tiptoed away from Jim and/she hoped not to be discovered.

c) Karen tiptoed away from Jim and/they carried on in single file.

d) Karen tiptoed towards Jim and/he didn't realise anyone was there.

e) Karen tiptoed towards Jim and/she moved as quietly as possible.

f) Karen tiptoed towards Jim and/they quietly discussed how to escape.

10a) Heather crawled away from Phil and/he started to cry very loudly.

b) Heather crawled away from Phil and/she was hidden by the bushes.

c) Heather crawled away from Phil and/they were soon quite far apart.

d) Heather crawled towards Phil and/he tried to shuffle along behind.

e) Heather crawled towards Phil and/she made very good progress indeed.

f) Heather crawled towards Phil and/they huddled together in the corner.

11a) Anna crept away from Justin and/he didn't hear anything at all.

b) Anna crept away from Justin and/she was as quiet as possible.

c) Anna crept away from Justin and/they were soon separated and lost.

d) Anna crept towards Justin and/he didn't hear the stealthy approach.

e) Anna crept towards Justin and/she kept as low as possible.

f) Anna crept towards Justin and/they were soon only inches apart.

12a) Marianne hopped away from Douglas and/he tried to hop along behind.

b) Marianne hopped away from Douglas and/she hopped out of the room.

c) Marianne hopped away from Douglas and/they tried to hop all day.

d) Marianne hopped towards Douglas and/he dodged out of the way.

e) Marianne hopped towards Douglas and/she ended up out of breath.

f) Marianne hopped towards Douglas and/they prepared for the sack race.

13a) Denise pedalled away from Richard and/he tried hard to keep up.

b) Denise pedalled away from Richard and/she disappeared quickly down the hill.

c) Denise pedalled away from Richard and/they raced all the way home.

d) Denise pedalled towards Richard and/he tried hard to get away.

e) Denise pedalled towards Richard and/she closed the distance very rapidly.

f) Denise pedalled towards Richard and/they rode home in single file.

14a) Debbie sprinted away from Neil and/he realised victory was slipping away.

b) Debbie sprinted away from Neil and/she reached the finishing line first.

c) Debbie sprinted away from Neil and/they were usually so evenly matched.

d) Debbie sprinted towards Neil and/he was alarmed and turned away.

e) Debbie sprinted towards Neil and/she caught up in no time.

f) Debbie sprinted towards Neil and/they were pleased to meet again.

15a) Alice sauntered away from Stanley and/he decided to follow behind slowly.

b) Alice sauntered away from Stanley and/she whistled happily on the way.

c) Alice sauntered away from Stanley and/they decided not to meet later.

d) Alice sauntered towards Stanley and/he shouted and waved a hand.

e) Alice sauntered towards Stanley and/she refused to go any faster.

f) Alice sauntered towards Stanley and/they embraced warmly and chatted happily.

16a) Tracy marched away from Peter and/he was left sad and alone.

b) Tracy marched away from Peter and/she was in a terrible mood.

c) Tracy marched away from Peter and/they were saddened by the separation.

d) Tracy marched towards Peter and/he leapt up from the chair.

e) Tracy marched towards Peter and/she sang merrily on the way.

f) Tracy marched towards Peter and/they had a long conversation together.

17a) John galloped away from Rachel and/he followed the old bridle path.

b) John galloped away from Rachel and/she successfully managed to keep pace.

c) John galloped away from Rachel and/they were soon hurtling towards home.

d) John galloped towards Rachel and/he got there in no time.

e) John galloped towards Rachel and/she waved and shouted a greeting.

f) John galloped towards Rachel and/they rode to the old mill.

18a) Anita trotted away from Stuart and/he raised a hand to wave.

b) Anita trotted away from Stuart and/she refused to stop and wait.

c) Anita trotted away from Stuart and/they promised to meet again soon.

d) Anita trotted towards Stuart and/he quickly ducked out of sight.

e) Anita trotted towards Stuart and/she asked where the showers were.

f) Anita trotted towards Stuart and/they headed for the tennis courts.

APPENDIX 2: MATERIALS USED IN EXPERIMENT 2

Sentence conditions as follows:

a) Apart description

b) Together description

1a) Paul moved away from Fiona and

b) Paul moved towards Fiona and

2a) Len drove away from Maisie and

b) Len drove towards Maisie and

3a) Ted swam away from Ruth and

b) Ted swam towards Ruth and

4a) Roger limped away from Charlotte and

b) Roger limped towards Charlotte and

5a) Simon ran away from Julia and

b) Simon ran towards Julia and

6a) Leo walked away from Laura and

b) Leo walked towards Laura and

7a) George strolled away from Katie and

b) George strolled towards Katie and

8a) Steve strode away from Shirley and

b) Steve strode towards Shirley and

9a) Karen tiptoed away from Jim and

b) Karen tiptoed towards Jim and

10a) Heather crawled away from Phil and

b) Heather crawled towards Phil and

11a) Anna crept away from Justin and

b) Anna crept towards Justin and

12a) Marianne hopped away from Douglas and

b) Marianne hopped towards Douglas and

13a) Denise pedalled away from Richard and

b) Denise pedalled towards Richard and

14a) Debbie sprinted away from Neil and

b) Debbie sprinted towards Neil and

15a) Alice sauntered away from Stanley and

b) Alice sauntered towards Stanley and

16a) Tracy marched away from Peter and

b) Tracy marched towards Peter and

17a) John galloped away from Rachel and

b) John galloped towards Rachel and

18a) Anita trotted away from Stuart and

b) Anita trotted towards Stuart and

APPENDIX 3: MATERIALS USED IN EXPERIMENT 3

Sentence conditions as follows;

a) Apart description/reference to 1st mentioned individual

b) Apart description/reference to 2nd mentioned individual

c) Apart description/reference to both individuals

d) Together description/reference to 1st mentioned individual

e) Together description/reference to 2nd mentioned individual

f) Together description/reference to both individuals

1a) Paul walked away from Fiona and/he was pleased to do so.

b) Paul walked away from Fiona and/she heaved a sigh of relief.

c) Paul walked away from Fiona and/they parted the best of friends.

d) Paul walked behind Fiona and/he was in a terrible mood.

e) Paul walked behind Fiona and/she soon found the right path.

f) Paul walked behind Fiona and/they went deeper into the woods.

2a) Len sat apart from Maisie and/he waited to see the doctor.

b) Len sat apart from Maisie and/she waited to see the doctor.

c) Len sat apart from Maisie and/they waited to see the doctor.

d) Len sat beside Maisie and/he tried to start a conversation.

e) Len sat beside Maisie and/she tried to start a conversation.

f) Len sat beside Maisie and/they had a nice long chat.

3a) Ted swam away from Ruth and/he did not come back again.

b) Ted swam away from Ruth and/she waded back to the beach.

c) Ted swam away from Ruth and/they had a nice long chat.

d) Ted swam beside Ruth and/he had to go very slowly.

e) Ted swam beside Ruth and/she went towards the deep end.

f) Ted swam beside Ruth and/they went towards the deep end.

4a) Roger waited in the next room to Charlotte and/he anxiously paced up and down.

b) Roger waited in the next room to Charlotte and/she tried to read a magazine.

c) Roger waited in the next room to Charlotte and/they didn't like being kept apart.

d) Roger waited in the same room as Charlotte and/he tried to start a conversation.

e) Roger waited in the same room as Charlotte and/she tried to start a conversation.

f) Roger waited in the same room as Charlotte and/they had a long friendly conversation.

5a) Simon ran away from Julia and/he sprinted all the way home.

b) Simon ran away from Julia and/she didn't bother to give chase.

c) Simon ran away from Julia and/they didn't intend to meet again.

d) Simon ran with Julia and/he was acting as a pace-maker.

e) Simon ran with Julia and/she was acting as a pace-maker.

f) Simon ran with Julia and/they were training for the Olympics.

6a) Leo waited at the station for Laura and/he hoped the train wasn't late.

b) Leo waited at the station for Laura and/she was travelling up from London.

c) Leo waited at the station for Laura and/they wondered anxiously about the meeting.

d) Leo waited at the station with Laura and/he hoped the train wasn't late.

e) Leo waited at the station with Laura and/she hoped the train wasn't late.

f) Leo waited at the station with Laura and/they hoped the train wasn't late.

7a) George strolled away from Katie and/he didn't bother to say goodbye.

b) George strolled away from Katie and/she went to see a film.

c) George strolled away from Katie and/they were sad about the parting.

d) George strolled along with Katie and/he enjoyed walking through the park.

e) George strolled along with Katie and/she enjoyed walking through the park.

f) George strolled along with Katie and/they enjoyed walking through

the park.

8a) Steve jogged in the opposite direction to Shirley and/he was beginning to feel tired.

b) Steve jogged in the opposite direction to Shirley and/she heaved a sigh of relief.

c) Steve jogged in the opposite direction to Shirley and/they were undoubtedly no longer friends.

d) Steve jogged around the park with Shirley and/he was beginning to feel tired.

e) Steve jogged around the park with Shirley and/she was beginning to feel tired.

f) Steve jogged around the park with Shirley and/they were beginning to feel tired.

9a) Karen tiptoed away from Jim and/she didn't want to be discovered.

b) Karen tiptoed away from Jim and/he was completely unaware of it.

c) Karen tiptoed away from Jim and/they didn't meet again after that.

d) Karen tiptoed alongside Jim and/she was worried about being heard.

e) Karen tiptoed alongside Jim and/he was worried about being heard.

f) Karen tiptoed alongside Jim and/they were worried about being heard.

10a) Heather left Phil and/she was miserable for weeks afterwards.

b) Heather left Phil and/he was miserable for weeks afterwards.

c) Heather left Phil and/they didn't intend to meet again.

d) Heather met Phil and/she was about an hour late.

e) Heather met Phil and/he handed over the offending letter.

f) Heather met Phil and/they chatted happily all evening long.

11a) Anna crept away from Justin and/she was as quiet as possible.

b) Anna crept away from Justin and/he was left alone and afraid.

c) Anna crept away from Justin and/they were soon separated and lost.

d) Anna crept along with Justin and/she tried to move completely silently.

e) Anna crept along with Justin and/he tried to move completely silently.

f) Anna crept along with Justin and/they tried to move completely silently.

12a) Maisie talked to Douglas and/she missed the last bus home.

b) Maisie talked to Douglas and/he missed the last bus home.

c) Maisie talked to Douglas and/they agreed to meet again later.

d) Maisie wrote to Douglas and/she received a reply weeks later.

e) Maisie wrote to Douglas and/he received the letter weeks later.

f) Maisie wrote to Douglas and/they arranged to meet in London.

13a) Denise pedalled away from Richard and/she disappeared quickly down
the road.

b) Denise pedalled away from Richard and/he frantically tried to keep up.

c) Denise pedalled away from Richard and/they were separated in the traffic.

d) Denise pedalled in front of Richard and/she loved cycling on the tandem.

e) Denise pedalled in front of Richard and/he managed to keep pace easily.

f) Denise pedalled in front of Richard and/they cycled home in single file.

14a) Debbie sprinted away from Neil and/she reached home in record time.

b) Debbie sprinted away from Neil and/he was unable to keep up.

c) Debbie sprinted away from Neil and/they were soon some distance apart.

d) Debbie sprinted next to Neil and/she was beginning to feel tired.

e) Debbie sprinted next to Neil and/he was determined not to lose.

f) Debbie sprinted next to Neil and/they cycled home in single file.

15a) Alice sauntered away from Stanley and/she was soon out of sight.

b) Alice sauntered away from Stanley and/he was soon left far behind.

c) Alice sauntered away from Stanley and/they decided not to meet again.

d) Alice sauntered along with Stanley and/she refused to go any faster.

e) Alice sauntered along with Stanley and/he enjoyed the hot summer evening.

f) Alice sauntered along with Stanley and/they enjoyed the hot summer evening.

16a) Tracy marched away from Peter and/she refused to stop and wait.

b) Tracy marched away from Peter and/he was left without a partner.

c) Tracy marched away from Peter and/they were never to meet again.

d) Tracy marched behind Peter and/she loved being in big parades.

e) Tracy marched behind Peter and/he loved being in big parades.

f) Tracy marched behind Peter and/they were in the same parade.

17a) John galloped away from Rachel and/he followed the old bridle path.

b) John galloped away from Rachel and/she successfully managed to keep pace.

c) John galloped away from Rachel and/they returned to the stables separately.

d) John galloped alongside Rachel and/he enjoyed riding with other people.

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e) John galloped alongside Rachel and/she enjoyed riding with other people.

f) John galloped alongside Rachel and/they rode to the old mill.

18a) Anita trotted away from Stuart and/she refused to stop and wait.

b) Anita trotted away from Stuart and/he went back into the stable.

c) Anita trotted away from Stuart and/they agreed to meet again soon.

d) Anita trotted beside Stuart and/she liked riding with other people.

e) Anita trotted beside Stuart and/he liked riding with other people.

f) Anita trotted beside Stuart and/they went down by the river.

Sentence conditions as follows:

a) Apart description

b) Together description

1a) Paul walked away from Fiona and

b) Paul walked behind Fiona and

2a) Len sat apart from Maisie and

b) Len sat beside Maisie and

3a) Ted swam away from Ruth and

b) Ted swam beside Ruth and

4a) Roger waited in the next room to Charlotte and

b) Roger waited in the same room as Charlotte and

5a) Simon ran away from Julia and

b) Simon ran with Julia and

6a) Leo waited at the station for Laura and

b) Leo waited at the station with Laura and

7a) George strolled away from Katie and

b) George strolled along with Katie and

8a) Steve jogged in the opposite direction to Shirley and

b) Steve jogged around the park with Shirley and

9a) Karen tiptoed away from Jim and

b) Karen tiptoed alongside Jim and

10a) Heather left Phil and

b) Heather met Phil and

11a) Anna crept away from Justin and

b) Anna crept along with Justin and

12a) Maisie talked to Douglas and

b) Maisie wrote to Douglas and

13a) Denise pedalled away from Richard and

b) Denise pedalled in front of Richard and

14a) Debbie sprinted away from Neil and

b) Debbie sprinted next to Neil and

15a) Alice sauntered away from Stanley and

b) Alice sauntered along with Stanley and

16a) Tracy marched away from Peter and

b) Tracy marched behind Peter and

17a) John galloped away from Rachel and

b) John galloped alongside Rachel and

18a) Anita trotted away from Stuart and

b) Anita trotted beside Stuart and

APPENDIX 5: MATERIALS USED IN EXPERIMENT 5

Sentence conditions as follows;

a) Conjoined NPs/Together description/reference to 1st mentioned individual

b) Conjoined NPs/Together description/reference to 2nd mentioned individual

c) Conjoined NPs/Together description/reference to both individuals

d) Subj.-Predicate/Together description/reference to 1st mentioned individual

e) Subj.-Predicate/Together description/reference to 2nd mentioned individual

f) Subj.-Predicate/Together description/reference to both individuals.

g) Conjoined NPs/Apart description/reference to 1st mentioned individual

h) Conjoined NPs/Apart description/reference to 2nd mentioned individual

i) Conjoined NPs/Apart description/reference to both individuals

j) Subj.-Predicate/Apart description/reference to 1st mentioned individual

k) Subj.-Predicate/Apart description/reference to 2nd mentioned individual

l) Subj.-Predicate/Apart description/reference to both individuals

TOGETHER CONTEXT SENTENCES

John and Karen were in the science lab when the brand new equipment arrived. It was very tightly packed and very hard to assemble.

1a) John and Karen read the instructions and/he was even more confused afterwards.

b) John and Karen read the instructions and/she was even more confused afterwards.

c) John and Karen read the instructions and/they were even more confused afterwards.

d) John read the instructions to Karen and/he found them difficult to understand.

e) John read the instructions to Karen and/she found them difficult to understand.

f) John read the instructions to Karen and/they found them difficult to understand.

APART CONTEXT SENTENCES

John was in the lab and Karen in the equipment room, when the brand new equipment arrived. It was very tightly packed and very hard to assemble.

g) John and Karen read the instructions and/he was even more confused afterwards.

h) John and Karen read the instructions and/she was even more confused afterwards.

i) John and Karen read the instructions and/they were even more confused afterwards.

j) John phoned Karen about the instructions and/he was even more confused afterwards.

k) John phoned Karen about the instructions and/she was even more confused afterwards.

l John phoned Karen about the instructions and/they were even more confused afterwards.

TOGETHER CONTEXT SENTENCES

Emma and Garry were at the supermarket buying the week's shopping. It was very heavy and cumbersome, and cost a lot of money.

2a) Garry and Emma carried the bags and/he was soon quite worn out.

b) Garry and Emma carried the bags and/she was soon quite worn out.

c) Garry and Emma carried the bags and/they were soon quite worn out.

d) Garry carried the bags for Emma and/he was soon quite worn out.

e) Garry carried the bags for Emma and/she was grateful for the help.

f) Garry carried the bags for Emma and/they were soon back at home.

APART CONTEXT SENTENCES

Emma was at the supermarket and Garry at the fruit stall, buying the week's

shopping. It was very heavy and cumbersome, and cost a lot of money.

g) Garry and Emma carried the bags and/he was soon quite worn out.

h) Garry and Emma carried the bags and/she was soon quite worn out.

i) Garry and Emma carried the bags and/they were soon quite worn out.

j) Garry carried the bags for Emma and/he walked quickly to the car.

k) Garry carried the bags for Emma and/she walked quickly to the car.

l) Garry carried the bags for Emma and/they walked quickly to the car.

TOGETHER CONTEXT SENTENCES

Andrew and Kate were at the post-office waiting in the queue. It was

crowded and very stuffy inside, but the windows wouldn't open.

3a) Andrew and Kate posted a letter and/he bought another book of stamps.

b) Andrew and Kate posted a letter and/she bought another book of stamps.

c) Andrew and Kate posted a letter and/they went to the cinema afterwards.

d) Andrew posted a letter for Kate and/he bought another book of stamps.

e) Andrew posted a letter for Kate and/she bought another book of stamps.

f) Andrew posted a letter for Kate and/they went to the cinema

afterwards.

APART CONTEXT SENTENCES

Andrew went into the post office while Kate was at the post-box.

Although it was a bright, sunny day, there was a very cold wind.

g) Andrew and Kate posted a letter and/he bought another book of stamps.

h) Andrew and Kate posted a letter and/she needed another book of stamps.

i) Andrew and Kate posted a letter and/they went to the cinema afterwards.

j) Andrew posted a letter for Kate and/he bought another book of stamps.

k) Andrew posted a letter for Kate and/she checked the mail collection times.

l) Andrew posted a letter for Kate and/they went to the cinema afterwards.

TOGETHER CONTEXT SENTENCES

Ellen and Alan were in the kitchen and a cookery programme was on T.V.

It was showing a recipe for "Peking Duck", which sounded delicious.

4a) Alan and Ellen cooked a meal and/he used too much salt again.

b) Alan and Ellen cooked a meal and/she used too much salt again.

c) Alan and Ellen cooked a meal and/they used too much salt again.

d) Alan cooked a meal for Ellen and/he used too much salt again.

e) Alan cooked a meal for Ellen and/she objected to all the salt.

f) Alan cooked a meal for Ellen and/they argued about the washing up.

APART CONTEXT SENTENCES

Ellen was in the tea room at work, and Alan was in the kitchen at home. It was that time of day when nothing seems really satisfying.

g) Alan and Ellen made some tea and/he looked everywhere for the sugar.

h) Alan and Ellen made some tea and/she looked everywhere for the sugar.

i) Alan and Ellen made some tea and/they looked everywhere for the sugar.

j) Alan made some tea for Ellen and/he hoped it wouldn't get cold.

k) Alan made some tea for Ellen and/she hoped it wouldn't get cold.

l) Alan made some tea for Ellen and/they argued because it got cold.

TOGETHER CONTEXT SENTENCES

Paul and Ruth were at home waiting for the racing results on television. It was Saturday afternoon and the horse racing coverage was very good.

5a) Paul and Ruth won some money and/he spent it all on alcohol.

b) Paul and Ruth won some money and/she spent it all on alcohol.

c) Paul and Ruth won some money and/they spent it all on alcohol.

d) Paul won some money from Ruth and/he spent it all on alcohol.

e) Paul won some money from Ruth and/she handed it over very reluctantly.

f) Paul won some money from Ruth and/they fell out over the wager.

APART CONTEXT SENTENCES

Paul was at the betting shop, Ruth was at home. It was Saturday afternoon and the horse-racing coverage had just finished.

g) Paul and Ruth won some money and/he told everyone the good news.

h) Paul and Ruth won some money and/she told everyone the good news.

i) Paul and Ruth won some money and/they told everyone the good news.

j) Paul won some money from Ruth and/he went over to collect it.

k) Paul won some money from Ruth and/she handed it over at work.

l) Paul won some money from Ruth and/they fell out over the wager.

TOGETHER CONTEXT SENTENCES

Marie and Frank were in town with Christmas gifts for friends. It had been difficult to know what to buy, but the perfume seemed ideal.

6a)   Frank and Marie delivered the parcel and/he hoped it would be appreciated.

b)   Frank and Marie delivered the parcel and/she hoped it would be appreciated.

c) Frank and Marie delivered the parcel and/they hoped it would be appreciated.

d) Frank delivered the parcel for Marie and/he hoped it would be appreciated.

e) Frank delivered the parcel for Marie and/she hoped it would be appreciated.

f) Frank delivered the parcel for Marie and/they hoped it would be appreciated.

APART CONTEXT SENTENCES

Marie was in the high street, while Frank was in Bridge street, and the shops were full of Christmas gifts but the perfume seemed the ideal present.

g) Frank and Marie delivered the parcel and/he hoped it would be appreciated.

h) Frank and Marie delivered the parcel and/she hoped it would be appreciated.

i) Frank and Marie delivered the parcel and/they hoped it would be appreciated.

j) Frank delivered the parcel for Marie and/he hoped it would be appreciated.

k) Frank delivered the parcel for Marie and/she hoped it would be appreciated.

l) Frank delivered the parcel for Marie and/they hoped it would be appreciated.

TOGETHER CONTEXT SENTENCES

Dave and Joyce were at the garage, examining the cars on display. It was summer and lots of people were organising touring holidays.

7a) Dave and Joyce hired a car and/he paid for it in advance.

b) Dave and Joyce hired a car and/she paid for it in advance.

c) Dave and Joyce hired a car and/they paid for it in advance.

d) Dave hired a car from Joyce and/he paid for it in advance.

e) Dave hired a car from Joyce and/she asked for payment in advance.

f) Dave hired a car from Joyce and/they sorted out the insurance arrangements.

APART CONTEXT SENTENCES

Dave was at a telephone box, Joyce was in a car showroom. It was summer and lots of people were organising touring holidays.

g) Dave and Joyce hired a car and/he paid for it in advance.

h) Dave and Joyce hired a car and/she paid for it in advance.

i) Dave and Joyce hired a car and/they paid for it in advance.

j) Dave hired a car from Joyce and/he paid for it in advance.

k) Dave hired a car from Joyce and/she asked for payment in advance.

l) Dave hired a car from Joyce and/they had sorted out the insurance.

TOGETHER CONTEXT SENTENCES

Debbie and Colin were in town when it started raining. It was a cold, damp and miserable day.

8a) Colin and Debbie walked to the shops and/he complained about the wet weather.

b) Colin and Debbie walked to the shops and/she complained about the wet. weather.

c) Colin and Debbie walked to the shops and/they complained about the wet weather.

d) Colin walked Debbie to the shops and/he complained about the wet weather.

e) Colin walked Debbie to the shops and/she complained about the wet weather.

f) Colin walked Debbie to the shops and/they complained about the wet weather.

APART CONTEXT SENTENCES

Debbie was just outside town, Colin was in the high street when the downpour started. It was a cold, damp, and miserable day.

g) Colin and Debbie walked to the shops and/he wished the rain would stop.

h) Colin and Debbie walked to the shops and/she wished the rain would stop.

i) Colin and Debbie walked to the shops and/they wished the rain would stop.

j) Colin walked to the shops for Debbie and/he wished the rain would stop.

k) Colin walked to the shops for Debbie and/she wished the rain would stop.

l) Colin walked to the shops for Debbie and/they wished the rain would stop.

TOGETHER CONTEXT SENTENCES

Elaine and Max were in the car during rush hour. The city seemed to be especially crowded that day.

9a) Max and Elaine studied the map and/he decided to turn first left.

b) Max and Elaine drove to town and/she decided to turn first left.

c) Max and Elaine drove to town and/they decided to turn first left.

d) Max showed Elaine the map and/he decided to turn first left.

e) Max showed Elaine the map and/she decided to turn first left.

f) Max showed Elaine the map and/they decided to turn first left.

APART CONTEXT SENTENCES

Elaine was on the motorway, Max on a dual carriageway. The city seemed to be especially crowded that day and all the roads were packed with traffic.

g) Max and Elaine studied the map and/he decided to avoid the town.

h) Max and Elaine studied the map and/she decided to avoid the town.

i) Max and Elaine studied the map and/they decided to avoid the town.

j) Max carried a map for Elaine and/he decided to avoid the town.

k) Max carried a map for Elaine and/she did not know about it.

l) Max carried a map for Elaine and/they waited impatiently in the traffic.

TOGETHER CONTEXT SENTENCES

Stan and Eileen were in the park on a sunny spring day. It was warm and the trees swayed in the breeze.

10a) Stan and Eileen sat on a park bench and/he fed the ducks some bread.

b) Stan and Eileen sat on a park bench and/she fed the ducks some bread.

c) Stan and Eileen sat on a park bench and/they fed the ducks some bread.

d) Stan sat on a park bench near Eileen and/he fed the ducks some bread.

e) Stan sat on a park bench near Eileen and/she fed the ducks some bread.

f) Stan sat on a park bench near Eileen and/they fed the ducks some bread.

APART CONTEXT SENTENCES

Stan was near the pond, Eileen beneath a tree. It was warm and the trees swayed in the breeze.

g) Stan and Eileen sat on a park bench and/he fed the ducks some bread.

h) Stan and Eileen sat on a park bench and/she fed the ducks some bread.

i) Stan and Eileen sat on a park bench and/they fed the ducks some bread.

j) Stan sat on a park bench away from Eileen and/he fed the ducks some bread.

k) Stan sat on a park bench away from Eileen and/she fed the ducks some bread.

l) Stan sat on a park bench away from Eileen and/they fed the ducks some bread.

TOGETHER CONTEXT SENTENCES

Jean and Tom were at the airport, at the baggage check-in desk. There were lots of people there and the flight would be crowded.

11a) Tom and Jean stood in the queue and/he was utterly sick of waiting.

b) Tom and Jean stood in the queue and/she was utterly sick of waiting.

c) Tom and Jean stood in the queue and/they were utterly sick of waiting.

d) Tom stood in the next queue to Jean and/he was utterly sick of waiting.

e) Tom stood in the next queue to Jean and/she was utterly sick of waiting.

f) Tom stood in the next queue to Jean and/they were utterly sick of waiting.

APART CONTEXT SENTENCES

Jean was in the cafeteria, John at the baggage check-in desk. The airport was crowded and the flight was delayed.

g) Tom and Jean stood in the queues and/he was utterly sick of waiting.

h) Tom and Jean stood in the queues and/she was utterly sick of waiting.

i) Tom and Jean stood in the queues and/they were utterly sick of waiting.

j) Tom stood in a longer queue than Jean and/he was utterly sick of waiting.

k) Tom stood in a longer queue than Jean and/she was utterly sick of waiting.

l) Tom stood in a longer queue than Jean and/they were utterly sick of waiting.

TOGETHER CONTEXT SENTENCES

Graham and Victoria were at the swimming baths. The water was warm and heavily chlorinated.

12a) Graham and Victoria swam in the pool and/he stayed close to the edge.

b) Graham and Victoria swam in the pool and/she stayed close to the edge.

c) Graham and Victoria swam in the pool and/they stayed close to the edge.

d) Graham swam in the same pool as Victoria and/he stayed close to the edge.

e) Graham swam in the same pool as Victoria and/she stayed close to the edge.

f) Graham swam in the same pool as Victoria and/they stayed close to the edge.

APART CONTEXT SENTENCES

Graham was in the adult pool, Victoria in the learner's pool. The water was warm and heavily chlorinated.

g) Graham and Victoria swam in the pools and/he stayed close to the edge.

h) Graham and Victoria swam in the pools and/she stayed close to the edge.

i) Graham and Victoria swam in the pools and/they stayed close to the edge.

j) Graham swam in a larger pool than Victoria and/he stayed close to the edge.

k) Graham swam in a larger pool than Victoria and/she stayed close to the edge.

l) Graham swam in a larger pool than Victoria and/they stayed close to the edge.

TOGETHER CONTEXT SENTENCES

Gordon and Julie competed in the same race, on Sunday morning. It was a chilly day, but there was no sign of rain.

13a) Julie and Gordon ran in the marathon and/she was exhausted by the end.

b) Julie and Gordon ran in the marathon and/he was exhausted by the end.

c) Julie and Gordon ran in the marathon and/they were exhausted by the end.

d) Julie ran in the same marathon as Gordon and/she was exhausted by the end.

e) Julie ran in the same marathon as Gordon and/he was exhausted by the end.

f) Julie ran in the same marathon as Gordon and/they were exhausted by the end.

APART CONTEXT SENTENCES

Gordon was in Newcastle, Julie was in London, competing in road races. It was a chilly day but there was no sign of rain.

g) Julie and Gordon ran in different marathons and/she was exhausted by the end.

h) Julie and Gordon ran in different marathons and/he was exhausted by the end.

i) Julie and Gordon ran in different marathons and/they were exhausted by the end.

j) Julie ran in a different marathon to Gordon and/she was exhausted by the end.

k) Julie ran in a different marathon to Gordon and/he was exhausted by the end.

l) Julie ran in a different marathon to Gordon and/they were exhausted by the end.

TOGETHER CONTEXT SENTENCES

Karen and Peter were at home in the flat. It was almost time to go to the restaurant to meet some friends.

14a) Karen and Peter ordered a taxi and/she hoped it wouldn't be late.

b) Karen and Peter ordered a taxi and/he hoped it wouldn't be late.

c) Karen and Peter ordered a taxi and/they hoped it wouldn't be late.

d) Karen ordered a taxi for Peter and/she hoped it wouldn't be late.

e) Karen ordered a taxi for Peter and/he hoped it wouldn't be late.

f) Karen ordered a taxi for Peter and/they hoped it wouldn't be late.

APART CONTEXT SENTENCES

Karen was in the flat, Peter was still at work. It was almost time to go to the restaurant.

g) Karen and Peter ordered taxis and/she hoped it wouldn't be late.

h) Karen and Peter ordered taxis and/he hoped it wouldn't be late.

i) Karen and Peter ordered taxis and/they hoped it wouldn't be late.

j) Karen ordered a taxi for Peter and/she hoped it wouldn't be late.

k) Karen ordered a taxi for Peter and/he hoped it wouldn't be late.

l) Karen ordered a taxi for Peter and/they hoped it wouldn't be late.

TOGETHER CONTEXT SENTENCES

Gavin and Pam were at home on Christmas day. It was cold outside and there had been a heavy snowfall.

15a) Pam and Gavin received a Christmas card and/she couldn't recall who sent it.

b) Pam and Gavin received a Christmas card and/he couldn't recall who sent it.

c) Pam and Gavin received a Christmas card and/they couldn't recall who sent it.

d) Pam received a Christmas card from Gavin and/she had bought a present too.

e) Pam received a Christmas card from Gavin and/he also got an expensive present.

f) Pam received a Christmas card from Gavin and/they exchanged gifts after eating lunch.

APART CONTEXT SENTENCE

Gavin lived in town and Pam lived in the suburbs. On Christmas day it was cold and there had been a heavy snowfall.

g) Pam and Gavin received some Christmas cards and/she hadn't sent any this year.

h) Pam and Gavin received some Christmas cards and/he hadn't sent any this year.

i) Pam and Gavin received some Christmas cards and/they hadn't sent any this year.

j) Pam received a Christmas card from Gavin and/she had sent a present too.

k) Pam received a Christmas card from Gavin and/he also got an expensive present.

l) Pam received a Christmas card from Gavin and/they exchanged greetings cards every year.

TOGETHER CONTEXT SENTENCES

Cathy and Arthur were in the high street on a wet Autumn afternoon. It was National children's day and people were feeling charitable.

16a) Cathy and Arthur sold some raffle tickets and/she made a lot of money.

b) Cathy and Arthur sold some raffle tickets and/he made a lot of money.

c) Cathy and Arthur sold some raffle tickets and/they made a lot of money.

d) Cathy sold some raffle tickets for Arthur and/she made a lot of money.

e) Cathy sold some raffle tickets for Arthur and/he made a lot of money.

f) Cathy sold some raffle tickets for Arthur and/they made a lot of money.

APART CONTEXT SENTENCES

Cathy was in the high street, Arthur in the shopping mall on a wet Autumn afternoon. It was National children's day and people were feeling charitable.

g) Cathy and Arthur sold some raffle tickets and/she made a lot of money.

h) Cathy and Arthur sold some raffle tickets and/he made a lot of money.

i) Cathy and Arthur sold some raffle tickets and/they made a lot of money.

j) Cathy sold some raffle tickets for Arthur and/she made a lot of money.

k) Cathy sold some raffle tickets for Arthur and/he made a lot of money.

l) Cathy sold some raffle tickets for Arthur and/they made a lot of money.

TOGETHER CONTEXT SENTENCES

Simon and Lucy were at the supermarket, on a Friday evening. The prices were the lowest in town.

17a) Lucy and Simon bought some groceries and/she carried them to the car.

b) Lucy and Simon bought some groceries and/he carried them to the car.

c) Lucy and Simon bought some groceries and/they carried them to the car.

d) Lucy bought some groceries for Simon and/she carried them to the car.

e) Lucy bought some groceries for Simon and/he carried them to the car.

f) Lucy bought some groceries for Simon and/they carried them to the car.

APART CONTEXT SENTENCES

Simon was at the grocers, Lucy was at the supermarket. It was a Friday evening and lots of people were shopping.

g) Lucy and Simon bought some groceries and/she spent far too much money.

h) Lucy and Simon bought some groceries and/he spent far too much money.

i) Lucy and Simon bought some groceries and/they spent far too much money.

j) Lucy bought some groceries for Simon and/she was grateful for the favour.

k) Lucy bought some groceries for Simon and/he carried them to the car.

l) Lucy bought some groceries for Simon and/they settled the cost later on.

TOGETHER CONTEXT SENTENCES

Ann and Michael were on holiday in Cornwall in a town near Truro. The weather was fine and it didn't rain at all.

18a) Ann and Michael stayed in a hotel and/she asked for breakfast in bed.

b) Ann and Michael stayed in a hotel and/he asked for breakfast in bed.

c) Ann and Michael stayed in a hotel and/they asked for breakfast in bed.

d) Ann stayed in the same hotel room as Michael and/she asked for breakfast in bed.

e) Ann stayed in the same hotel room as Michael and/he asked for breakfast in bed.

f) Ann stayed in the same hotel room as Michael and/they asked for breakfast in bed.

APART CONTEXT SENTENCES

Ann holidayed in Cornwall as did Michael, in a town near Truro. The weather was fine and it didn't rain at all.

g) Ann and Michael stayed in a hotel and/she had a ground floor room.

h) Ann and Michael stayed in a hotel and/he had a ground floor room.

i) Ann and Michael stayed in a hotel and/they had rooms on different floors.

j) Ann stayed in the same hotel as Michael and/she had a ground floor room.

k) Ann stayed in the same hotel as Michael and/he had a ground floor room.

l) Ann stayed in the same hotel as Michael and/they had rooms on different floors.

TOGETHER CONTEXT SENTENCES

Bob and Pauline were travelling together on the same aeroplane which left from Heathrow. It was off-season and the air-fares were reduced.

19a) Pauline and Bob flew to Austria and/she regretted buying an economy ticket.

b) Pauline and Bob flew to Austria and/he regretted buying an economy ticket.

c) Pauline and Bob flew to Austria and/they regretted buying the economy tickets.

d) Pauline flew to Austria on the same plane as Bob and/she regretted buying an economy ticket.

e) Pauline flew to Austria on the same plane as Bob and/he regretted buying an economy ticket.

f) Pauline flew to Austria on the same plane as Bob and/they regretted buying the economy tickets.

APART CONTEXT SENTENCES

Bob was on a Swissair plane, Pauline on a British Airways flight. It was off-season so the airfares were cheaper.

g) Pauline and Bob flew to Austria and/she regretted buying an economy ticket.

h) Pauline and Bob flew to Austria and/he regretted buying an economy ticket.

i) Pauline and Bob flew to Austria and/they regretted buying the economy tickets.

j) Pauline flew to Austria at the same time as Bob and/she regretted buying an economy ticket.

k) Pauline flew to Austria at the same time as Bob and/he regretted buying an economy ticket.

l) Pauline flew to Austria at the same time as Bob and/they regretted buying the economy tickets.

TOGETHER CONTEXT SENTENCES

Will and Jenny had always been friends who shared everything together. One day things started to go badly wrong.

20a) Jenny and Will had stolen some money and/she felt very guilty about it.

b) Jenny and Will had stolen some money and/he felt very guilty about it.

c) Jenny and Will had stolen some money and/they felt very guilty about it.

d) Jenny had stolen some money from Will and/he didn't notice it was   missing.

e) Jenny stole some money from Will and/she felt very guilty about it.

f) Jenny stole some money from Will and/they stopped speaking because of it.

APART CONTEXT SENTENCES

Will lived in Newcastle but Jenny was at school in Durham. One day things started to go badly wrong.

g) Jenny and Will had stolen some money and/she felt very guilty about it.

h) Jenny and Will had stolen some money and/he felt very guilty about it.

i) Jenny and Will had stolen some money and/they felt very guilty about it.

j) Jenny had stolen some money from Will and/she only discovered it by accident.

k) Jenny stole some money from Will and/he felt very guilty about it.

l) Jenny stole some money from Will and/they stopped speaking because of it.

TOGETHER CONTEXT SENTENCES

Brian and Rachel were in the shopping centre. A shop-owner had hired some people to help with an advertising campaign.

21a) Rachel and Brian handed out some leaflets and/she found the job very dull.

b) Rachel and Brian handed out some leaflets and/he found the job very dull.

c) Rachel and Brian handed out some leaflets and/they found the job very dull.

d) Rachel handed out some leaflets for Brian and/she found the job very dull.

e) Rachel handed out some leaflets for Brian and/he found the job very dull.

f) Rachel handed out some leaflets for Brian and/they found the job very dull.

APART CONTEXT SENTENCES

Brian was in the high street, Rachel was in the shopping centre. A shop-owner had hired some people to help with an advertising campaign.

g) Rachel and Brian handed out some leaflets and/she found the job very dull.

h) Rachel and Brian handed out some leaflets and/he found the job very dull.

i) Rachel and Brian handed out some leaflets and/they found the job very dull.

j) Rachel handed out some leaflets for Brian and/she found the job very dull.

k) Rachel handed out some leaflets for Brian and/he was at home watching television.

l) Rachel handed out some leaflets for Brian and/they were working two different areas.

TOGETHER CONTEXT SENTENCES

Fiona and Ed played some games and had done for hours. The games were usually hard fought.

22a) Fiona and Ed played chess and/she was easily the better player.

b) Fiona and Ed played chess and/he was easily the better player.

c) Fiona and Ed played chess and/they were quite evenly matched players.

d) Fiona played chess against Ed and/she was easily the better player.

e) Fiona played chess against Ed and/he was easily the better player.

f) Fiona played chess against Ed and/they were quite evenly matched players.

APART CONTEXT SENTENCES

Fiona was at a chess-board in London, Ed at a chess-board in Watford. Chess players often played by mail and, the games were usually hard fought.

g) Fiona and Ed played chess and/she was easily the better player.

h) Fiona and Ed played chess and/he was easily the better player.

i) Fiona and Ed played chess and/they were quite evenly matched players.

j) Fiona played chess against Ed and/she was easily the better player.

k) Fiona played chess against Ed and/he was easily the better player.

l) Fiona played chess against Ed and/they were quite evenly matched players.

TOGETHER CONTEXT SENTENCES

Ken and Susan were at a restaurant at a corner table. It was an up-market place with high prices.

23a) Susan and Ken paid the bill and/she left the waiter a tip.

b) Susan and Ken paid the bill and/he left the waiter a tip.

c) Susan and Ken paid the bill and/they left the waiter a tip.

d) Susan paid the bill for Ken and/she was glad to help out.

e) Susan paid the bill for Ken and/he relaxed with a black coffee.

f) Susan paid the bill for Ken and/they left the restaurant after that.

APART CONTEXT SENTENCES

Ken sat at a corner table and Susan near the entrance to the restaurant. It was an up-market place with high prices, and it had a very snooty waiter.

g) Susan and Ken paid the bills and/she left the waiter a tip.

h) Susan and Ken paid the bills and/he left the waiter a tip.

i) Susan and Ken paid the bills and/they left the waiter a tip.

j) Susan paid the bill for Ken and/she was left with no money.

k) Susan paid the bill for Ken and/he was very embarrassed about it.

l) Susan paid the bill for Ken and/they made note of the debt.

TOGETHER CONTEXT SENTENCES

Amanda and Stuart were in the library, near the end of term. Work had built up and it was difficult to finish it all.

24a) Amanda and Stuart wrote an essay and/she worried about finishing in time.

b) Amanda and Stuart wrote an essay and/he worried about finishing in time.

c) Amanda and Stuart wrote an essay and/they worried about finishing in time.

d) Amanda wrote an essay for Stuart and/she hoped no-one would find out.

e) Amanda wrote an essay for Stuart and/he hoped no-one would find out.

f) Amanda wrote an essay for Stuart and/they hoped no-one would find out.

APART CONTEXT SENTENCES

Amanda was in the library, Stuart at the halls of residence. It was near the end of term and a huge amount of work had built up.

g) Amanda and Stuart wrote essays and/she worried about finishing in time.

h) Amanda and Stuart wrote essays and/he worried about finishing in time.

i) Amanda and Stuart wrote essays and/they worried about finishing in time.

j) Amanda wrote an essay for Stuart and/she hoped no-one would find out.

k) Amanda wrote an essay for Stuart and/he hoped no-one would find out.

l) Amanda wrote an essay for Stuart and/they hoped no-one would find out.

APPENDIX 6: MATERIALS USED IN EXPERIMENT 6

Sentence conditions as follows:

a) Conjoined NPs/Together description

b) Subj.-Predicate/Together description

c) Conjoined NPs/Apart description

d) Subj.-Predicate/Apart description

TOGETHER CONTEXT SENTENCES

John and Karen were in the science lab when the brand new equipment arrived. It was very tightly packed and very hard to assemble.

1a) John and Karen read the instructions.

b) John read the instructions to Karen.

APART CONTEXT SENTENCES

John was in the lab and Karen in the equipment room, when the brand new equipment arrived. It was very tightly packed and very hard to assemble.

c) John and Karen read the instructions.

d) John phoned Karen about the instructions.

TOGETHER CONTEXT SENTENCES

Emma and Garry were at the supermarket buying the week's shopping. It was very heavy and cumbersome, and cost a lot of money.

2a) Garry and Emma carried the bags.

b) Garry carried the bags for Emma.

APART CONTEXT SENTENCES

Emma was at the supermarket and Garry at the fruit stall, buying the week's shopping. It was very heavy and cumbersome, and cost a lot of money.

c) Garry and Emma carried the bags.

d) Garry carried the bags for Emma.

TOGETHER CONTEXT SENTENCES

Andrew and Kate were at the post-office waiting in the queue. It was crowded and very stuffy inside, but the windows wouldn't open.

3a) Andrew and Kate posted a letter.

b) Andrew posted a letter for Kate.

APART CONTEXT SENTENCES

Andrew went into the post office while Kate was at the post-box. Although it was a bright sunny day, there was a very cold wind.

c) Andrew and Kate posted a letter.

d) Andrew posted a letter for Kate.

TOGETHER CONTEXT SENTENCES

Ellen and Alan were in the kitchen and a cookery programme was on T.V. It was showing a recipe for "Peking Duck", which sounded delicious.

4a) Alan and Ellen cooked a meal.

b) Alan cooked a meal for Ellen.

APART CONTEXT SENTENCES

Ellen was in the tea room at work, and Alan was in the kitchen at home. It was that time of day when nothing seems really satisfying.

c) Alan and Ellen made some tea.

d) Alan made some tea for Ellen.

TOGETHER CONTEXT SENTENCES

Paul and Ruth were at home waiting for the racing results on television. It was Saturday afternoon and the horse racing coverage was very good.

5a) Paul and Ruth won some money.

b) Paul won some money from Ruth.

APART CONTEXT SENTENCES

Paul was at the betting shop, Ruth was at home. It was Saturday afternoon and the horse-racing coverage had just finished.

c) Paul and Ruth won some money.

d) Paul won some money from Ruth.

TOGETHER CONTEXT SENTENCES

Marie and Frank were in town with Christmas gifts for friends. It had been difficult to know what to buy, but the perfume seemed ideal.

6a) Frank and Marie delivered the parcel.

b) Frank delivered the parcel for Marie.

APART CONTEXT SENTENCES

Marie was in the high street, while Frank was in Bridge street, and the shops were full of Christmas gifts but the perfume seemed the ideal present.

c) Frank and Marie delivered the parcel.

d) Frank delivered the parcel for Marie.

TOGETHER CONTEXT SENTENCES

Dave and Joyce were at the garage, examining the cars on display. It was summer and lots of people were organising touring holidays.

7a) Dave and Joyce hired a car.

b) Dave hired a car from Joyce.

APART CONTEXT SENTENCES

Dave was at a telephone box, Joyce was in a car showroom. It was summer and lots of people were organising touring holidays.

c) Dave and Joyce hired a car.

d) Dave hired a car from Joyce.

TOGETHER CONTEXT SENTENCES

Debbie and Colin were in town when it started raining. It was a cold, damp and miserable day.

8a) Colin and Debbie walked to the shops.

b) Colin walked Debbie to the shops.

Debbie was just outside town, Colin was in the high street when the downpour started. It was a cold, damp, and miserable day.

c) Colin and Debbie walked to the shops.

d) Colin walked to the shops for Debbie.

TOGETHER CONTEXT SENTENCES

Elaine and Max were in the car during rush hour. The city seemed to be especially crowded that day.

9a) Max and Elaine studied the map.

b) Max showed Elaine the map.

APART CONTEXT SENTENCES

Elaine was on the motorway, Max on a dual carriageway. The city seemed to be especially crowded that day and all the roads were packed with traffic.

c) Max and Elaine studied the map.

d) Max carried a map for Elaine.

TOGETHER CONTEXT SENTENCES

Stan and Eileen were in the park on a sunny spring day. It was warm and the trees swayed in the breeze.

10a) Stan and Eileen sat on a park bench.

b) Stan sat on a park bench near Eileen.

APART CONTEXT SENTENCES

Stan was near the pond, Eileen beneath a tree. It was warm and the trees swayed in the breeze.

c) Stan and Eileen sat on a park bench.

d) Stan sat on a park bench away from Eileen.

TOGETHER CONTEXT SENTENCES

Jean and Tom were at the airport, at the baggage check-in desk. There were lots of people there and the flight would be crowded.

11a) Tom and Jean stood in the queue.

b) Tom stood in the next queue to Jean.

APART CONTEXT SENTENCES

Jean was in the cafeteria, John at the baggage check-in desk. The airport was crowded and the flight was delayed.

c) Tom and Jean stood in the queues.

d) Tom stood in a longer queue than Jean.

TOGETHER CONTEXT SENTENCES

Graham and Victoria were at the swimming baths. The water was warm and heavily chlorinated.

12a) Graham and Victoria swam in the pool.

b) Graham swam in the same pool as Victoria.

APART CONTEXT SENTENCES

Graham was in the adult pool, Victoria in the learner's pool. The water was warm and heavily chlorinated.

c) Graham and Victoria swam in the pools.

d) Graham swam in a larger pool than Victoria.

TOGETHER CONTEXT SENTENCES

Gordon and Julie competed in the same race, on Sunday morning. It was a chilly day, but there was no sign of rain.

13a) Julie and Gordon ran in the marathon.

b) Julie ran in the same marathon as Gordon.

APART CONTEXT SENTENCES

Gordon was in Newcastle, Julie was in London, competing in road races. It was a chilly day but there was no sign of rain.

c) Julie and Gordon ran in different marathons.

d) Julie ran in a different marathon to Gordon.

TOGETHER CONTEXT SENTENCES

Karen and Peter were at home in the flat. It was almost time to go to the restaurant to meet some friends.

14a Karen and Peter ordered a taxi.

b Karen ordered a taxi for Peter.

APART CONTEXT SENTENCES

Karen was in the flat, Peter was still at work. It was almost time to go to the restaurant.

c) Karen and Peter ordered taxis.

d) Karen ordered a taxi for Peter.

TOGETHER CONTEXT SENTENCES

Gavin and Pam were at home on Christmas day. It was cold outside and there had been a heavy snowfall.

15a) Pam and Gavin received a Christmas card.

b) Pam received a Christmas card from Gavin.

APART CONTEXT SENTENCES

Gavin lived in town and Pam lived in the suburbs. On Christmas day it was cold and there had been a heavy snowfall.

c) Pam and Gavin received some Christmas cards.

d) Pam received a Christmas card from Gavin.

TOGETHER CONTEXT SENTENCES

Cathy and Arthur were in the high street on a wet Autumn afternoon. It was National children's day and people were feeling charitable.

16a) Cathy and Arthur sold some raffle tickets.

b) Cathy sold some raffle tickets for Arthur.

APART CONTEXT SENTENCES

Cathy was in the high street, Arthur in the shopping mall on a wet Autumn afternoon. It was National children's day and people were feeling charitable.

c) Cathy and Arthur sold some raffle tickets.

d) Cathy sold some raffle tickets for Arthur.

TOGETHER CONTEXT SENTENCES

Simon and Lucy were at the supermarket, on a Friday evening. The prices were the lowest in town.

17a) Lucy and Simon bought some groceries.

b) Lucy bought some groceries for Simon.

APART CONTEXT SENTENCES

Simon was at the grocers, Lucy was at the supermarket. It was a Friday evening and lots of people were shopping.

c) Lucy and Simon bought some groceries.

d) Lucy bought some groceries for Simon.

Ann and Michael were on holiday in Cornwall in a town near Truro. The weather was fine and it didn't rain at all.

18a) Ann and Michael stayed in a hotel.

b Ann stayed in the same hotel room as Michael.

APART CONTEXT SENTENCES

Ann holidayed in Cornwall as did Michael, in a town near Truro. The weather was fine and it didn't rain at all.

c) Ann and Michael stayed in a hotel.

d) Ann stayed in the same hotel as Michael.

TOGETHER CONTEXT SENTENCES

Bob and Pauline were travelling together on the same aeroplane which left from Heathrow. It was off-season and the air-fares were reduced.

19a) Pauline and Bob flew to Austria.

b) Pauline flew to Austria on the same plane as Bob.

APART CONTEXT SENTENCES

Bob was on a Swissair plane, Pauline on a British Airways flight. It was off-season so the airfares were cheaper.

c) Pauline and Bob flew to Austria.

d) Pauline flew to Austria at the same time as Bob.

TOGETHER CONTEXT SENTENCES

Will and Jenny had always been friends who shared everything together. One day things started to go badly wrong.

20a) Jenny and Will had stolen some money.

b) Jenny had stolen some money from Will.

Will lived in Newcastle but Jenny was at school in Durham. One day things started to go badly wrong.

c) Jenny and Will had stolen some money.

d) Jenny had stolen some money from Will.

TOGETHER CONTEXT SENTENCES

Brian and Rachel were in the shopping centre. A shop-owner had hired some people to help with an advertising campaign.

21a) Rachel and Brian handed out some leaflets.

b) Rachel handed out some leaflets for Brian.

APART CONTEXT SENTENCES

Brian was in the high street, Rachel was in the shopping centre. A shop-owner had hired some people to help with an advertising campaign.

c) Rachel and Brian handed out some leaflets.

d) Rachel handed out some leaflets for Brian.

TOGETHER CONTEXT SENTENCES

Fiona and Ed played some games and had done for hours. The games were usually hard fought.

22a) Fiona and Ed played chess.

b) Fiona played chess against Ed.

APART CONTEXT SENTENCES

Fiona was at a chess-board in London, Ed at a chess-board in Watford. Chess players often played by mail and, the games were usually hard fought.

c) Fiona and Ed played chess.

d) Fiona played chess against Ed.

TOGETHER CONTEXT SENTENCES

Ken and Susan were at a restaurant at a corner table. It was an up-market place with high prices.

23a) Susan and Ken paid the bill.

b) Susan paid the bill for Ken.

APART CONTEXT SENTENCES

Ken sat at a corner table and Susan near the entrance to the restaurant. It was an up-market place with high prices, and it had a very snooty waiter.

c) Susan and Ken paid the bills.

d) Susan paid the bill for Ken.

TOGETHER CONTEXT SENTENCES

Amanda and Stuart were in the library, near the end of term. Work had built up and it was difficult to finish it all.

24a) Amanda and Stuart wrote an essay.

b) Amanda wrote an essay for Stuart.

APART CONTEXT SENTENCES

Amanda was in the library, Stuart at the halls of residence. It was near the end of term and a huge amount of work had built up.

c) Amanda and Stuart wrote essays.

d) Amanda wrote an essay for Stuart.

Sentence conditions are as follows:

a)Together description/Conjoined NPs/reference to 1st mentioned person

b)Together description/Conjoined NPs/reference to 2nd mentioned person

c)Together description/Conjoined NPs/reference to both people

d)Together description/Subj.-Pred./reference to 1st mentioned person

e)Together description/Subj.-Pred./reference to 2nd mentioned person

f)Together description/Subj.-Pred./reference to both people

g)Apart description/Conjoined NPs/reference to 1st mentioned person

h)Apart description/Conjoined NPs/reference to 2nd mentioned person

i)Apart description/Conjoined NPs/reference to both people

j)Apart description/Subj.-Pred./reference to 1st mentioned person

k)Apart description/Subj.-Pred./reference to 2nd mentioned person

l)Apart description/Subj.-Pred./reference to both people

1)John and Karen were in the science lab when the new equipment arrived.

a)He found it difficult to assemble.

b)She found it difficult to assemble.

c)They found it difficult to assemble.

John was in the lab and so was Karen when the new equipment arrived.

d)He found it difficult to assemble.

e)She found it difficult to assemble.

f)They found it difficult to assemble.

John and Karen were in different parts of the building when the new equipment arrived.

g)He found it difficult to assemble.

h)She found it difficult to assemble.

i)They found it difficult to assemble.

John was in a different part of the building from Karen when the new equipment arrived.

j)He found it difficult to assemble.

k)She found it difficult to assemble.

l)They found it difficult to assemble.

2)Emma and Garry had just bought the week's shopping at the supermarket.

a)She carried it to the car.

b)He carried it to the car.

c)They carried it to the car.

Emma had just bought the week's shopping at the supermarket with Garry.

d)She carried it to the car.

e)He carried it to the car.

f)They carried it to the car.

Emma and Garry were buying groceries in different shops.

g)She carried them to the car.

h)He carried them to the car.

i)They carried them to the car.

Emma was buying groceries in the supermarket, while Garry was out buying shoes.

j)She carried them to the car.

k)He carried them to the car.

l)They carried them to the car.

3)Andrew and Kate were at the post-office waiting in the queue.

a)He bought some books of stamps.

b)She bought some books of stamps.

c)They bought some books of stamps.

Andrew waited next to Kate in the post-office queue.

d)He bought some books of stamps.

e)She bought some books of stamps.

f)They bought some books of stamps.

Andrew and Kate were in queues in different post-offices.

g)He bought some books of stamps.

h)She bought some books of stamps.

i)They bought some books of stamps.

Andrew was in the sub-post office while Kate was at the main branch.

j)He bought some books of stamps.

k)She bought some books of stamps.

l)They bought some books of stamps.

4)Ellen and Alan were in the kitchen preparing some food.

a)She used far too much salt.

b)He used far too much salt.

c)They used far too much salt.

Ellen was cooking the meat while Alan was making the sauce.

d)She used far too much salt.

e)He used far too much salt.

f)They used far too much salt.

Ellen and Alan were having lunch at their separate work canteens.

g)She used far too much salt.

h)He used far too much salt.

i)They used far too much salt.

Ellen was at work in the cafe while Alan was at home in the kitchen.

j)She used far too much salt.

k)He used far too much salt.

l)They used far too much salt.

5)Paul and Ruth were at home watching the football results on television.

a)He had won a few pounds.

b)She had won a few pounds.

c)They had won a few pounds.

Paul was in the same betting shop as Ruth watching the horse racing.

d)He had won a few pounds.

e)She had won a few pounds.

f)They had won a few pounds.

Paul and Ruth were at betting shops in different streets.

g)He had won a few pounds.

h)She had won a few pounds.

i)They had won a few pounds.

Paul was at "Coral's" betting shop while Ruth was at "Ladbroke's".

j)He had won a few pounds.

k)She had won a few pounds.

l)They had won a few pounds.

6)Marie and Frank were in town buying Christmas presents for friends.

a)She hoped the gifts were suitable.

b)He hoped the gifts were suitable.

c)They hoped the gifts were suitable.

Marie was in town buying Christmas presents and so was Frank.

d)She hoped the gifts were suitable.

e)He hoped the gifts were suitable.

f)They hoped the gifts were suitable.

Marie and Frank were in different shops buying Christmas presents.

g)She hoped the gifts were suitable.

h)He hoped the gifts were suitable.

i)They hoped the gifts were suitable.

Marie was in the shopping mall while Frank was in the high street just before Christmas.

j)She hoped the gifts were suitable.

k)He hoped the gifts were suitable.

l)They hoped the gifts were suitable.

7)Dave and Joyce were at the garage, examining the cars on display.

a)He decided to buy one elsewhere.

b)She decided to buy one elsewhere.

c)They decided to buy one elsewhere.

Dave was at the auction examining the cars on display and Joyce was there too.

d)He decided to buy one elsewhere.

e)She decided to buy one elsewhere.

f)They decided to buy one elsewhere.

Dave and Joyce were at different garages looking for cars to buy.

g)He decided to buy one elsewhere.

h)She decided to buy one elsewhere.

i)They decided to buy one elsewhere.

Dave was at the auction looking at cars to buy while Joyce was at the showroom.

j)He decided to buy one elsewhere.

k)She decided to buy one elsewhere.

l)They decided to buy one elsewhere.

8)Debbie and Colin were in town doing the shopping.

a)She had difficulty carrying the bags.

b)He had difficulty carrying the bags.

c)They had difficulty carrying the bags.

Debbie was in town doing the shopping and Colin was there too.

d)She had difficulty carrying the bags.

e)He had difficulty carrying the bags.

f)They had difficulty carrying the bags.

Debbie and Colin were shopping in different parts of town.

g)She had difficulty carrying the bags.

h)He had difficulty carrying the bags.

i)They had difficulty carrying the bags.

Debbie was in the market when Colin was in the high street.

j)She had difficulty carrying the bags.

k)He had difficulty carrying the bags.

l)They had difficulty carrying the bags.

9)Elaine and Max were in the car during the rush hour.

a)She decided to avoid the city.

b)He decided to avoid the city.

c)They decided to avoid the city.

Elaine was in the car during the rush hour and Max was sitting alongside.

d)She decided to avoid the city.

e)He decided to avoid the city.

f)They decided to avoid the city.

Elaine and Max were driving separate cars during the rush hour.

g)She decided to avoid the city.

h)He decided to avoid the city.

i)They decided to avoid the city.

Elaine was in a different car to Max during the rush hour.

j)She decided to avoid the city.

k)He decided to avoid the city.

l)They decided to avoid the city.

10)Stan and Eileen were in the park.

a)He fed the ducks some bread.

b)She fed the ducks some bread.

c)They fed the ducks some bread.

Stan was in the park standing next to Eileen.

d)He fed the ducks some bread.

e)She fed the ducks some bread.

f)They fed the ducks some bread.

Stan and Eileen were in different parts of the park.

g)He fed the ducks some bread.

h)She fed the ducks some bread.

i)They fed the ducks some bread.

Stan was in a different part of the park to Eileen.

j)He fed the ducks some bread.

k)She fed the ducks some bread.

l)They fed the ducks some bread.

11)Jean and Tom were at the check-in desk at the airport.

a)She was utterly sick of waiting.

b)He was utterly sick of waiting.

c)They were utterly sick of waiting.

Jean was queuing at the airport check-in desk behind Tom.

d)She was utterly sick of waiting.

e)He was utterly sick of waiting.

f)They were utterly sick of waiting.

Jean and Tom were queuing at different check-in desks at the airport.

g)She was utterly sick of waiting.

h)He was utterly sick of waiting.

i)They were utterly sick of waiting.

Jean was in a queue at a different check-in desk to Tom.

j)She was utterly sick of waiting.

k)He was utterly sick of waiting.

l)They were utterly sick of waiting.

12)Graham and Victoria were at the public swimming baths.

a)He stayed close to the edge.

b)She stayed close to the edge.

c)They stayed close to the edge.

Graham was at the swimming baths and Victoria was there too.

d)He stayed close to the edge.

e)She stayed close to the edge.

f)They stayed close to the edge.

Graham and Victoria were at different swimming baths.

g)He stayed close to the edge.

h)She stayed close to the edge.

i)They stayed close to the edge.

Graham was in the outdoor pool while Victoria was in the indoor one.

j)He stayed close to the edge.

k)She stayed close to the edge.

l)They stayed close to the edge.

13)Gordon and Julie competed in the same race.

a)He was exhausted by the end.

b)She was exhausted by the end.

c)They were exhausted by the end.

Gordon was competing in the same race as Julie.

d)He was exhausted by the end.

e)She was exhausted by the end.

f)They were exhausted by the end.

Gordon and Julie were competing in races in different towns.

g)He was exhausted by the end.

h)She was exhausted by the end.

i)They were exhausted by the end.

Gordon was running in London while Julie was in the Great North run.

j)He was exhausted by the end.

k)She was exhausted by the end.

l)They were exhausted by the end.

14)Karen and Peter were at home in the flat.

a)She was going out later on.

b)He was going out later on.

c)They were going out later on.

Karen was in the flat at the same time as Peter.

d)She was going out later on.

e)He was going out later on.

f)They were going out later on.

Karen and Peter were at their homes at opposite ends of the town.

g)She was going out later on.

h)He was going out later on.

i)They were going out later on.

Karen was at home at the opposite end of town to Peter.

j)She was going out later on.

k)He was going out later on.

l)They were going out later on.

15)Gavin and Pam were down at the pub.

a)He had drunk far too much.

b)She had drunk far too much.

c)They had drunk far too much.

Gavin was down at the pub and Pam was sitting at the same table.

d)He had drunk far too much.

e)She had drunk far too much.

f)They had drunk far too much.

Gavin and Pam were out at different pubs.

g)He had drunk far too much.

h)She had drunk far too much.

i)They had drunk far too much.

Gavin was at the "New Inn" while Pam was at the "Dun Cow".

j)He had drunk far too much.

k)She had drunk far too much.

l)They had drunk far too much.

16)Cathy and Arthur were in the high street selling raffle tickets.

a)She made a lot of money.

b)He made a lot of money.

c)They made a lot of money.

Cathy was in the high street selling raffle tickets next to Arthur.

d)She made a lot of money.

e)He made a lot of money.

f)They made a lot of money.

Cathy and Arthur were selling raffle tickets in different parts of town.

g)She made a lot of money.

h)He made a lot of money.

i)They made a lot of money.

Cathy was in the high street selling raffle tickets and Arthur was on the bridge.

j)She made a lot of money.

k)He made a lot of money.

l)They made a lot of money.

17)Simon and Lucy were at the sports centre playing badminton.

a)He was very good at it.

b)She was very good at it.

c)They were very good at it.

Simon was at the sports centre playing squash at the same time as Lucy.

d) He was very good at it.

e)She was very good at it.

f)They were very good at it.

Simon and Lucy were playing squash at different sports centres.

g)He was very good at it.

h)She was very good at it.

i)They were very good at it.

Simon was at the University sports centre playing squash and Lucy was playing at the squash club.

j)He was very good at it.

k)She was very good at it.

l)They were very good at it.

18)Ann and Michael were on holiday in Cornwall.

a)She stayed in a boarding house.

b)He stayed in a boarding house.

c)They stayed in a boarding house.

Ann was on holiday in Cornwall and Michael was there too.

d)She stayed in a boarding house.

e)He stayed in a boarding house.

f)They stayed in a boarding house.

Ann and Michael were on holiday in different countries.

g)She stayed in a boarding house.

h)He stayed in a boarding house.

i)They were staying in boarding houses.

Ann was on holiday in a different country to Michael.

j)She stayed in a boarding house.

k)He stayed in a boarding house.

l)They were staying in boarding houses.

19)Bob and Pauline were travelling on the same aeroplane.

a)He regretted buying an economy ticket.

b)She regretted buying an economy ticket.

c)They regretted buying the economy tickets.

Bob was travelling on the same aeroplane as Pauline.

d)He regretted buying an economy ticket.

e)She regretted buying an economy ticket.

f)They regretted buying the economy tickets.

Bob and Pauline were travelling on different aeroplanes.

g)He regretted buying an economy ticket.

h)She regretted buying an economy ticket.

i)They regretted buying the economy tickets.

Bob was travelling on a different plane to Pauline.

j)He regretted buying an economy ticket.

k)She regretted buying an economy ticket.

l)They regretted buying the economy tickets.

20)Will and Jenny were in the same class at school.

a)He was always very well behaved.

b)She was always very well behaved.

c)They were always very well behaved.

Will was in the same class at school as Jenny.

d)He was always very well behaved.

e)She was always very well behaved.

f)They were always very well behaved.

Will and Jenny were in different classes at school.

g)He was always very well behaved.

h)She was always very well behaved.

i)They were always very well behaved.

Will was in a different class at school to Jenny.

j)He was always very well behaved.

k)She was always very well behaved.

l)They were always very well behaved.

21)Brian and Rachel were in the shopping centre handing out leaflets.

a)He found the job very dull.

b)She found the job very dull.

c)They found the job very dull.

Brian was in the shopping centre handing out leaflets alongside Rachel.

d)He found the job very dull.

e)She found the job very dull.

f)They found the job very dull.

Brian and Rachel were handing out leaflets in different parts of town.

g)He found the job very dull.

h)She found the job very dull.

i)They found the job very dull.

Brian was handing out leaflets in a different part of town to Rachel.

j)He found the job very dull.

k)She found the job very dull.

l)They found the job very dull.

22)Fiona and Ed were playing chess.

a)She wasn't a very good player.

b)He wasn't a very good player.

c)They weren't really very good players.

Fiona was playing Ed at chess.

d)She wasn't a very good player.

e)He wasn't a very good player.

f)They weren't really very good players.

Fiona and Ed were playing chess by post.

g)She wasn't a very good player.

h)He wasn't a very good player.

i)They weren't really very good players.

Fiona was playing Ed at chess by post.

j)She wasn't a very good player.

k)He wasn't a very good player.

l)They weren't really very good players.

23)Ken and Susan were at a restaurant.

a)He left the waiter a tip.

b)She left the waiter a tip.

c)They left the waiter a tip.

Ken was in a restaurant and Susan was there too.

d)He left the waiter a tip.

e)She left the waiter a tip.

f)They left the waiter a tip.

Ken and Susan were in a restaurant sitting at different tables.

g)He left the waiter a tip.

h)She left the waiter a tip.

i)They left the waiter a tip.

Ken was sitting at a different table in the restaurant to Susan.

j)He left the waiter a tip.

k)She left the waiter a tip.

l)They left the waiter a tip.

24)Amanda and Stuart were in the library near the end of term.

a)She was revising for an exam.

b)He was revising for an exam.

c)They were revising for an exam.

Amanda was sitting next to Stuart in the library.

d)She was revising for an exam.

e)He was revising for an exam.

f)They were revising for an exam.

Amanda and Stuart were on different floors of the library.

g)She was revising for an exam.

h)He was revising for an exam.

i)They were revising for an exam.

Amanda was on a different floor of the library to Stuart.

j)She was revising for an exam.

k)He was revising for an exam.

l)They were revising for an exam.

Sentence conditions are as follows:

a)Together description/Conjoined NPs

b)Together description/Subj.-Pred.

c)Apart description/Conjoined NPs

d)Apart description/Subj.-Pred.

1a)John and Karen were in the science lab when the new equipment arrived.

b)John was in the lab and so was Karen when the new equipment arrived.

c)John and Karen were in different parts of the building when the new equipment arrived.

d)John was in a different part of the building from Karen when the new equipment arrived.

2a)Emma and Garry had just bought the week's shopping at the supermarket.

b) Emma had just bought the week's shopping at the supermarket with Garry.

c)Emma and Garry were buying groceries in different shops.

d)Emma was in the supermarket, while Garry was in the shoe shop.

3a)Andrew and Kate were at the post-office waiting in the queue.

b)Andrew waited next to Kate in the post-office queue.

c)Andrew and Kate were in queues in different post-offices.

d)Andrew was in the sub-post office while Kate was at the main branch.

4a)Ellen and Alan were in the kitchen preparing some food.

b)Ellen was cooking the meat while Alan was making the sauce.

c)Ellen and Alan were having lunch at their separate work canteens.

d)Ellen was at work in the cafe while Alan was at home in the kitchen.

5a)Paul and Ruth were at home watching the football results on television.

b)Paul was in the same betting shop as Ruth watching the horse racing.

c)Paul and Ruth were at betting shops in different streets.

d)Paul was at "Coral's" betting shop while Ruth was at "Ladbroke's".

6a)Marie and Frank were in town buying Christmas presents for friends.

b)Marie was in town buying Christmas presents and so was Frank.

c)Marie and Frank were in different shops buying Christmas presents.

d)Marie was in the shopping mall while Frank was in the high street.

7a)Dave and Joyce were at the garage, examining the cars on display.

b)Dave was at the auction examining the cars on display and Joyce was there too.

c)Dave and Joyce were at different garages looking for cars to buy.

d)Dave was at the auction looking at cars to buy while Joyce was at the showroom.

8a)Debbie and Colin were in town doing the shopping.

b)Debbie was in town doing the shopping and Colin was there too.

c)Debbie and Colin were shopping in different parts of town.

d)Debbie was in the market when Colin was in the high street.

9a)Elaine and Max were in the car during the rush hour.

b)Elaine was in the car during the rush hour and Max was sitting alongside.

c)Elaine and Max were driving separate cars during the rush hour.

d)Elaine was in a different car to Max during the rush hour.

10a)Stan and Eileen were in the park.

b)Stan was in the park standing next to Eileen.

c)Stan and Eileen were in different parts of the park.   .

d)Stan was in a different part of the park to Eileen.

11a)Jean and Tom were at the check-in desk at the airport.

b)Jean was queuing at the airport check-in desk behind Tom.

c)Jean and Tom were queuing at different check-in desks at the airport.

d)Jean was in a queue at a different check-in desk to Tom.

12a)Graham and Victoria were at the public swimming baths.

b)Graham was at the swimming baths and Victoria was there too.

c)Graham and Victoria were at different swimming baths.

d)Graham was in the outdoor pool while Victoria was in the indoor one.

13a)Gordon and Julie competed in the same race.

b)Gordon was competing in the same race as Julie.

c)Gordon and Julie were competing in races in different towns.

d)Gordon was running in London while Julie was in the Great North run.

14a)Karen and Peter were at home in the flat.

b)Karen was in the flat at the same time as Peter.

c)Karen and Peter were at their homes at opposite ends of the town.

d)Karen was at home at the opposite end of town to Peter.

15a)Gavin and Pam were down at the pub.

b)Gavin was down at the pub and Pam was sitting at the same table.

c)Gavin and Pam were out at different pubs.

d)Gavin was at the "New Inn" while Pam was at the "Dun Cow".

16a)Cathy and Arthur were in the high street selling raffle tickets.

b)Cathy was in the high street selling raffle tickets next to Arthur.

c)Cathy and Arthur were selling raffle tickets in different parts of town.

d)Cathy was in the high street selling raffle tickets and Arthur was on the bridge.

17a)Simon and Lucy were at the sports centre playing badminton.

b)Simon was at the sports centre playing squash at the same time as Lucy.

c)Simon and Lucy were playing squash at different sports centres.

d)Simon was at the University sports centre playing squash and Lucy was playing at the squash club.

18a)Ann and Michael were on holiday in Cornwall.

b)Ann was on holiday in Cornwall and Michael was there too.

c)Ann and Michael were on holiday in different countries.

d)Ann was on holiday in a different country to Michael.

19a)Bob and Pauline were travelling on the same aeroplane.

b)Bob was travelling on the same aeroplane as Pauline.

c)Bob and Pauline were travelling on different aeroplanes.

d)Bob was travelling on a different plane to Pauline.

20a)Will and Jenny were in the same class at school.

b)Will was in the same class at school as Jenny.

c)Will and Jenny were in different classes at school.

d)Will was in a different class at school to Jenny.

21a)Brian and Rachel were in the shopping centre handing out leaflets.

b)Brian was in the shopping centre handing out leaflets alongside Rachel.

c)Brian and Rachel were handing out leaflets in different parts of town.

d)Brian was handing out leaflets in a different part of town to Rachel.

22a)Fiona and Ed were playing chess.

b)Fiona was playing Ed at chess.

c)Fiona and Ed were playing chess by post.

d)Fiona was playing Ed at chess by post.

23a)Ken and Susan were at a restaurant.

b)Ken was in a restaurant and Susan was there too.

c)Ken and Susan were in a restaurant sitting at different tables.

d)Ken was sitting at a different table in the restaurant to Susan.

24a)Amanda and Stuart were in the library near the end of term.

b)Amanda was sitting next to Stuart in the library.

c)Amanda and Stuart were on different floors of the library.

d)Amanda was on a different floor of the library to Stuart.

APPENDIX 9: MATERIALS USED IN EXPERIMENT 9

Sentence conditions as follows:

a)Apart description/reference to 1st mentioned person

b)Apart description/reference to 2nd mentioned person

c)Apart description/reference to both people

d)Together description/reference to 1st mentioned person

e)Together description/reference to 2nd mentioned person

f)Together description/reference to both people

1a) Paul is far away from Fiona and/he is next to a fast flowing river.

b) Paul is far away from Fiona and/she is next to a fast flowing river.

c) Paul is far away from Fiona and/they are next to a fast flowing river.

d) Paul is beside Fiona and/he is next to a fast flowing river.

e) Paul is beside Fiona and/she is next to a fast flowing river.

f) Paul is beside Fiona and/they are next to a fast flowing river.

2a) Len is at the opposite end of the street to Maisie and/he is to the left of the junction.

b) Len is at the opposite end of the street to Maisie and/she is to the left of the junction.

c) Len is at the opposite end of the street to Maisie and/they are to the left of the junction.

d) Len is just behind Maisie and/he is to the left of the junction.

e) Len is just behind Maisie and/she is to the left of the junction.

f) Len is just behind Maisie and/they are to the left of the junction.

3a) Ted is some distance from Ruth and/he is to the right of the lake.

b) Ted is some distance from Ruth and/she is to the right of the lake.

c) Ted is some distance from Ruth and/they are to the right of the lake.

d) Ted is alongside Ruth and/he is to the right of the lake.

e) Ted is alongside Ruth and/she is to the right of the lake.

f) Ted is alongside Ruth and/they are to the right of the lake.

4a) Roger is separated from Charlotte by a valley and/he is to the left of the waterfall.

b) Roger is separated from Charlotte by a valley and/she is to the left of the waterfall.

c) Roger is separated from Charlotte by a valley and/they are to the left of the waterfall.

d) Roger is near Charlotte and/he is to the left of the waterfall.

e) Roger is near Charlotte and/she is to the left of the waterfall.

f) Roger is near Charlotte and/they are to the left of the waterfall.

5a) Simon is far beyond Julia and/he is near to a small shallow stream.

b) Simon is far beyond Julia and/she is near to a small shallow stream.

c) Simon is far beyond Julia and/they are near to a small shallow stream.

d) Simon is next to Julia and/he is near to a small shallow stream.

e) Simon is next to Julia and/she is near to a small shallow stream.

f) Simon is next to Julia and/they are near to a small shallow stream.

6a) Leo is higher up the hill than Laura and/he is to the right of the path.

b) Leo is higher up the hill than Laura and/she is to the right of the path.

c) Leo is higher up the hill than Laura and/they are to the right of the path.

d) Leo is just in front of Laura and/he is to the right of the path.

e) Leo is just in front of Laura and/she is to the right of the path.

f) Leo is just in front of Laura and/they are to the right of the path.

7a) George is a long distance away from Katie and/he is on top of a long ridge.

b) George is a long distance away from Katie and/she is on top of a long ridge.

c) George is a long distance away from Katie and/they are on top of a long ridge.

d) George is adjacent to Katie and/he is on top of a long ridge.

e) George is adjacent to Katie and/she is on top of a long ridge.

f) George is adjacent to Katie and/they are on top of a long ridge.

8a) Steve is on the other side of the lake to Shirley and/he is near the edge of the water.

b) Steve is on the other side of the lake to Shirley and/she is near the edge of the water.

c) Steve is on the other side of the lake to Shirley and/they are near the edge of the water.

d) Steve is close to Shirley and/he is near the edge of the water.

e) Steve is close to Shirley and/she is near the edge of the water.

f) Steve is close to Shirley and/they are near the edge of the water.

9a) Jim is to the South of Karen and/he is to the West of the road.

b) Jim is to the South of Karen and/she is to the West of the road.

c) Jim is to the South of Karen and/they are to the West of the road.

d) Jim is just next to Karen and/he is to the West of the road.

e) Jim is just next to Karen and/she is to the West of the road.

f) Jim is just next to Karen and/they are to the West of the road.

10a) Heather is across the river from Phil and/she is right beside the old iron bridge.

b) Heather is across the river from Phil and/he is right beside the old iron bridge.

c) Heather is across the river from Phil and/they are right beside the old iron bridge.

d) Heather is side by side with Phil and/she is right beside the old iron bridge.

e) Heather is side by side with Phil and/he is right beside the old iron bridge.

f) Heather is side by side with Phil and/they are right beside the old iron bridge.

11a) Anna is to the North of Justin and/she is to the East of the hill.

b) Anna is to the North of Justin and/he is to the East of the hill.

c) Anna is to the North of Justin and/they are to the East of the hill.

d) Anna is abreast of Justin and/she is to the East of the hill.

e) Anna is abreast of Justin and/he is to the East of the hill.

f) Anna is abreast of Justin and/they are to the East of the hill.

12a) Marianne is to the East of Douglas and/she is to the South of the farm.

b) Marianne is to the East of Douglas and/he is to the South of the farm.

c) Marianne is to the East of Douglas and/they are to the South of the farm.

d) Marianne is nearby Douglas and/she is to the South of the farm.

e) Marianne is nearby Douglas and/he is to the South of the farm.

f) Marianne is nearby Douglas and/they are to the South of the farm.

13a) Denise is to the West of Richard and/she is to the South of the castle.

b) Denise is to the West of Richard and/he is to the South of the castle.

c) Denise is to the West of Richard and/they are to the South of the castle.

d) Denise is slightly behind Richard and/she is to the South of the castle.

e) Denise is slightly behind Richard and/he is to the South of the castle.

f) Denise is slightly behind Richard and/they are to the South of the castle.

14a) Debbie is far from Neil and/she is located in a copse of trees.

b) Debbie is far from Neil and/he is located in a copse of trees.

c) Debbie is far from Neil and/they are located in a copse of trees.

d) Debbie is just to the right of Neil and/she is located in a copse of trees.

e) Debbie is just to the right of Neil and/he is located in a copse of trees.

f) Debbie is just to the right of Neil and/they are located in a copse of trees.

15a) Alice is a long way away from Stanley and/she is to the left of the church.

b) Alice is a long way away from Stanley and/he is to the left of the church.

c) Alice is a long way away from Stanley and/they are to the left of the church.

d) Alice is just to the left of Stanley and/she is to the left of the church.

e) Alice is just to the left of Stanley and/he is to the left of the church.

f) Alice is just to the left of Stanley and/they are to the left of the church.

16a) Tracy is lower down the hill than Peter and/she is to the left of the path.

b) Tracy is lower down the hill than Peter and/he is to the left of the path.

c) Tracy is lower down the hill than Peter and/they are to the left of the path.

d) Tracy is on one side of Peter and/she is to the left of the path.

e) Tracy is on one side of Peter and/he is to the left of the path.

f) Tracy is on one side of Peter and/they are to the left of the path.

17a) Rachel is far removed from John and/she is to the East of the mountains.

b) Rachel is far removed from John and/he is to the East of the mountains.

c) Rachel is far removed from John and/they are to the East of the mountains.

d) Rachel is only just in front of John and/she is to the East of the mountains.

e) Rachel is only just in front of John and/he is to the East of the mountains.

f) Rachel is only just in front of John and/they are to the East of the mountains.

18a) Anita is in a different room to Stuart and/she is in a chair in the corner.

b) Anita is in a different room to Stuart and/he is in a chair in the corner.

c) Anita is in a different room to Stuart and/they are sitting in chairs in the corners.

d) Anita is in the same room as Stuart and/she is in a chair in the corner.

e) Anita is in the same room as Stuart and/he is in a chair in the corner.

f) Anita is in the same room as Stuart and/they are sitting on chairs in the corner.

APPENDIX 10: MATERIALS USED IN EXPERIMENT 10

Sentence conditions as follows:

a)Apart description

b)Together description

1a) Paul is far away from Fiona.

b) Paul is beside Fiona.

2a) Len is at the opposite end of the street to Maisie.

b) Len is just behind Maisie.

3a) Ted is some distance from Ruth.

b) Ted is alongside Ruth.

4a) Roger is separated from Charlotte by a valley.

b) Roger is near Charlotte.

5a) Simon is far beyond Julia.

b) Simon is next to Julia.

6a) Leo is higher up the hill than Laura.

b) Leo is just in front of Laura.

7a) George is a long distance away from Katie.

b) George is adjacent to Katie.

8a) Steve is on the other side of the lake to Shirley.

b) Steve is close to Shirley.

9a) Jim is to the South of Karen and/he is to the West of the road.

b) Jim is just next to Karen.

10a) Heather is across the river from Phil

b) Heather is side by side with Phil.

11a) Anna is to the North of Justin.

b) Anna is abreast of Justin.

12a) Marianne is to the East of Douglas.

b) Marianne is nearby Douglas.

13a) Denise is to the West of Richard.

b) Denise is slightly behind Richard.

14a) Debbie is far from Neil.

b) Debbie is just to the right of Neil.

15a) Alice is a long way away from Stanley.

b) Alice is just to the left of Stanley.

16a) Tracy is lower down the hill than Peter.

b) Tracy is on one side of Peter.

17a) Rachel is far removed from John.

b) Rachel is only just in front of John.

18a) Anita is in a different room to Stuart.

b) Anita is in the same room as Stuart.

Sentence Conditions as follows;

a)Conj.NPs/Apart description/reference to 1st mentioned person

b)Conj.NPs/Apart description/reference to 2nd mentioned person

c)Conj.NPs/Apart description/reference to both people

d)Conj.NPs/Together description/reference to 1st mentioned person

e)Conj.NPs/Together description/reference to 2nd mentioned person

f)Conj.NPs/Together description/reference to both people

g)Subj.-Pred./Apart description/reference to 1st mentioned person

h)Subj.-Pred./Apart description/reference to 2nd mentioned person

i)Subj.-Pred./Apart description/reference to both people

j)Subj.-Pred./Together description/reference to 1st mentioned person

k)Subj.-Pred./Together description/reference to 2nd mentioned person

l)Subj.-Pred./Together description/reference to both people

1a) Paul and Fiona are far away from one another and/he is next to a fast flowing river.

b) Paul and Fiona are far away from one another and/she is next to a fast flowing river.

c) Paul and Fiona are far away from one another and/they are next to a fast flowing river.

d) Paul and Fiona are beside one another and/he is next to a fast flowing river.

e) Paul and Fiona are beside one another and/she is next to a fast flowing river.

f) Paul and Fiona are beside one another and/they are next to a fast flowing river.

g) Paul is far away from Fiona and/he is next to a fast flowing river.

h) Paul is far away from Fiona and/she is next to a fast flowing river.

i) Paul is far away from Fiona and/they are next to a fast flowing river.

j) Paul is beside Fiona and/he is next to a fast flowing river.

k) Paul is beside Fiona and/she is next to a fast flowing river.

l) Paul is beside Fiona and/they are next to a fast flowing river.

2a) Len and Maisie are at opposite ends of the street and/he is to the left of the junction.

b) Len and Maisie are at opposite ends of the street and/she is to the left of the junction.

c) Len and Maisie are at opposite ends of the street and/they are to the left of the junction.

d) Len and Maisie are just behind a parked car and/he is to the left of the junction.

e) Len and Maisie are just behind a parked car and/she is to the left of the junction.

f) Len and Maisie are just behind a parked car and/they are to the left of the junction.

g) Len is at the opposite end of the street to Maisie and/he is to the left of the junction.

h) Len is at the opposite end of the street to Maisie and/she is to the left of the junction.

i) Len is at the opposite end of the street to Maisie and/they are to the left of the junction.

j) Len is just behind Maisie and/he is to the left of the junction.

k) Len is just behind Maisie and/she is to the left of the junction.

) Len is just behind Maisie and/they are to the left of the junction.

3a)Ted and Ruth are some distance apart and/he is to the right of the lake.

b) Ted and Ruth are some distance apart and/she is to the right of the lake.

c) Ted and Ruth are some distance apart and/they are to the right of the lake.

d) Ted and Ruth are alongside each other and/he is to the right of the lake.

e) Ted and Ruth are alongside each other and/she is to the right of the lake.

f) Ted and Ruth are alongside each other and/they are to the right of the lake.

g) Ted is some distance from Ruth and/he is to the right of the lake.

h) Ted is some distance from Ruth and/she is to the right of the lake.

i) Ted is some distance from Ruth and/they is to the right of the lake.

j) Ted is alongside Ruth and/he is to the right of the lake.

k) Ted is alongside Ruth and/she is to the right of the lake.

l) Ted is alongside Ruth and/they are to the right of the lake.

4a) Roger and Charlotte are separated by a valley and/he is to the left of the waterfall.

b) Roger and Charlotte are separated by a valley and/she is to the left of the waterfall.

c) Roger and Charlotte are separated by a valley and/they are to the left of the waterfall.

d) Roger and Charlotte are near to each other and/he is to the left of the waterfall.

e) Roger and Charlotte are near to each other and/she is to the left of the waterfall.

f) Roger and Charlotte are near to each other and/they are to the left of the waterfall.

g) Roger is separated from Charlotte by a valley and/he is to the left of the waterfall.

h) Roger is separated from Charlotte by a valley and/she is to the left of the waterfall.

i) Roger is separated from Charlotte by a valley and/they are to the left of the waterfall.

j) Roger is near Charlotte and/he is to the left of the waterfall.

k) Roger is near Charlotte and/she is to the left of the waterfall.

l) Roger is near Charlotte and/they are to the left of the waterfall.

5a) Simon and Julia are far apart and/he is near to a small shallow stream.

b) Simon and Julia are far apart and/she is near to a small shallow stream.

c)Simon and Julia are far apart and/they are near to a small shallow stream.

d)Simon and Julia are next to one another and/he is near to a small shallow stream.

e)Simon and Julia are next to one another and/she is near to a small shallow stream.

f)Simon and Julia are next to one another and/they are near to a small shallow stream.

g)Simon is far beyond Julia and/he is near to a small shallow stream.

h)Simon is far beyond Julia and/she is near to a small shallow stream.

i)Simon is far beyond Julia and/they are near to a small shallow stream.

j)Simon is next to Julia and/he is near to a small shallow stream.

k)Simon is next to Julia and/she is near to a small shallow stream.

l)Simon is next to Julia and/they are near to a small shallow stream.

6a)Leo and Laura are on different parts of the hill and/he is to the right of the path.

b)Leo and Laura are on different parts of the hill and/she is to the right of the path.

c)Leo and Laura are on different parts of the hill and/they are to the right of the path.

d)Leo and Laura are just in front of the tree and/he is to the right of the path.

e)Leo and Laura are just in front of the tree and/she is to the right of the path.

f)Leo and Laura are just in front of the tree and/they are to the right of the path.

g)Leo is higher up the hill than Laura and/he is to the right of the path.

h)Leo is higher up the hill than Laura and/she is to the right of the path.

i)Leo is higher up the hill than Laura and/they are to the right of the path.

j)Leo is just in front of Laura and/he is to the right of the path.

k)Leo is just in front of Laura and/she is to the right of the path.

l)Leo is just in front of Laura and/they are to the right of the path.

7a)George and Katie are a long distance apart and/he is on top of a long ridge.

b)George and Katie are a long distance apart and/she is on top of a long ridge.

c)George and Katie are a long distance apart and/they are on top of a long ridge.

d)George and Katie are adjacent and/he is on top of a long ridge.

e)George and Katie are adjacent and/she is on top of a long ridge.

f)George and Katie are adjacent and/they are on top of a long ridge.

g)George is a long distance away from Katie and/he is on top of a long ridge.

h)George is a long distance away from Katie and/she is on top of a long ridge.

i)George is a long distance away from Katie and/they are on top of a long ridge.

j)George is adjacent to Katie and/he is on top of a long ridge.

k)George is adjacent to Katie and/she is on top of a long ridge.

l)George is adjacent to Katie and/they are on top of a long ridge.

8a)Steve and Shirley are on different sides of the lake and/he is near the edge of the water.

b)Steve and Shirley are on different sides of the lake and/she is near the edge of the water.

c)Steve and Shirley are on different sides of the lake and/they are near the edge of the water.

d)Steve and Shirley are close together and/he is near the edge of the water.

e)Steve and Shirley are close together and/she is near the edge of the water.

f)Steve and Shirley are close together and/they are near the edge of the water.

g)Steve is on the other side of the lake to Shirley and/he is near the edge of the water.

h)Steve is on the other side of the lake to Shirley and/she is near the edge of the water.

i)Steve is on the other side of the lake to Shirley and/they are near the edge of the water.

j)Steve is close to Shirley and/he is near the edge of the water.

k)Steve is close to Shirley and/she is near the edge of the water.

l)Steve is close to Shirley and/they are near the edge of the water.

9a)Jim and Karen are in different countries and/he is on top of a high mountain.

b)Jim and Karen are in different countries and/she is on top of a high mountain.

c)Jim and Karen are in different countries and/they are on top of a high mountain.

d)Jim and Karen are just next to each other and/he is on top of a high mountain.

e)Jim and Karen are just next to each other and/she is on top of a high mountain.

f)Jim and Karen are just next to each other and/they are on top of a high mountain.

g)Jim is in a different country to Karen and/he is on top of a high mountain.

h)Jim is in a different country to Karen and/she is on top of a high mountain.

i)Jim is in a different country to Karen and/they are on top of a high mountain.

j)Jim is just next to Karen and/he is on top of a high mountain.

k)Jim is just next to Karen and/she is on top of a high mountain.

l)Jim is just next to Karen and/they are on top of a high mountain.

10a)Heather and Phil are across the river from each other and/she is right beside the old iron bridge.

b)Heather and Phil are across the river from each other and/he is right beside the old iron bridge.

c)Heather and Phil are across the river from each other and/they are right beside the old iron bridge.

d)Heather and Phil are side by side and/she is right beside the old iron bridge.

e)Heather and Phil are side by side and/he is right beside the old iron bridge.

f)Heather and Phil are side by side and/they are right beside the old iron bridge.

g)Heather is across the river from Phil and/she is right beside the old iron bridge.

h)Heather is across the river from Phil and/he is right beside the old iron bridge.

i)Heather is across the river from Phil and/they are right beside the old iron bridge.

j)Heather is side by side with Phil and/she is right beside the old iron bridge.

k)Heather is side by side with Phil and/he is right beside the old iron bridge.

l)Heather is side by side with Phil and/they are right beside the old iron bridge.

11a)Anna and Justin are miles apart and/she is to the East of a hill.

b)Anna and Justin are miles apart and/he is to the East of a hill.

c)Anna and Justin are miles apart and/they are to the East of a hill.

d)Anna and Justin are abreast of one another and/she is to the East of a hill.

e)Anna and Justin are abreast of one another and/he is to the East of a hill.

f)Anna and Justin are abreast of one another and/they are to the East of a hill.

g)Anna is miles away from Justin and/she is to the East of a hill.

h)Anna is miles away from Justin and/he is to the East of a hill.

i)Anna is miles away from Justin and/they are to the East of a hill.

j)Anna is abreast of Justin and/she is to the East of a hill.

k)Anna is abreast of Justin and/he is to the East of a hill.

l)Anna is abreast of Justin and/they are to the East of a hill.

12a)Marianne and Douglas are separated and/she is to the South of the farm.

b)Marianne and Douglas are separated and/he is to the South of the farm.

c)Marianne and Douglas are separated and/they are to the South of the farm.

d)Marianne and Douglas are a short distance from one another and/she is to the South of the farm.

e)Marianne and Douglas are a short distance from one another and/he is to the South of the farm.

f)Marianne and Douglas are a short distance from one another and/they are to the South of the farm.

g)Marianne is separated from Douglas and/she is to the South of the farm.

h)Marianne is separated from Douglas and/he is to the South of the farm.

i)Marianne is separated from Douglas and/they are to the South of the farm.

j)Marianne is a short distance from Douglas and/she is to the South of the farm.

k)Marianne is a short distance from Douglas and/he is to the South of the farm.

l)Marianne is a short distance from Douglas and/they are to the South of the farm.

13a)Denise and Richard are in different towns and/she is far to the South of Glasgow.

b)Denise and Richard are in different towns and/he is far to the South of Glasgow.

c)Denise and Richard are in different towns and/they are far to the South of Glasgow.

d)Denise and Richard are slightly behind the bus and/she is far to the South of Glasgow.

e)Denise and Richard are slightly behind the bus and/he is far to the South of Glasgow.

f)Denise and Richard are slightly behind the bus and/they are far to the South of Glasgow.

g)Denise is in a different town to Richard and/she is far to the South of Glasgow.

h)Denise is in a different town to Richard and/he is far to the South of Glasgow.

i)Denise is in a different town to Richard and/they are far to the South of Glasgow.

j)Denise is slightly behind Richard and/she is far to the South of Glasgow.

k)Denise is slightly behind Richard and/he is far to the South of Glasgow.

l)Denise is slightly behind Richard and/they are far to the South of Glasgow.

14a)Debbie and Neil are far from each other and/she is located in a copse of trees.

b)Debbie and Neil are far from each other and/he is located in a copse of trees.

c)Debbie and Neil are far from each other and/they are located in a copse of trees.

d)Debbie and Neil are just to the right of a stream and/she is located in a copse of woods.

e)Debbie and Neil are just to the right of a stream and/he is located in a copse of woods.

f)Debbie and Neil are just to the right of a stream and/they are located in a copse of woods.

g)Debbie is far from Neil and/she is located in a copse of trees.

h)Debbie is far from Neil and/he is located in a copse of trees.

i)Debbie is far from Neil and/they are located in a copse of trees.

j)Debbie is just to the right of Neil and/she is located in a copse of trees.

k)Debbie is just to the right of Neil and/he is located in a copse of trees.

l)Debbie is just to the right of Neil and/they are located in a copse of trees.

15a)Alice and Stanley are a long way from one another and/she is to the left of the church.

b)Alice and Stanley are a long way from one another and/he is to the left of the church.

c)Alice and Stanley are a long way from one another and/they are to the left of the church.

d)Alice and Stanley are just to the left of the gate and/she is to the left of the church.

e)Alice and Stanley are just to the left of the gate and/he is to the left of the church.

f)Alice and Stanley are just to the left of the gate and/they are to the left of the church.

g)Alice is a long way away from Stanley and/she is to the left of the church.

h)Alice is a long way away from Stanley and/he is to the left of the church.

i)Alice is a long way away from Stanley and/they are to the left of the church.

j)Alice is just to the left of Stanley and/she is to the left of the church.

k)Alice is just to the left of Stanley and/he is to the left of the church.

l)Alice is just to the left of Stanley and/they are to the left of the church.

16a)Tracy and Peter are at different heights on the hill and/she is to the left of a path.

b)Tracy and Peter are at different heights on the hill and/he is to the left of a path.

c)Tracy and Peter are at different heights on the hill and/they are to the left of a path.

d)Tracy and Peter are a few feet apart and/she is to the left of a path.

e)Tracy and Peter are a few feet apart and/he is to the left of a path.

f)Tracy and Peter are a few feet apart and/they are to the left of a path.

g)Tracy is lower down the hill than Peter and/she is to the left of a path.

h)Tracy is lower down the hill than Peter and/he is to the left of a path.

i)Tracy is lower down the hill than Peter and/they are to the left of a path.

j)Tracy is a few feet away from Peter and/she is to the left of a path.

k)Tracy is a few feet away from Peter and/he is to the left of a path.

l)Tracy is a few feet away from Peter and/they are to the left of a path.

17a)Rachel and John are far removed from one another and/she is to the East of the mountains.

b)Rachel and John are far removed from one another and/he is to the East of the mountains.

c)Rachel and John are far removed from one another and/they are to the East of the mountains.

d)Rachel and John are in front of the fence and/she is to the East of the mountains.

e)Rachel and John are in front of the fence and/he is to the East of the mountains.

f)Rachel and John are in front of the fence and/they are to the East of the mountains.

g)Rachel is far removed from John and/she is to the East of the mountains.

h)Rachel is far removed from John and/he is to the East of the mountains.

i)Rachel is far removed from John and/they are to the East of the mountains.

j)Rachel is only just in front of John and/she is to the East of the mountains.

k)Rachel is only just in front of John and/he is to the East of the mountains.

l)Rachel is only just in front of John and/they are to the East of the mountains.

18a)Anita and Stuart are in different rooms and/she is in a chair in the corner.

b)Anita and Stuart are in different rooms and/he is in a chair in the corner.

c)Anita and Stuart are in different rooms and/they are sitting on chairs in the corners.

d)Anita and Stuart are in the same room and/she is in a chair in the corner.

e)Anita and Stuart are in the same room and/he is in a chair in the corner.

f)Anita and Stuart are in the same room and/they are sitting on chairs in the corners.

g)Anita is in a different room to Stuart and/she is in a chair in the corner.

h)Anita is in a different room to Stuart and/he is in a chair in the corner.

i)Anita is in a different room to Stuart and/they are sitting on chairs in the corners.

j)Anita is in the same room as Stuart and/she is in a chair in the corner.

k)Anita is in the same room as Stuart and/he is in a chair in the corner.

l)Anita is in the same room as Stuart and/they are sitting on chairs in the corners.

19a)Susan and Graham are in different buildings and/she is right next to the main stairs.

b)Susan and Graham are in different buildings and/he is right next to the main stairs.

c)Susan and Graham are in different buildings and/they are right next to the main stairs.

d)Susan and Graham are in the same building and/she is right next to the main stairs.

e)Susan and Graham are in the same building and/he is right next to the main stairs.

f)Susan and Graham are in the same building and/they are right next to the main stairs.

g)Susan is in a different building to Graham and/she is right next to the main stairs.

h)Susan is in a different building to Graham and/he is right next to the main stairs.

i)Susan is in a different building to Graham and/they are right next to the main stairs.

j)Susan is in the same building as Graham and/she is right next to the main stairs.

k)Susan is in the same building as Graham and/he is right next to the main stairs.

l)Susan is in the same building as Graham and/they are right next to the main stairs.

20a)Joan and Bill are in neighbouring houses and/she is sitting in front of the television.

b)Joan and Bill are in neighbouring houses and/he is sitting in front of the television.

c)Joan and Bill are in neighbouring houses and/they are sitting in front of the television.

d)Joan and Bill are in the same house and/she is sitting in front of the television.

e)Joan and Bill are in the same house and/he is sitting in front of the television.

f)Joan and Bill are in the same house and/they are sitting in front of the television.

g)Joan is in a neighbouring house to Bill and/she is sitting in front of the television.

h)Joan is in a neighbouring house to Bill and/he is sitting in front of the television.

i)Joan is in a neighbouring house to Bill and/they are sitting in front of the television.

j)Joan is in the same house as Bill and/she is sitting in front of the television.

k)Joan is in the same house as Bill and/he is sitting in front of the television.

l)Joan is in the same house as Bill and/they are sitting in front of the television.

21a)Wendy and Tom are in offices next door to each other and/she is right next to the filing cabinet.

b)Wendy and Tom are in offices next door to each other and/he is right next to the filing cabinet.

c)Wendy and Tom are in offices next door to each other and/they are right next to some filing cabinets.

d)Wendy and Tom are in the same office and/she is right next to the filing cabinet.

e)Wendy and Tom are in the same office and/he is right next to the filing cabinet.

f)Wendy and Tom are in the same office and/they are right next to some filing cabinets.

g)Wendy is in the office next door to Tom and/she is right next to the filing cabinet.

h)Wendy is in the office next door to Tom and/he is right next to the filing cabinet.

i)Wendy is in the office next door to Tom and/they are right next to some filing cabinets.

j)Wendy is in the same office as Tom and/she is right next to the filing cabinet.

k)Wendy is in the same office as Tom and/he is right next to the filing cabinet.

l)Wendy is in the same office as Tom and/they are right next to some filing cabinets.

22a)Matt and Kate are on different floors and/he is near to a West facing window.

b)Matt and Kate are on different floors and/she is near to a West facing window.

c)Matt and Kate are on different floors and/they are near to a West facing window.

d)Matt and Kate are on the same floor and/he is near to a West facing window.

e)Matt and Kate are on the same floor and/she is near to a West facing window.

f)Matt and Kate are on the same floor and/they are near to a West facing window.

g)Matt is on a different floor to Kate and/he is near to a West facing window.

h)Matt is on a different floor to Kate and/she is near to a West facing window.

i)Matt is on a different floor to Kate and/they are near to a West facing window.

j)Matt is on the same floor as Kate and/he is near to a West facing window.

k)Matt is on the same floor as Kate and/she is near to a West facing window.

l)Matt is on the same floor as Kate and/they are near to a West facing window.

23a)Julie and Arthur are across town from each other and/she is sitting comfortably on a park bench.

b)Julie and Arthur are across town from each other and/he is sitting comfortably on a park bench.

c)Julie and Arthur are across town from each other and/they are sitting comfortably on some park benches.

d)Julie and Arthur are in a car and/she is sitting comfortably in the back seat.

e)Julie and Arthur are in a car and/he is sitting comfortably in the back seat.

f)Julie and Arthur are in a car and/they are sitting comfortably in the back seat.

g)Julie is across town from Arthur and/she is sitting comfortably on a park bench.

h)Julie is across town from Arthur and/he is sitting comfortably on a park bench.

i)Julie is across town from Arthur and/they are sitting comfortably on some park benches.

j)Julie is in a car with Arthur and/she is sitting comfortably in the back seat.

k)Julie is in a car with Arthur and/he is sitting comfortably in the back seat.

l)Julie is in a car with Arthur and/they are sitting comfortably in the back seat.

24a)Simon and Michelle are over the road from each other and/he is right next to the traffic lights.

b)Simon and Michelle are over the road from each other and/she is right next to the traffic lights.

c)Simon and Michelle are over the road from each other and/they are right next to the traffic lights.

d)Simon and Michelle are on the same side of the road and/he is right next to the traffic lights.

e)Simon and Michelle are on the same side of the road and/she is right next to the traffic lights.

f)Simon and Michelle are on the same side of the road and/they are right next to the traffic lights.

g)Simon is over the road from Michelle and/he is right next to the traffic lights.

h)Simon is over the road from Michelle and/she is right next to the traffic lights.

i)Simon is over the road from Michelle and/they are right next to the traffic lights.

j)Simon is on the same side of the road as Michelle and/he is right next to the traffic lights.

k)Simon is on the same side of the road as Michelle and/she is right next to the traffic lights.

l)Simon is on the same side of the road as Michelle and/they are right next to the traffic lights.

APPENDIX 12: MATERIALS USED IN EXPERIMENT 12

Sentence Conditions as follows:

a)Conj.NPs/Apart description

b)Conj.NPs/Together description

c)Subj.-Pred./Apart description

d)Subj.-Pred./Together description

1a) Paul and Fiona are far away from one another.

b) Paul and Fiona are beside one another.

c) Paul is far away from Fiona.

d) Paul is beside Fiona.

2a) Len and Maisie are at opposite ends of the street.

b)Len and Maisie are just behind a parked car.

c)Len is at the opposite end of the street to Maisie.

d)Len is just behind Maisie.

3a)Ted and Ruth are some distance apart.

b)Ted and Ruth are alongside each other.

c)Ted is some distance from Ruth.

d)Ted is alongside Ruth.

4a)Roger and Charlotte are separated by a valley.

b)Roger and Charlotte are near to each other.

c)Roger is separated from Charlotte by a valley.

d)Roger is near Charlotte.

5a)Simon and Julia are far apart.

b)Simon and Julia are next to one another.

c)Simon is far beyond Julia.

d)Simon is next to Julia.

6a)Leo and Laura are on different parts of the hill.

b)Leo and Laura are just in front of the tree.

c)Leo is higher up the hill than Laura.

d)Leo is just in front of Laura.

7a)George and Katie are a long distance apart.

b)George and Katie are adjacent.

c)George is a long distance away from Katie.

d)George is adjacent to Katie.

8a)Steve and Shirley are on different sides of the lake.

b)Steve and Shirley are close together.

c)Steve is on the other side of the lake to Shirley.

d)Steve is close to Shirley.

9a)Jim and Karen are in different countries.

b)Jim and Karen are just next to each other.

c)Jim is in a different country to Karen.

d)Jim is just next to Karen.

10a)Heather and Phil are across the river from each other.

b)Heather and Phil are side by side.

c)Heather is across the river from Phil.

d)Heather is side by side with Phil.

11a)Anna and Justin are miles apart.

b)Anna and Justin are abreast of one another.

c)Anna is miles away from Justin.

d)Anna is abreast of Justin.

12a)Marianne and Douglas are separated.

b)Marianne and Douglas are a short distance from one another.

c)Marianne is separated from Douglas.

d)Marianne is a short distance from Douglas.

13a)Denise and Richard are in different towns.

b)Denise and Richard are slightly behind the bus.

c)Denise is in a different town to Richard.

d)Denise is slightly behind Richard.

14a)Debbie and Neil are far from each other.

b)Debbie and Neil are just to the right of a stream.

c)Debbie is far from Neil.

d)Debbie is just to the right of Neil.

15a)Alice and Stanley are a long way from one another

b)Alice and Stanley are just to the left of the gate

c)Alice is a long way away from Stanley.

d)Alice is just to the left of Stanley.

16a)Tracy and Peter are at different heights on the hill.

b)Tracy and Peter are a few feet apart.

c)Tracy is lower down the hill than Peter

d)Tracy is a few feet away from Peter.

17a)Rachel and John are far removed from one another.

b)Rachel and John are in front of the fence

c)Rachel is far removed from John.

d)Rachel is only just in front of John.

18a)Anita and Stuart are in different rooms

b)Anita and Stuart are in the same room.

c)Anita is in a different room to Stuart.

d)Anita is in the same room as Stuart.

19a)Susan and Graham are in different buildings.

b)Susan and Graham are in the same building.

c)Susan is in a different building to Graham.

d)Susan is in the same building as Graham.

20a)Joan and Bill are in neighbouring houses.

b)Joan and Bill are in the same house.

c)Joan is in a neighbouring house to Bill.

d)Joan is in the same house as Bill.

21a)Wendy and Tom are in offices next door to each other.

b)Wendy and Tom are in the same office.

c)Wendy is in the office next door to Tom.

d)Wendy is in the same office as Tom

22a)Matt and Kate are on different floors.

b)Matt and Kate are on the same floor.

c)Matt is on a different floor to Kate

d)Matt is on the same floor as Kate.

23a)Julie and Arthur are across town from each other.

b)Julie and Arthur are in a car.

c)Julie is across town from Arthur.

d)Julie is in a car alongside Arthur.

24a)Simon and Michelle are over the road from each other.

b)Simon and Michelle are on'the same side of the road.

c)Simon is over the road from Michelle

d)Simon is on the same side of the road as Michelle.

APPENDIX 13: MATERIALS USED IN EXPERIMENT 13

Sentence Conditions are as follows:

First clause contains thematic roles 1 & 2 (G-So, E-St or A-P) and introduction types (N-N, R-R, N-R, R-N). Target clause varies antecedent referred to: antecedent is thematic role 1 or 2; introduction type of antecedent and sentence position (first or second mention).

a) $\theta1$ (N), $\theta2$ (N) / Antecedent= $\theta1$, NAME, 1st mention position.

b) $\theta2$ (N), $\theta1$ (N) / Antecedent= $\theta1$, NAME, 2nd mention position.

c) $\theta1$ (R), $\theta2$ (R) / Antecedent= $\theta1$, ROLE, 1st mention position.

d) $\theta2$ (R), $\theta1$ (R) / Antecedent= $\theta1$, ROLE, 2nd mention position.

e) $\theta1$ (N), $\theta2$ (R) / Antecedent= $\theta1$, NAME, 1st mention position.

f) $\theta2$ (N), $\theta1$ (R) / Antecedent= $\theta1$, ROLE, 2nd mention position.

g) $\theta1$ (R), $\theta2$ (N) / Antecedent= $\theta1$, ROLE, 1st mention position.

h) $\theta2$ (R), $\theta1$ (N) / Antecedent= $\theta1$, NAME, 2nd mention position.

i) $\theta2$ (N), $\theta1$ (N) / Antecedent= $\theta2$, NAME, 1st mention position.

j) $\theta1$ (N), $\theta2$ (N) / Antecedent= $\theta2$, NAME, 2nd mention position.

k) $\theta2$ (R), $\theta1$ (R) / Antecedent= $\theta2$, ROLE, 1st mention position.

l) $\theta1$ (R), $\theta2$ (R) / Antecedent= $\theta2$, ROLE, 2nd mention position.

m) $\theta2$ (N), $\theta1$ (R) / Antecedent= $\theta2$, NAME, 1st mention position.

n) $\theta1$ (N), $\theta2$ (R) / Antecedent= $\theta2$, ROLE, 2nd mention position.

o) $\theta2$ (R), $\theta1$ (N) / Antecedent= $\theta2$, ROLE, 1st mention position.

p) $\theta1$ (R), $\theta2$ (N) / Antecedent= $\theta2$, NAME, 2nd mention position.

KEY

$\theta1$= Goal, Experiencer or Agent $\theta2$= Source, Stimulus or Patient

N= Name   R= Role name (e.g. waiter)

G= Goal   E= Experiencer   A= Agent

So= Source   St= Stimulus   P= Patient

GOAL-SOURCE SENTENCES

1a) John seized the comic from Bill and/he put it on the table.

1b) John passed the comic to Bill and/he put it on the table

1c) The man seized the comic from the boy and/he put it on the table.

1d) The man passed the comic to the boy and/he put it on the table.

1e) John seized the comic from the boy and/he put it on the table.

1f) John passed the comic to the boy and/he put it on the table.

1g) The man seized the comic from Bill and/he put it on the table.

1h) The man passed the comic to Bill and/he put it on the table.

1i) John passed the comic to Bill and/he started reading a book instead.

1j) John seized the comic from Bill and/he started reading a book instead.

1k) The man passed the comic to the boy and/he started reading a book instead.

1l) The man seized the comic from the boy and/he started reading a book instead.

1m) John passed the comic to the boy and/he started reading a book instead.

1n) John seized the comic from the boy and/he started reading a book instead.

1o) The man passed the comic to Bill and/he started reading a book instead.

1p) The man seized the comic from Bill and/he started reading a book instead.

2a) Malcolm won some money from Stuart and/he spent it all on beer.

2b) Malcolm gave some money to Stuart and/he spent it all on beer.

2c) The foreman won some money from the painter and/he spent it all on beer.

2d) The foreman gave some money to the painter and/he spent it all on beer.

2e) Malcolm won some money from the painter and/he spent it all on beer.

2f) Malcolm gave some money to the painter and/he spent it all on beer.

2g) The foreman won some money from Stuart and/he spent it all on beer.

2h) The foreman gave some money to Stuart and/he spent it all on beer.

2i) Malcolm gave some money to Stuart and/he insisted it was spent sensibly.

2j) Malcolm won some money from Stuart and/he handed it over very reluctantly.

2k) The foreman gave some money to the painter and/he insisted it was spent sensibly.

2l). The foreman won some money from the painter and/he handed it over very reluctantly.

2m) Malcolm gave some money to the painter and/he insisted it was spent sensibly.

2n) Malcolm won some money from the painter and/he handed it over very reluctantly.

2o) The foreman gave some money to Stuart and/he insisted it was spent sensibly.

2p) The foreman won some money from Stuart and he handed it over very reluctantly.

3a) Colin caught the ball from Gary and/he kicked it over the line.

3b) Colin threw the ball to Gary and/he caught it with one hand.

3c) The fullback caught the ball from the forward and/he kicked it over the line.

3d) The fullback threw the ball to the forward and/he caught it with one hand.

3e) Colin caught the ball from the forward and/he kicked it over the line.

3f) Colin threw the ball to the forward and/he caught it with one hand.

3g) The fullback caught the ball from Gary and/he kicked it over the line.

3h) The fullback threw the ball to Gary and/he caught it with one hand.

3i) Colin threw the ball to Gary and/he picked up another practice ball.

3j) Colin caught the ball from Gary and/he was jealous of the catch.

3k) The fullback threw the ball to the forward and/he picked up another practice ball.

3l) The fullback caught the ball from the forward and/he was jealous of the catch.

3m) Colin threw the ball to the forward and/he picked up another practice ball.

3n) Colin caught the ball from the forward and/he was jealous of the catch.

3o) The fullback threw the ball to Gary and/he picked up another practice ball.

3p) The fullback caught the ball from Gary and/he was jealous of the catch.

4a) Matthew grasped the microphone from Tony and/he started to speak straight away.

4b) Matthew handed the microphone to Tony and/he started to speak straight away.

4c) The politician grasped the microphone from the announcer and/he started to speak straight away.

4d) The politician handed the microphone to the announcer and/he started to speak straight away.

4e) Matthew grasped the microphone from the announcer and/he started to speak straight away.

4f) Matthew handed the microphone to the announcer and/he started to speak straight away.

4g) The politician grasped the microphone from Tony and/he started to speak straight away.

4h) The politician handed the microphone to Tony and/he started to speak straight away.

4i) Matthew handed the microphone to Tony and/he left the stage after that.

4j) Matthew grasped the microphone from Tony and/he asked for it back again.

4k) The politician handed the microphone to the announcer and/he left the stage after that.

4l) The politician grasped the microphone from the announcer and/he asked for it back again.

4m) Matthew handed the microphone to the announcer and/he left the stage after that.

4n) Matthew grasped the microphone from the announcer and/he asked for it back again.

4o) The politician handed the microphone to Tony and/he left the stage after that.

4p) The politician grasped the microphone from Tony and/he asked for it back again.

5a) Robert confiscated the parcel from Duncan and/he asked for proof of owner-ship.

5b) Robert delivered the parcel to Duncan and/he opened it with trembling fingers.

5c) The postman confiscated the parcel from the owner and/he asked for proof of owner-ship.

5d) The postman delivered the parcel to the owner and/he opened it with trembling fingers.

5e) Robert confiscated the parcel from the owner and/he asked for proof of owner ship.

5f) Robert delivered the parcel to the owner and/he opened it with trembling fingers.

5g) The postman confiscated the parcel from Duncan and/he asked for proof of owner ship.

5h) The postman delivered the parcel to Duncan and/he opened it with trembling fingers.

5i) Robert delivered the parcel to Duncan and/he waited to get a signature.

5j) Robert confiscated the parcel from Duncan and/he demanded to have it back.

5k) The postman delivered the parcel to the owner and/he waited to get a signature.

5l) The postman confiscated the parcel from the owner and/he demanded to have it back.

5m) Robert delivered the parcel to the owner and/he waited to get a signature.

5n) Robert confiscated the parcel from the owner and/he demanded to have it back.

5o) The postman delivered the parcel to Duncan and/he waited to get a signature.

5p) the postman confiscated the parcel from Duncan and/he demanded to have it back.

6a) Jason stole some sweets from Trevor and/he was ashamed to admit it.

6b) Jason handed out some sweets to Trevor and/he ate them all straight away.

6c) The youth stole some sweets from the boy and/he was ashamed to admit it.

6d) The youth handed out some sweets to the boy and/he ate them all straight away.

6e) Jason stole some sweets from the boy and/he was ashamed to admit it.

6f) Jason handed out some sweets to the boy and/he ate them all straight away.

6g) The youth stole some sweets from Trevor and/he was ashamed to admit it.

6h) The youth handed out some sweets to Trevor and/he ate them all straight away.

6i) Jason handed out some sweets to Trevor and/he kept the rest for later.

6j) Jason stole some sweets from Trevor and/he wondered where they had gone.

6k) The youth handed out some sweets to the boy and/he kept the rest for later.

6l) The youth stole some sweets from the boy and/he wondered where they had gone.

6m) Jason handed out some sweets to the boy and/he kept the rest for later.

6n) Jason stole some sweets from the boy and/he wondered where they had gone.

6o) The youth handed out some sweets to Trevor and/he kept the rest for later.

6p) The youth stole some sweets from Trevor and/he wondered where they had gone.

7a) Vincent took the money from Kenneth and/he put it in the safe.

7b) Vincent gave the money to Kenneth and/he counted it with great speed.

7c) The man took the money from the bank clerk and/he put it in the safe.

7d) The man gave the money to the bank clerk and/he counted it with great speed.

7e) Vincent took the money from the bank clerk and/he put it in the safe.

7f) Vincent gave the money to the bank clerk and/he counted it with great speed.

7g) The man took the money from Kenneth and/he put it in the safe.

7h) The man gave the money to Kenneth and/he counted it with great speed.

7i) Vincent gave the money to Kenneth and/he watched while it was counted.

7j) Vincent took the money from Kenneth and/he tried to press the alarm.

7k) The man gave the money to the bank clerk and/he watched while it was counted.

7l) The man took the money from the bank clerk and/he tried to press the alarm.

7m) Vincent gave the money to the bank clerk and/he watched while it was counted.

7n) Vincent took the money from the bank clerk and/he tried to press the alarm.

7o) The man gave the money to Kenneth and/he watched while it was counted.

7p) The man took the money from Kenneth and/he tried to press the alarm.

8a) Derek grabbed the balloon from Michael and/he burst it with a pin.

8b) Derek tossed the balloon to Michael and/he burst it with a pin.

8c) The prefect grabbed the balloon from the new boy and/he burst it with a pin.

8d) The prefect tossed the balloon to the new boy and/he burst it with a pin.

8e) Derek grabbed the balloon from the new boy and/he burst it with a pin.

8f) Derek tossed the balloon to the new boy and/he burst it with a pin.

8g) The prefect grabbed the balloon from Michael and/he burst it with a pin.

8h) The prefect tossed the balloon to Michael and/he burst it with a pin.

8i) Derek tossed the balloon to Michael and/he played with a ball instead.

8j) Derek grabbed the balloon from Michael and/he was very upset about it.

8k) The prefect tossed the balloon to the new boy and/he played with a ball instead.

8l) The prefect grabbed the balloon from the new boy and/he was very upset about it.

8m) Derek tossed the balloon to the new boy and/he played with a ball instead.

8n) Derek grabbed the balloon from the new boy and/he was very upset about it.

8o) The prefect tossed the balloon to Michael and/he played with a ball instead.

8p) The prefect grabbed the balloon from Michael and/he was very upset about it.

9a) Julie pinched the ball from Rachel and/she quickly ran off with it.

9b) Julie rolled the ball to Rachel and/she refused to roll it back.

9c) The head girl pinched the ball from the schoolgirl and/she quickly ran off with it.

9d) The head girl rolled the ball to the schoolgirl and/she refused to roll it back.

9e) Julie pinched the ball from the schoolgirl and/she quickly ran off with it.

9f) Julie rolled the ball to the schoolgirl and/she refused to roll it back.

9g) The head girl pinched the ball from Rachel and/she quickly ran off with it.

9h) The head girl rolled the ball to Rachel and/she refused to roll it back.

9i) Julie rolled the ball to Rachel and/she hoped that it would reach.

9j) Julie pinched the ball from Rachel and/she tried to get it back.

9k) The head girl rolled the ball to the schoolgirl and/she hoped that it would reach.

9l) The head girl pinched the ball from the schoolgirl and/she tried to get it back.

9m) Julie rolled the ball to the schoolgirl and/she hoped that it would reach.

9n) Julie pinched the ball from the schoolgirl and/she tried to get it back.

9o) The head girl rolled the ball to Rachel and/she hoped that it would reach.

9p) The head girl pinched the ball from Rachel and/she tried to get it back.

10a) Nicola claimed the cheque from Eleanor and/she spent it all at once.

10b) Nicola issued the cheque to Eleanor and/she spent it all at once.

10c) The woman claimed the cheque from the secretary and/she spent it all at once.

10d) The woman issued the cheque to the secretary and/she spent it all at once.

10e) Nicola claimed the cheque from the secretary and/she spent it all at once.

10f) Nicola issued the cheque to the secretary and/she spent it all at once.

10g) The woman claimed the cheque from Eleanor and/she spent it all at once.

10h) The woman issued the cheque to Eleanor and/she spent it all at once.

10i) Nicola issued the cheque to Eleanor and/she made a speech of congratulation.

10j) Nicola claimed the cheque from Eleanor and/she presented it with a flourish.

10k) The woman issued the cheque to the secretary and/she made a speech of congratulation.

10l) The woman claimed the cheque from the secretary and/she presented it with a flourish.

10m) Nicola issued the cheque to the secretary and/she made a speech of congratulation.

10n) Nicola claimed the cheque from the secretary and/she presented it with a flourish.

10o) The woman issued the cheque to Eleanor and/she made a speech of congratulation.

10p) The woman claimed the cheque from Eleanor and/she presented it with a flourish.

11a) Alec received a letter from Mark and/he replied to it at once.

11b) Alec wrote a letter to Mark and/he replied to it at once.

11c) The tutor received a letter from the student and/he replied to it at once.

11d) The tutor wrote a letter to the student and/he replied to it at once.

11e) Alec received a letter from the student and/he replied to it at once.

11f) Alec wrote a letter to the student and/he replied to it at once.

11g) The tutor received a letter from Mark and/he replied to it at once.

11h) The tutor wrote a letter to Mark and/he replied to it at once.

11i) Alec wrote a letter to Mark and/he posted it the same day.

11j) Alec received a letter from Mark and/he apologised for the poor handwriting.

11k) The tutor wrote a letter to the student and/he posted it the same day.

11l) The tutor received a letter from the student and/he apologised for the poor handwriting.

11m) Alec wrote a letter to the student and/he posted it the same day.

11n) Alec received a letter from the student and/he apologised for the poor handwriting.

11o) The tutor wrote a letter to Mark and/he posted it the same day.

11p) The tutor received a letter from Mark and/he apologised for the poor handwriting.

12a) Sarah borrowed a record from Jenny and/she listened to it that evening.

12b) Sarah loaned a record to Jenny and/she listened to it that evening.

12c) The soprano borrowed a record from the dancer and/she listened to it that evening.

12d) The soprano loaned a record to the dancer and/she listened to it that evening.

12e) Sarah borrowed a record from the dancer and/she listened to it that evening.

12f) Sarah loaned a record to the dancer and/she listened to it that evening.

12g) The soprano borrowed a record from Jenny and/she listened to it that evening.

12h) The soprano loaned a record to Jenny and/she listened to it that evening.

12i) Sarah loaned a record to Jenny and/she asked for it back again.

12j) Sarah borrowed a record from Jenny and/she asked for it back again.

12k) The soprano loaned a record to the dancer and/she asked for it back again.

12l) The soprano borrowed a record from the dancer and/she asked for it back again.

12m) Sarah loaned a record to the dancer and/she asked for it back again.

12n) Sarah borrowed a record from the dancer and/she asked for it back again.

12o) The soprano loaned a record to Jenny and/she asked for it back again.

12p) The soprano borrowed a record from Jenny and/she asked for it back again.

13a) Victoria accepted a lift from Emma and/she was very grateful for it.

13b) Victoria offered a lift to Emma and/she was very grateful for it..

13c) The girl accepted a lift from the old woman and/she was very grateful for it.

13d) The girl offered a lift to the old woman and/she was very grateful for it..

13e) Victoria accepted a lift from the old woman and/she was very grateful for it.

13f) Victoria offered a lift to the old woman and/she was very grateful for it..

13g) The girl accepted a lift from Emma and/she was very grateful for it.

13h) The girl offered a lift to Emma and/she was very grateful for it..

13i) Victoria offered a lift to Emma and/she refused any money for petrol.

13j) Victoria accepted a lift from Emma and/she refused any money for petrol.

13k) The girl offered a lift to the old woman and/she refused any money for petrol.

13l) The girl accepted a lift from the old woman and/she refused any money for petrol.

13m) Victoria offered a lift to the old woman and/she refused any money for petrol.

13n) Victoria accepted a lift from the old woman and/she refused any money for petrol.

13o) The girl offered a lift to Emma and/she refused any money for petrol.

13p) the girl accepted a lift from Emma and/she refused any money for petrol.

14a) Diane collected some jumble from Angela and/she took it to the sale.

14b) Diane donated some jumble to Angela and/she was very grateful for it.

14c) The woman collected some jumble from the old lady and/she took it to the sale.

14d) The woman donated some jumble to the old lady and/she was very grateful for it.

14e) Diane collected some jumble from the old lady and/she took it to the sale.

14f) Diane donated some jumble to the old lady and/she was very grateful for it.

14g) The woman collected some jumble from Angela and/she took it to the sale.

14h) The woman donated some jumble to Angela and/she was very grateful for it.

14i) Diane donated some jumble to Angela and/she included some jewellery by mistake.

14j) Diane collected some jumble from Angela and/she was glad it had gone.

14k) The woman donated some jumble to the old lady and/she included some jewellery by mistake.

14l) The woman collected some jumble from the old lady and/she was glad it had gone.

14m) Diane donated some jumble to the old lady and/she included some jewellery by mistake.

14n) Diane collected some jumble from the old lady and/she was glad it had gone.

14o) The woman donated some jumble to Angela and/she included some jewellery by mistake.

14p) The woman collected some jumble from Angela and/she was glad it had gone.

15a) Barbara snatched the book from Joanne and/she tore the cover off it.

15b) Barbara returned the book to Joanne and/she was relieved to see it.

15c) The girl snatched the book from the woman and/she tore the cover off it.

15d) The girl returned the book to the woman and/she was relieved to see it.

15e) Barbara snatched the book from Joanne and/she tore the cover off it.

15f) Barbara returned the book to Joanne and/she was relieved to see it.

15g) The girl snatched the book from Joanne and/she tore the cover off it.

15h) The girl returned the book to Joanne and/she was relieved to see it.

15i) Barbara returned the book to Joanne and/she apologised for tearing a page.

15j) Barbara snatched the book from Joanne and/she was left standing empty handed.

15k) The girl returned the book to the woman and/she apologised for tearing a page.

15l) The girl snatched the book from the woman and/she was left standing empty handed.

15m) Barbara returned the book to the woman and/she apologised for tearing a page.

15n) Barbara snatched the book from the woman and/she was left standing empty handed.

15o) The girl returned the book to Joanne and/she apologised for tearing a page.

15p) The girl snatched the book from Joanne and/she was left standing empty handed.

16a) Nigel hired the car from Brendan and/he paid for it in advance.

16b) Nigel rented the car to Brendan and/he paid for it in advance.

16c) The young man hired the car from the motorist and/he paid for it in advance.

16d) the young man rented the car to the motorist and/he paid for it in advance.

16e) Nigel hired the car from the motorist and/he paid for it in advance.

16f) Nigel rented the car to the motorist and/he paid for it in advance.

16g) The young man hired the car from Brendan and/he paid for it in advance.

16h) The young man rented the car to Brendan and/he paid for it in advance.

16i) Nigel rented the car to Brendan and/he asked for payment in advance.

16j) Nigel hired the car from Brendan and/he asked for payment in advance.

16k) The young man rented the car to the motorist and/he asked for payment in advance.

16l) The young man hired the car from the motorist and/he asked for payment in advance.

16m) Nigel rented the car to the motorist and/he asked for payment in advance.

16n) Nigel hired the car from the motorist and/he asked for payment in advance.

16o) The young man rented the car to Brendan and/he asked for payment in advance.

16p) The young man hired the car from Brendan and/he asked for payment in advance.

EXPERIENCER-STIMULUS SENTENCES

1a) Ken admired Geoff and/he tried not to show it.

1b) Ken impressed Geoff and/he tried to act the same.

1c) The tutor admired the student and/he tried not to show it.

1d) The tutor impressed the student and/he tried to act the same.

1e) Ken admired the student and/he tried not to show it.

1f) Ken impressed the student and/he tried to act the same.

1g) The tutor admired Geoff and/he tried not to show it.

1h) The tutor impressed Geoff and/he tried to act the same.

1i) Ken impressed Geoff and/he was not aware of it.

1j) Ken admired Geoff and/he didn't feel worthy of it.

1k) The tutor impressed the student and/he was not aware of it.

1l) The tutor admired the student and/he didn't feel worthy of it.

1m) Ken impressed the student and/he was not aware of it.

1n) Ken admired the student and/he didn't feel worthy of it.

1o) The tutor impressed Geoff and/he was not aware of it.

1p) The tutor admired Geoff and/he didn't feel worthy of it.

2a) Charles liked Alan and/he wasn't ashamed to show it.

2b) Charles pleased Alan and/he wasn't usually easy to please.

2c) The journalist liked the editor and/he wasn't ashamed to show it.

2d) The journalist pleased the editor and/he wasn't usually easy to please.

2e) Charles liked the editor and/he wasn't ashamed to show it.

2f) Charles pleased the editor and/he wasn't usually easy to please.

2g) The journalist liked Alan and/he wasn't ashamed to show it.

2h) The journalist pleased Alan and/he wasn't usually easy to please.

2i) Charles pleased Alan and/he was glad to be appreciated.

2j) Charles liked Alan and/he was pleased to be popular.

2k) The journalist pleased the editor and/he was glad to be appreciated.

2l) The journalist liked the editor and/he was pleased to be popular.

2m) Charles pleased the editor and/he was glad to be appreciated.

2n) Charles liked the editor and/he was pleased to be popular.

2o) The journalist pleased Alan and/he was glad to be appreciated.

2p) The journalist liked Alan and/he was pleased to be popular.

3a) Ray envied Jake and/he tried hard to hide it.

3b) Ray irritated Jake and/he tried hard to hide it.

3c) The barrister envied the judge and/he tried hard to hide it.

3d) The barrister irritated the judge and/he tried hard to hide it.

3e) Ray envied the judge and/he tried hard to hide it.

3f) Ray irritated the judge and/he tried hard to hide it.

3g) The barrister envied Jake and/he tried hard to hide it.

3h) The barrister irritated Jake and/he tried hard to hide it.

3i) Ray irritated Jake and/he irritated everyone else as well.

3j) Ray envied Jake and/he really did not deserve it.

3k) The barrister irritated the judge and/he irritated everyone else as well.

3l) The barrister envied the judge and/he really did not deserve it.

3m) Ray irritated the judge and/he irritated everyone else as well.

3n) Ray envied the judge and/he really did not deserve it.

3o) The barrister irritated Jake and/he irritated everyone else as well.

3p) The barrister envied Jake and/he really did not deserve it.

4a) Frank hated James and/he couldn't conceal it from anyone.

4b) Frank bored James and/he tried not to fall asleep.

4c) The pilot hated the navigator and/he couldn't conceal it from anyone.

4d) The pilot bored the navigator and/he tried not to fall asleep.

4e) Frank hated the navigator and/he couldn't conceal it from anyone.

4f) Frank bored the navigator and/he tried not to fall asleep.

4g) The pilot hated James and/he couldn't conceal it from anyone.

4h) The pilot bored James and/he tried not to fall asleep.

4i) Frank bored James and/he bored most other people too.

4j) Frank hated James and/he was surprised at being disliked.

4k) The pilot James and/he bored most other people too.

4l) The pilot hated James and/he was surprised at being disliked.

4m) Frank bored the navigator and/he bored most other people too.

4n) Frank hated the navigator and/he was surprised at being disliked.

4o) The pilot bored James and/he bored most other people too.

4p) The pilot hated James and/he was surprised at being disliked.

5a) Andrew despised Jeremy and/he didn't try to hide it.

5b) Andrew shocked Jeremy and/he sat down quickly in surprise.

5c) The hooligan despised the priest and/he didn't try to hide it.

5d) The hooligan shocked the priest and/he sat down quickly in surprise.

5e) Andrew despised the priest and/he didn't try to hide it.

5f) Andrew shocked the priest and/he sat down quickly in surprise.

5g) The hooligan despised Jeremy and/he didn't try to hide it.

5h) The hooligan shocked Jeremy and/he sat down quickly in surprise.

5i) Andrew shocked Jeremy and/he shocked many other people too.

5j) Andrew despised Jeremy and/he was upset at being disliked.

5k) The hooligan shocked the priest and/he shocked many other people too.

5l) The hooligan despised the priest and/he was upset at being disliked.

5m) Andrew shocked the priest and/he shocked many other people too.

5n) Andrew despised the priest and/he was upset at being disliked.

5o) The hooligan shocked Jeremy and/he shocked many other people too.

5p) The hooligan despised Jeremy and/he was upset at being disliked.

6a) Tom detested Mark and/he didn't mind who knew it.

6b) Tom disgusted Mark and/he felt sick after every conversation.

6c) The drunk detested the barman and/he didn't mind who knew it.

6d) The drunk disgusted the barman and/he felt sick after every conversation.

6e) Tom detested the barman and/he didn't mind who knew it.

6f) Tom disgusted the barman and/he felt sick after every conversation.

6g) The drunk detested Mark and/he didn't mind who knew it.

6h) The drunk disgusted Mark and/he felt sick after every conversation.

6i) Tom disgusted Mark and/he didn't appeal to others either.

6j) Tom detested Mark and/he felt it was very unfair.

6k) The drunk disgusted the barman and/he didn't appeal to others either.

6l) The drunk detested the barman and/he felt it was very unfair.

6m) Tom disgusted the barman and/he didn't appeal to others either.

6n) Tom detested the barman and/he felt it was very unfair.

6o) The drunk disgusted Mark and/he didn't appeal to others either.

6p) The drunk detested Mark and/he felt it was very unfair.

7a) Clive distrusted Fred and/he always kept the safe locked.

7b) Clive angered Fred and/he decided to resign at once.

7c) The manager distrusted the chef and/he always kept the safe locked.

7d) The manager angered the chef and/he decided to resign at once.

7e) Clive distrusted the chef and/he always kept the safe locked.

7f) Clive angered the chef and/he decided to resign at once.

7g) The manager distrusted Fred and/he always kept the safe locked.

7h) The manager Fred and/he decided to resign at once.

7i) Clive angered Fred and/he often upset other people too.

7j) Clive distrusted Fred and/he wasn't worthy of anyone's trust.

7k) The manager angered the chef and/he often upset other people too.

7l) The manager distrusted the chef and/he wasn't worthy of anyone's trust.

7m) Clive angered the chef and/he often upset other people too.

7n) Clive distrusted the chef and/he wasn't worthy of anyone's trust.

7o) The manager angered Fred and/he often upset other people too.

7p) The manager distrusted Fred and/he wasn't worthy of anyone's trust.

8a) Henry resented Bruce and/he hated to feel that way.

8b) Henry infuriated Bruce and/he got more and more angry.

8c) The artist resented the sculptor and/he hated to feel that way.

8d) The artist infuriated the sculptor and/he got more and more angry.

8e) Henry resented the sculptor and/he hated to feel that way.

8f) Henry infuriated the sculptor and/he got more and more angry.

8g) The artist resented Bruce and/he hated to feel that way.

8h) The artist infuriated Bruce and/he got more and more angry.

8i) Henry infuriated Bruce and/he got more and more angry.

8j) Henry resented Bruce and/he hated to feel that way.

8k) The artist infuriated the sculptor and/he got more and more angry.

8l) The artist resented the sculptor and/he hated to feel that way.

8m) Henry infuriated the sculptor and/he got more and more angry.

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8n) Henry resented the sculptor and/he hated to feel that way.

8o) The artist infuriated Bruce and/he got more and more angry.

8p) The artist resented Bruce and/he hated to feel that way.

9a) Reggie noticed Luke and/he pretended not to have done.

9b) Reggie charmed Luke and/he was well and truly deceived.

9c) The guest noticed the host and/he pretended not to have done.

9d) The guest charmed the host and/he was well and truly deceived.

9e) Reggie noticed the host and/he pretended not to have done.

9f) Reggie charmed the host and/he was well and truly deceived.

9g) The guest noticed Luke and/he pretended not to have done.

9h) The guest charmed Luke and/he was well and truly deceived.

9i) Reggie charmed Luke and/he was offered the marketing job.

9j) Reggie noticed Luke and/he looked quite nervous this evening.

9k) The guest charmed the host and/he was offered the marketing job.

9l) The guest noticed the host and/he looked quite nervous this evening.

9m) Reggie charmed the host and/he was offered the marketing job.

9n) Reggie noticed the host and/he looked quite nervous this evening.

9o) The guest charmed Luke and/he was offered the marketing job.

9p) The guest noticed Luke and/he looked quite nervous this evening.

10a) Dick loathed Carl and/he told everyone at the meeting.

10b) Dick deceived Carl and/he discovered the deceit by accident.

10c) The treasurer loathed the president and/he told everyone at the meeting.

10d) The treasurer deceived the president and/he discovered the deceit by accident.

10e) Dick loathed the president and/he told everyone at the meeting.

10f) Dick deceived the president and/he discovered the deceit by accident.

10g)The treasurer loathed Carl and/he told everyone at the meeting.

10h) The treasurer deceived Carl and/he discovered the deceit by accident.

10i) Dick deceived Carl and/he felt very ashamed about it.

10j) Dick loathed Carl and/he wasn't used to being disliked.

10k) The treasurer deceived the president and/he felt very ashamed about it.

10l) The treasurer loathed the president and/he wasn't used to being disliked.

10m) Dick deceived the president and/he felt very ashamed about it.

10n) Dick loathed the president and/he wasn't used to being disliked.

10o) The treasurer deceived Carl and/he felt very ashamed about it.

10p) The treasurer loathed Carl and/he wasn't used to being disliked.

11a) Ernest appreciated Ben and/he tried hard to show it.

11b) Ernest troubled Ben and/he wondered how best to help.

11c) The patient appreciated the doctor and/he tried hard to show it.

11d) The patient troubled the doctor and/he wondered how best to help.

11e) Ernest appreciated the doctor and/he tried hard to show it.

11f) Ernest troubled the doctor and/he wondered how best to help.

11g)The patient appreciated Ben and/he tried hard to show it.

11h) the patient troubled Ben and/he wondered how best to help.

11i) Ernest troubled Ben and/he apologised for being a nuisance.

11j) Ernest appreciated Ben and/he felt pleased to be valued.

11k) The patient troubled the doctor and/he apologised for being a nuisance.

11l) The patient appreciated the doctor and/he felt pleased to be valued.

11m) Ernest troubled the doctor and/he apologised for being a nuisance.

11n) Ernest appreciated the doctor and/he felt pleased to be valued.

11o) The patient troubled Ben and/he apologised for being a nuisance.

11p) The patient appreciated Ben and/he felt pleased to be valued.

12a) Bert heard Mike and/he wondered what was going on.

12b) Bert upset Mike and/he asked for an immediate apology.

12c) The landlord heard the tenant and/he wondered what was going on.

12d) The landlord upset the tenant and/he asked for an immediate apology.

12e) Bert heard the tenant and/he wondered what was going on.

12f) Bert upset the tenant and/he asked for an immediate apology.

12g) The landlord heard Mike and/he wondered what was going on.

12h) The landlord upset Mike and/he asked for an immediate apology.

12i) Bert upset Mike and/he felt very sorry about it.

12j) Bert heard Mike and/he apologised for being a nuisance.

12k) The landlord upset the tenant and/he felt very sorry about it.

12l) The landlord heard the tenant and/he apologised for being a nuisance.

12m) Bert upset the tenant and/he felt very sorry about it.

12n) Bert heard the tenant and/he apologised for being a nuisance.

12o) The landlord upset Mike and/he felt very sorry about it.

12p) The landlord heard Mike and/he apologised for being a nuisance.

13a) Warren saw Clarence and/he stopped to look more closely.

13b) Warren worried Clarence and/he couldn't concentrate on anything else.

13c) The headmaster saw the teenager and/he stopped to look more closely.

13d) The headmaster worried the teenager and/he couldn't concentrate on anything else.

13e) Warren saw the teenager and/he stopped to look more closely.

13f) Warren worried the teenager and/he couldn't concentrate on anything else.

13g) The headmaster saw Clarence and/he stopped to look more closely.

13h) The headmaster worried Clarence and/he couldn't concentrate on anything else.

13i) Warren worried Clarence and/he felt very guilty about it.

13j) Warren saw Clarence and/he appeared to be fast asleep.

13k) The headmaster worried the teenager and/he felt very guilty about it.

13l) The headmaster saw the teenager and/he appeared to be fast asleep.

13m) Warren worried the teenager and/he felt very guilty about it.

13n) Warren saw the teenager and/he appeared to be fast asleep.

13o) The headmaster worried Clarence and/he felt very guilty about it.

13p) The headmaster saw Clarence and/he appeared to be fast asleep.

14a) Billy respected Gerald and/he tried to act the same.

14b) Billy amused Gerald and/he couldn't help roaring with laughter.

14c) The student respected the lecturer and/he tried to act the same.

14d) the student amused the lecturer and/he couldn't help roaring with laughter.

14e) Billy respected the lecturer and/he tried to act the same.

14f) Billy amused the lecturer and/he couldn't help roaring with laughter.

14g) The student respected Gerald and/he tried to act the same.

14h) The student amused Gerald and/he couldn't help roaring with laughter.

14i) Billy amused Gerald and/he liked to make others laugh.

14j) Billy respected Gerald and/he felt honoured to be valued.

14k) The student amused the lecturer and/he liked to make others laugh.

14l) The student respected the lecturer and/he felt honoured to be valued.

14m) Billy amused the lecturer and/he liked to make others laugh.

14n) Billy respected the lecturer and/he felt honoured to be valued.

14o) The student amused Gerald and/he liked to make others laugh.

14p) The student respected Gerald and/he felt honoured to be valued.

15a) Darren disliked Martin and/he made it clear to everyone.

15b) Darren annoyed Martin and/he stormed out of the room.

15c) The foreman disliked the welder and/he made it clear to everyone.

15d) The foreman annoyed the welder and/he stormed out of the room.

15e) Darren disliked the welder and/he made it clear to everyone.

15f) Darren annoyed the welder and/he stormed out of the room.

15g) The foreman disliked Martin and/he made it clear to everyone.

15h) the foreman annoyed Martin and/he stormed out of the room.

15i) Darren annoyed Martin and/he regretted it later that evening.

15j) Darren disliked Martin and/he reciprocated the ill will entirely.

15k) The foreman annoyed the welder and/he regretted it later that evening.

15l) The foreman disliked the welder and/he reciprocated the ill will entirely.

15m) Darren annoyed the welder and/he regretted it later that evening.

15n) Darren disliked the welder and/he reciprocated the ill will entirely.

15o) The foreman annoyed Martin and/he regretted it later that evening.

15p) The foreman disliked Martin and/he reciprocated the ill will entirely.

16a) Wendy pitied Cath and/she was glad to be different.

16b) Wendy aggravated Cath and/she finally screamed with sheer frustration.

16c) The model pitied the hairdresser and/she was glad to be different.

16d) The model aggravated the hairdresser and/she finally screamed with sheer frustration.

16e) Wendy pitied the hairdresser and/she was glad to be different.

16f) Wendy aggravated the hairdresser and/she finally screamed with sheer frustration.

16g) The model pitied Cath and/she was glad to be different.

16h) The model aggravated Cath and/she finally screamed with sheer frustration.

16i) Wendy aggravated Cath and/she tended to do this often.

16j) Wendy pitied Cath and/she didn't like to be pitied.

16k) The model aggravated the hairdresser and/she tended to do this often.

16l) The model pitied the hairdresser and/she didn't like to be pitied.

16m) Wendy aggravated the hairdresser and/she tended to do this often.

16n) Wendy pitied the hairdresser and/she didn't like to be pitied.

16o) The model aggravated Cath and/she tended to do this often.

16p) The model pitied Cath and/she didn't like to be pitied.

AGENT-PATIENT SENTENCES

1a) Joseph hit Patrick and/he made sure that it hurt.

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1b) Patrick was hit by Joseph and/he made sure that it hurt.

1c) The teacher hit the pupil Patrick and/he made sure that it hurt.

1d) The pupil was hit by the teacher and/he made sure that it hurt.

1e) Joseph hit the pupil and/he made sure that it hurt.

1f) Patrick was hit by the teacher and/he made sure that it hurt.

1g) The teacher hit Patrick and/he made sure that it hurt.

1h) The pupil was hit by Joseph and/he made sure that it hurt.

1i) Patrick was hit by Joseph and/he began to cry very loudly.

1j) Joseph hit Patrick and/he began to cry very loudly.

1k) The pupil was hit by the teacher and/he began to cry very loudly.

1l) the teacher hit the pupil and/he began to cry very loudly.

1m) Patrick was hit by the teacher and/he began to cry very loudly.

1n) Joseph hit the pupil and/he began to cry very loudly.

1o) The pupil was hit by Joseph and/he began to cry very loudly.

1p) The teacher hit Patrick and/he began to cry very loudly.

2a) Jonathan pushed Sam and/he denied doing it on purpose.

2b) Sam was pushed by Jonathan and/he denied doing it on purpose.

2c) The thug pushed the freshman and/he denied doing it on purpose.

2d) The freshman was pushed by the thug and/he denied doing it on purpose.

2e) Jonathan pushed the freshman and/he denied doing it on purpose.

2f) The freshman was pushed by Jonathan and/he denied doing it on purpose.

2g)The thug pushed Sam and/he denied doing it on purpose.

2h) Sam was pushed by the thug and/he denied doing it on purpose.

2i) Sam was pushed by Jonathan and/he fell over into a puddle.

2j) Jonathan pushed Sam and/he fell over into a puddle.

2k) The freshman was pushed by Jonathan and/he fell over into a puddle.

2l) Jonathan pushed the freshman and/he fell over into a puddle.

2m) Sam was pushed by the thug and/he fell over into a puddle.

2n) The thug pushed Sam and/he fell over into a puddle.

2o) The freshman was pushed by Jonathan and/he fell over into a puddle.

2p) Jonathan pushed the freshman and/he fell over into a puddle.

3a) Terry kicked Nathan and/he should have kicked the ball.

3b) Nathan was kicked by Terry and/he should have kicked the ball.

3c) The goalkeeper kicked the striker and/he should have kicked the ball.

3d) The striker was kicked by the goalkeeper and/he should have kicked the ball.

3e) Terry kicked the striker and/he should have kicked the ball.

3f) The striker was kicked by Terry and/he should have kicked the ball.

3g) The goalkeeper kicked Nathan and/he should have kicked the ball.

3h) Nathan was kicked by the goalkeeper and/he should have kicked the ball.

3i) Nathan was kicked by Terry and/he limped back home in agony

3j) Terry kicked Nathan and/he limped back home in agony.

3k) The striker was kicked by the goalkeeper and/he limped back home in agony

3l) The goalkeeper kicked the striker and/he limped back home in agony.

3m) Nathan was kicked by the goalkeeper and/he limped back home in agony

3n) The goalkeeper kicked Nathan and/he limped back home in agony.

3o) The striker was kicked by Terry and/he limped back home in agony

3p) Terry kicked the striker and/he limped back home in agony.

4a) Scott disobeyed Marcus and/he was extremely angry about it.

4b) Marcus was disobeyed by Scott and/he was extremely angry about it.

4c) The soldier disobeyed the sergeant and/he was extremely angry about it.

4d) The sergeant was disobeyed by the soldier and/he was extremely angry about it.

4e) Scott disobeyed the sergeant and/he was extremely angry about it.

4f) The sergeant was disobeyed by Scott and/he was extremely angry about it.

4g) The soldier disobeyed Marcus and/he was extremely angry about it.

4h) The sergeant was disobeyed by Scott and/he was extremely angry about it.

4i) Marcus was disobeyed by Scott and/he was immediately put on report.

4j) Scott disobeyed Marcus and/he was immediately put on report.

4k) The sergeant was disobeyed by the soldier and/he was immediately put on report.

4l) The soldier disobeyed the sergeant and/he was immediately put on report.

4m) Marcus was disobeyed by the soldier and/he was immediately put on report.

4n) The soldier disobeyed Marcus and/he was immediately put on report.

4o) The sergeant was disobeyed by Scott and/he was immediately put on report.

4p) Scott disobeyed the sergeant and/he was immediately put on report.

5a) Timothy helped Ian and/he felt very virtuous about it.

5b) Ian was helped by Timothy and/he felt very virtuous about it.

5c) The parson helped the pensioner and/he felt very virtuous about it.

5d) The pensioner was helped by the parson and/he felt very virtuous about it.

5e) Timothy helped the pensioner and/he felt very virtuous about it.

5f) The pensioner was helped by Timothy and/he felt very virtuous about it.

5g) The parson helped Ian and/he felt very virtuous about it.

5h) The pensioner was helped by Timothy and/he felt very virtuous about it.

5i) Ian was helped by Timothy and/he very relieved and grateful.

5j) Timothy helped Ian and/he felt very relieved and grateful.

5k) The pensioner was helped by the parson and/he very relieved and grateful.

5l) The parson helped the pensioner and/he felt very relieved and grateful.

5m) Ian was helped by the pensioner and/he very relieved and grateful.

5n) The pensioner helped Ian and/he felt very relieved and grateful.

5o) The parson was helped by Timothy and/he very relieved and grateful.

5p) Timothy helped the pensioner and/he felt very relieved and grateful.

6a) Brian insulted David and/he felt better after doing so.

6b) David was insulted by Brian and/he felt better after doing so.

6c) The demonstrator insulted the policeman and/he felt better after doing so.

6d) The policeman was insulted by the demonstrators and/he felt better after doing so.

6e) Brian insulted the policeman and/he felt better after doing so.

6f) The policeman was insulted by Brian and/he felt better after doing so.

6g) The demonstrator insulted David and/he felt better after doing so.

6h) David was insulted by the demonstrator and/he felt better after doing so.

6i) David was insulted by Brian and/he felt angry at being abused.

6j) Brian insulted David and/he felt angry at being abused.

6k) The policeman was insulted by the demonstrator and/he felt angry at being abused.

6l) The demonstrator insulted the policeman and/he felt angry at being abused.

6m) David was insulted by the demonstrator and/he felt angry at being abused.

6n) The demonstrator insulted David and/he felt angry at being abused.

6o) The policeman was insulted by Brian and/he felt angry at being abused.

6p) Brian insulted the policeman and/he felt angry at being abused.

7a) Cliff bullied Nicholas and/he pushed other people around too.

7b) Nicholas was bullied by Cliff and/he pushed other people around too.

7c) The director bullied the executive and/he pushed other people around too.

7d) The executive was bullied by the director and/he pushed other people around too.

7e) Cliff bullied the executive and/he pushed other people around too.

7f) The executive was bullied by Cliff and/he pushed other people around too.

7g) The director bullied Nicholas and/he pushed other people around too.

7h) Nicholas was bullied by the director and/he pushed other people around too.

7i) Nicholas was bullied by Cliff and/he was annoyed at being intimidated.

7j) Cliff bullied Nicholas and/he was annoyed at being intimidated.

7k) The executive was bullied by the director and/he was annoyed at being intimidated.

7l) The director bullied the executive and/he was annoyed at being intimidated.

7m) Nicholas was bullied by the director and/he was annoyed at being intimidated.

7n) The director bullied Nicholas and/he was annoyed at being intimidated.

7o) The executive was bullied by Cliff and/he was annoyed at being intimidated.

7p) Cliff bullied the executive and/he was annoyed at being intimidated.

8a) Rob accused William and/he demanded the money back immediately.

8b) William was accused by Rob and/he demanded the money back immediately.

8c) The manager accused the clerk and/he demanded the money back immediately.

8d) The clerk was accused by the manager and/he demanded the money back immediately.

8e) Rob accused the clerk and/he demanded the money back immediately.

8f) The clerk was accused by Rob and/he demanded the money back immediately.

8g) The manager accused William and/he demanded the money back immediately.

8h) William was accused by the manager and/he demanded the money back immediately.

8i) William was accused by Rob and/he was surprised by the accusation.

8j) Rob accused William and/he was surprised by the accusation.

8k) The clerk was accused by the manager and/he was surprised by the accusation.

8l) The manager accused the clerk and/he was surprised by the accusation.

8m) The clerk was accused by Rob and/he was surprised by the accusation.

8n) Rob accused the clerk and/he was surprised by the accusation.

8o) The clerk was accused by Rob and/he was surprised by the accusation.

8p) Rob accused the clerk and/he was surprised by the accusation.

9a) Alfred criticised Boris and/he bitterly regretted having done so.

9b) Boris was criticised by Alfred and/he bitterly regretted having done so.

9c) The producer criticised the director and/he bitterly regretted having done so.

9d) The director was criticised by the producer and/he bitterly regretted having done so.

9e) Alfred criticised the director and/he bitterly regretted having done so.

9f) The director was criticised by Alfred and/he bitterly regretted having done so.

9g) The producer criticised Boris and/he bitterly regretted having done so.

9h) Boris was criticised by the producer and/he bitterly regretted having done so.

9i) Boris was criticised by Alfred and/he felt very upset and humiliated.

9j) Alfred criticised Boris and/he felt very upset and humiliated.

9k) The director was criticised by the producer and/he felt very upset and humiliated.

9l) The producer criticised the director and/he felt very upset and humiliated.

9m) Boris was criticised by the producer and/he felt very upset and humiliated.

9n) The producer criticised Boris and/he felt very upset and humiliated.

9o) The director was criticised by Alfred and/he felt very upset and humiliated.

9p) Alfred criticised the director and/he felt very upset and humiliated.

10a) Stephanie blamed Kim and/she didn't hesitate to say so.

10b) Kim was blamed by Stephanie and/she didn't hesitate to say so.

10c) The model blamed the seamstress and/she didn't hesitate to say so.

10d) The seamstress was blamed by the model and/she didn't hesitate to say so.

10e) Stephanie blamed the seamstress and/she didn't hesitate to say so.

10f) The seamstress was blamed by Stephanie and/she didn't hesitate to say so.

10g) The model blamed Kim and/she didn't hesitate to say so.

10h) Kim was blamed by the model and/she didn't hesitate to say so.

10i) Kim was blamed by Stephanie and/she felt it was quite unjustified.

10j) Stephanie blamed Kim and/she felt it was quite unjustified.

10k) The seamstress was blamed by the model and/she felt it was quite unjustified.

10l) The model blamed the seamstress and/she felt it was quite unjustified.

10m) Kim was blamed by the model and/she felt it was quite unjustified.

10n) The model blamed Kim and/she felt it was quite unjustified.

10o) The seamstress was blamed by Stephanie and/she felt it was quite unjustified.

10p) Stephanie blamed the seamstress and/she felt it was quite unjustified.

11a) Alex congratulated Thomas and/he tried not to feel jealous.

11b) Thomas was congratulated by Alex and/he tried not to feel jealous.

11c) The runner-up congratulated the winner and/he tried not to feel jealous.

11d) The winner was congratulated by the runner-up and/he tried not to feel jealous.

11e) Alex congratulated the winner and/he tried not to feel jealous.

11f) The winner was congratulated by Alex and/he tried not to feel jealous.

11g) The runner-up congratulated Thomas and/he tried not to feel jealous.

11h) Thomas was congratulated by the runner-up and/he tried not to feel jealous.

11i) Thomas was congratulated by Alex and/he accepted the praise with embarrassment.

11j) Alex congratulated Thomas and/he accepted the praise with embarrassment.

11k) The winner was congratulated by the runner-up and/he accepted the praise with embarrassment.

11l) The runner-up congratulated the winner and/he accepted the praise with embarrassment.

11m) Thomas was congratulated by the runner-up and/he accepted the praise with embarrassment.

11n) The runner-up congratulated Thomas and/he accepted the praise with embarrassment.

11o) The winner was congratulated by Alex and/he accepted the praise with embarrassment.

11p) Alex congratulated The winner and/he accepted the praise with embarrassment.

12a) Suzanne phoned Vanessa and/she thought about reversing the charges.

12b) Vanessa was phoned by Suzanne and/she thought about reversing the charges.

12c) The girl phoned the old lady and/she thought about reversing the charges.

12d) The old lady was phoned by the girl and/she thought about reversing the charges.

12e) Suzanne phoned the old lady and/she thought about reversing the charges.

12f) The old lady was phoned by Suzanne and/she thought about reversing the charges.

12g) The girl phoned Vanessa and/she thought about reversing the charges.

12h) Vanessa was phoned by the girl and/she thought about reversing the charges.

12i) Vanessa was phoned by Suzanne and/she did not answer the phone.

12j) Suzanne phoned Vanessa and/she did not answer the phone.

12k) The old lady was phoned by Suzanne and/she did not answer the phone.

12l) The girl phoned the old lady and/she did not answer the phone.

12m) The old lady was phoned by Suzanne and/she did not answer the phone.

12n) Suzanne phoned the old lady and/she did not answer the phone.

12o) Vanessa was phoned by the girl and/she did not answer the phone.

12p) The girl phoned Vanessa and/she did not answer the phone.

13a) Trish pinched Lizzie and/she fully intended it to hurt.

13b) Lizzie was pinched by Trish and/she fully intended it to hurt.

13c) The head girl pinched the new girl and/she fully intended it to hurt.

13d) The new girl was pinched by the head girl and/she fully intended it to hurt.

13e) Trish pinched the new girl and/she fully intended it to hurt.

13f) The new girl was pinched by Trish and/she fully intended it to hurt.

13g) The head girl pinched Lizzie and/she fully intended it to hurt.

13h) Lizzie was pinched by the new girl and/she fully intended it to hurt.

13i) Lizzie was pinched by Trish and/she told the teacher about it.

13j) Trish pinched Lizzie and/she told the teacher about it.

13k) The new girl was pinched by the head girl and/she told the teacher about it.

13l) The head girl pinched the new girl and/she told the teacher about it.

13m) Lizzie was pinched by the head girl and/she told the teacher about it.

13n) The head girl pinched Lizzie and/she told the teacher about it.

13o) The new girl was pinched by Trish and/she told the teacher about it.

13p) Trish pinched the new girl and/she told the teacher about it.

14a) Roland applauded Eric and/he clapped longer than everyone else.

14b) Eric was applauded by Roland and/he clapped longer than everyone else.

14c) The critic applauded the performer and/he clapped longer than everyone else.

14d) The performer was applauded by the critic and/he clapped longer than everyone else.

14e) Roland applauded the performer and/he clapped longer than everyone else.

14f) The performer was applauded by Roland and/he clapped longer than everyone else.

14g) The critic applauded Eric and/he clapped longer than everyone else.

14h) Eric was applauded by the critic and/he clapped longer than everyone else.

14i) Eric was applauded by Roland and/he felt embarrassed by the praise.

14j) Roland applauded Eric and/he felt embarrassed by the praise.

14k) The performer was applauded by the critic and/he felt embarrassed by the praise.

14l) The critic applauded the performer and/he felt embarrassed by the praise.

14m) Eric was applauded by the critic and/he felt embarrassed by the praise.

14n) The critic applauded Eric and/he felt embarrassed by the praise.

14o) The performer was applauded by Roland and/he felt embarrassed by the praise.

14p) Roland applauded the performer and/he felt embarrassed by the praise.

15a) Sharon scolded Melanie and/she hated having to do so.

15b) Melanie was scolded by Sharon and/she hated having to do so.

15c) The baby-sitter scolded the little girl and/she hated having to do so.

15d) The little girl was scolded by the baby-sitter and/she hated having to do so.

15e) Sharon scolded the little girl and/she hated having to do so.

15f) The little girl was scolded by Sharon and/she hated having to do so.

15g) The baby-sitter scolded Melanie and/she hated having to do so.

15h) Melanie was scolded by the baby-sitter and/she hated having to do so.

15i) Melanie was scolded by Sharon and/she promised not to misbehave again.

15j) Sharon scolded Melanie and/she promised not to misbehave again.

15k) The little girl was scolded by the baby-sitter and/she promised not to misbehave again.

15l) The baby-sitter scolded the little girl and/she promised not to misbehave again.

15m) Melanie was scolded by the baby-sitter and/she promised not to misbehave again.

15n) The baby-sitter scolded Melanie and/she promised not to misbehave again.

15o) The little girl was scolded by Sharon and/she promised not to misbehave again.

15p) Sharon scolded the little girl and/she promised not to misbehave again.

16a) Albert stopped Harold and/he explained the road was blocked.

16b) Harold was stopped by Albert and/he explained the road was blocked.

16c) The villager stopped the tourist and/he explained the road was blocked.

16d) The tourist was stopped by the villager and/he explained the road was blocked.

16e) Albert stopped the tourist and/he explained the road was blocked.

16f) The tourist was stopped by Albert and/he explained the road was blocked.

16g) The villager stopped Harold and/he explained the road was blocked.

16h) Harold was stopped by the villager and/he explained the road was blocked.

16i) Harold was stopped by Albert and/he resented being stopped so abruptly.

16j) Albert stopped Harold and/he resented being stopped so abruptly.

16k) The tourist was stopped by the villager and/he resented being stopped so abruptly.

16l) The villager stopped the tourist and/he resented being stopped so abruptly.

16m) Harold was stopped by the villager and/he resented being stopped so abruptly.

16n) The villager stopped Harold and/he resented being stopped so abruptly.

16o) The tourist was stopped by Albert and/he resented being stopped so abruptly.

16p) Albert stopped the tourist and/he resented being stopped so abruptly.

APPENDIX 13.1: DEFINITIONS OF THEMATIC ROLES USED IN EXPERIMENTS 13 AND 14

GOAL: someone or something towards which something moves.

Examples: *Mary* in *"John gave the book to Mary"*; *Peter* in *"Peter took the book from Susan."*

SOURCE: someone or something from which something moves.

Examples: *John* in *"John gave the book to Mary"*; *Susan* in *"Peter took the book from Susan."*

AGENT: the instigator of an action.

Examples: subjects of *kill, eat, smash, kick, wash.*

PATIENT: someone or something affected by an action.

Examples: objects of *kill, eat, smash, kick, wash.*

EXPERIENCER: someone or something having a given experience.

Examples: subject of *love*, object of *annoy.*

STIMULUS: someone or something giving rise to a certain experience.

Examples: object of *love*, subject of *annoy.*

(N.B.:The above definitions are those used by Stevenson et al 1994)

Sentence Conditions are as follows:

Thematic roles 1 & 2 (G-So, E-St or A-P), introduction types (N-N, R-R, N-R, R-N) and sentence position are varied in each fragment according to the table below.

a) $\theta1$ (N), $\theta2$ (N)

b) $\theta2$ (N), $\theta1$ (N)

c) $\theta1$ (R), $\theta2$ (R)

d) $\theta2$ (R), $\theta1$ (R)

e) $\theta1$ (N), $\theta2$ (R)

f) $\theta2$ (N), $\theta1$ (R)

g) $\theta1$ (R), $\theta2$ (N)

h) $\theta2$ (R), $\theta1$ (N)

i) $\theta2$ (N), $\theta1$ (N)

j) $\theta1$ (N), $\theta2$ (N)

k) $\theta2$ (R), $\theta1$ (R)

l) $\theta1$ (R), $\theta2$ (R)

m) $\theta2$ (N), $\theta1$ (R)

n) $\theta1$ (N), $\theta2$ (R)

o) $\theta2$ (R), $\theta1$ (N)

p) $\theta1$ (R), $\theta2$ (N)

KEY

$\theta1$ = Goal, Experiencer or Agent $\theta2$ = Source, Stimulus or Patient

N= Name   R= Role name (e.g. waiter)

G= Goal   E= Experiencer   A= Agent

So= Source   St= Stimulus   P= Patient

GOAL-SOURCE SENTENCES

1a) John seized the comic from Bill and he

1b) John passed the comic to Bill and he

1c) The man seized the comic from the boy and he

1d) The man passed the comic to the boy and he

1e) John seized the comic from the boy and he

1f) John passed the comic to the boy and he

1g) The man seized the comic from Bill and he

1h) The man passed the comic to Bill and he

1i) John passed the comic to Bill and he

1j) John seized the comic from Bill and he

1k) The man passed the comic to the boy and he

1l) The man seized the comic from the boy and he

1m) John passed the comic to the boy and he

1n) John seized the comic from the boy and he

1o) The man passed the comic to Bill and he

1p) The man seized the comic from Bill and he

2a) Malcolm won some money from Stuart and he

2b) Malcolm gave some money to Stuart and he

2c) The foreman won some money from the painter and he

2d) The foreman gave some money to the painter and he

2e) Malcolm won some money from the painter and he

2f) Malcolm gave some money to the painter and he

2g) The foreman won some money from Stuart and he

2h) The foreman gave some money to Stuart and he

2i) Malcolm gave some money to Stuart and he

2j) Malcolm won some money from Stuart and he

2k) The foreman gave some money to the painter and he

2l). The foreman won some money from the painter and he

2m) Malcolm gave some money to the painter and he

2n) Malcolm won some money from the painter and he

2o) The foreman gave some money to Stuart and he

2p) The foreman won some money from Stuart and he

3a) Colin caught the ball from Gary and he

3b) Colin threw the ball to Gary and he

3c) The fullback caught the ball from the forward and he

3d)The fullback threw the ball to the forward and he

3e) Colin caught the ball from the forward and he

3f) Colin threw the ball to the forward and he

3g) The fullback caught the ball from Gary and he

3h) The fullback threw the ball to Gary and he

3i) Colin threw the ball to Gary and he

3j) Colin caught the ball from Gary and he

3k) The fullback threw the ball to the forward and he

3l) The fullback caught the ball from the forward and he

3m) Colin threw the ball to the forward and he

3n) Colin caught the ball from the forward and he

3o) The fullback threw the ball to Gary and he

3p) The fullback caught the ball from Gary and he

4a) Matthew grasped the microphone from Tony and he

4b) Matthew handed the microphone to Tony and he

4c) The politician grasped the microphone from the announcer and he

4d) The politician handed the microphone to the announcer and he

4e) Matthew grasped the microphone from the announcer and he

4f) Matthew handed the microphone to the announcer and he

4g) The politician grasped the microphone from Tony and he

4h) The politician handed the microphone to Tony and he

4i) Matthew handed the microphone to Tony and he

4j) Matthew grasped the microphone from Tony and he

4k) The politician handed the microphone to the announcer and he

4l) The politician grasped the microphone from the announcer and he

4m) Matthew handed the microphone to the announcer and he

4n) Matthew grasped the microphone from the announcer and he

4o) The politician handed the microphone to Tony and he

4p) The politician grasped the microphone from Tony and he

5a) Robert confiscated the parcel from Duncan and he

5b) Robert delivered the parcel to Duncan and he

5c) The postman confiscated the parcel from the owner and he

5d) The postman delivered the parcel to the owner and he

5e) Robert confiscated the parcel from the owner and he

5f) Robert delivered the parcel to the owner and he

5g) The postman confiscated the parcel from Duncan and he

5h) The postman delivered the parcel to Duncan and he

5i) Robert delivered the parcel to Duncan and he

5j) Robert confiscated the parcel from Duncan and he

5k) The postman delivered the parcel to the owner and he

5l) The postman confiscated the parcel from the owner and he

5m) Robert delivered the parcel to the owner and he

5n) Robert confiscated the parcel from the owner and he

5o) The postman delivered the parcel to Duncan and he

5p) the postman confiscated the parcel from Duncan and he

6a) Jason stole some sweets from Trevor and he

6b) Jason handed out some sweets to Trevor and he

6c) The youth stole some sweets from the boy and he

6d) The youth handed out some sweets to the boy and he

6e) Jason stole some sweets from the boy and he

6f) Jason handed out some sweets to the boy and he

6g) The youth stole some sweets from Trevor and he

6h) The youth handed out some sweets to Trevor and he

6i) Jason handed out some sweets to Trevor and he

6j) Jason stole some sweets from Trevor and he

6k) The youth handed out some sweets to the boy and he

6l) The youth stole some sweets from the boy and he

6m) Jason handed out some sweets to the boy and he

6n) Jason stole some sweets from the boy and he

6o) The youth handed out some sweets to Trevor and he

6p) The youth stole some sweets from Trevor and he

7a) Vincent took the money from Kenneth and he

7b) Vincent gave the money to Kenneth and he

7c) The man took the money from the bank clerk and he

7d) The man gave the money to the bank clerk and he

7e) Vincent took the money from the bank clerk and he

7f) Vincent gave the money to the bank clerk and he

7g) The man took the money from Kenneth and he

7h) The man gave the money to Kenneth and he

7i) Vincent gave the money to Kenneth and he

7j) Vincent took the money from Kenneth and he

7k) The man gave the money to the bank clerk and he

7l) The man took the money from the bank clerk and he

7m) Vincent gave the money to the bank clerk and he

7n) Vincent took the money from the bank clerk and he

7o) The man gave the money to Kenneth and he

7p) The man took the money from Kenneth and he

8a) Derek grabbed the balloon from Michael and he

8b) Derek tossed the balloon to Michael and he

8c) The prefect grabbed the balloon from the new boy and he

8d) The prefect tossed the balloon to the new boy and he

8e) Derek grabbed the balloon from the new boy and he

8f) Derek tossed the balloon to the new boy and he

8g) The prefect grabbed the balloon from Michael and he

8h) The prefect tossed the balloon to Michael and he

8i) Derek tossed the balloon to Michael and he

8j) Derek grabbed the balloon from Michael and he

8k) The prefect tossed the balloon to the new boy and he

8l) The prefect grabbed the balloon from the new boy and he

8m) Derek tossed the balloon to the new boy and he

8n) Derek grabbed the balloon from the new boy and he

8o) The prefect tossed the balloon to Michael and he

8p) The prefect grabbed the balloon from Michael and he

9a) Julie pinched the ball from Rachel and she

9b) Julie rolled the ball to Rachel and she

9c) The head girl pinched the ball from the schoolgirl and she

9d) The head girl rolled the ball to the schoolgirl and she

9e) Julie pinched the ball from the schoolgirl and she

9f) Julie rolled the ball to the schoolgirl and she.

9g) The head girl pinched the ball from Rachel and she

9h) The head girl rolled the ball to Rachel and she

9i) Julie rolled the ball to Rachel and she

9j) Julie pinched the ball from Rachel and she

9k) The head girl rolled the ball to the schoolgirl and she

9l) The head girl pinched the ball from the schoolgirl and she

9m) Julie rolled the ball to the schoolgirl and she

9n) Julie pinched the ball from the schoolgirl and she

9o) The head girl rolled the ball to Rachel and she

9p) The head girl pinched the ball from Rachel and she

10a) Nicola claimed the cheque from Eleanor and she

10b) Nicola issued the cheque to Eleanor and she

10c) The woman claimed the cheque from the secretary and she

10d) The woman issued the cheque to the secretary and she

10e) Nicola claimed the cheque from the secretary and she

10f) Nicola issued the cheque to the secretary and she

10g) The woman claimed the cheque from Eleanor and she

10h) The woman issued the cheque to Eleanor and she

10i) Nicola issued the cheque to Eleanor and she

10j) Nicola claimed the cheque from Eleanor and she

10k) The woman issued the cheque to the secretary and she

10l) The woman claimed the cheque from the secretary and she

10m) Nicola issued the cheque to the secretary and she

10n) Nicola claimed the cheque from the secretary and she

10o) The woman issued the cheque to Eleanor and she

10p) The woman claimed the cheque from Eleanor and she

11a) Alec received a letter from Mark and he

11b) Alec wrote a letter to Mark and he

11c) The tutor received a letter from the student and he

11d) The tutor wrote a letter to the student and he

11e) Alec received a letter from the student and he

11f) Alec wrote a letter to the student and he

11g) The tutor received a letter from Mark and he

11h) The tutor wrote a letter to Mark and he

11i) Alec wrote a letter to Mark and he

11j) Alec received a letter from Mark and he

11k) The tutor wrote a letter to the student and he

11l) The tutor received a letter from the student and he

11m) Alec wrote a letter to the student and he

11n) Alec received a letter from the student and he

11o) The tutor wrote a letter to Mark and he

11p) The tutor received a letter from Mark and he

12a) Sarah borrowed a record from Jenny and she

12b) Sarah loaned a record to Jenny and she

12c) The soprano borrowed a record from the dancer and she

12d) The soprano loaned a record to the dancer and she

12e) Sarah borrowed a record from the dancer and she

12f) Sarah loaned a record to the dancer and she

12g) The soprano borrowed a record from Jenny and she

12h) The soprano loaned a record to Jenny and she

12i) Sarah loaned a record to Jenny and she

12j) Sarah borrowed a record from Jenny and she

12k) The soprano loaned a record to the dancer and she

12l) The soprano borrowed a record from the dancer and she

12m) Sarah loaned a record to the dancer and she

12n) Sarah borrowed a record from the dancer and she

12o) The soprano loaned a record to Jenny and she

12p) The soprano borrowed a record from Jenny and she

13a) Victoria accepted a lift from Emma and she

13b) Victoria offered a lift to Emma and she

13c) The girl accepted a lift from the old woman and she

13d) The girl offered a lift to the old woman and she

13e) Victoria accepted a lift from the old woman and she

13f) Victoria offered a lift to the old woman and she

13g) The girl accepted a lift from Emma and she

13h) The girl offered a lift to Emma and she

13i) Victoria offered a lift to Emma and she

13j) Victoria accepted a lift from Emma and she

13k) The girl offered a lift to the old woman and she

13l) The girl accepted a lift from the old woman and she

13m) Victoria offered a lift to the old woman and she

13n) Victoria accepted a lift from the old woman and she

13o) The girl offered a lift to Emma and she

13p) the girl accepted a lift from Emma and she

14a) Diane collected some jumble from Angela and she

14b) Diane donated some jumble to Angela and she

14c) The woman collected some jumble from the old lady and she

14d) The woman donated some jumble to the old lady and she

14e) Diane collected some jumble from the old lady and she

14f) Diane donated some jumble to the old lady and she

14g) The woman collected some jumble from Angela and she

14h) The woman donated some jumble to Angela and she

14i) Diane donated some jumble to Angela and she

14j) Diane collected some jumble from Angela and she

14k) The woman donated some jumble to the old lady and she

14l) The woman collected some jumble from the old lady and she

14m) Diane donated some jumble to the old lady and she

14n) Diane collected some jumble from the old lady and she

14o) The woman donated some jumble to Angela and she

14p) The woman collected some jumble from Angela and she

15a) Barbara snatched the book from Joanne and she

15b) Barbara returned the book to Joanne and she

15c) The girl snatched the book from the woman and she

15d) The girl returned the book to the woman and she

15e) Barbara snatched the book from Joanne and she

15f) Barbara returned the book to Joanne and she

15g) The girl snatched the book from Joanne and she

15h) The girl returned the book to Joanne and she

15i) Barbara returned the book to Joanne and she

15j) Barbara snatched the book from Joanne and she

15k) The girl returned the book to the woman and she

15l) The girl snatched the book from the woman and she

15m) Barbara returned the book to the woman and she

15n) Barbara snatched the book from the woman and she

15o) The girl returned the book to Joanne and she

15p) The girl snatched the book from Joanne and she

16a) Nigel hired the car from Brendan and he

16b) Nigel rented the car to Brendan and he

16c) The young man hired the car from the motorist and he

16d) the young man rented the car to the motorist and he

16e) Nigel hired the car from the motorist and he.

16f) Nigel rented the car to the motorist and he

16g) The young man hired the car from Brendan and he

16h) The young man rented the car to Brendan and he

16i) Nigel rented the car to Brendan and he

16j) Nigel hired the car from Brendan and he

16k) The young man rented the car to the motorist and he

16l) The young man hired the car from the motorist and he

16m) Nigel rented the car to the motorist and he

16n) Nigel hired the car from the motorist and he

16o) The young man rented the car to Brendan and he

16p) The young man hired the car from Brendan and he

EXPERIENCER-STIMULUS SENTENCES

1a) Ken admired Geoff and he

1b) Ken impressed Geoff and he

1c) The tutor admired the student and he

1d) The tutor impressed the student and he

1e) Ken admired the student and he

1f) Ken impressed the student and he

1g) The tutor admired Geoff and he

1h) The tutor impressed Geoff and he

1i) Ken impressed Geoff and he

1j) Ken admired Geoff and he

1k) The tutor impressed the student and he

1l) The tutor admired the student and he

1m) Ken impressed the student and he

1n) Ken admired the student and he

1o) The tutor impressed Geoff and he

1p) The tutor admired Geoff and he

2a) Charles liked Alan and he

2b) Charles pleased Alan and he

2c) The journalist liked the editor and he

2d) The journalist pleased the editor and he

2e) Charles liked the editor and he

2f) Charles pleased the editor and he

2g) The journalist liked Alan and he

2h) The journalist pleased Alan and he

2i) Charles pleased Alan and he

2j) Charles liked Alan and he

2k) The journalist pleased the editor and he

2l) The journalist liked the editor and he

2m) Charles pleased the editor and he

2n) Charles liked the editor and he

2o) The journalist pleased Alan and he.

2p) The journalist liked Alan and he

3a) Ray envied Jake and he

3b) Ray irritated Jake and he

3c) The barrister envied the judge and he

3d) The barrister irritated the judge and he

3e) Ray envied the judge and he

3f) Ray irritated the judge and he

3g) The barrister envied Jake and he

3h) The barrister irritated Jake and he

3i) Ray irritated Jake and he

3j) Ray envied Jake and he

3k) The barrister irritated the judge and he

3l) The barrister envied the judge and he

3m) Ray irritated the judge and he

3n) Ray envied the judge and he

3o) The barrister irritated Jake and he

3p) The barrister envied Jake and he

4a) Frank hated James and he

4b) Frank bored James and he

4c) The pilot hated the navigator and he

4d) The pilot bored the navigator and he

4e) Frank hated the navigator and he

4f) Frank bored the navigator and he

4g) The pilot hated James and he

4h) The pilot bored James and he

4i) Frank bored James and he

4j) Frank hated James and he

4k) The pilot James and he

4l) The pilot hated James and he

4m) Frank bored the navigator and he

4n) Frank hated the navigator and he

4o) The pilot bored James and he

4p) The pilot hated James and he

5a) Andrew despised Jeremy and he

5b) Andrew shocked Jeremy and he

5c) The hooligan despised the priest and he

5d) The hooligan shocked the priest and he

5e) Andrew despised the priest and he

5f) Andrew shocked the priest and he

5g) The hooligan despised Jeremy and he

5h) The hooligan shocked Jeremy and he

5i) Andrew shocked Jeremy and he

5j) Andrew despised Jeremy and he

5k) The hooligan shocked the priest and he

5l) The hooligan despised the priest and he

5m) Andrew shocked the priest and he

5n) Andrew despised the priest and he

5o) The hooligan shocked Jeremy and he

5p) The hooligan despised Jeremy and he

6a) Tom detested Mark and he

6b) Tom disgusted Mark and he

6c) The drunk detested the barman and he

6d) The drunk disgusted the barman and he

6e) Tom detested the barman and he

6f) Tom disgusted the barman and he

6g) The drunk detested Mark and he

6h) The drunk disgusted Mark and he

6i) Tom disgusted Mark and he

6j) Tom detested Mark and he

6k) The drunk disgusted the barman and he

6l) The drunk detested the barman and he

6m) Tom disgusted the barman and he

6n) Tom detested the barman and he

6o) The drunk disgusted Mark and he

6p) The drunk detested Mark and he

7a) Clive distrusted Fred and he

7b) Clive angered Fred and he

7c) The manager distrusted the chef and he

7d) The manager angered the chef and he

7e) Clive distrusted the chef and he

7f) Clive angered the chef and he

7g) The manager distrusted Fred and he

7h) The manager Fred and he

7i) Clive angered Fred and he

7j) Clive distrusted Fred and he

7k) The manager angered the chef and he

7l) The manager distrusted the chef and he

7m) Clive angered the chef and he

7n) Clive distrusted the chef and he

7o) The manager angered Fred and he

7p) The manager distrusted Fred and he

8a) Henry resented Bruce and he

8b) Henry infuriated Bruce and he

8c) The artist resented the sculptor and he

8d) The artist infuriated the sculptor and he

8e) Henry resented the sculptor and he

8f) Henry infuriated the sculptor and he

8g) The artist resented Bruce and he

8h) The artist infuriated Bruce and he

8i) Henry infuriated Bruce and he

8j) Henry resented Bruce and he

8k) The artist infuriated the sculptor and he

8l) The artist resented the sculptor and he

8m) Henry infuriated the sculptor and he

8n) Henry resented the sculptor and he

8o) The artist infuriated Bruce and he

8p) The artist resented Bruce and he

9a) Reggie noticed Luke and he

9b) Reggie charmed Luke and he

9c) The guest noticed the host and he

9d) The guest charmed the host and he

9e) Reggie noticed the host and he

9f) Reggie charmed the host and he

9g) The guest noticed Luke and he.

9h) The guest charmed Luke and he.

9i) Reggie charmed Luke and he

9j) Reggie noticed Luke and he

9k) The guest charmed the host and he

9l) The guest noticed the host and he

9m) Reggie charmed the host and he

9n) Reggie noticed the host and he

9o) The guest charmed Luke and he

9p) The guest noticed Luke and he

10a) Dick loathed Carl and he

10b) Dick deceived Carl and he

10c) The treasurer loathed the president and he

10d) The treasurer deceived the president and he

10e) Dick loathed the president and he

10f) Dick deceived the president and he

10g)The treasurer loathed Carl and he

10h) The treasurer deceived Carl and he

10i) Dick deceived Carl and he

10j) Dick loathed Carl and he

10k) The treasurer deceived the president and he

10l) The treasurer loathed the president and he

10m) Dick deceived the president and he

10n) Dick loathed the president and he

10o) The treasurer deceived Carl and he

10p) The treasurer loathed Carl and he

11a) Ernest appreciated Ben and he

11b) Ernest troubled Ben and he

11c) The patient appreciated the doctor and he

11d) The patient troubled the doctor and he

11e) Ernest appreciated the doctor and he

11f) Ernest troubled the doctor and he

11g)The patient appreciated Ben and he

11h) the patient troubled Ben and he

11i) Ernest troubled Ben and he

11j) Ernest appreciated Ben and he

11k) The patient troubled the doctor and he

11l) The patient appreciated the doctor and he

11m) Ernest troubled the doctor and he

11n) Ernest appreciated the doctor and he

11o) The patient troubled Ben and he

11p) The patient appreciated Ben and he

12a) Bert heard Mike and he

12b) Bert upset Mike and he

12c) The landlord heard the tenant and he

12d) The landlord upset the tenant and he

12e) Bert heard the tenant and he

12f) Bert upset the tenant and he

12g) The landlord heard Mike and he

12h) The landlord upset Mike and he

12i) Bert upset Mike and he

12j) Bert heard Mike and he

12k) The landlord upset the tenant and he

12l) The landlord heard the tenant and he

12m) Bert upset the tenant and he

12n) Bert heard the tenant and he

12o) The landlord upset Mike and he

12p) The landlord heard Mike and he

13a) Warren saw Clarence and he

13b) Warren worried Clarence and he

13c) The headmaster saw the teenager and he

13d) The headmaster worried the teenager and he

13e) Warren saw the teenager and he

13f) Warren worried the teenager and he

13g) The headmaster saw Clarence and he

13h) The headmaster worried Clarence and he

13i) Warren worried Clarence and he

13j) Warren saw Clarence and he

13k) The headmaster worried the teenager and he

13l) The headmaster saw the teenager and he

13m) Warren worried the teenager and he

13n) Warren saw the teenager and he

13o) The headmaster worried Clarence and he

13p) The headmaster saw Clarence and he

14a) Billy respected Gerald and he

14b) Billy amused Gerald and he

14c) The student respected the lecturer and he

14d) the student amused the lecturer and he

14e) Billy respected the lecturer and he

14f) Billy amused the lecturer and he

14g) The student respected Gerald and he

14h) The student amused Gerald and he

14i) Billy amused Gerald and he

14j) Billy respected Gerald and he

14k) The student amused the lecturer and he

14l) The student respected the lecturer and he

14m) Billy amused the lecturer and he

14n) Billy respected the lecturer and he

14o) The student amused Gerald and he

14p) The student respected Gerald and he

15a) Darren disliked Martin and he

15b) Darren annoyed Martin and he

15c) The foreman disliked the welder and he

15d) The foreman annoyed the welder and he

15e) Darren disliked the welder and he

15f) Darren annoyed the welder and he

15g) The foreman disliked Martin and he

15h) the foreman annoyed Martin and he

15i) Darren annoyed Martin and he

15j) Darren disliked Martin and he

15k) The foreman annoyed the welder and he

15l) The foreman disliked the welder and he

15m) Darren annoyed the welder and he

15n) Darren disliked the welder and he

15o) The foreman annoyed Martin and he

15p) The foreman disliked Martin and he

16a) Wendy pitied Cath and she

16b) Wendy aggravated Cath and she

16c) The model pitied the hairdresser and she

16d) The model aggravated the hairdresser and she

16e) Wendy pitied the hairdresser and she

16f) Wendy aggravated the hairdresser and she

16g) The model pitied Cath and she

16h) The model aggravated Cath and she

16i) Wendy aggravated Cath and she

16j) Wendy pitied Cath and she

16k) The model aggravated the hairdresser and she

16l) The model pitied the hairdresser and she

16m) Wendy aggravated the hairdresser and she

16n) Wendy pitied the hairdresser and she

16o) The model aggravated Cath and she

16p) The model pitied Cath and she

AGENT-PATIENT SENTENCES

1a) Joseph hit Patrick and/he

1b) Patrick was hit by Joseph and/he

1c) The teacher hit the pupil Patrick and/he

1d) The pupil was hit by the teacher and/he

1e) Joseph hit the pupil and/he

1f) Patrick was hit by the teacher and/he

1g) The teacher hit Patrick and/he

1h) The pupil was hit by Joseph and/he

1i) Patrick was hit by Joseph and/he

1j) Joseph hit Patrick and/he

1k) The pupil was hit by the teacher and/he

1l) the teacher hit the pupil and/he

1m) Patrick was hit by the teacher and/he

1n) Joseph hit the pupil and/he

1o) The pupil was hit by Joseph and/he

1p) The teacher hit Patrick and/he

2a) Jonathan pushed Sam and he

2b) Sam was pushed by Jonathan and he

2c) The thug pushed the freshman and he

2d) The freshman was pushed by the thug and he

2e) Jonathan pushed the freshman and he

2f) The freshman was pushed by Jonathan and he

2g)The thug pushed Sam and he

2h) Sam was pushed by the thug and he

2i) Sam was pushed by Jonathan and he

2j) Jonathan pushed Sam and he

2k) The freshman was pushed by Jonathan and he

2l) Jonathan pushed the freshman and he

2m) Sam was pushed by the thug and he

2n) The thug pushed Sam and he

2o) The freshman was pushed by Jonathan and he

2p) Jonathan pushed the freshman and he

3a) Terry kicked Nathan and he

3b) Nathan was kicked by Terry and he

3c) The goalkeeper kicked the striker and he

3d) The striker was kicked by the goalkeeper and he

3e) Terry kicked the striker and he

3f) The striker was kicked by Terry and he

3g) The goalkeeper kicked Nathan and he

3h) Nathan was kicked by the goalkeeper and he

3i) Nathan was kicked by Terry and he

3j) Terry kicked Nathan and he

3k) The striker was kicked by the goalkeeper and he

3l) The goalkeeper kicked the striker and he

3m) Nathan was kicked by the goalkeeper and he

3n) The goalkeeper kicked Nathan and he

3o) The striker was kicked by Terry and he

3p) Terry kicked the striker and he

4a) Scott disobeyed Marcus and he

4b) Marcus was disobeyed by Scott and he

4c) The soldier disobeyed the sergeant and he

4d) The sergeant was disobeyed by the soldier and he

4e) Scott disobeyed the sergeant and he

4f) The sergeant was disobeyed by Scott and he

4g) The soldier disobeyed Marcus and he

4h) The sergeant was disobeyed by Scott and he

4i) Marcus was disobeyed by Scott and he

4j) Scott disobeyed Marcus and he

4k) The sergeant was disobeyed by the soldier and he

4l) The soldier disobeyed the sergeant and he

4m) Marcus was disobeyed by the soldier and he

4n) The soldier disobeyed Marcus and he

4o) The sergeant was disobeyed by Scott and he

4p) Scott disobeyed the sergeant and he

5a) Timothy helped Ian and he

5b) Ian was helped by Timothy and he

5c) The parson helped the pensioner and he

5d) The pensioner was helped by the parson and he

5e) Timothy helped the pensioner and he

5f) The pensioner was helped by Timothy and he

5g) The parson helped Ian and he

5h) The pensioner was helped by Timothy and he

5i) Ian was helped by Timothy and he

5j) Timothy helped Ian and he

5k) The pensioner was helped by the parson and he

5l) The parson helped the pensioner and he

5m) Ian was helped by the pensioner and he.

5n) The pensioner helped Ian and he

5o) The parson was helped by Timothy and he

5p) Timothy helped the pensioner and he

6a) Brian insulted David and he

6b) David was insulted by Brian and he

6c) The demonstrator insulted the policeman and he

6d) The policeman was insulted by the demonstrator and he

6e) Brian insulted the policeman and he

6f) The policeman was insulted by Brian and he

6g) The demonstrator insulted David and he

6h) David was insulted by the demonstrator and he

6i) David was insulted by Brian and he

6j) Brian insulted David and he

6k) The policeman was insulted by the demonstrator and he

6l) The demonstrator insulted the policeman and he

6m) David was insulted by the demonstrator and he

6n) The demonstrator insulted David and he

6o) The policeman was insulted by Brian and he

6p) Brian insulted the policeman and he

7a) Cliff bullied Nicholas and he

7b) Nicholas was bullied by Cliff and he

7c) The director bullied the executive and he

7d) The executive was bullied by the director and he

7e) Cliff bullied the executive and he

7f) The executive was bullied by Cliff and he

7g) The director bullied Nicholas and he

7h) Nicholas was bullied by the director and he

7i) Nicholas was bullied by Cliff and he

7j) Cliff bullied Nicholas and he

7k) The executive was bullied by the director and he

7l) The director bullied the executive and he

7m) Nicholas was bullied by the director and he

7n) The director bullied Nicholas and he

7o) The executive was bullied by Cliff and he

7p) Cliff bullied the executive and he

8a) Rob accused William and he

8b) William was accused by Rob and he

8c) The manager accused the clerk and he

8d) The clerk was accused by the manager and he

8e) Rob accused the clerk and he

8f) The clerk was accused by Rob and he

8g) The manager accused William and he

8h) William was accused by the manager and he

8i) William was accused by Rob and he

8j) Rob accused William and he

8k) The clerk was accused by the manager and he

8l) The manager accused the clerk and he

8m) The clerk was accused by Rob and he

8n) Rob accused the clerk and he

8o) The clerk was accused by Rob and he

8p) Rob accused the clerk and he

9a) Alfred criticised Boris and he

9b) Boris was criticised by Alfred and he

9c) The producer criticised the director and he

9d) The director was criticised by the producer and he

9e) Alfred criticised the director and he

9f) The director was criticised by Alfred and he

9g) The producer criticised Boris and he

9h) Boris was criticised by the producer and he

9i) Boris was criticised by Alfred and he

9j) Alfred criticised Boris and he

9k) The director was criticised by the producer and he

9l) The producer criticised the director and he

9m) Boris was criticised by the producer and he

9n) The producer criticised Boris and he

9o) The director was criticised by Alfred and he

9p) Alfred criticised the director and he

10a) Stephanie blamed Kim and she

10b) Kim was blamed by Stephanie and she

10c) The model blamed the seamstress and she

10d) The seamstress was blamed by the model and she

10e) Stephanie blamed the seamstress and she

10f) The seamstress was blamed by Stephanie and she

10g) The model blamed Kim and she

10h) Kim was blamed by the model and she

10i) Kim was blamed by Stephanie and she

10j) Stephanie blamed Kim and she

10k) The seamstress was blamed by the model and she

10l) The model blamed the seamstress and she

10m) Kim was blamed by the model and she

10n) The model blamed Kim and she

10o) The seamstress was blamed by Stephanie and she

10p) Stephanie blamed the seamstress and she

11a) Alex congratulated Thomas and he

11b) Thomas was congratulated by Alex and he

11c) The runner-up congratulated the winner and he

11d) The winner was congratulated by the runner-up and he

11e) Alex congratulated the winner and he

11f) The winner was congratulated by Alex and he

11g) The runner-up congratulated Thomas and he

11h) Thomas was congratulated by the runner-up and he

11i) Thomas was congratulated by Alex and he

11j) Alex congratulated Thomas and he

11k) The winner was congratulated by the runner-up and he

11l) The runner-up congratulated the winner and he

11m) Thomas was congratulated by the runner-up and he

11n) The runner-up congratulated Thomas and he

11o) The winner was congratulated by Alex and he

11p) Alex congratulated The winner and he

12a) Suzanne phoned Vanessa and she

12b) Vanessa was phoned by Suzanne and she

12c) The girl phoned the old lady and she

12d) The old lady was phoned by the girl and she

12e) Suzanne phoned the old lady and she

12f) The old lady was phoned by Suzanne and she

12g) The girl phoned Vanessa and she

12h) Vanessa was phoned by the girl and she

12i) Vanessa was phoned by Suzanne and she

12j) Suzanne phoned Vanessa and she

12k) The old lady was phoned by Suzanne and she

12l) The girl phoned the old lady and she

12m) The old lady was phoned by Suzanne and she

12n) Suzanne phoned the old lady and she

12o) Vanessa was phoned by the girl and she

12p) The girl phoned Vanessa and she

13a) Trish pinched Lizzie and she

13b) Lizzie was pinched by Trish and she

13c) The head girl pinched the new girl and she

13d) The new girl was pinched by the head girl and she

13e) Trish pinched the new girl and she

13f) The new girl was pinched by Trish and she

13g) The head girl pinched Lizzie and she

13h) Lizzie was pinched by the new girl and she

13i) Lizzie was pinched by Trish and she

13j) Trish pinched Lizzie and she

13k) The new girl was pinched by the head girl and she

13l) The head girl pinched the new girl and she

13m) Lizzie was pinched by the head girl and she

13n) The head girl pinched Lizzie and she

13o) The new girl was pinched by Trish and she

13p) Trish pinched the new girl and she

14a) Roland applauded Eric and he

14b) Eric was applauded by Roland and he

14c) The critic applauded the performer and he

14d) The performer was applauded by the critic and he

14e) Roland applauded the performer and he

14f) The performer was applauded by Roland and he

14g) The critic applauded Eric and he

14h) Eric was applauded by the critic and he

14i) Eric was applauded by Roland and he

14j) Roland applauded Eric and he

14k) The performer was applauded by the critic and he

14l) The critic applauded the performer and he

14m) Eric was applauded by the critic and he

14n) The critic applauded Eric and he

14o) The performer was applauded by Roland and he

14p) Roland applauded the performer and he

15a) Sharon scolded Melanie and she

15b) Melanie was scolded by Sharon and she

15c) The baby-sitter scolded the little girl and she

15d) The little girl was scolded by the baby-sitter and she

15e) Sharon scolded the little girl and she

15f) The little girl was scolded by Sharon and she

15g) The baby-sitter scolded Melanie and she

15h) Melanie was scolded by the baby-sitter and she

15i) Melanie was scolded by Sharon and she

15j) Sharon scolded Melanie and she

15k) The little girl was scolded by the baby-sitter and she

15l) The baby-sitter scolded the little girl and she

15m) Melanie was scolded by the baby-sitter and she

15n) The baby-sitter scolded Melanie and she

15o) The little girl was scolded by Sharon and she

15p) Sharon scolded the little girl and she

16a) Albert stopped Harold and he

16b) Harold was stopped by Albert and he

16c) The villager stopped the tourist and he

16d) The tourist was stopped by the villager and he

16e) Albert stopped the tourist and he

16f) The tourist was stopped by Albert and he

16g) The villager stopped Harold and he

16h) Harold was stopped by the villager and he

16i) Harold was stopped by Albert and he

16j) Albert stopped Harold and he

16k) The tourist was stopped by the villager and he

16l) The villager stopped the tourist and he

16m) Harold was stopped by the villager and he

16n) The villager stopped Harold and he

16o) The tourist was stopped by Albert and he

16p) Albert stopped the tourist and he

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