A PSYCHOLOGICAL INVESTIGATION OF THE USE AND INTERPRETATION OF ENGLISH QUANTIFIERS

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Abstract

The work in this thesis is an investigation of quantifiers as they are used and interpreted in everyday language. Attention in the present work is paid to problems of proportion and emphasis, rather than to questions of the scope of quantifiers, which must account for a great deal of the literature on quantification in language. The literature reviews are accordingly restricted and do not address the question of scope.

Experiments 1 to 5 are designed to answer questions about the way in which quantifiers relate to amounts or proportions. Experiment 1, in which subjects were invited to describe things in proportional terms, provides a large corpus of quantifiers and the proportions they are used to describe. Experiments 2 to 5 explore the effect of prior expectations on the meaning of quantifiers, and the effects of the use of quantifiers on the proportion which the speaker is believed to expect. These studies show that the proportions denoted by any one quantifier are influenced little, if at all, by prior expectations, a somewhat surprising finding. However, quantifiers do have various effects on the proportion which subjects believe the speaker to have expected in the situation she is describing.

The second part of the thesis, and experiments 6 to 8, consider certain aspects of the meanings of quantifiers which are not related to amounts or proportions. Particular attention is paid to the way in which quantifiers can emphasise different subsets of the set

which follows them in a piece of discourse. These differences in emphasis are assessed using a sentence continuation method. They are related to the idea of 'focus' which is used in later chapters.

Finally, a computer program is used to illustrate one possible process which allows the various aspects of quantifier meanings to be assigned interpretation. The program, like the empirical studies, aims to discover and describe the effects of various quantifiers as they are used by human language users in descriptions of simple situations.

Chapter 1

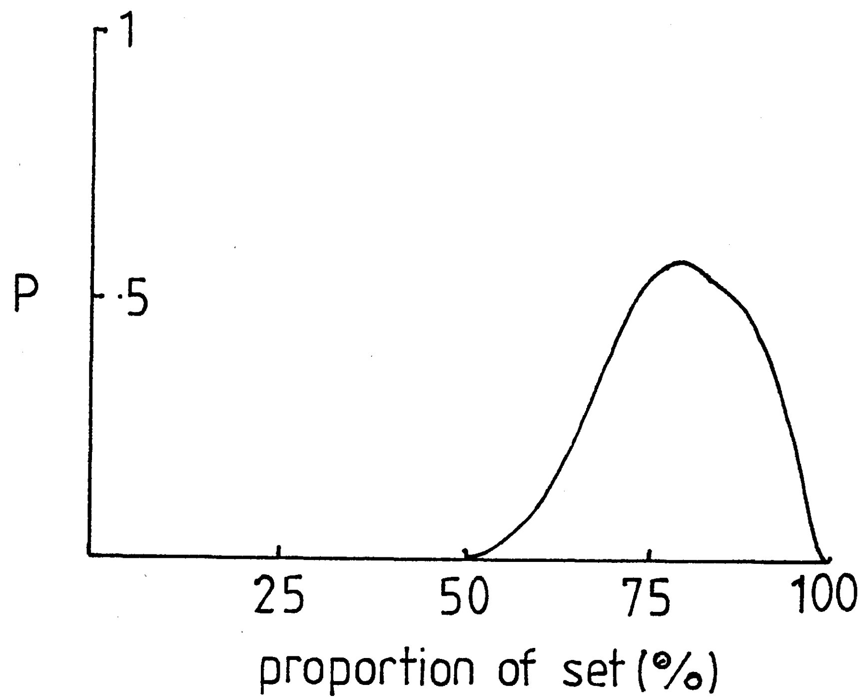
INTRODUCTION

The aim of this thesis is to explain the role of natural language quantifiers within the process of understanding language. These words appear frequently in everyday discourse, and at first glance their role in understanding may appear simple and relatively insignificant. The word 'few' in 'few people' simply denotes a small proportion or number of the set of people. Any predicate appearing after this noun phrase is therefore being asserted of this small proportion rather than of the whole set. It will be shown, however, that quantifiers play a greater role in communication than merely denoting proportions of sets. What is more, the way in which proportions are denoted by these words is not as obvious as it may appear at first. These points are best illustrated by some examples:

(1) Most of the students will pass the final exam.

This sentence is easily understood. It asserts that a large proportion of the set of students have a certain property (they will pass the exam). But what proportion of students is denoted? If several people were asked to state the proportion denoted by 'most', the distribution of responses is likely to resemble the following graph:

Figure 1.1 Hypothetical distribution of proportions denoted by 'most'



Given the distribution in figure 1.1, how can one say what proportion is denoted by 'most', once and for all? The answer is that there is no such single proportion. Perhaps then, there is some rule which can describe the proportional meaning of 'most', such as 'greater than 50%' or 'more than a half'. This description is inadequate however. Although few people would take 'most' as denoting less than 50%, it is quite clear that it is more often taken as denoting 70% than as denoting 51%. It appears that quantifiers denote proportions within certain ranges, but it is quite likely that their distribution within this range is uneven. Clearly, the way in which these words denote proportions requires further investigation before an adequate explanation can be given.

Differences between Quantifiers

Another interesting question concerns the variety of quantifiers which may be used to denote the same proportion, rather than the proportions which can be denoted by a single quantifier. Consider, for example, sentence (2):

(2) Rather a lot of the students passed the exam.

Asking several people to state the proportion denoted by 'rather a lot' would most probably result in a distribution which is similar to that shown in figure 1.1 for 'most'. Indeed, other quantifiers such as 'many' and 'a lot' may have the same sort of distribution. Why, then, would one choose to say one of these quantifiers over the others? If the proportion or the range of proportions denoted were all that mattered, then surely there would be no preference. A clue to the difference between 'most' and 'rather a lot' lies in the difference in tense between sentences (1) and (2). Consider the following:

(1a) Most of the students will pass the exam.

(1b) Most of the students passed the exam.

(2a) Rather a lot of the students will pass the exam.

(2b) Rather a lot of the students passed the exam.

(2a) would seem a strange utterance unless the speaker was planning to make sure that a large proportion of students will pass. It seems to me that 'rather a lot' implies that the speaker is surprised at the proportion denoted, while 'most' does not. In other words, 'rather a lot' provides information about what would normally be expected by the speaker, namely that the actual proportion being conveyed is not what was expected. 'Most' on the other hand, does not in itself provide this sort of information. It may therefore be argued not only that quantifiers can denote different proportions, but they can also provide other sorts of information, such as information about the speaker's prior expectations, for example.

The influence of the proportion expected

There is a distinct possibility that the student who is told that 'Most students will pass the exam', already has prior expectations about the pass rate. If this is the case then it may also be the case that the proportion expected by the student will influence her interpretation of the word 'most'. If the proportion expected by this student was say 50%, and the proportion expected by another student was 90%, it is possible that their interpretations of 'most' will be different in some way. There may be some sort of 'anchor' effect for example, so that the student who believed 90% thinks that the speaker intended to convey around 90%, while the student who believed 50% thinks that the speaker intended to convey only 70%.

In this way prior expectations may have a direct effect on the denotation of a quantifier. The extent and the direction of this effect may depend on a number of factors such as the strength of the student's prior expectations, her faith in the speaker, and her beliefs about the intentions of the speaker. If, for example, the student who had expected that 50% would pass is utterly convinced that this is correct, she may now believe that the speaker intended to convey that only <u>60%</u> will pass. On the other hand, if the student's expectations are very weak (in the sense that she would guess at 50% if pushed), then she may now believe that the speaker intended to convey that <u>80%</u> of the students will pass.

Although the students in the above example may go away thinking that different proportions of the class will pass the exam, this does not mean that 'most' was taken as <u>denoting</u> different proportions. One must be careful to separate the meaning of the words uttered from the listener's beliefs after hearing these words from a particular speaker on a particular occasion. Nevertheless, if prior expectations influence either the <u>denotation</u> or the final <u>interpretation</u> of a statement, then it is clear that the result of processing the statement is a function of both the words used and prior expectations.

Whether or not one includes expectation in one's account of language understanding depends on one's view of <u>meaning</u>. Does meaning mean denotation, or does it mean <u>all</u> of what is understood after a piece of discourse is processed? In this thesis, <u>meaning</u> is seen in this latter sense. The meaning of a sentence is then all of its effects on the listener's model of what is going on. The meaning of 'most' for the student, will not only be the proportion which it denotes, but also the proportion which the student now <u>believes</u> and any other changes which occur as a result of the use of this word.

Given the approach taken here, there is a less direct way in which a quantifier might contribute to the full meaning of what is said. It has been argued that one's own beliefs and expectations (including beliefs about the speaker) may influence the meaning of the speaker's utterance directly or indirectly. It is also possible, however, that the words used <u>provide</u> information, giving the listener new beliefs about the speaker. These in turn may influence the meaning given to the speaker's subsequent statements. Thus, for example, the speaker's use of the word 'most' may lead one to believe that the speaker's prior expectations of the proportion were lower than one's own. If the listener expected 80%, and then the speaker says 'most', then 'most' may be taken as denoting 80%, and the proportion believed by the listener may be 80%. However the listener may now think that the <u>speaker</u> had <u>previously</u> expected some proportion less than 80%. Perhaps these arguments are most plausibly illustrated by the following q-exps: 'Only a few' and 'not many' (which appear to imply that the speaker had expected more), and 'rather a lot' (which appears to imply that the speaker had expected less). These particular examples are rather arbitrary. However, the point really being made is that the listener's beliefs about the speaker may also be influenced by the speakers choice of words. In this event, the meaning of a sentence is not only the propositional content plus changes in one's own beliefs, but also changes in one's beliefs about the speaker's beliefs. This sort of difference between the various quantifiers used in natural language is in need of empirical exploration.

So far, only those aspects of the meaning of quantifiers which relate to proportions and amounts have been considered. In fact, there are other non-proportional functions of quantifiers which will be introduced and described shortly. First, however, it is necessary to discuss an issue which arises from the way in which quantifiers denote proportions, and which will become important for arguments presented in later chapters. This issue can be summed up as follows: Given that quantifiers denote ranges of proportions rather than unique proportions, these expressions are <u>vague</u>. How, then, does one assess the truth of a quantified statement? Indeed, is it possible for something which is vague to be absolutely true or false?

<u>Vagueness and Truth</u>

Although the sentence 'most students will pass their final exam' may be true, it is nevertheless vague. It is possible to argue that something which is vague cannot be <u>absolutely</u> true, but only true to a degree. This view assumes that there are degrees of truth ranging from true to false. The truth value of 'Most students will pass the exam' might be ascertained by assessing the probability that the predicate is true for any one student, for example. In this way it is not the proportion of students which is vague, but the degree to which the relationship between the set and the predicate is true. Given the sentence 'most students will pass the final exam', should one understand that some range of proportions (eg. 60-90%) of students will pass, or that the statement has a truth value based on the probability that any one student will pass, for example, .8. The answer lies with what it was that the speaker wished to convey by the sentence, namely that the proportion of students who will pass will be within a range of proportions. The speaker wished to convey a vague proportion. She did not wish to convey the truth value of a proposition. The degree to which the statement is true can be given in addition to the quantifier, for example, 'It is almost true to say that most students will pass the exam' or 'I am reasonably sure that most students will pass the exam'.

Further evidence that truth and vagueness should be treated as separate factors, is given by the following examples:

(3) Margaret Thatcher has appeared on television.

(4) Most people have watched television.

(5) William Shakespeare has appeared on television.

(6) Few children like television.

(3) and (4) are true; (5) and (6) are false. (3) and (5) are not vague at least in as much as the initial noun phrase denotes a unique individual of whom the predicate is or is not true. (4) and

(6) on the other hand, are vague since it is not clear exactly what proportion of the sets are denoted, and therefore of whom the predicate is being asserted. It is nevertheless possible to believe that (4) is completely true and (6) is completely false with the highest degree of certainty.

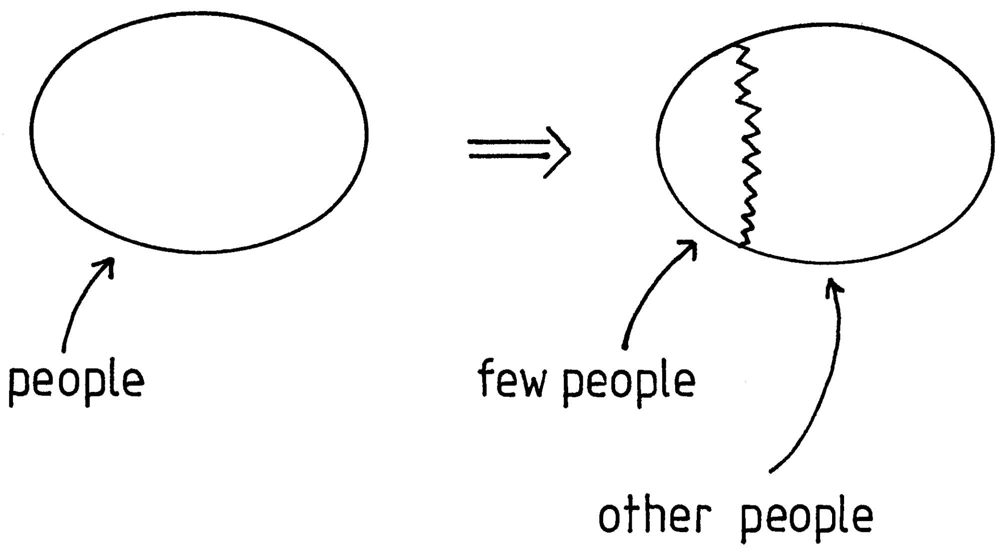
Another point should be noted about examples (3) to (6) above. That is, one is more likely to question (5) and (6) than to question (3) and (4). Given sentence (5), one desperately tries to find a sense in which the proposition is true. Perhaps some actor has played the part of William Shakespeare on television, for example. Sentence (3) on the other hand, does not lead one to search for senses in which the proposition is true or false. Sentence (6) also seems to invoke senses in which the proposition is true. One might consider, for example, that a particular set of children are being referred to - a set which the speaker has not explicitly described. This is not the case with sentence (4). One does not question so readily which set of people is being talked about. It therefore seems that statements which are believed by the reader to be true are accepted without question. Statements which are believed by the reader to be false, are questioned to find a sense in which they are true. This notion fits with the Gricean principles that a speaker is assumed to be truthful and cooperative (Grice, 1975). Readers assume, unless they have reason to believe otherwise, that the speaker is telling the truth. If at first the speaker's statement appears false, then there must be a sense in which it is true. The same argument does not hold for vagueness. People may try to be as precise as possible, but readers do not always impose precise interpretations on the words of writers. Such a lack of understanding of the imprecise nature of the world would result in a total inability to communicate.

After discussing the relationship between proportions and quantifiers earlier in this chapter, it was noted that there are some aspects of quantifier meaning which are not related to proportions or amounts. In this thesis, a great deal of attention is paid to one such aspect, namely, the way in which quantifiers partition sets and the effects which this has on subsequent interpretation.

Set Partitioning

Yet another function of quantifiers is to partition sets. It has already been argued that these words denote proportions or amounts of sets. Thus for example, 'few people' denotes a small proportion of people. This may be represented as follows:

Figure 1.2 A set partitioned by 'few'



In figure 1.2, the section labelled 'few people' has been severed from the rest of the set of people and it is distinguished as the part of the set being talked about. Consider, however, the following example:

(7) Few people sang the hymn. They didn't know the words.

Clearly, 'they' in (7) refers to those people who did not sing the hymn. That is, it is the section labelled 'other people' in figure 1.2 which is being talked about. Quantifiers, therefore, do not necessarily sever one part of the set from the other, since it is possible subsequently to refer to either subset with at least some of them. The function of the quantifier may then be to partition the set rather than simply to denote one subset. It is then possible for the speaker or listener to 'focus' on either subset or on the whole set. The particular quantifier used determines not only the relative sizes of the subsets, but also the emphasis which is placed on each subset. Consider, for example, the following sentences:

(7) Few people sang the hymn. They didn't know the words.

(8) Most people sang the hymn. They didn't know the words.

The 'they' in sentences (7) and (8) refers to different subsets, and this appears to depend entirely upon the quantifier. In (7), those who did not sing are emphasised; in (8), it is those who did sing. However, the quantifier is not the sole determinant of which subset will be emphasised. Consider the sentences in (9) and (10) for example:

(9) Few of our cars need repairs within two years of purchase. They...

(10) A few of our cars need repairs within two years of purchase. They...

Apart from the interesting fact that (9) is an obvious advantage whereas (10) is an obvious disadvantage for sales(!), the difference between these sentences is that 'they' is likely to refer to different subsets in each case. That is, a continuation of (9) is most likely to be about the good quality of the cars. This is not the case for sentence (10). The only real difference between (9) and (10) is that (9) begins with 'few' while (10) begins with 'a few'. In fact, the modifier 'a' appears to have influenced the entire message.

One might argue that 'a few' and 'few' denote different ranges of proportions, and that this effect is due entirely to the size of the subset denoted by a quantifier. However, experiment 1 (reported in chapter 3) shows that there is little or no difference in the proportions denoted by these two expressions. The effects of various quantifiers on subset emphasis are explored at great length in the second half of this thesis, and possible reasons for the difference between quantifiers will be discussed at that point. For now, it is sufficient to note that this sort of difference must be explained.

An explanation of the influence of quantifiers on the referent of 'they' necessitates a discussion of their influence on what the listener is attending to, and hence on the listener's model of what is being said. It is necessary to find a way of representing the listener's model, and to explain how this may be altered as a result of various quantifiers. Indeed, the theoretical concepts of 'focus' and 'emphasis' have already been introduced, and these terms are in need of clarification. Therefore, before concluding this introductory chapter, there will be a brief examination of such things as the representation of quantifiers, and a review of some ideas related to 'focus' and 'emphasis' in theories of discourse understanding.

The Mental Representation of Quantifiers

Perhaps the most extensive treatment of the mental representation of quantified statements has been given by Johnson-Laird and his associates (see Johnson-Laird, 1983, and Johnson-Laird and Steedman, 1978). Johnson-Laird explains how it is that people solve classical syllogisms by manipulating 'mental models' of states of affairs describing quantified statements. Figure 1.3 shows a representation of a mental model constructed for the statement 'Some solicitors drink beer':

Figure 1.3 A mental model for 'some solicitors drink beer'

Solicitors		Beerdrinkers
s	--------------	b
s	--------------	b
s	--------------	b
(s)		(b)
(s)		(b)
(s)		(b)

Figure 1.3 contains tokens which represent solicitors and beer drinkers, and possible tokens (in brackets) which represent the possible existence of other solicitors and beer drinkers. Combined with the statement 'some beer drinkers are trouble makers' one can see why it is possible for one person to conclude that some solicitors are trouble makers, while another person comes to no conclusion about the relationship between solicitors and trouble makers. Figure 1.4 represents a model which may have been constructed by the first person and figure 1.5 represents that constructed by the second person:

Figure 1.4 Model constructed by person 1

Solicitors		Beer drinkers		Trouble makers
s	————————	b		
s	————————	b	————————	t
s	————————	b	————————	t
(s)		(b)		(t)

Figure 1.5 Model constructed by person 2

Solicitors		Beer drinkers		Trouble makers
s	————————	b		
s	————————	b		
s	————————	b		
(s)		b	————————	t
		b	————————	t
		(b)		(t)

Thus, this system allows one to examine what is logically possible given a statement and a particular mental model. Given that people construct mental models of states of affairs, one might argue that the contents of this model are what is in focus or what is being attended to by the person constructing it. The set partition created by the quantifier 'some' can be represented by the tokens representing solicitors which are not in brackets versus those which are in brackets. The manipulation of such models can explain how it is that people come up with various conclusions given different statements. The problem is that this system does not explain the emphasis placed on different parts of the model when different quantifiers are processed. If it is assumed that pronouns refer most easily to entities which are most accessible, and therefore most emphasised, then mental models constructed for examples (7) and (8) would show that 'few' emphasises the tokens which are not linked to other tokens, while 'most' emphasises those tokens which are linked. Existing ideas about mental models do not appear to explain why this should be the case.

Ideas about focus and emphasis have also come from the areas of discourse linguistics and the psychology of discourse (see for example, Chafe, 1972, and Sanford and Garrod, 1981). Indeed, according to Chafe (1972) a pronoun can only refer to entities which are foregrounded, and Sanford and Garrod (1981) relate this notion of foregrounding to a focus system. However, although these accounts distinguish emphasis on the subject from that on the predicate, they do not explain differences in emphasis which occur as a result of set partitioning and quantifiers.

Sanford and Garrod have argued (Sanford and Garrod, 1981, Garrod and Sanford, 1982 and 1983) that not all aspects of discourse can be on equal footing, and that such factors as recency and topicalisation can determine what information is most accessible at any given point in processing (cf. Moar, Sanford and Garrod in preparation, and Garrod and Sanford, 1985). These authors distinguish two kinds of focus: explicit focus is somewhat akin to working memory and contains information which is made available from the discourse itself; implicit focus consists of 'world knowledge' used in processing. Entities in explicit focus can be referred to using a pronoun, while a fuller noun phrase is normally required for reference to enitities in implicit focus (for example, Sanford, Garrod, Lucas and Henderson, 1983). This system of focus has been used to explain many discourse phenomena, such as anaphoric reference where there is no explicit antecedent available in the discourse. However, it does not explain the emphasis produced by quantifiers. That is, the pronoun 'they' after 'few people sang the hymn' can refer to a subset of the set of people which has not been mentioned, and which cannot be in explicit focus.

The problem posed here for existing accounts of focus becomes even more difficult when the role of quantifiers in natural language is explored further. For example, it will be shown in later chapters that quantifiers such as 'few' and 'not many' often lead readers to seek reasons or explanations for the proposition which follows them. Nevertheless, the notion of focus is clearly useful, if not necessary, for an account of language understanding. The term 'focus' as used by Sanford and Garrod and others (for example, Grosz, 1977), has a limited meaning within each of the theoretical systems in which it is used. For present purposes, however, it should be thought of as broadly denoting the state of attention of a listener or reader as discourse is encountered on a moment to moment basis.

The influence of various quantifiers on the contents of focus and on the information emphasised must be explored empirically to give a full account of their meaning, and the second half of this thesis is devoted to an investigation of this sort. Obviously it is difficult to discover exactly what is in focus for any one individual interpreting a sentence, but it is possible to establish some of its contents. It is also possible to argue that one subset is more likely to be in focus after a given sentence, than the other subset, and certainly that one subset is emphasised more than another.

Before chapter 2, there will be a brief overview of the thesis, but first a definition of the quantifiers to be explained is in order.

Definition

There have been many studies involving natural language words which correspond to the universal and existential quantifiers (in logic these are represented by $\forall$ and $\exists$ respectively). The symbol $\forall$ can be translated to 'all', 'every' or 'each' while $\exists$ translates to 'some' (designating 'at least one'). This means that these two symbols (along with the negation symbol) can represent the following: 'All/every/each', 'Not/every/each', 'some' and 'not some' (designating 'none'). Classical studies of syllogistic reasoning have focussed on this set of words in that the premises and admissable conclusions are comprised of these quantifiers alone, for instance:

All As are Bs/every A is a B

Some As are Bs

Some As are not Bs

No As are Bs

Within psychology, these classical syllogisms based on quantifiers describable in terms of $\forall$ and $\exists$, have formed the almost exclusive basis of the study of syllogistic reasoning (see for example, Johnson-Laird and Steedman 1978, or earlier work such as Woodworth and Sells, 1935). However, one cannot define natural languge quantifiers simply as those words or phrases which can be translated into $\forall$ and $\exists$ symbols in first order predicate calculus. Other natural language quantifiers, such as 'most', 'many', and 'a few' are not adequately translated by $\forall$ and $\exists$, or even a combination of the two (see, e.g., McCawley, 1981), and common expressions such as 'only a very few' seem even more difficult to translate into straightforward $\forall$ and $\exists$ quantifiers.

Words or phrases such as 'most', or 'only a very few', are much less open to a logical interpretation than those mentioned earlier, and in order to analyse their meaning it is much easier to think in terms of <u>sets</u>. So, for example, 'most xs' refers to a certain proportion of the set of x and 'only a very few ys' refers to a certain proportion of the set of ys. In fact, for the purpose of this thesis, a <u>quantity expression</u> is defined as any word or phrase which, given a set, indicates a proportion of that set without providing any other discriminating information about the set members. Thus 'most' is a quantity expression, but 'blue' is not. Either of these words accompanied by the word 'buses' would denote a subset of buses (i.e. a proportion of the set of buses), but the subset 'blue buses' carries extra information about the buses (they are blue, the rest of the buses are not), whereas the subset 'most buses' carries no more information. Note that 'all', 'every' and 'each' are still quantity expressions under this definition. Although in some sense they are used to refer to the whole set rather than a subset of the whole set, they do provide proportional information which emphasises the whole set. It is in order to emphasize the words/phrases allowed by this definition rather than just those relating to $\forall$ and $\exists$ that I have called these expressions (normally called quantifiers) quantity expressions. Throughout this thesis the term 'quantity expression' will be written 'q-exp'.

Overview of The Thesis

This thesis is an exploration of the use and functions of various q-exps. A major aim will be to discover not only what q-exps can mean in terms of the proportions they can denote, but also to discover some of the assumptions which readers or listeners make once a q-exp is interpreted. This will include any influence of prior expectation or effects on beliefs about the speaker's expectations. It will also include the influence of q-exps on the partitioning of sets and the consequences of these partitions on the processing of subsequent discourse. The approach taken in this thesis assumes that understanding language is a process whereby linguistic input interacts with knowledge already available to the processor. The denotation of a word does not constitute the full meaning of that word for the processor. Neither does the truth value of a given sentence constitute the meaning of that sentence. The full meaning of a word or sentence for the processor, includes all changes in the state of the processor which occur as a result of the linguistic input.

Perhaps it seems that such a view of meaning cannot possibly lead to a coherent model of language understanding. If the meaning of a word is equated with its consequences for the understanding process then it is possible to argue that the same word will mean a different thing on each occasion of its use. What must be remembered, however, is that one's interpretation of something is the <u>result</u> of one's processing of it. If a word is seen not only as having a denotation, but also as having various functions which operate only in certain circumstances, then the <u>result</u> of processing the word may be different in different situations, although the denotation and the functions associated with the word are the same. The meaning of the word may differ depending on where it is used, because the functions associated with the word <u>consistently</u> interact with contextual factors which can have different values. If it is possible to evaluate what a word means or does to the final interpretation in different contexts, then it should also be possible to construct a model of the functions associated with the word and the interactions of these functions with context. In this thesis, the use and functions of q-exps are explored using this approach.

Previous work on q-exps has been carried out in different disciplines. Psychological work has considered the relationship between amounts or proportions and individual q-exps, and a great deal of work has investigated q-exps in the context of reasoning tasks (eg. syllogistic reasoning). Linguistic and logical work has evaluated the syntactic and semantic role of q-exps <u>within a sentence structure</u>. Throughout the thesis work from these areas has been used as a starting point for the exploration of various aspects of the meaning of q-exps. Little is said about the work on syllogistic reasoning and indeed about many other interesting studies involving q-exps. The studies which are mentioned centre around aspects of q-exp meaning which have already (briefly) been mentioned: proportions denoted by q-exps, and the way in which q-exps partition the set of which the predicate is asserted. Psychological studies of the relationship between proportions and q-exp have generally involved the denotations of q-exps in isolation (without sentences) and are reviewed in the next chapter. Studies of q-exps within sentences are reviewed in chapter 6.

In chapters 2, 3, 4 and 5 studies of the proportional meaning of q-exps are reported. For the reasons already given, only proportions denoted by q-exps and not absolute amounts are considered in this work. Chapter 2 begins with a brief review of psychological studies which have investigated the relationship between q-exps and amounts or proportions of things. Experiment 1 is then described. This experiment provides a corpus of q-exps produced by subjects, and reveals a range of proportions which subjects used each q-exp to describe. Experiment 2 investigates the acceptability of various q-exps as descriptions of different proportions. Experiments 3 to 5 reveal the ranges of proportions which various q-exps are interpreted as denoting. All of these studies (experiments 1 to 5) also attempt to evaluate the role of expectation in the proportional interpretation of a q-exp.

Chapter 6 provides a brief review of some logical studies on q-exp meaning. The logical approach is quite different from the way in which q-exps are investigated here. Nevertheless the conclusions of these studies are interesting, and will provide hypotheses about the meanings of various q-exps. This chapter and chapters 7, 8 and 9 aim to evaluate the processing consequences of using various q-exps, and the results of exps 6, 7 and 8 reported in these chapters are used not only to reveal aspects of q-exp meaning, but also to reveal information about the way in which q-exps are processed.

The final chapter includes a discussion of all experimental findings, and describes a process which interprets q-exps according to these findings. The description is in the form of a computer program.

Chapter 2

Quantity Expressions and Scales

The most obvious function of q-exps in natural language is to denote quantities or proportions of things, yet it seems likely that the same q-exp may denote different proportions for different people. It may be that each individual associates a particular proportion with each q-exp, although intuitively it is certain that people could give the range of proportions associated with q-exps, if asked. A later experiment (experiment 2) also shows that people will accept the same q-exps as descriptions of quite different proportions. This would suggest that individuals associate a range of proportions rather than an absolute proportion with each q-exp. Regardless of whether this is the case, it is clear that, within the language community, q-exps must be seen as denoting a range of proportions rather than one single proportion. That is, 'Some' may denote 25% to 40%, but it cannot denote exactly 32%. Furthermore, given the large variety of q-exps available in natural language, the range of proportions denoted by one expression is likely to overlap with the ranges of proportions denoted by others. 'Many', for example, might easily denote proportions between 35% and 70%, thus overlapping with the proportions which can be denoted by 'some'.

Evidence of overlapping ranges comes from a study by Bass, Cascio and O'connor (1974). The major aim of this work was to find various sets of (quantity) expressions which are optimally discriminable on a scale. Such expressions are typically employed in the design of questionnaires, and optimally discriminating expressions in a scale are practically useful. Subjects in this study were asked first to assign a numerical value to 'some', and then to assign numerical values to 43 other expressions of amount, relative to the value they had assigned to 'some' (see e.g. Stevens, 1961, for this method). By adjusting each subject's value for 'some' to be equivalent, it was then possible to look at the relationships between the numerical values for all expressions across all subjects. It was found that the rank-order position of expressions on the scale remained consistent over different populations. The absolute values given varied from subject to subject, of course, since the initial values assigned to 'some' varied greatly. The scale produced when 'some' was made 'equivalent' also revealed that each expression corresponds to a range of values. From the list of 44 expressions used, the authors attempted to discover expressions which, if used in a questionnaire, would maximally discriminate between points on a scale. Not surprisingly, it was found that the finer the desired scale (ie. the more q-exps considered), the greater the degree of overlap between the expressions. Hence the more likely it is that variation in questionnaire responses would occur as a result of variation in interpretation of the expressions used. One practical outcome was that if one wishes to employ nine expressions corresponding to a nine-point scale which is statistically optimal, there is a mean overlap of 19.87% between adjacent points on the scale.

Not only is it possible to assess differences between q-exps in terms of a scale, but some evidence exists which has been taken as suggesting that some aspects of the meaning of q-exps may be <u>stored</u> on a scale. Holyoak and Glass (1978) constructed confusion matrices based on subjects' abilities to remember 'all', 'many', 'some', 'a few' and 'none' after these were presented in a piece of text. It was assumed that the degree of confusion between any two expressions may reflect the degree of similarity between their meaning-representations. From an analysis of the confusions, it would then be possible to answer questions about the way in which such expressions are represented in memory. It was found that the degree of confusion between expressions does in fact depend on the expressions being compared. That is, some expressions are confused more frequently than others. One hypothesis was that q-exps are represented as sets of features. For example, 'many' may be stored as +ve rather than -ve, large rather than small etc. Confusions between two expressions would then be more likely to occur if these expressions had many features in common. The confusions made by subjects gave some support for this hypothesis in that expressions which were more easily confused appeared to have more features in common. Another hypothesis however, was that q-exps are represented on a scale. The proximity of expressions on this scale would then predict the degree to which they would be confused. That is, the smaller the proportional difference between expressions the more likely it is that these expressions will be confused. The authors report that the confusion data fits this model very well, and conclude that quantity information is likely to be represented on an internal scale, although some features may also be represented in memory.

It is clear that q-exps do denote proportional or quantity information, and that such expressions may be placed on a scale of proportions according to the proportions or quantities they are generally taken to denote. Holyoak and Glass suggest that (at least) part of the denotation of a q-exp is its association with a scale value. The results of Bass et al. however, suggest that if q-exps are associated with scale values, it is with distributions rather than single values. The fact that each subject may give a single numerical value does not prove that there is a single value associated with the subject's representation - there may be a range. In fact, on another day, in another situation, an individual subject is likely to have given a different numerical value. Given that a major function of q-exps must be to communicate quantity information to others, an individual cannot afford to associate a q-exp with a single value, at least not if she wishes to communicate effectively. Therefore it is likely that the proportional or quantity information associated with q-exps corresponds to ranges or distributions rather than to single values. Bass et al. used 44 different expressions in their study and, as noted, found a very large amount of overlap. In natural language there must be more than 44 ways of communicating proportions/quantities however, making the amount of overlap even greater. This creates no problems for the notion that q-exps are associated with ranges of proportions, but if q-exps are represented on an internal scale, one can see many complications arising when all q-exps are considered along with all the proportions they can be taken to denote.

Holyoak and Glass (1978) used their confusion data to support the 'linear scale' hypothesis. However, suppose that q-exps are associated with ranges of proportions and that once a q-exp is interpreted, this range of proportions remains, among other things, as part of what is remembered. The large degree of overlap in the ranges of proportions denoted by various expressions would ensure that a degree of confusion would arise in subjects' recall of q-exps. Clearly, the greater the degree of overlap between ranges denoted by q-exps, the more likely they are to be confused (and, incidentally, the more likely they are to appear next to each other on a scale of proportions denoted by q-exps).

Several questions arise from the view that q-exps denote overlapping ranges of proportions: How does the use of a q-exp by a speaker relate to its interpretation by a listener? If the speaker wishes to convey a particular proportion, which q-exp will she choose and what governs her choice? For example, will she choose a q-exp whose range of proportions has the particular proportion she wishes to describe as its mean value? Given that ranges denoted are broad enough to overlap with the ranges denoted by other q-exps, one would expect that q-exps will often be misinterpreted, because the proportion interpreted by the listener could be different from the proportion intended by the speaker. Another question is whether a speaker who uses an expression with the intention of communicating a proportion is actually effective in his communication. Will the listener be able to infer with any precision the actual proportion which the speaker intended to convey?

In order to examine these questions one must have access to a data base which relates q-exps to the ranges of proportions they can denote. The data base should be made up of natural language descriptions of quantities produced by people who are communicating with each other. It must also be large enough to give a good idea of the ranges of proportions denoted by various expressions, and to allow some assessment of the overlap between these ranges.

In a situation where q-exps are produced naturally, many phrases containing 'modifiers' are to be expected. That is, 'basic' q-exps such as 'few', 'many', 'lot', and so on, will often be accompanied by phrases such as 'Only a' 'Quite a' and 'Very'. Thus, another question which must be asked is whether all phrases with 'few' denote the same range of proportions, for example, or whether the 'modifier' phrases can influence the range of proportions being denoted. If the latter is in fact the case, then each <u>modifier</u> $\pm$ <u>basic q-exp</u> combination must be treated as a different expression (at least as far as an analysis of the proportions denoted is concerned). (see note 1).

<u>The Role of Set Size</u>

A great deal of work on the relationship between q-exps and the proportions or quantities they can denote has been concerned with the influence of set size on this relationship. For example, there is no doubt that 'many' is taken as denoting a different number of entities in the following examples:

(1) Many people go to Spain on holiday.

(2) Many planets orbit our Sun.

In one study, Borges and Sawyers (1974) looked at the relationship between 'few', 'several', 'some', 'lots', 'many' and 'most', and the proportions or quantities of entities which they were taken to denote with sets of different sizes. In the first experiment reported, subjects were asked to transfer 'few', 'several' etc. marbles from one jar to another. The total number of marbles in the jar was varied, and the number of marbles transferred was counted after each trial. The authors found that 'few' resulted in the smallest number of marbles being transferred, followed by 'several', 'some', 'many' and finally 'most', for which the largest number of marbles was transferred. It was also found that there was a linear relationship between the number transfered for each q-exp, and the size of the set of marbles presented. Thus, the more marbles available for transfer, the more marbles were transferred. The second experiment was presented as a pencil and paper task. Subjects were presented with a statement containing a q-exp and the size of the set of marbles, and they were asked to indicate how many marbles they <u>would</u> take. The order of the q-exps from smallest to largest was slightly different for this task, since some of the subjects appear to have interpreted 'several' very much in the same way as 'few', while others interpreted 'several' as a quantity between 'some' and 'many'. Nevertheless, there was still a linear relationship between the amount denoted by the q-exp and the set size. Borges and Sawyers conclude that this relationship appears to follow a simple multiplying rule.

Newstead and Pollard (1984) attempted to replicate the second experiment in Borges and Sawyer's study, using the same q-exps. They discovered that q-exps which denote small proportions ('few' and 'several', which they call 'low magnitude quantifiers') were taken to denote different <u>proportions</u> of sets which differed in their set size, as well as different absolute values. In order to investigate this finding, they carried out a second experiment using more q-exps ('none', 'a few', 'few', 'some', 'several', 'half', 'some not', 'many', 'lots', 'most' and 'all') and a larger collection of set sizes. 'None', 'half' and 'all' were found to denote the same proportion regardless of set size and 'a few' and 'few' (the lowest magnitude quantifiers) were found to vary more with set size than the other expressions in terms of the proportion they were taken to denote.

This finding seems odd in the light of an earlier study by Cohen, Dearnley and Hansel (1958). The study investigated the quantities and proportions of entities in different sized sets which were denoted by the expressions 'a lot', 'some' and 'a few'. It was found that 'a lot' denoted more than 'some', which denoted more than 'a few'. Like Borges and Sawyer, these authors discovered that the absolute number taken increased linearly with the size of the set (of beads) presented. However, the <u>proportion</u> of beads taken decreased as the size of the set presented was increased, this being true for all three q-exps. The q-exps used by Newstead and Pollard included all three used by Cohen at al. (if one equates 'lots' with 'a lot'), and the set sizes used by Newstead and Pollard are within the range of set sizes used by Cohen et al., apart from one condition in Newstead and Pollard's second experiment which used a set of 1000 marbles. Another possibility is that marbles and beads create different effects, but this seems unlikely. The most likely detectable difference between these studies is that Cohen et al. used children between 6 and 13 years as subjects. Perhaps these subjects simply did not relate q-exps to proportions in the same way as adults. Or perhaps perception of set size, and therefore its effects on the interpretation of q-exps, is less accurate with young subjects.

The discrepancy between the results of the two studies just described may or may not be due to differences in perception of set size. However, if the denotation of a q-exp depends on set size, perception of set-size is an important factor. That is, the nearer perceived set size is to actual set size, the better defined will be the correlation between the proportion interpreted and the size of the set.

The problem is that many factors may contribute to the perception of set size in a situation where the actual set size is not given explicitly as, for instance, where one's idea of set size depends on what one expects rather than on what one actually perceives. Thus, the number of surgeons one expects to work in a hospital may influence one's interpretation of the phrase 'Many surgeons'. It may also be possible for information outside of the nounphrase containing the q-exp to affect the interpretation of the q-exp. For example, the size of the set of surgeons that one expects to be female may affect the interpretation of 'many' in 'many surgeons are female'. This may be illustrated by the proportions which are intuitively suggested by the following two sentences:

(1) Many surgeons work extremely hard.

(2) Many surgeons are now women.

'Many' intuitively denotes a smaller proportion of surgeons in (2) than in (1).

The experiment now to be reported was designed partly to answer the questions and problems which have so far arisen. A summary of these is listed below:

(1) If q-exps denote overlapping ranges of proportions, how precise are they as methods of communicating proportions? Are they effective?

(2) Are q-exps more likely to be misinterpreted (or confused) as the amount of overlap in the ranges of proportions they denote increases?

(3) Do modifiers such as 'quite', 'very' etc influence the range of proportions denoted by the q-exp which follows them?

(4) Does expected set size influence perceived set size so that it alters the proportion denoted by a q-exp?

A more general aim of the study reported here was to provide a large data base with a very wide variety of naturally produced q-exps. In order to discover anything about the use and function of q-exps it is necessary to know exactly what sort of things people say, and it is all too easy to suppose that people say things regularly which they say rarely! A reasonable data base will allow questions to be answered about the proportions denoted by various q-exps, and will also provide information about the structure of 'every day' descriptions of quantities/proportions. Such 'structural' information will be useful for an investigation into the function of q-exps within sentences and larger pieces of discourse, which will be described in ch 6.

Experiment One - A Natural Q-exp Data-base

Producing and Interpreting Q-exps in a Communicative Setting

In this experiment, subjects were asked to produce sentences describing controlled situations where the purpose was clearly to enable some other person to pick out which situation was being described. This not only ensures a natural use of q-exps, but incorporates and controls a context for speaker and listener, so that each must consider information available to the other.

Materials

The situations that were presented to subjects were in the form of simple sketches. The use of sketches was to ensure that the descriptions produced would be unaffected by prior suggestion of linguistic form, scale anchors, etc. If, for example, the situations had been presented linguistically, the presentation itself might bias subjects towards a particular type of description. Given that subjects were given very little linguistic information, and given that the purpose of the experiment was to look at subjects' descriptions of quantities, it was necessary to present sketches which would make it obvious to subjects that their descriptions should contain information about quantity. This was done by presenting different situations, involving two groups of entities. The situations were identical except that the relative proportions of each group of entities varied between sketches (see table 2.1). Subjects were aware that their descriptions were later to be matched against the sketches by another subject. It was hoped that these two facts - the need to differentiate between sketches and the obvious proportional differences - would combine to make subjects' descriptions focus on the quantity information contained in the sketches.

TABLE 2.1 - Proportions of Male and Female Surgeons in the Six Sketches

Sketch number	% male	% female
1	90	10
2	75	25
3	60	40
4	40	60
5	25	75
6	10	90

The sketches each contained pin-figures representing surgeons, and they varied with respect to the relative proportions of surgeons who were male versus female. Male and female surgeons were used since surgeons are normally thought of as male rather than female. In fact, it is well-known that there are more male than female surgeons. In a different area of research Sanford, McDougall and Simons (in preparation) have shown that people expect less than 10% of surgeons to be female. Also, studies of well-known presupposition problems and of the time taken to resolve pronominal anaphors indicate that given the mention of a surgeon, people presuppose that the surgeon is male (see Sanford et al., also Noordman, 1978, for the power of presupposition of gender). Hence the expected size of the set of female surgeons is likely to be smaller than that of the set of male surgeons for subjects in experiment 1. The 'facts' to be described (as depicted in the sketches) were the same for both male and female surgeons in that for each sketch containing X% male, Y% female, there was another sketch containing Y% male, X% female. However any description of a sketch is likely to reflect the perceived set size with respect to the expected set size (both subjects' expectations and subjects beliefs about the expectations of the person interpreting the sentences). That is, if the speaker is aware that what she wishes to convey is contrary to expectation, she will produce a different description from the one which might be produced if the information to be conveyed was consistent with what was expected. In some of the sketches, the perceived proportion of female surgeons depicted is much larger than would normally be expected in the real world, and this may be reflected in sentences produced to describe these sketches. In particular, the q-exp may be different since the unexpected information is proportional information. If indeed subjects do use different q-exps to describe sketches which are identical except that the relative proportion of males/females is reversed, then it will be clear that the q-exp used (and therefore interpreted) is affected by the expected size of the subset being described (male or female surgeons) as well as its perceived set size. Interpretations of these q-exps may be compared by considering the accuracy with which the subjects' sentences are later matched with the sketches, by another subject.

Hypotheses

The nature of this study is such that the data collected is expected to have certain properties. Studies mentioned earlier (for example, Bass et al., 1974), have shown that q-exps denote ranges of proportion, rather than single proportions. Hence each q-exp produced in the present experiment is likely to be used to describe more than one proportion. This fits well with intuitions about the vague information which q-exps provide. Indeed, this property of q-exps makes them very valuable in natural language communciation, as argued in chapter 1.

Work carried out by Bass et al. also suggests that the ranges of proportions denoted by q-exps overlap to some considerable extent. Similar findings are expected with data from the present experiment. If the ranges of proportions do in fact overlap, then it is also expected that subjects' descriptions will often be misinterpreted. That is, sentences produced as descriptions of one sketch will often be interpreted as descriptions of a different sketch by other subjects.

The experiment is exploratory in that it aims to discover how people describe quantities and how these descriptions of quantity relate to the quantities being described. However some general hypotheses/expectations about the data may be stated as follows:

First, subjects are expected to produce a large variety of q-exps. Of course it is difficult to decide exactly what constitutes "a large variety" of q-exps, and so it is difficult to decide whether or not subjects produced "a large variety" of these. Simply, it would be useful to have some idea of the number of ways in which people may choose to describe proportions of sets. It is expected that there are many ways and, hence, subjects will produce many different q-exps in their descriptions of the sketches. One could argue that subjects are likely to use only a small number of expressions since there are only six sketches and they will choose q-exps which maximally discriminate between them. However, it seems more reasonable to suppose that there is no agreed upon set of q-exps which are known to minimally overlap, and so it is expected that a group of subjects will try a variety of possible expressions.

Secondly, many q-exps produced may contain modifiers, such as 'quite a', which may or may not affect the range of proportions denoted by the q-exp attached to it. If, for example, X is the q-exp and all other phrases containing X denote some proportion between 10% and 40% while 'quite a X' denotes 75% one might argue that 'quite a' alters the range of quantities denoted by X. As already noted, while this might be sensibly anticipated for some expressions, others are not at all clear in this respect.

Third, it is expected that subjects will produce different q-exps to describe unexpected information than those produced to describe proportional information which is consistent with what we know about the real world. This third hypothesis does not concern the direct effects of set size as, for instance, in the work of Newstead and Pollard. Indeed, the total number of surgeons depicted in each sketch and for each subject is the same, at 100. Discrepancies between the results of studies aimed at discovering the effects of set size raised the problem of how set size is perceived by different subjects. Of course, it is difficult to control perception of set size beyond ensuring that the actual set size remains constant. However, when no explicit set size is given, subjects must rely on prior knowledge of the set and this amounts to their <u>expectations</u> of the set size. Where explicit set size <u>is</u> given, and this conflicts with prior knowledge of the set size, one might expect that interpretation of the new information will be influenced by the proportion which the subject expected a priori. For example, suppose that one is asked to describe a sketch which depicts 25% female surgeons (the rest being male), when one expects a smaller proportion of female surgeons. On the assumption that a listener holds similar expectations, one is more likely to use 'many surgeons are female' than 'few surgeons are female' as a description of the sketch. If, on the other hand, one is asked to describe a sketch depicting 25% male surgeons (the rest being female), one is more likely to use 'few surgeons are male' than 'many surgeons are male'.

Finally, it is expected that the wider the range of proportions a particular expression is used to describe, the more it will be misinterpreted by subjects asked to assign interpretations. This final hypothesis relates to the discussion of the confusion study carried out by Holyoak and Glass (1978), of which it was suggested that more confusions would occur with q-exps which greatly overlap with other q-exps in terms of the ranges of proportions they are taken to denote. The present experiment measures manifest misinterpretations rather than confusions in recall.

Procedure

Subjects were each provided with six sketches along with the following information:

"Each of the sketches contains 100 pin-figures, representing the surgeons employed at a particular hospital. The number of male versus female surgeons varies between sketches,

 - a male surgeon

 - a female surgeon"

Subjects were asked to wait until they had 10 minutes alone, in which to describe each of the sketches using a simple sentence. The number of each sketch was to be put against the sentence describing it. They were instructed not to produce sentences containing numbers (eg. 4 or four), proportions (eg. 40%), or fractions (eg. 2/5 or two fifths). Having described the sketches within these constraints, subjects were asked to copy the sentences they had produced onto a separate sheet of paper - this time without placing the sketch numbers next to the sentences. This second sheet of paper was then to be cut in strips so that each strip contained only one sentence. The strips were than exchanged for those of another subject, known as the subject's partner. Sentences received from partners were then to be copied on to a third sheet of paper, and subjects were asked to put alongside their partner's sentences the number of the sketch they thought each sentence was intended to describe.

Each subject then had the 6 sentences they themselves produced (on a sheet of paper marked '1'), and the 6 sentences produced by their partner (on a sheet of paper marked '3'). The names of the subject and the subject's partner were written on both sheets so that when collected from the subjects, the data could be sorted into (a) sentences produced, and (b) interpretation of sentences in terms of the sketch which the sentence was taken to describe.

Subjects

Subjects were 241 first year psychology students. In order for each subject to provide 'interpretation' data based on the sentences produced by a partner, the number of subjects should be even. However, the experiment was run as part of a laboratory course for first year students, so not all of the subjects were able to find a partner (partners had to be other subjects all of whom were other students in the first year class).

Results

Preliminary Treatment

Data from 18 of the 241 subjects are not included in the analysis, since their descriptions did not contain words relating to quantities. This does not mean that these subjects failed to describe the sketches, but that they described the sketches without directly mentioning the proportions of male versus female surgeons depicted. An example of such a sentence is: "The females are making a takeover bid", which was used by one subject to describe sketch 5 (75% female, 25% male).

The data was first sorted into 'production' data (those sentences which subjects produced as descriptions of sketches), and 'interpretation' data (those sentences which subjects had matched with the sketches). Of course, the sentences used for both types of data were the same, but 'interpretation' data came from sheets marked '3' while 'production' data came from the sheets marked '1' (see procedure, page 45). Although 223 subjects produced sentences, only 185 of these managed to return 'interpretation' data. That is, some of the subjects did not return a sheet '3', containing the sketch numbers which they had assigned to their partner's sentences. The 38 subjects who failed to return this information were obviously not included in the interpretation analysis although they were included in all other analyses. Table 2.2 shows the number of subjects whose production/interpretation data was used in the analysis.

TABLE 2.2 - Number of Subjects used in Experiment 1

	No. of Subjects
Production data only	38
Production and Interpretation	185
Neither production nor interpretation	18
Total	241

The 'production' data sentences were split into segments for analysis using the INGRES database system under UNIX (see note 2). The segments were sorted under the following headings: QNP (the first noun phrase in each sentence containing information about quantity); QVP (verb phrases containing quantity for each sentence containing such a verb phrase); NP2 (second noun phrase for each sentence containing more than one noun phrase); NP3 (third noun phrases for sentences with more than two noun phrases). The number of the subject who produced a sentence, the number of the sketch which the subject used the sentence to describe, and information about the effectiveness of the sentence (ie. whether or not it was matched to the appropriate sketch) were each recorded along with each segment of each sentence. Table 2.3 shows the total number of each type of segment collected for each of the sketches described. The total number of sentence segments thus obtained was 2528.

TABLE 2.3 - Number and Type of Segments obtained for each Sketch

Sketch No.	QNP	QVP	NP2	NP3	
1	211	13	159	26	409
2	203	23	172	25	423
3	179	51	168	22	420
4	163	67	177	16	423
5	203	26	179	28	436
6	206	23	162	26	417
TOT	1165	203	1017	143	2528

Specific Analyses

The data were expected to contain a large variety of q-exps used by subjects to describe the sketches. The great variety is evident in the full listing in Appendix A. What is clear is that there are groups of noun phrases which share the same q-exp, but differ with respect to 'modifiers'. From here, the term 'basic q-exp' (b-q-exp) will be used to refer to the main q-exp which normally precedes <u>of/the/of the/ ± noun</u>; 'modifier' will refer to words in a quantified noun phrase preceding the b-q-exp; and modifier + b-q-exp combination will refer to a modifier followed by a b-q-exp. It is clear from Appendix A that subjects produced many different b-q-exps, and that some of these could be preceded by many different modifiers. To this extent, subjects produced a large variety of q-exps.

It was also expected that q-exps would be used to refer to a 'range' of proportions rather than to one proportion. In attempting to discover whether the q-exps produced by subjects do denote ranges of proportions, one is faced with two major problems, however. First, the data base contains many expressions which have low frequencies, thus making comparison of range complex. Second, subjects produced many descriptions which consisted of ratios between male and female surgeons rather than the proportion of the whole set belonging to one or other or the subsets. An example of such a description is "There are fewer male than female surgeons", as opposed to "Few of the surgeons are male". The proportional information given in the former example should be described as a ratio (25:75, for example) rather than as a proportion (such as 25%). Since our interest lies with the proportions which an expression can denote, descriptions of ratios are be omitted from this analysis.

The second problem can be dealt with by simply excluding from the analysis those expressions which can only be interpreted as <u>explicit</u> comparisons between the two subsets (ratios). A solution to the first problem necessitates the exclusion of q-exps with low frequencies from the analysis, and for this some criterion of what constitutes a low frequency must be applied. The adopted solution consisted of two basic steps: first, phrases which contained b-q-exps with low frequencies (less than 10) were excluded; and then from the remaining phrases, all those with modifiers which occurred less than 5 times were excluded. Thus, the information presented about the ranges of proportions which an expression can denote, will be based on phrases which appear 5 times or more in the data base.

Fourteen b-q-exps were found to have frequencies of 10 or more, after all ratio descriptions had been excluded. These are listed in Table 2.4, along with their accompanying modifiers which have frequencies of five or more. The term [OTHER] in table 2.4 represents all accompanying modifiers with frequencies of less than 5, and the number opposite [OTHER] is the total frequency of the modifiers in this category. Appendix A lists <u>all</u> the modifiers produced with the 14 b-q-exps. The specific effect of modifiers on the ranges denoted by b-q-exps will be discussed later. For now, it is sufficient to note that even <u>with</u> modifiers, b-q-exps often denote fairly large ranges of proportions and this conforms with expectations based on previous studies.

It was expected that the ranges of proportions denoted by different q-exps would overlap to some extent. Table 2.4 reveals a great deal of overlap. One can see, for example, that 'Quite a few' overlaps with 'Nearly all'. They were both used at least once to refer to 75%. To get some idea of the overlap, see Fig 2.1 showing the overlap of ranges based on <u>some</u> of the modifier + b-q-exp combinations in the table (see note 3). Given the degree to which these expressions overlap, one would expect many sentences to be interpreted as descriptions of the wrong sketch.

TABLE 2.4 - Ranges and Frequency of Q-exps

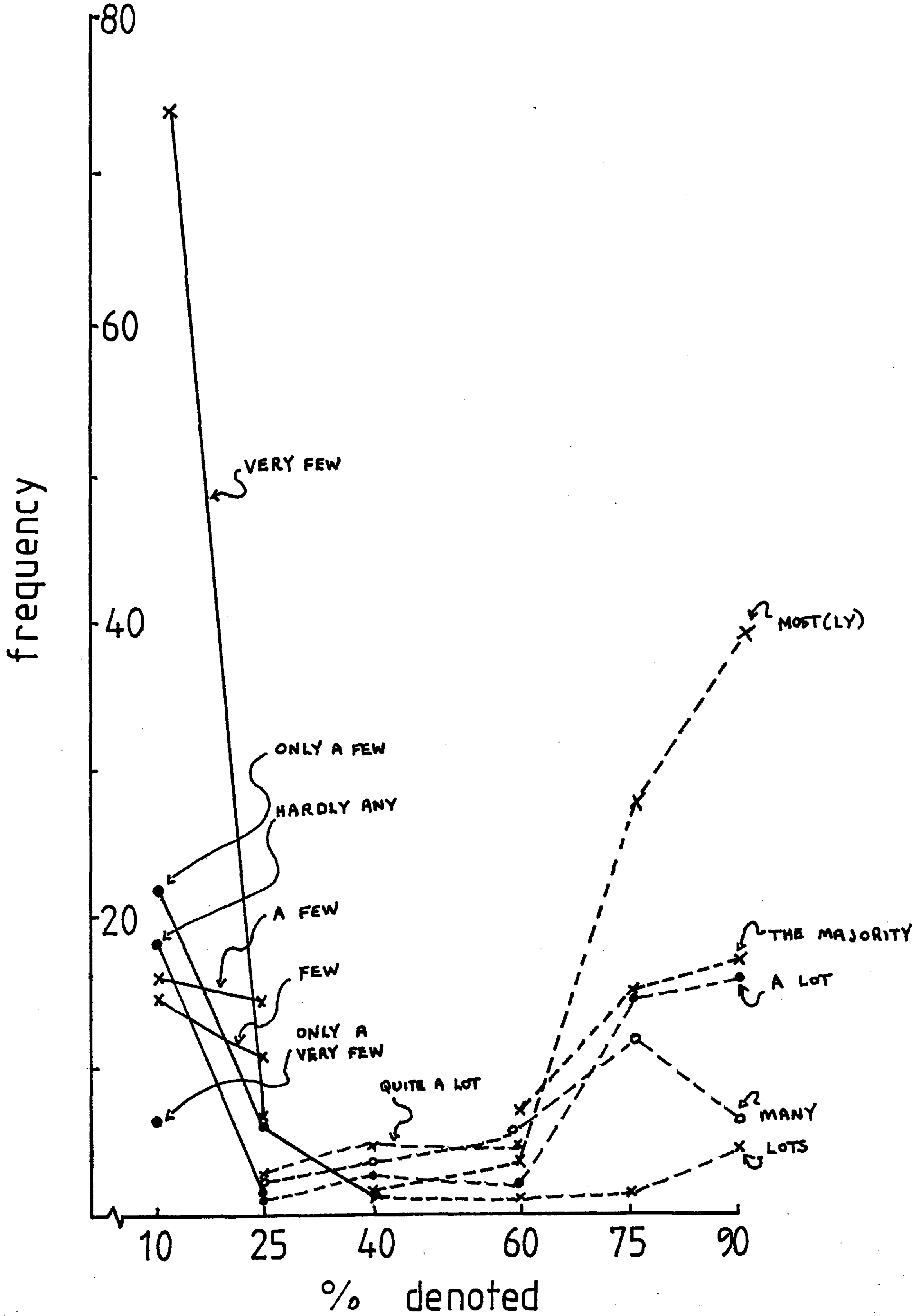
Q-exp	Modifier	Range*	Frequency
All	almost	75-90	12
	nearly	75-90	13
	practically	75-90	10
	virtually	90	6
	[OTHER]		5
Amount	[OTHER]		27
Any	hardly	10-25	19
	[OTHER]		0
Few	No modifier	10-25	25
	a	10-25	30
	only a	10-40	29
	only a very	10	6
	quite a	25-75	16
	very	10-25	82
	[OTHER]		9
Handful	[OTHER]		10
Lot(s)	no modifier	40-90	8
	a	25-90	37
	quite a	25-60	11
	[OTHER]		1
Many	no modifier	25-90	29
	[OTHER]		14
Mainly	no modifier	60-90	18
	[OTHER]		0
Majority	no modifier	60-90	12
	a	60-90	13
	a large	75-90	6
	a slight	60	6
	the	40-90	38
	the vast	75-90	14
	vast	75-90	6
	[OTHER]		28
Minority	[OTHER]		14
Most(ly)	no modifier	25-90	70
	[OTHER]		1
Number	no modifier	10-90	12
	a large	60-90	8
	the	10-90	27
	[OTHER]		87

Table 2.4 continued

Q-exp	Modifier	Range*	Frequency
Proportion	[OTHER]		34
Some	no modifier	25-75	18
	[OTHER]		0

*These are literal ranges, since range extremes are representative of maxima and minima which are relevant for communication in the present study.

Figure 2.1 - The ranges of some modifier + b-q-exp combinations



Ranges

Table 2.5 shows the number of matched and mismatched sentences containing each of the b-q-exps. 152 phrases containing b-q-exps were produced by subjects who did not provide interpretation data. Of the 659 remaining phrases, 101 were mismatched; in other words, no less than 15.3% of phrases containing b-q-exps were misinterpreted, the sketch they were understood as describing by one subject differing from the sketch for which they were given as descriptions by another subject. Perhaps this does not seem an unlikely percentage until one recalls that the smallest difference in proportion between sketches is 15%. In order for a subject to misinterpret the proportional information given by a particular b-q-exp, it must be assigned a proportion of at least 15% more or less than the proportion intended to be conveyed by the producer.

TABLE 2.5 - Number of Sentences matched and mismatched

Words	Number Matched	Number Mismatched	Total	Other	Total
All	36	4	40	6	46
Amount	18	5	23	4	27
Any	17	1	18	1	19
Few	140	17	157	40	197
Handful	6	4	10	0	10
Lot(s)	42	7	49	8	57
Many	23	11	34	9	43
Mainly	10	4	14	4	18
Majority	78	15	93	30	123
Minority	8	4	12	2	14
Most(ly)	43	9	52	19	71
Number(s)	96	15	111	23	134
Proportion	24	4	28	6	34
Some	17	1	18	0	18
TOTAL	558	101	659	152	811

It was expected that modifiers would influence the range of proportions denoted by a b-q-exp. The extent to which this is the case can be evaluated from table 2.4 which shows the ranges for all modifier + b-q-exp combinations with frequencies of 5 or more. Table 2.6 shows the overall range of proportions denoted by phrases containing each b-q-exp, those modifier + b-q-exp combinations with the same range as the overall range, and those modifier + b-q-exp combinations whose ranges of proportions differ from the overall range.

TABLE 2.6 - The Influence of Modifiers on Ranges

Basic q-exp	Range	Modifiers with same range	Other modifiers	range
ALL	75-90	Almost(12) Nearly(13) Practically(10)	Virtually(6)	90
ANY	10-25	Hardly(19)	-	-
FEW	10-75	-	No modifier(25) A(30) Only a(29) Only a very(6) Quite a(16) Very(82)	10-25 10-25 10-40 10 25-75 10-25
LOT(S)	25-90	A(37)	No modifier(8) Quite a(11)	40-90 25-60
MANY	10-90	-	No modifier(29)	25-60
MAINLY	60-90(18)	-	-	-
MAJORITY	40-90	The(38)	No modifier(12) A(13) A large(6) A slight(6) The vast(14) Vast(6)	60-90 60-90 75-90 60 75-90 75-90
MOST(LY)	25-90	No modifier(70)	-	-
NUMBER	10-90	No modifier(12) The(27)	A large(8)	60-90
SOME	25-75	No modifier(18)	-	-

Differences in the frequencies of the expressions in the table make it difficult to compare the ranges of proportions denoted. That is, expressions which occur more frequently are likely to denote broader ranges of proportions. Another problem is that the difference in proportional information between sketches is rather large (the smallest difference being 15%), and this makes it impossible to detect differences which happen to be smaller than 15% between the expressions. Nevertheless it is possible to make some speculations on the basis of the data in table 2.6.

(1) The article 'a' appeared in phrases containing 'few', 'lot' and 'majority'. 'A few' and 'a majority' each referred to the same range of proportions as these b-q-exps without modifiers. 'A lot' has a slightly different range from 'lots', but the difference in frequency between these phrases (37 and 8 respectively) probably explains the difference in range. Thus it seems that <u>'a' has no influence on the range of proportions of the b-q-exp which follows it</u>. For instance, <u>a few</u> denotes the same range as <u>few</u>.

(2) 'Only' appeared in phrases containing 'few'. 'Only a few' denoted a larger range (10-40%) than 'a few' (10-25%), while their frequencies were very similar (29 and 30 respectively). However, only one subject used 'only a few' to describe a sketch containing 40% male surgeons. 'Only a very few' denoted a smaller range (10%) than 'very few' and 'a few' (both 10-25%), but the frequency of 'only a very few' was 6 and this may explain the difference. <u>It is therefore doubtful that 'only' affects the range of proportions denoted by a b-q-exp</u>.

(3) 'Quite' appears in phrases containing 'few' and 'lot'. 'Quite a few' denotes a much higher range of proportions (25-75%) than does 'a few' (10-25%), and their frequencies are both reasonably large

(16 and 30 respectively). Although there is an overlap, it is quite possible that 'quite' does influence the proportion denoted by 'few'. 'Quite a lot' has a narrower range than 'a lot' and denotes proportions at the lower end of the range of proportions denoted by 'a lot'. Since 'quite a lot' was used in only 11 sentences and 'a lot' was used in 37, it is possible that 'quite' does not in fact influence the proportions denoted by 'a lot'.

Central Tendencies

Tables 2.4 and 2.6 show the frequency of 'a few', 'quite a few', 'a lot' and 'quite a lot' for proportions from 10-90%. These tables show obvious differences produced by 'quite', and the number of cases which allow for statistical comparison. A 2x2 Chi-square test was carried out to compare the frequency with which 'a few' was used to denote 10% versus 25% or more, with the frequency of the same denotations for 'quite a few'. The difference between these two expressions was highly significant ($X2 = 10.84$, $df=1$, $p<.001$). A similar test was carried out to compare 'a lot' and 'quite a lot', this time using the frequencies of use for 40% or less versus 60% or more. Again the expressions were found to differ ($X2 = 14.192$, $df=1$, $p<.001$). Thus _'quite' does influences the proportion denoted by b-q-exps_: it increases the proportion denoted by 'a few' and reduces the proportion denoted by 'a lot'. Perhaps this could be described as 'weakening' or 'moderating' the proportional information given by the b-q-exp.

(4) 'Very' appeared in phrases containing 'few'. 'Very few' was used in 82 sentences compared with the 25 instances of 'few', and on only 8 of the 82 times 'very few' was used did it denote 25%. For this reason, although the ranges of 'very few' and 'few' are the same, a 2x2 Chi square test was carried out on the frequency of these two expressions at 10% versus 25% in an attempt to assess any differences in distribution. The difference was found to be significant ($X2 = 10.45$), $df=1$, $p< .01$). Thus 'very few' is more likely to denote 10% than is 'few'. It is difficult to generalise about the influence of 'very' since the frequencies of 'very' + other b-q-exps are not sufficiently large to allow even rudimentary statistical analysis. Perhaps 'very' strengthens the proportional information, or makes it more extreme, just as 'quite' makes it more moderate. This would mean that 'very few' on average denotes smaller proportions than 'few' (which is supported here) and, for example, 'very many' might denote larger proportions than 'many' (which seems likely, but cannot be tested with this data).

(5) The frequencies of 'a large majority', 'a slight majority', 'vast majority' and 'a large number' are all rather small, but these do appear to have a strong influence on the proportions denoted by these b-q-exps without modifiers, as does 'the vast majority' which has a slightly larger frequency (14).

(6) All the expressions in table 2.6 which contain 'all' denote 75% or 90%, and although 'virtually all' denotes only 90% this is very likely to be due to the small number of times this expression was

used (6). Since it is natural to assume that 'all' denotes 100%, all these modifiers reduce the proportion denoted. There is some evidence (note 4) which suggests that 'all' does not always denote 100%, but it is unlikely that its normal meaning is as low as 90%. The b-q-exps 'mainly', 'most(ly)', and 'some' are never accompanied by modifiers, and since 'hardly' always accompanies 'any' it is not possible to assess the contribution of each word to the proportion denoted. 'Many' however can only denote proportions between 25 and 60%, while modifiers + 'many' range from 10-90%. Since the individual frequencies of these modifiers are so small it is not possible to assess their individual effects, although it is possible that they do carry some influence.

To summarise, while it was not possible to assess the influence of many modifiers produced by subjects due to the low frequency of expressions containing them, there is fair evidence that 'a' and 'only' do <u>not</u> influence the proportions denoted by b-q-exps , while 'quite', 'very', all modifiers of 'all', and other modifiers clearly do.

<u>The Influence of Expectation</u>

It was hypothesised that subjects would produce different expressions in their descriptions depending on whether the information to be described was consistent or inconsistent with expectation. Since one normally expects few female surgeons, and certainly less than 50%, the expressions used to describe sketches 1-3 are expected to differ from those used to describe sketches 4-6. The first three sketches depicted between 10% and 40% females, and between 90% and 60% males, while sketches 4-6 depicted between 10% and 40% males and between 90% and 60% females. Hence, if 'Few' (for example), was used to denote 10%-60% of surgeons in sketches 1-3 it was used to denote 10-40% female surgeons, and 60% of male surgeons.

It must also be noted that there are two kinds of unexpected information depicted in sketches 4-6 which may influence the expressions produced in the descriptions. Descriptions of the proportion of female surgeons may be affected because the proportion to be described is unexpectedly large. Sentences describing the proportion of male surgeons, however, may be affected because the proportion to be described is unexpectedly small. Similarly, there are two kinds of expected information depicted in sketches 1-3. The proportion of female surgeons is expected and small, while the proportion of male surgeons is expected and large.

Table 2.7 shows the range of proportions denoted by all of the <u>modifier</u> <u>±</u> <u>b-q-exp</u> combinations with frequencies of 5 or more, depending on whether the information to be described was expected or unexpected, and noting the gender of the surgeons as denoted by the quantified noun phrase produced by the subject.

TABLE 2.7 - Ranges denoted by Q-exps partitioned by expectation and gender

	EXPECTED Range(Sketch 1-3)			UNEXPECTED Range(Sketch 4-6)		
Q-exp	F	M	Freq	F	M	Freq
Almost all	-	90	3	75-90	-	9
Nearly all	-	75-90	6	90	-	7
Practically all	-	75-90	5	90	-	5
Virtually all	-	90	2	90	-	4
Hardly any	10	-	6	-	10-25	13
A few	10-25	-	22	-	10-25	8
Few	10-25	-	15	-	10-25	10
Only a few	10-25	-	12	-	10-40	17
Only a very few	10	-	4	-	10	2
Quite a few	25-40	-	12	75	25-40	4
Very few	10-25	-	47	-	10-25	35
A lot	40	60-90	18	60-90	25-40	19
Lot(s)	40	75-90	3	90	-	5
Quite a lot	25-40	60	8	60	40	3
Many	25-40	60-90	14	60-90	40	15
Mainly	-	75-90	12	60-90	-	6
A large majority	-	75-90	3	75-90	-	3
A majority	-	60-75	4	60-90	-	9
A slight majority	-	60	2	60	-	4
Majority	-	75-90	8	60-90	-	4
The majority	40	60-90	24	60-90	-	14
The vast majority	-	75-90	8	75-90	-	6
Vast majority	-	90	4	75-90	-	2
Most(ly)	25	60-90	35	60-90	-	35
A large number	-	75-90	4	60-90	-	4
Number	10-40	60-90	6	60-90	10-40	6
The number	10-40	60-90	15	60-90	10-40	12
Some	25-40	75	11	-	25	7

From table 2.7 it is possible to find two sorts of difference between descriptions of expected and unexpected information. There may be differences in the range of proportions each expression denotes; there may also be differences in the frequency with which expressions are used in descriptions of expected versus unexpected sketch configurations. Before making these comparisons, it must be noted that there may be a relationship between frequency and range of proportions. That is, the larger the number of instances of an expression within the data base, the broader the range of proportions which that expression is likely to denote. For example, a q-exp which is used five times (say for expected information) is likely to have a broader range when used to describe unexpected information.

Table 2.8 shows the frequencies of <u>modifier</u> $\pm$ <u>b-q-exp</u> combinations for expected and unexpected information and for small versus large proportions. The table has been simplified by collapsing the frequencies of q-exps which contain the same b-q-exp <u>and</u> which have been used to denote similar ranges of proportions. A 2 x 2 Chi Square test was carried out on the total frequencies for expected against unexpected and for expressions used mostly to describe small proportions versus expressions used mostly to describe large proportions. It was found that the frequency of expressions used to describe expected versus unexpected information depends on the size of the proportion to be described ($X2 = 5.25$, $df=1$, $p<.05$). From table 2.8, it seems likely that the frequency of expressions describing small proportions is influenced more by whether the information is expected or unexpected than the frequency of large proportion expressions.

TABLE 2.8 - Frequency of q-exps for expected and unexpected information

Q-exp	Freq(Expected) female	Freq(Expected) male	Freq(Unexpected) female	Freq(Unexpected) male
All	-	16	25	-
Hardly any	6	-	-	13
A few/few/very few	84	-	-	53
Only a (very) few	16	-	-	19
Quite a few	12	-	1	3
A lot/Lots	3	18	22	2
Quite a lot	7	1	2	1
Many	3	11	13	2
Mainly	-	12	6	-
A majority/majority	-	12	6	-
A slight majority	-	2	4	-
A large/The vast/ Vast majority	-	15	11	-
Most	1	34	35	-
A large number	-	4	4	-
Some	10	1	-	7

In order to investigate the frequency differences further, the expressions in table 2.8 were divided into four groups: (1)

expressions which were only used to describe small proportions (10-40%); (2) expressions which were used more often to describe small proportions than large proportions; (3) expressions which were used more often to describe large proportions (60-90%) than small proportions; and (4) expressions which were always used to describe large proportions.

Groups 2 and 3 consisted of modifier + b-q-exp combinations which were used to refer to both small and large proportions. Two Chi Square tests were carried out on the data from these groups. The first compared frequencies of expressions describing mostly small ((2) above) versus mostly large ((3) above) proportions ('Quite a few', 'Quite a lot' and 'Some' versus 'A lot', 'Many' and 'Most') as to whether they were describing expected or unexpected small proportions. No significant difference was found (X2 = .039, df=1). The second Chi Square test compared the same expressions as to whether they were used to describe expected or unexpected large proportions. Again, no significant difference was found (X2 = .017, df=1).

Two more Chi Square tests were carried out on expressions which were used to describe only large ((4) above) and only small ((1) above) proportions. The first test compared expressions containing 'all', 'mainly', and expressions with 'majority' or 'number'. No significant difference was found between these expressions in terms of their use to describe expected and unexpected information (X2 = 3.959, df=2, p<.2). The second X2 test compared 'hardly any' with expressions containing 'few' (except 'quite a few', which was used to describe large as well as small proportions). These expressions were significantly different ($X2$ = [illegible], df=1, $p<.05$) in their use in descriptions of expected versus unexpected proportions. A one-sample $X2$ test of 'hardly any' showed that this expression was not responsible for the overall difference ($X2$ = [illegible], df=1, $p<.1$). The same test of expressions with 'few' however was significant ($X2$ = 4.558, df=1, $p<.05$).

It seems therefore that expressions containing 'few' are connected with the differences in frequency for expected versus unexpected information. From table 2.4, it can be seen that these expressions are used more often to describe expected rather than unexpected information. Since each sketch used in the experiment by definition contained both a larger proportion and a smaller proportion (making up 100 surgeons), it was possible for subjects to choose which proportion to describe, while they were not able to choose whether the information was expected (sketches 1-3) or unexpected (sketches 4-6). When the information was expected, subjects showed a weak tendency to describe the small proportion (142 times as opposed to 126 descriptions of large proportions). However, when the information was unexpected, the large proportion was more often described (136 times as opposed to 100 descriptions of small proportions). The results of the X2 test imply that this may be due to, or may result in, more use of 'few' in descriptions of expected, rather than unexpected, information. In the absence of evidence to the contrary, it is most likely that the effect <u>results in</u> the different frequencies of expressions containing 'few'.

These findings do not necessarily support the hypothesis that subjects use different expressions to describe expected and unexpected information. They merely suggest, that if there is a choice of describing a small or a large proportion, then the choice made is partly determined by whether or not the information to be described is expected or unexpected.

Another test of this hypothesis is a test of range differences between expressions used to describe expected information and those same expressions used to describe unexpected information. Such differences can also be assessed from table 2.7. Table 2.9 shows all expressions in table 2.7 which have broader ranges in sketches 1-3, all those which have broader ranges in sketches 4-6, and all those which are indifferent to these sketches. The frequencies of these expressions are shown in brackets, the first number being the frequency for expected information, and the second the frequency for unexpected information. <u>All</u> but one of the differences between the ranges of proportions denoted disappear if: (a) expressions are omitted when the range difference can be explained by frequency differences between expected and unexpected information; and (b) expressions are omitted if the range difference is due to data obtained from a single subject. The remaining difference is in the range of 'lots', which is broader when describing sketches 1-3. However the total frequency of occurrence of this expression is only 8, and it is not possible to procede with a more detailed analysis.

Table 2.9

Range reduces in 4-6	Range expand in 4-6	Same range
Nearly all(6 7)	Almost all(3 9)	Virtually all(2 4)
Practically all(5 5)	Hardly any(6 13)	A few(22 8)
Lots(3 5)	Only a few(12 17)	Few(15 10)
Quite a lot(8 3)	Quite a few(12 4)	Only a very few (4 2)
Many(14 15)	A lot(18 19)	Very few(47 35)
The majority(24 14)	Mainly(12 6)	A large majority (3 3)
Most(ly)(35 35)	A majority(4 9)	A slight majority (2 4)
Some(11 7)	Majority(8 4)	The vast majority (8 6)
	Vast majority(4 2)	Number (6 6)
	A large number(4 4)	The number(15 12)

Thus, on the basis of the present experiment there appear to be no real differences in the expressions used to describe expected versus unexpected information. The only reliable difference is in the frequency of expressions containing 'few', but this is probably due to a preference on the part of subjects to describe small proportions where the information is expected and large proportions where the information is unexpected.

Effectiveness of Communication

The final hypothesis was that the more proportions a particular q-exp is used to describe, the more it will be misinterpreted by subjects assigning interpretations. Table 2.10 shows the ranges and the percentage of mismatches from all sentences containing one of the 14 b-q-exps + modifier combinations occurring more than 5 times. The percentages are based on the interpretation data which means that subjects who did not provide such data are excluded. Hence, in Table 2.10, the ranges and % mismatch of some expressions used in tests of other hypotheses are not presented, since the frequency of these words in the interpretation data is 5 or less.

TABLE 2.10 - The relation of ranges to communication failure (% mismatch) Note: Expressions are roughly ordered by range-size.

Q-exp	Range	Range-size	%mismatched	Freq
A slight majority	-	-	-	1
Lots	-	-	-	5
Only a very few	-	-	-	5
Vast majority	-	-	-	5
Virtually all	-	-	-	3
Almost all	75-90	15	0%	10
Practically all	75-90	15	0%	9
Hardly any	10-25	15	5.5%	18
Very few	10-25	15	6.2%	68
Nearly all	75-90	15	9.1%	11
A few	10-25	15	13%	23
Few	10-25	15	15%	20
A large majority	75-90	15	16.6%	6
The vast majority	75-90	15	16.6%	12
A large number	60-90	30	0%	8
A majority	60-90	30	10%	10
Majority	60-90	30	10%	10
Only a few	10-40	30	13%	23
Mainly	60-90	30	28.6%	14
Quite a lot	25-60	35	37.5%	8
Some	25-75	50	5.5%	18
The majority	40-90	50	17.2%	29
Quite a few	25-75	50	30%	10
A lot	25-90	65	11.1%	36
Most(ly)	25-90	65	17.6%	51
Many	25-90	65	37.5%	24
The number	10-90	80	4%	25
Number	10-90	80	66.6%	12

The expressions in Table 2.10 are ordered from those with small ranges (at the top) to those with large ranges (at the bottom), and it does appear that the proportion of misinterpretations is generally higher towards the bottom of the table. It is not always the case however that a large range leads to a high proportion of misinterpretations, nor that a small range leads to a low proportion of misinterpretations. For example, 'A lot', which can denote proportions of 25-90% is misinterpreted only 11.1% of the time, while 'Few' which can only denote proportions of 10-25% is misinterpreted 15% of the time.

A Spearman rank correlation coefficient was calculated to test the relationship between range size and the percentage mismatched for each expression. This showed a significant correlation ($rs = .402$, $t = 2.012$, $df=21$, $p<.05$). Another test showed that the interquartile ranges (which avoid the influence of extreme proportions) are also correlated with the percentage of mismatches ($rs = .388$, $t = 1.882$, $df = 21$, $p<.05$). The hypothesis that the percentage of misinterpretations increases with the size of the range denoted is therefore supported to the extent that these two factors show a significant correlation.

Additional Observations

There are many aspects of the data collected from this experiment which are not directly related to the hypotheses, but which may provide important information about the way in which q-exps function in natural language. These will be described and discussed in the next chapter. At this point, a summary of observations made up to now about the results of this study is in order:

(1) As expected, subjects used many different q-exps in their descriptions of the sketches. Each expression was found to denote a range of proportions rather than just one, and the ranges of different q-exps overlapped. This last point is consistent with the findings of other researchers in less realistic tasks.

(2) Certain modifiers were found to influence the range of proportions denoted by the <u>b-q-exps</u> which followed them, while other modifiers had no influence. These data will be used in later studies.

(3) 'Few' occurred significantly more often in descriptions of expected information than in descriptions of unexpected information. Most probably, this is the case because subjects prefer to describe the smaller proportion when the proportion to be described is expected. There were no other real differences in frequency of range dependent on whether the proportions depicted were expected or unexpected.

(4) There is a significant correlation between the size of the range of proportions which a q-exp denotes and the liklihood that the q-exp will be misinterpreted.

The data of experiment 1 is very rich and the above conclusions appear rather weak. Apart from the difficulties over low-frequency expressions, however, it must be remembered that an exploratory study of this sort suggests many new hypotheses and ideas. It is used in this way in relation to various aspects of the rest of the thesis. What is clear, however, is that even with only six well-spaced proportions to describe, and with all of natural language available, subjects found it difficult to achieve effective communication.

Chapter notes

(1) Obviously, explicit negation such as 'not many' will differ from 'many', but the differences between 'few', 'a few', 'only a few', 'quite a few' and 'very few' etc are less obvious.

(2) INGRES is a relational database system which allows one to treat categories such as QNP and QVP as domains. It is then possible to search these domains for the occurrence of any particular word or phrase, and to calculate the frequencies of words and phrases in the database.

(3) It must be noted that the q-exps discussed denote proportions at the ends rather than the middle of the graph. This does not mean that the middle proportions were not described. Sketches depicting 40% and 60% were usually described by the relative sizes of the two subsets (ie. as ratios), rather than proportions of the whole set. Hence verb phrases with quantity information normally described these sketches.

(4) There is some evidence that all is 'fuzzy' in that it is sometimes used in descriptions even when there are one or two exceptions to the rule. See, for example, Newstead and Griggs

(unpublished report).

Chapter 3

Further Discussion and Experiment 2

The major aim of experiment 1 was to find out as much as possible about the way in which people describe quantities or proportions when there is little experimental control over the expressions used. The fact that the data conforms to some of the expectations outlined in the last chapter is not surprising, but at least confirms intuition. If people describe quantities in many different ways and other people can 'understand' these descriptions, it means that there is no obviously 'best' way to describe proportions using natural language expressions. If a q-exp denotes a range of proportions rather than a single proportion, this means that the q-exp is to some extent a <u>vague</u> indicator of quantity. The fact that the range of proportions of one q-exp can overlap quite considerably with the range of proportions of other q-exps explains why confusions may arise between q-exps, and why they were frequently misinterpreted in the experiment.

In the course of exploring the data from experiment 1, it was necessary to reduce the amount of data under consideration so that questions about 'ranges of proportion' could be investigated. For the general questions posed, general answers were required which meant that only reasonably frequent expressions could be used when seeking an answer. This does not defeat the point of the experiment, however, which was to look not only at trends in the expressions people commonly choose, but also to look at what it is <u>possible</u> for people to say in the experimental situation. In fact, the data obtained from this experiment provide a great deal of information about the structure of quantified noun phrases. Chapter

6 considers the order of words in some of the phrases produced by subjects in experiment 1. This information will then be used to evaluate aspects of the meaning of such phrases which do not relate directly to proportions or quantities.

This and subsequent chapters will investigate more specifically the role of subjects' expectations in their interpretation of q-exps, the role of modifiers within a quantified noun phrase, and the degree to which q-exps are vague. The discussion begins with some ideas about these factors following the results of experiment 1.

Expectation

Obviously the proportion expected, and the degree to which this proportion is expected, varies from one situation to another and from one individual to another. This makes it difficult to control the proportion expected, and in experiment 1 all that is known about the 'expectation' factor is that the sketches differ in their concordance with expectation. The actual proportion expected by each subject is not known, and so little is known of the relationship between proportion expected and the q-exps used to denote the actual proportion.

In fact, it is not really clear that subjects <u>had</u> expectations about the proportions presented. They may well have thought of the sketches as depicting pin-figures rather than male and female surgeons. For this reason experiment 1 cannot be said to show that expectations of proportion have no effect on the use and interpretation of q-exps, and this possibility is explored further in chapter 4.

Modifiers

The results show that some of the modifiers used by subjects could influence the range of proportions denoted. Modifiers like 'quite a' preceded more than one b-q-exp ('few' and 'lot') with different effects depending on the b-q-exp. Thus 'quite a few' appears to denote larger proportions than other phrases containing 'few', while 'quite a lot' denotes smaller proportions than other phrases containing 'lot'. It was suggested that one of the functions of 'quite a' might be to bring the range of proportions of a q-exp nearer to some moderate proportion, eg 50%. This view is tested in experiment 2, reported later in this chapter. These and other properties of the modifiers 'Very' and 'quite' are also explored further in chapters 4 and 5.

Vagueness

In the last chapter, it was assumed that q-exps were to varying extents vague, and that this would be reflected both in the size of the range of proportions any q-exp was used to denote, and in the number of misinterpretations of the q-exp. In fact, these two measures of vagueness were found to correlate in experiment 1. What is surprising about the results of that experiment is that there was such a high percentage of misinterpretations. All subjects who matched sentences to sketches had previously described those same sketches with their own sentences. Hence subjects were aware of the possiblities. Also, the smallest proportional difference between sketches was 15%, so that any errors which did occur were fairly large errors. If the subjects had not been able to 'relativise' their partners' 6 sentences to the 6 sketches, the percentage of misinterpretations is likely to have been higher. Indeed, it is possible that in a non-experimental context people will interpret just about any q-exp as denoting just about any proportion, on the assumption that the speaker is trying to be truthful and cooperative. This will be so especially when the speaker is describing a situation in a straightforward manner, rather than being obviously persuasive (c f. chapter 1). Experiment 2 assesses the acceptability of q-exps as descriptions of different proportions in contexts which are more and less persuasive. However, before describing experiment 2, some other notes should be made on the basis of experiment 1.

Different Types of Quantity Expression

Up until now, all of the expressions presented have been treated in much the same way. This was necessary in order to answer the questions posed about ranges of proportions. On looking at these words in Table 2.4, however, it is obvious that there are important differences between various basic q-exps. Of course, at one level they are all different (they are different words), but at a higher level one can say there are at least three different types of b-q-exp:

(1) Dimension q-exps: These words can form part of a reference to any proportion from 10-90%, and are usually accompanied by words which explicitly denote size eg. small, high etc. B-q-exps in this category are Amount(s), Numbers(s), and Proportion(s). They specify abstract dimensions.

(2) Dimension-Anchored q-exps: These words are related to definite points on a dimension (as do top, bottom and middle) in a logical or commonly negotiated way. In experiment 1 they were usually accompanied by modifiers (probably because none of the sketches depicted 0%, 50% or 100%), and these modifiers altered the range of proportions in particular directions from the point associated with the b-q-exp. Words in this category are 'All' (whose anchor is 100% and whose modifiers reduced this), 'Any' (accompanied by 'Hardly', and anchored at 0+%), 'Majority' (whose anchors are 50+ - 100% and whose modifiers reduce the proportions denoted to some small range within this larger one), and minority (whose anchors are 0+ - 50% and whose modifiers reduce the proportions denoted to some range within this range).

(3) Dimension-Unanchored q-exps: Words in this category can all be placed on dimensions, but they are not in themselves dimensions, nor

are they anchored at definite points on a dimension. These words do have ranges of proportions and they are often accompanied by modifiers such as 'Very', 'Quite a' etc. Dimension-Unanchored words from experiment 1 are Few, Handful, Lot(s), Many, Mainly, Most(ly) and Some.

There are doubtless other ways in which the 14 basic quantity expressions could be categorised, but the above categorisation is interesting. Category 1 words seem intuitively more related to numbers or relationships between numbers of things; Category 2 words seem intuitively to be more related to standard logic, and to provide rule-like information about states of affairs; thus, 'All' and 'Any' correspond closely to the logical universal and existential quantifiers $\forall$ and $\exists$. The natural language 'Any' relates more to the logical 'Some' (meaning at least one) than the natural language 'some' does. Thus 'Hardly any' means something like 'Nearly none' or 'Nearly not some'. The other two words in this category are also more logical than other b-q-exps since the ranges of proportions they can denote can be expressed as simple rules: majority = >50%; minority = <50%. Category (3) words seem intuitively to be very vague. One expects them to be used in situations where actual amounts are not known, or where the speaker does not wish to reveal precise amounts for some reason. The fact that the ranges of proportions denoted by these words are not anchored, nor accompanied by 'size' words like 'small' etc., makes it unlikely that one learns their 'meaning' in a structured rule-like way. This explains why they seem, intuitively, to be so vague, and why they are of particular interest as parts of natural language descriptions of quantity and/or proportion within the context of this thesis.

Phrases based on q-exps in each of the above categories can denote different proportions. However, there are interesting differences in the distribution of these words when considered as descriptions of small and large proportions. Category 1 words all range from 10-90%, and the total frequency of these words as basic q-exps is 195. The distribution and frequency of words in category 2 is given in the following table:

Basically small (< 50%)	Freq	Basically large (> 50%)	Freq
Any	19	All	46
Minority	14	Majority	123

A Chi Square test shows that 'All' and 'Majority' are used far more frequently than 'Any' and 'Minority' (X2 = 91.56, df = 1, p< .001). That is, with words in this category people prefer to describe the larger subset rather than the smaller subset. One possible reason for this is that it may be easier to perceive that a particular subset is large than that the other is small. That is, if one looks at one of the sketches presented to subjects, the most obvious subset of surgeons will be the larger subset. Perhaps obvious things are even treated as larger (even in some cases where they are not), and perhaps things are described in terms of obvious aspects rather than less obvious aspects. Alternatively, it may be argued that information about large subsets is seen as <u>more</u> informative than information about small subsets since large subsets make up more of the world than small subsets. If this is true, and if subjects wish to be more rather than less informative, they will choose to focus their descriptions on the larger subset.

Category 3 words are also interesting with respect to differences between the amounts they can denote. The words and their frequencies are shown in the following table:

Basically small	Freq	Basically large	Freq	Middle	Freq
Few	197	Lot(s)	57	Some	18
Handful	10	Many	43		
		Mainly	18		
		Most(ly)	71		
	207		189		18

Although there are more words for describing large proportions than for describing smaller proportions, the total frequencies of words describing large versus small proportions are not very different (189 versus 207). The number of words available for describing these proportions may support the above arguments about the treatment of particularly salient aspects and informativeness, but the frequency of small versus large proportion descriptions does not. In the analysis of expected versus unexpected information, it was found that the type of information to be described affected whether the proportion which the subjects chose to describe was small or large. This effect was reflected in the greater frequency of the term 'few' in descriptions of expected information. Given the lack of dimension-unanchored phrases available for describing smaller proportions, it is not surprising that the difference was reflected in the frequency of 'few'. Various properties of the meaning of 'few' (both proportional and otherwise) are discussed throughout this thesis. At this point, however, it is clear that phrases containing 'few' are the most popular way of describing small proportions. It must be noted that expressions describing large proportions in category 3 are accompanied by different modifiers, and that most of these modifiers can accompany 'few'. For example, 'A lot' and 'quite a lot' versus 'a few' and 'quite a few', and 'Very many' versus 'Very few'. 'Not', however, which can accompany 'many', cannot accompany 'few'. and 'only a' does not apply readily to the q-exps denoting larger proportions.

Experiment 2 was designed to explore further the communication of information via q-exps. Subjects in experiment 1 were asked to match 6 sentences to sketches which they themselves had already described. It was argued that in a situation where the sentences could not be 'relativised' or scaled to suit the sketches, the proportion of mismatches could have been even higher reflecting an even greater degree of vagueness in the meaning of the q-exps employed. However, it is also possible that subjects did not think of the sketches as depicting surgeons, but rather as depicting pih-figures. It may be argued that the difference in meaning between many q-exps may be lost in such a 'bland' context. Perhaps where subjects know something about a state of affairs, they use different criteria in deciding which q-exp to use in describing it. In such a context, every aspect of the meaning of a q-exp may be used to interpret what is being said. In a bland context, on the other hand, only some of the information given by the q-exp may be used and it is possible that many q-exps contain the same quantity information in this situation. In this case it may be argued that the proportion of misinterpretations would <u>decrease</u> if subjects had some knowledge of the context presented and the meaning of q-exps would be less vague.

Experiment 2 compares the interpretation of some q-exps in two different contexts. Each subject was presented with only one situation and one of the q-exps, so that it was not possible for them to interpret the q-exp relative to another situation or another q-exp. One of the contexts was 'bland' and the other 'rich' in the sense that subjects are likely to have some knowledge of the situation described. Thus, if the results of this study show that the denotations of q-exps are even more vague than is suggested by experiment 1, this may be taken to support the idea that subjects in experiment 1 interpreted the q-exps relative to the sketches and to other q-exps. If, on the other hand, the denotations of q-exps are more vague in the bland context than in the rich context, it may be argued that q-exps have more precise denotations when more is known about the context in which they appear.

The q-exps used in this study were 'A few', 'A lot', 'Quite a few' and 'Quite a lot'. These particular expressions were chosen for two reasons. First, 'a few' always denoted a small proportion while 'a lot' always denoted a large proportion in exp 1. It is important to know whether, for example, descriptions of small proportions are influenced more by context than are descriptions of large proportions. If this were true and if the context presented in experiment 1 influenced descriptions of small proportions, then this might partly explain why subjects chose to describe large proportions more often than small proportions. Secondly, 'quite' can modify both 'a few' and 'a lot'. Data from exp 1 suggests that 'quite' denotes more moderate proportions than do 'a few' or 'a lot'. The present experiment provides a more specific test of this hypothesis.

The contexts used in this study were: (a) the proportion of figures representing females in a sketch (this time there was no need to actually present sketches, and the figures did not represent surgeons), and (b) the proportion of people who were influenced by a speech at a party conference. It was assumed that subjects would have more information about people at a party conference, and the likelihood of such people being influenced by a speech, than they would about the figures in a sketch and the likelihood of these figures being female.

The proportions used were 30% and 70%. These amounts were chosen because they are small and large respectively, while neither of them are close to 'anchors' (0%, 50% or 100%). Also, the dimension-unanchored expressions produced in exp 1 were most commonly used to describe proportions below 40% and over 60% and the q-exps used in the present experiment are all dimension-unanchored.

This study involves assessing interpretations of the q-exps, given a proportion and the information given by the context. Subjects were asked to assess interpretations using a simple scale which incorporated two factors - truth and vagueness. These factors are quite different although they are in some way related. That is, an expression may be true and not vague, true <u>and</u> vague, untrue <u>and</u> vague, or untrue and not vague (see example and discussion in chapter 1, page 8). At the same time, if something is true and not vague it may be seen as more true than something which is true <u>and</u> vague, which in turn is more true than something which is <u>untrue</u> <u>and</u> vague. By asking subjects to categorise the interpretation of a q-exp in this way, it will be possible to have some measure of the degree to which the use of the q-exp is appropriate. It may also be possible to find out for example, if the vagueness or the truth of q-exp interpretation is influenced by the context.

Hypotheses

The first hypothesis is that the q-exp presented will affect subjects' judgements about the appropriateness of a q-exp as a description of a proportion, regardless of context. Specifically, 'a few' will be judged more true for 30% than for 70% and 'a lot' will be judged more true for 70% than for 30%. 'Quite a few' and 'quite a lot' may also differ with the proportion being described, although the proportions denoted by these q-exps in exp 1 were often between 30% and 70%, (more moderate than the proportions denoted by the b-q-exps alone).

For similar reasons, subjects' judgements are expected to depend partly on the proportion which the q-exp was intended to describe. For example, where 30% is the amount being described, 'a few' will be judged more appropriate than 'a lot'.

The second hypothesis is that the <u>context</u> will influence subjects' judgements. The 'bland' context is expected to produce more 'vague' judgements than the 'rich' context, since more information will be used by subjects in interpreting the q-exp in a rich context. This will result in the meaning of the q-exp being more precise.

Subjects

Subjects were 240 students from the University of Strathclyde, the University of Glasgow, and London Polytechnic.

Design and Procedure

There were three factors in this experiment: two topics, two proportions and four q-exps. The various combinations of factors yield 16 different conditions. Each of the 240 subjects was presented with only one of the conditions so that there were 15 subjects in each condition and each of the conditions was independent.

Subjects were first presented with one of the following 'facts':

"30% of the figures depicted in a sketch represent females"

"70% of the figures depicted in a sketch represent females"

"30% of the people attending a party conference have been influenced by a particular speech"

"70% of the people attending a party conference have been influenced by a particular speech"

This was followed by:

"Mr. Brown was asked to describe this situation and he responded as follows:

"A few of the figures are females"

or "A few of the people were influenced by the speech"

or "Quite a few of the figures are females"

etc.

The subjects were asked to respond as follows:

"Do you think Mr. Brown's description is:

(a) reasonably accurate and truthful

(b) unnecessarily vague, but truthful

(c) slightly misleading

(d) misleading to the point of being untruthful"

(Tick one only)

Thus (a) and (b) indicate that his description is true, while (c) and (d) indicate that it is false. Also (a) and (d) indicate that regardless of truth Mr. Brown is not being vague, while (b) and (c) indicate that he is being vague.

Results

The frequencies of a's, b's, c's, and d's were calculated for each of the 16 conditions. It is possible to measure any differences between groups of subjects in three ways. First, it is possible to evaluate the frequencies of 'true' or 'false' judgements between groups. This may be done by finding the frequency of a + b or the frequency of c + d, on the assumption that categories a + b indicate that the description was judged 'true' by the subject, while categories c + d indicate a false judgement. Second, the degree to which descriptions were judged as vague, or not vague, can be assessed by finding the frequency of a + d or the frequency of b + c. Finally, it is possible to assign a value to each of the 4 possible responses, thus treating the responses a - d as a scale from true to false. By comparing these numerical values between groups, there would then be another measure of differences between conditions.

Subjects had been asked to tick one of the 4 sentences a - d according to their view of Mr. Brown's description. These statements could be seen as a scale of truth, or as four distinct categories involving truth and vagueness. For this reason, all three measures described above were used to test for differences between conditions.

(1) Frequency of true responses. For this analysis, the frequency of 'a' responses and 'b' responses were added together for each condition. Table 3.1 shows the resulting frequencies. A 2x2x4 Chi-square analysis, an analog of the parametric Analysis of Variance was carried out on the frequency data (procedure described in Winer, 1971; p.855). The results are shown in Table 3.2.

Table 3.1 Frequency of true responses in the 16 conditions.

	People		Figures	
	30%	70%	30%	70%
A few	7	2	8	3
Quite a few	12	8	10	9
Quite a lot	6	10	4	12
A lot	5	13	7	12

Table 3.2 Chi-square test comparing truth frequencies between conditions.

Source	X2	df	P-value
Topic (people/figures)	.032	1	<.9
Proportion	.782	1	<.5
Q-exp	6.812	3	<.1
Topic x Proportion	.122	1	<.8
Topic x Q-exp	.154	3	<.99
Proportion x Q-exp	12.904	3	<.01
Topic x % x Q-exp	.944	9	NS

From the analysis in Table 3.2, the only significant difference between conditions results from an interaction between proportion and q-exp ($X2 = 12.904$, df=3, $p<.01$). 2 x 2 Chi-squares were calculated for 4 pairs of q-exps and the two proportions (30% and 70%). Table 3.3 shows the results of these individual comparisons.

Table 3.3 - Results of Chi-square tests on pairs of Q-exps

Q-exp	X2	df	p-value
A few vs Quite a few	1.24	1	<.3
A few vs A lot	7.806	1	<.01
A lot vs Quite a lot	.024	1	<.9
Quite a few vs Quite a lot	3.536	1	<.1

The frequency of true responses for subjects presented with 'A few' is significantly different from that of subjects presented with 'A lot' ($X2 = 7.806$, $df=1$, $p<.01$). No other comparison revealed a significant difference ($p<.05$), although the difference between 'Quite a few' and 'Quite a lot' has only a 10% probability of occurring by chance ($X2 = 3.536$, $df=1$, $p<.1$). These results support the baseline hypothesis H1, which states that 'A few' will be more true at 30%, and 'A lot' will be more true at 70%. It was also suggested that 'Quite a few' and 'Quite a lot might differ. H2 states that the context will also influence subjects' judgements. It would appear from this analysis, however, that this factor does not influence the rate at which descriptions are judged true (a or b).

(2) Frequency of Vague Responses. For this analysis, the frequency of 'b' and 'c' responses were added together. Table 3.4 and 3.5 show the resulting frequencies and the results of a Chi-square test carried out on the data.

Table 3.4 - Frequency of vague responses in the 16 conditions.

	People		Figures	
	30%	70%	30%	70%
A few	13	8	11	10
Quite a few	11	10	14	8
Quite a lot	12	11	7	9
A lot	12	7	12	12

Table 3.5 - Results of Chi-square test on frequency of vague responses.

Source	X2	df	p-value
Topic (people/figures)	.006	1	<.95
Proportion	1.73	1	<.2
Q-exp	.256	3	<.98
Topic x proportion	1.23	1	<.3
Topic x Q-exp	1.789	3	<.7
Proportion x Q-exp	.93	3	<.9
Topic x % x Q-exp	.566	9	NS

The results of this analysis show that there are no statistically detectable differences in the frequency of 'vague' responses as a function of condition and quantifier.

(3) Comparison of scores based on subjects responses. For this analysis, each individual subject's response was converted to a numerical value. This was done on the following basis:

a -> 0

b -> 1

c -> 2

d -> 3

The fact that there are only 4 alternative responses makes any comparison of scores between groups difficult. Any test which involves ranking the scores produced by the 240 subjects is not appropriate, given the number of tied ranks which would result. For this reason an extension of the Median test was used. This test is based on the Chi-square test, but uses the frequency of scores above versus below the median, rather than the absolute frequencies taken directly from the data. The results of this analysis are similar to those obtained by the comparison of truth frequencies. The overall test was significant ($X2 = 47.607$, $df=15$, $p<.001$). Further tests revealed that the q-exp presented had some influence on subjects' responses ($X2 = 14,598$, $df=3$, $p<.001$), and that the interaction between q-exp and proportion has a significant effect ($X2 = 27.971$, $df=7$, $p<.001$). No other factor or interaction was found to contribute to the differences between scores. Hence, this analysis also supports H1, but provides no evidence to support H2.

In order to double-check the comparison of scores between subjects and conditions, a 3 way ANOVA was carried out on the data. Table 3.6 shows the results of this analysis. These results mirror exactly the results of the Median test. That is, the q-exp and the interaction between q-exp and proportion are the only significant factors in determining the responses made by subjects (F = 6.6168, p=.000446, and F = 13.9301, p=.000003 respectively).

Table 3.6 - Results of an ANOVA carried out on subjects' scores.

Source	SS	df	MS	F	P
Total	205.6625	239			
%	2.2042	1	2.2042	3.1677	0.071047
topic	0.1042	1	0.1042	0.1497	NS
% x topic	0.3375	1	0.3375	0.4850	NS
Q-exp	13.8125	3	4.6042	6.6168	0.000446
% x Q-exp	29.0792	3	9.6931	13.9301	0.000003
Topic x Q-exp	0.2458	3	0.0819	0.1178	NS
% x topic x Q	4.0125	3	1.3375	1.9222	0.123643
Error x % x topic x Q	155.8667	224	0.6958		

From the data obtained in this study there is no evidence that context influences subjects' judgements of the use of q-exps. There is some evidence that the q-exp and the proportion involved do affect these judgements, however.

Discussion

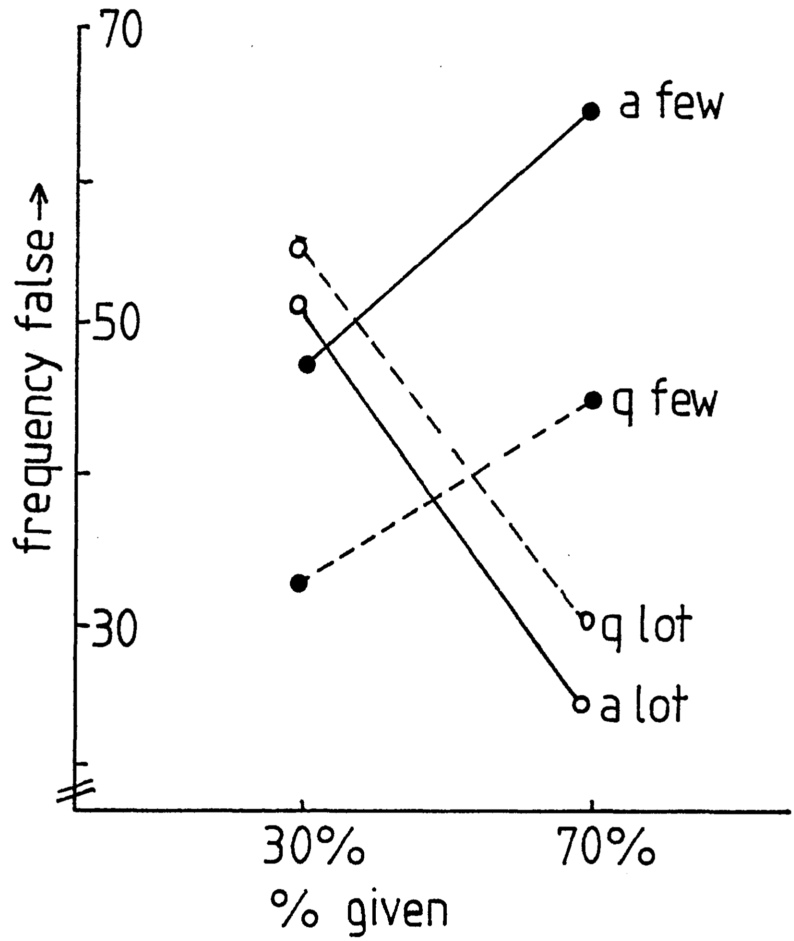
It is not surprising that the appropriateness of a q-exp overall depends on the q-exp and the proportion it was used to describe. It is perhaps surprising that no matter which of the 4 q-exps was used to describe either of the proportions, some subjects saw this as an appropriate description. This does not necessarily mean that some people will believe anything, but perhaps it shows that in some situations, some people will always make sense of what is said in terms of what they know. There appears to be an overwhelming tendency to assume that speakers are truthful unless there are good a priori reasons to assume otherwise. Certainly, it shows that q-exps are more vague than is suggested by experiment 1, thus supporting the view that subjects in the experiment 1 used and interpreted expressions relative to the sketches and other sentences produced.

Figure 3.1 shows the relationship between the 4 q-exps and the two proportions in terms of the scores assigned to subjects' responses. The lower the sum of scores in figure 3.1, the more 'true' judgements were made of the q-exp - proportion description by the subjects. The order of the 4 q-exps at 70% is exactly that expected on the basis of experiment 1. That is, 'A lot' has the most 'true' judgements, 'A few' has the least true, and 'Quite a' appears to make these judgements more moderate. This order changes however at 30%. In descriptions of this proportion, 'Quite a' leads to more extreme judgements than do the q-exps unaccompanied by 'Quite a'.

In fact, people judged 'a few' and 'a lot' as almost equally appropriate. At this point it is not clear why this should be.

Analyses of the subjects' overall scores have shown not only that judgements were influenced by the pairings of q-exp and proportion, but also that the q-exp had some influence independently of other factors. From the figure it is clear that 'Quite a few' was judged more true than 'a few' regardless of context and that 'a lot' was judged more true than 'Quite a lot'. The most likely explanation for this is that the proportions used in this study happen to be associated with 'a lot' and 'Quite a few' more than with the other q-exps. It may also be that these expressions are simply more vague and hence less likely to be judged as misleading. Further evidence is required to disentangle these possibilities.

Figure 3.1 - Scores obtained for the 4 q-exps for descriptions of 30% and 70%



The major aim of experiment 2 was to examine the influence of context on the relationship between q-exps and the proportions they are used to denote. The hypothesis was that q-exps would relate less vaguely to proportions in a 'rich' context where subjects had more prior knowledge of the situation being described. However the experimental manipulation had no effect whatsoever on subjects' responses. From this one can conclude:

(a) That context has no influence whatsoever on the relationship between q-exps and the proportions they are used to denote (in the present study, at least).

(b) That richness of context may have some influence, but that the contexts used in this study may not have been sufficiently different in terms of their 'richness'.

(c) That context may have some influence on the relationship between q-exps and proportions, but that this influence does not depend on 'richness'. Some other contextual factor may be involved.

The first of these explanations cannot be proven without examining all aspects of context which may influence interpretation. Certainly, there is nothing irrational about this hypothesis. However, a simple example will show that it does not meet with intuition:

(1) FACT: 20% of parents hate their children.

DESCRIPTION: Few parents hate their children.

(2) FACT: 20% of parents spoil their children.

DESCRIPTION: Few parents spoil their children.

The proportion of parents who are expected (a priori) to <u>hate</u> their children will be smaller than the 'fact' in (1) suggests for most people. 'Few' therefore seems an inappropriate description of the proportion. In fact 'many' may be more appropriate, and it seems reasonable to suppose that many subjects would judge the description in (1) to be 'misleading to the point of being untruthful', given the fact. The proportion of parents who are expected (a priori) to <u>spoil</u> their children is not likely to conflict with the proportion given in (2), however. In this case the description is not likely to be judged as misleading given the fact.

The second explanation is a little more plausible. In the sense that one of the contexts was more descriptive of the 'real ' world than the other, one could argue that it is richer. However, it may be that one has to know quite a lot about a situation before interpretations of words describing it are affected.

The third explanation is also plausible. In fact, it is quite likely that other contextual factors influence interpretation. For example, (1) and (2) above may have similar contexts and certainly they are likely to be equally rich and equally 'real'. The most important difference between them leading to the likely difference in judgements of appropriateness, is that one's a priori expectations of the proportions are different. Perhaps the proportion one expects is the only piece of relevant prior knowledge which is used in interpreting descriptions of an actual proportion. While the contexts used in the experiment are different, and one must have a reasonably 'rich' context to have expectations about proportions, the contexts used may not give rise to sufficiently strong expectations. The next series of studies address issues of expectation more directly still, and produce rather clearer data.

In summary, perhaps the most striking feature of the present experiment is the wide range of proportions which subjects will allow a q-exp to denote in order to judge so many extreme proportion-q-exp pairings as truthful.

Chapter 4

The role of Expectation and Experiments 3 and 4

Introduction

The major aim of the next two chapters is to assess the influence of prior expectations on the interpretation of q-exps more directly. The contexts presented to subjects in experiment 2 were found to have no differential effect on subjects' assessments. However, it has been suggested that these two contexts were not sufficiently different. Specifically, it was suggested that they may not lead subjects to hold different expectations of proportion and that this may be a key contextual influence on q-exp interpretation. An experiment reported in this chapter directly assessed the effect of two contexts which lead to different proportional expectations on the interpretation of q-exps.

The most simple way in which a listener's prior expectations of a proportion might influence her interpretation of a q-exp, can be expressed as follows:

(1) % APE and % D q-exp influence % INTERPRETED,

where APE is the <u>audience's prior expectations</u>, % D q-exp is the range of proportions normally denoted by a q-exp, and % INTERPRETED is the proportion which the audience believes to be the fact.

If (1) is true, and if a listener believes <u>a priori</u> that 2% of parents hate their children, while 20% spoil their children, then one might expect that her interpretation of 'few' will differ between these contexts. For example, 'few' may be interpreted as 2% and as 20% repectively. Hence it was argued in the last chapter that 'few' may be judged inappropriate in the first context, if the <u>fact</u> that '20% of parents hate their children' was presented to the listener.

(1) is not the only relationship between proportional expectation and interpretation of q-exps which is considered in this chapter, however. Another way in which a listener's expectation of proportion might influence interpretation, can be expressed as follows:

(2) % CPE and % D q-exp influence % INTERPRETED,

where % CPE is the proportion which the audience believes the <u>communicator to have expected a priori</u>.

Proposition (2) is more complicated than (1), and empirically less accessible. If it were true, it would mean that the q-exp used by a speaker is interpreted as denoting a proportion which is influenced not only by the q-exp itself, but by the listener's beliefs about the proportion the speaker had expected. A small illustration should help to clarify this proposition and explain the reason for entertaining it. Suppose that a listener believes that around 10% of nurses are male. A speaker states: 'Very few nurses are male'. The use of 'very few' may be taken to suggest that the actual proportion is less (or <u>even</u> less) than the proportion expected. The effect of the speaker's use of 'very few' may then lead the listener to believe that the proportion of nurses who are male is in fact much less than 10%. This would be in accordance with proposition (1). Alternatively, the use of 'very few' may leave the listener believing that 10% of nurses are male, but lead her to infer that the speaker must have previously expected far more than 10%. This can be explained by proposition (2). It is also possible that the listener's inferences about the actual proportion and about the speaker's expectations will both change, so that (1) and (2) both play a role. Several factors might influence the roles of (1) and (2), such as the strength of the listener's beliefs in her own prior expectations.

The situation becomes even more complicated when one considers how a listener might arrive at her present beliefs about the proportion which the speaker must have expected. If little is known about the speaker, the listener is likely to attribute the speaker with her own expectations, unless for example, she believes that the speaker's knowledge of the topic is far superior to that of anyone else. Thus, before the speaker speaks, it is most likely that % APE = % CPE (ie. the listener's prior expectations are the same as her beliefs about what the speaker/writer expects). However, as the example with 'very few' suggests, it may be possible that the q-exp used by a speaker to describe a proportion will influence the proportion which the listener believes the speaker to have expected. This can be represented as follows:

(3) % APE and % E q-exp influences % CPE,

where % E q-exp is the <u>proportional information which the use of a q-exp provides about what was expected</u>.

What (3) suggests is that the proportion which one believes a writer to expect will be influenced by the reader's own prior expectations <u>and</u> by the q-exp which the writer chose to use. In the absence of additional information about the writer and her beliefs, it is difficult to imagine other factors which might influence % CPE.

Putting propositions (2) and (3) together results in an even more complicated proposition, but one which appears a little more testable empirically:

(4) % APE and % E q-exp influence % CPE which together with % D q-exp influences % INTERPRETED.

Proposition (4) states that the proportion one expects a priori and the q-exp used by a speaker will influence one's beliefs about the proportion expected by the speaker. This, along with the proportion denoted normally by the q-exp, will influence the proportion which one believes to be fact.

Experiment 4, reported in this chapter, assesses the possibility that % APE and/or % CPE may influence % INTERPRETED (propositions (1) and (4)). It also takes into account the possibility (assumed in (4)) that a q-exp provides the listener with proportional information about expectation (% E q-exp). Finally, this study provides more information about the use and function of eight of the q-exps produced in experiment 1.

In order to investigate the role of proportional expectation on the interpretation of q-exps and to test the above propositions, it is necessary to present subjects with different q-exps in contexts which lead to different proportional expectations. It is then necessary to discover the prior expectations of subjects (% APE), the proportion which they believe the writer/speaker to have been expecting given the q-exp used (% CPE), and the proportion which the subject believes to be the fact (% INTERPRETED). Each of these requirements will be discussed in turn.

Choice of Quantity Expression

So far it has been shown that expressions containing 'few' are very popular as descriptions of small proportions. On the other hand, a rather greater variety of q-exps are used to describe large proportions. The analysis of modifiers in experiment 1 showed that 'quite' and 'very' actually alter the proportion denoted by 'a few', 'a lot' and 'few', and this would seem to happen in a fairly consistent way. That is, a q-exp which denotes a large proportion is made less by 'quite' and more by 'very'; a q-exp which denotes a small proportion is made more by 'quite' and less by 'very'. The hypothesis that 'quite' somehow moderates the proportion denoted by the q-exp which follows it, was more specifically tested in experiment 2. Indeed, when the proportion being described was 70%, the results do support this hypothesis. However, when used to describe 30%, expressions with 'quite' lead to more extreme judgements by subjects. That is, 'quite a lot' is judged less appropriate than 'a lot' and 'quite a few' is judged more appropriate than 'a few'. This does not fit with the findings of experiment 1 which showed that 'a lot' denoted proportions from 25-90% while 'quite a lot' denoted proportions from 25-60%. On the basis of these findings one would expect, if anything, that 'quite a lot' would be more appropriate than 'a lot', rather than less appropriate as a description of 30%.

It was also suggested in chapter 3 that 'very' functions to make the proportions denoted by the q-exp which follows it more extreme. Experiment 4 allows a specific test of this hypothesis, and another test of the effects of 'quite'. Since both 'quite' and 'very' can accompany 'few' and since 'few' is the most common q-exp used in experiment 1, the following expressions were used in the present study: Quite a few, a few, few and very few. In order to test the hypotheses about the function of 'quite' and 'very', q-exps which can accompany these modifiers and which normally denote larger proportions were also used. Unfortunately, two such q-exps had to be used since no one q-exp which denotes a large proportion is accompanied by both 'quite' and 'very'. The other expressions used in this study were: Quite a lot, a lot, very many, and many.

Choice of Contexts

Two different contexts were used in the experiment, in order to manipulate the percentage expected. The first described a Xmas party held by a residential association in the town hall, and the second described a political speech delivered by an individual at a party conference. It was hoped that the subjects would have intuitive expectations about the proportion of people at a residents association Xmas party who are likely to enjoy it, and the proportion of people at a party conference who are likely to be influenced by a speech. Furthermore, it was expected that subjects would expect a higher proportion to enjoy the party, since the context is less serious and does not involve the sort of persuasion necessary to influence a politically aware audience.

Before carrying out the major study, an initial test was carried out to assess the difference in the proportion expected between the two contexts (experiment 3). The hypothesis of this study is that subjects will expect a larger proportion of guests to enjoy a residents association Xmas party than the proportion of those attending a party conference who are expected to be influenced by a speech.

Experiment 3

Baseline Differences in Proportions Expected

Subjects

Subjects were 128 students from the ordinary psychology class at the University of Strathclyde, the ordinary Engineering class at the

University of Glasgow, and from students at North London Polytechnic. They were presented with the task in groups, and were told not to discuss the task with the other subjects.

Design and Procedure

Subjects were presented with the following information:

"I am interested in finding out the proportions or quantities of things which people expect in various situations. Please help me by looking at the situation below and answering a simple question about it"

This was followed by a short passage:

"In a newspaper article, you read -

'The residents associations annual Xmas party was held last night in the town hall.______'

Without any further information, you cannot know what proportion of the guests enjoyed the party. But please use your knowledge of such things in general (no matter how scant) to estimate or guess what proportion of the guests you would expect to enjoy the party.

____%"

For the party conference setting, the following statement was made:

"In a newspaper article, you read -

'At yesterday's party conference, Mr. Cameron spoke about the effects of education cuts on British Universities.__'

Without any further information, you cannot know what proportion of the audience was influenced by Mr. Cameron's conclusions. But please use your knowledge of such things in general (no matter how scant), to estimate or guess what proportion of the audience you would expect to be influenced by the speech.

___%"

Each subject was presented with only one event and produced only one expected proportion, so that the two experimental conditions are independent. There were thus 64 subjects in each condition.

Results

The mean proportion given by subjects in the residents association condition was 65.86% (standard deviation = 19.36), while the mean proportion obtained for the party conference condition was only 50.02% (standard deviation = 22.16).

A t-test was carried out on the proportions produced to detect any difference between the means of the two groups. Prior to this, an arc transformation for percentage data was applied. The difference was significant ($t = 4.111$, $df=126$, $p<.001$), while the difference between variances was not significant ($F(63, 63) = 1.313$).

Conclusion

The proportion of guests who were thought to enjoy the residents association party is significantly greater than the proportion of an audience who were thought to be influenced by a speech at a party conference, although the figures reveal a considerable spread in the distributions.

These two contexts were used in experiment 4 to ensure that subjects in each group had different prior proportional expectations. These were presented, as before, in the form of short passages from a newspaper article.

The prior proportional expectations of subjects has already been discovered from experiment 3. After presenting subjects in experiment 4 with a short passage containing a q-exp, it is a simple matter to ask them to indicate the proportion they believe the writer to have been expecting, and the proportion they believe to be the fact.

Before describing experiment 4, a more formal statement of the basic hypothesis is in order:

Hypothesis: The proportion which subjects expect in a given situation is expected to influence their interpretation of the q-exp used to describe it. This influence may be direct as proposition (1) suggests, and/or indirect and more complex as is suggested by proposition (4).

The design of experiment 4 should make it possible to make inferences such as:

(1) If the proportion given as an interpretation by subjects differs between contexts in a straightforward manner, according to the prior expectations given the context (experiment 3), then their interpretation of the q-exp is influenced <u>directly</u> by prior expectations of the proportion involved. If the proportions estimated do not differ along these lines then interpretation of the q-exp is not <u>directly</u> influenced by prior expectations.

(2) If the proportion estimated by subjects differs with the proportion which <u>the writer is thought to have expected</u>, then the proportion interpreted or understood is influenced <u>indirectly</u> by prior expectations.

(3) If the proportion estimated by subjects does not differ with the proportion expected, given the context without a q-exp, nor with the proportion which the writer is thought to expect, but depends exclusively on the proportion given by the q-exp, then the proportion expected has not in any way influenced the interpreted proportion in this experiment.

Whether or not the proportion expected by the audience or the proportion which the communicator is thought to expect influences interpretation, it is possible that the first part of proposition (4) is true. That is, the proportion which the communicator is thought to expect may be influenced by the q-exp used as well as by the audience's own prior expectations. If q-exps do indeed provide the audience with this sort of information (% E q-exp), then this may be an important part of communication even if it is not the sort of information given as part of the semantics of q-exps. An account of the function of q-exps in natural language must take account of all aspects of the use and interpretation of q-exps.

There may also be more specific hypotheses about the particular q-exps presented. In all respects, the expressions used are expected to conform with the findings of experiment 1. That is, expressions with 'few' are expected to denote different proportions than those with 'lot'; 'quite' is expected to lead to more moderate proportions; and 'very' to lead to more extreme proportions.

Design and Procedure

Each subject was presented with a 3-page booklet. On the first page, the following instructions were given:

"NAME:________________

The following passage is an extract from an article in the local newspaper. Please read it and answer the questions on the following pages. There are no right or wrong answers - we are interested only in your opinions"

On the same page, subjects saw a short passage. The passages presented to subjects contained one of eight quantity expressions:

very few, few, many, very many, a few, quite a few, a lot, quite a lot. The "topic" of the passages also varied between subjects - one type of passage described a Xmas party, and the other described a speech at a conference. Thus, there were 16 conditions. Each subject read only one of the 16 passages, so that the conditions were independent. The actual passages used were as follows (where <u>Q-exp</u> stands for one of the eight possible quantity expressions):

PASSAGE 1

"The residents associations annual Xmas party was held last night in the town hall. <u>Q-exp</u> of those who attended the party enjoyed what might be called the social event of their year"

PASSAGE 2

"At yesterday's party conference, Mr. Cameron spoke about the effects of the education cuts on British Universities. <u>Q-exp</u> of his audience were convinced by his conclusions"

On the next two pages, subjects were asked questions about the passage they had read. They were told that the passages could be referred to at any point, while answering the questions. The first question asked what percentage of the guests/audience had enjoyed the party/been convinced by the speech, and answers were given by circling one of the following:

(a) 0-10%
(b)11-20%
(c)21-30% etc.

Question 2 asked what percentage subjects thought the writer had expected to enjoy the party/be convinced by the speech, before he had gone to the party/heard the speech. Answers were to be given in the same form as answers to question 1. Data from these two questions was to be used to test the hypotheses, and to assess the value of expressing the percentage denoted by quantity expressions as a function of the percentage expected.

Results

Each subject's answer to question (1) was converted into the percentage in the middle of the range of percentages they had circled. For instance, if a subject circled (b)11-20%, the answer was taken to be 15%. The same conversion process was carried out on answers to question (2). This was done so that the subjects' answers to these questions could be statistically analysed. The mean % which subjects believed to be expected by the writer and the mean % interpreted for each condition is shown in Table 4.1.

Table 4.1 - mean percentages for every condition in experiment 4.

	Residents Assoc.		Party Conference	
	Interpreted	Expected	Interpreted	Expected
Few	20	62.5	15	33.75
Very few	17.5	62.5	11.25	45
Many	55	66.25	58.75	48.75
Very many	77.5	60	62.5	45
A few	20	46.25	31.25	28.75
Quite a few	50	48.75	42.5	30
A lot	68.75	65	61.25	47.5
Quite a lot	48.75	70	58.75	48.75

Interpretation Data

The major hypothesis was that the proportion of people which subjects interpret from the writer's description, may be influenced by their own prior expectations, or by their estimates of the writer's expectations, or on any combination of these. First, the possible influence of prior expectations on the proportion interpreted by subjects will be considered.

The results of experiment 3 show a significant difference between the proportions which subjects expected given the two topics. Hence, if prior expectations influence the proportion interpreted from a q-exp, one may anticipate that the proportion which subjects interpret from a q-exp would differ between topics. The mean proportion interpreted for each topic of experiment 4, and the mean proportion expected by subjects in experiment 3 for each topic are shown in table 4.2.

Table 4.2 - Mean % interpreted and mean prior expectations.

	Residents assoc.	Party conference
% prior expected (exp 3)	65.859%	50.016%
% interpreted (exp 4)	44.687%	42.656%

It is clear from the table that while there is an overall effect of topic on the mean proportion expected, there is no such effect on interpretation. An arcsin transformation was carried out on the proportion interpreted scores for each topic, and a t-test revealed that there is no significant difference between interpretations in the residents association context and those in the party conference context ($t(126) = .529$). Hence, these data provide no support for the hypothesis that prior expectations influence directly the proportion one interprets a q-exp as denoting.

Another way in which subjects' interpretations may be influenced by proportional expectation is the more complex influence of the proportion which subjects believe the writer to have been expecting. This hypothesis may be tested using the data of experiment 4 alone, as shown in table 4.1. Table 4.3 shows the results of an Anova carried out on these data. Note that there are three factors in this analysis. Q-exp (the four q-expressions) and topic (the two contexts) are both between-subjects factors, while %exp vs %int (the proportion subjects thought the writer had expected versus the proportion they thought to be fact) is a within-subjects factor.

Table 4.3 = Anova table comparing all conditions in table 1.

KEY: q-exp - the q-exp factor
topic - the different settings
%exp vs %int - % expected and interpreted by subjects.
% - ditto
E - error

Source	SS	df	MS	F	P
Total	84.7826	255			
q-exp	20.0496	7	2.8642	11.8221	0.000
topic	3.5462	1	3.5462	14.6370	0.000
q-exp x topic	0.6707	7	0.0958	0.3954	NS
Error x q-exp x topic	27.1351	112	0.2423		
%exp vs %int	1.7188	1	1.7188	10.9181	0.001
q-exp x %	11.0578	7	1.5797	10.0343	0.000
topic x %	2.1249	1	2.1249	13.4979	0.000
q-exp x topic x %	0.8475	7	0.1211	0.7691	NS
Error x q-exp x topic x %	17.6320	112	0.1574		

The Anova table shows that there is a significant difference between estimates of the proportion expected and the proportion interpreted (this factor is shown as %exp versus %int in the table, with $F = 10.9181$, $p = 0.001538$). The proportion expected/interpreted estimates also interact with the q-exp (Q-expx%, $F = 10.0343$, $p = 0.000001$) and with topic (topicx%, $F = 13.4979$, $p = 0.000599$).

On the basis of this analysis alone, however, it is difficult to determine if there is in fact a relationship between the proportion expected by the writer and the proportion interpreted. There is a difference between them, and this difference is influenced both by the q-exp presented and by the topic. Figures 4.1 and 4.2 show the mean proportions interpreted for each condition and the mean proportions expected for each condition, respectively. The q-exps on the horizontal axes of both figures are ordered from the lowest to the highest proportion. Given the difference in the order of these q-exps from left to right, it is not at all surprising that the proportion expected means turned out to be significantly different from the proportion interpreted means. In fact, there is no apparent relationship between the two kinds of proportion. However, two more Anovas were carried out in order to discover whether the interactions with q-exp and topic are due to a relationship between the proportion expected by the writer and the proportion interpreted or to some other factor.

Tables 4.4 and 4.5 show the results of Anovas on the proportion interpreted data and the proportion expected data, respectively.

Figure 4.1 - the mean proportions interpreted by subjects

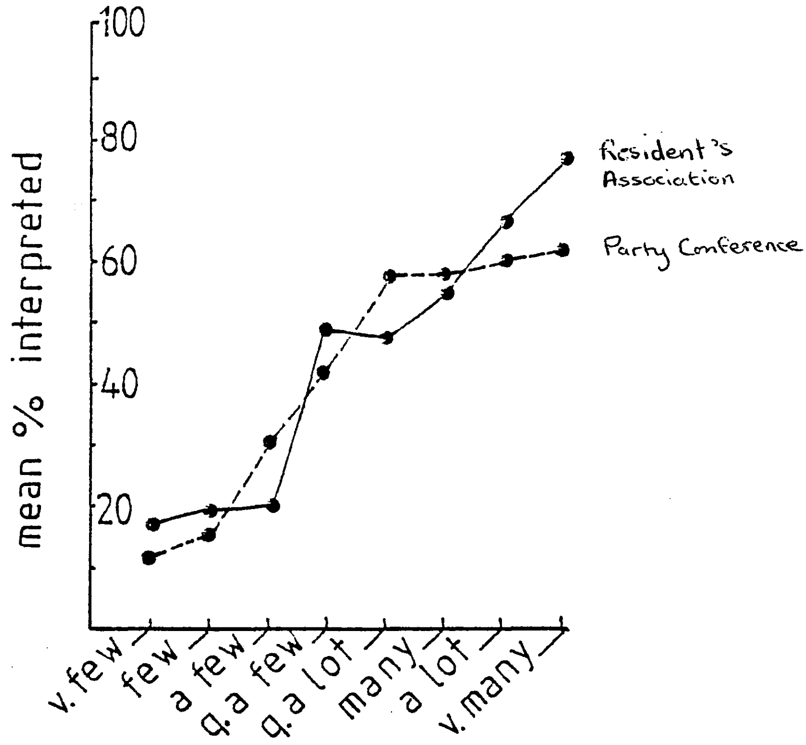


Figure 4.2 - the mean proportions the writer is thought to expect

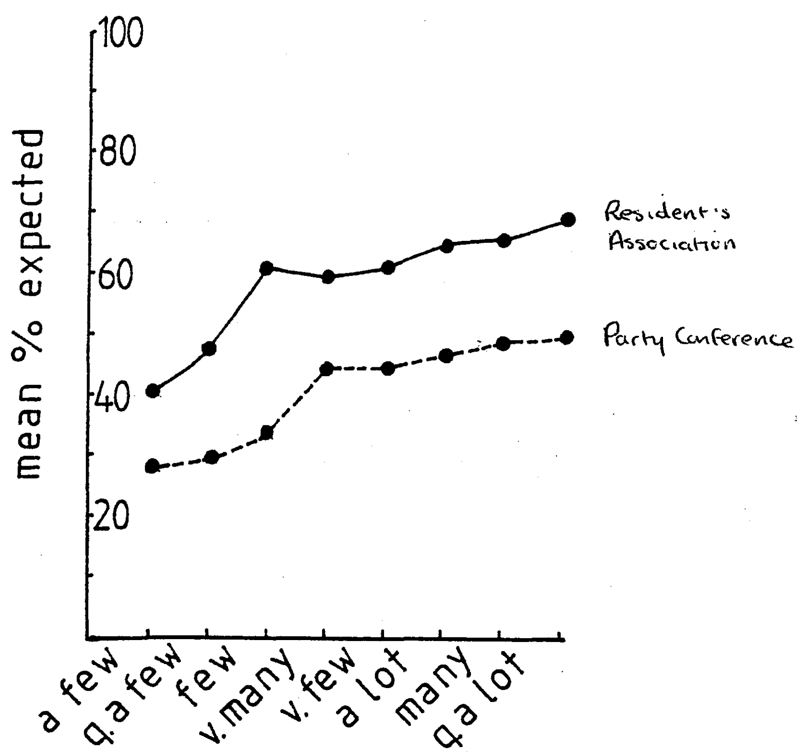


Table 4.4 - Anova table comparing % interpreted between q-exps and topics.

Source	SS	df	MS	F	P
Total	40.8205	127			
Q-exp	26.9308	7	3.8473	34.3437	0.000
Topic	0.0905	1	0.0905	0.8078	NS
Q-exp x topic	1.2528	7	0.1790	1.5976	0.141
Error x Q-exp x topic	12.5465	112	0.1120		

Table 4.5 - Anova table comparing % expected between q- exps and topics.

Source	SS	df	MS	F	P
Total	42.2432	127			
Q-exp	4.1766	7	0.5967	2.0740	0.050
Topic	5.5807	1	5.5807	19.3987	0.000
Q-exp x topic	0.2654	7	0.0379	0.1318	NS
Error x Q-exp x topic	32.2206	112	0.2877		

Table 4.4 shows that the q-exp is the only significant factor which influences the proportion interpreted ($F = 34.3437$, $P = 0.000000$). Q-exp is also a significant factor for the proportion expected data, but much less so ($F = 2.0740$, $P = 0.050035$). This difference in the extent of significance is reflected in the numerical values depicted

in figures 4.1 and 4.2. That is, the difference between the lowest and the highest q-exp means is much greater for both topics in figure 4.1 than the corresponding differences in figure 4.2. The interaction between %exp and %int in table 4.3 is easily explained by different extents to which the q-exp has influenced these proportions. The interaction with topic is also explained by the results in tables 4.4 and 4.5. Topic has a very significant influence on the proportions which subjects believed the writer to expect, but no significant influence on the proportion interpreted.

From the above analysis, it is clear that the proportion expected has not influenced either directly or indirectly, the interpretation of q-exps in this study. The analysis of interpretation data demonstrates quite conclusively that the only experimental variable which significantly affects the proportion interpreted by subjects is the q-exp presented to them. This would suggest that propositions (1) and (4) (presented at the beginning of this chapter) are incorrect. Perhaps a more appropriate proposition is:

(5) % D q-exp influences % INTERPRETED.

Nevertheless, there is a part of proposition (4) which concerns part of the meaning of a q-exp, yet which remains to be tested. This is the first part of (4):

(6) % APE and % E q-exp influence % CPE.

This proposition states that the proportion one believes the communicator to have expected is influenced both by one's own prior expectations, and by information from the q-exp relating to expectation. In order to test this, an Anova was carried out on the proportion expected estimates of subjects from experiment 3 and experiment 4 after an arcsin transformation, and table 4.6 shows the results of this analysis.

Table 4.6 - Anova table for prior expectations versus % expected by the writer.

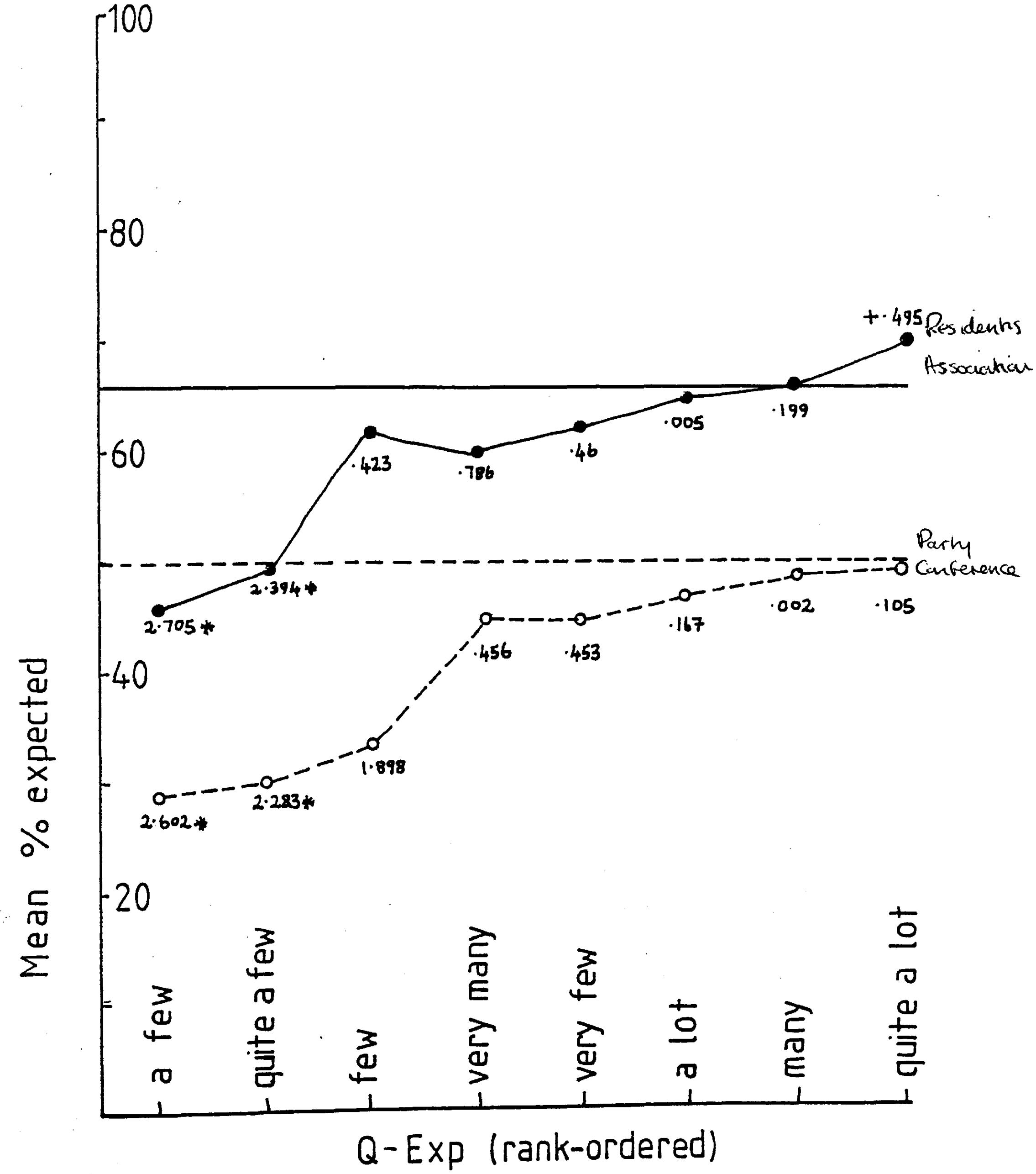
Source	SS	DF	MS	F	P
Total	78.8564	255			
Topic	9.6814	1	9.6814	36.0719	0.000
Prior vs writer	1.4880	1	1.4880	5.5441	0.017
Topic x % exp	0.0526	1	0.0526	0.1960	NS
Error x topic x %exp	67.6345	252	0.2684		

As suggested by experiment 3, there is a difference in the proportion expected depending on the topic, and this remains whether or not a q-exp is present. There is also a significant difference between the prior expectations and the proportion which the writer is thought to expect ie. % expected in experiment 3 vs experiment 4 ($F = 5.441$, $df=1$, $p = 0.017374$).

The Influence of Particular Q-exps on Writer Expectation Judgements

Figure 4.3 shows the mean proportion expected for each individual q-exp, and for the two topics without q-exps (from experiment 3). In spite of the fact that the results of the 16 q-exp conditions are based on independent groups of subjects, there is a remarkable similarity between the curves. What the figure suggests is that the writer's use of a q-exp does in fact alter the proportion expected, generally decreasing it, while the degree to which the proportion expected alters depends on the particular q-exp. The analysis of proportion expected scores in table 4.5 shows that q-exp is in fact a significant factor on the proportion the writer is thought to have expected, and this supports proposition (6). That is, both % E q-exp and % APE influence % CPE.

Figure 4.3 - the mean proportion expected for each q-exp and topic, and for each topic without q-exps



Given that the null hypothesis is that the q-exp will not influence the proportion expected, one can assume that each of the q-exp conditions represents a sample from the population of % expected scores when no q-exp is presented. The possibility that a q-exp does influence the % expected can be assessed by finding the probability that the proportion expected scores of the q-exp condition do come from the same population as the control condition (which was presented without q-exps). Thus, the 8 conditions containing a q-exp ± the Xmas party setting (experiment 4) can be compared with the no q-exp/Xmas party condition (experiment 3). The 8 conditions with a q-exp ± the conference setting (experiment 4) can be compared with the no q-exp/conference condition (experiment 3).

Below each point in figure 4.3 there is a z-score. This reflects the position of the corresponding q-exp mean on the distribution of scores from its control condition. 'A few' and 'Quite a few' were found to be significantly different from the controls for both topics ($P < .05$). None of the other q-exp conditions were significantly different.

The results shown in figure 4.3 are clearly more complicated than is suggested by this statistical analysis. For example, it must be noted that those q-exps which stray furthest from the control conditions, contain the word 'few'. For both topics, 'a lot', 'many' and 'quite a lot', which all denote large proportions, come very near to the proportion expected scores in the control conditions. 'Very few' and 'very many' appear in the middle of the curves for both topics.

At the beginning of the next chapter, a small experiment is carried out using another q-exp, '<u>not many</u>'. The possible effects of each q-exp used in experiment 4 will be discussed fully after the results of experiment 5 are reported. Before describing this, the following is a summary of conclusions based on the major hypotheses tested in experiment 4:

(1) Subjects' prior expectations do not influence the proportions they interpreted, given the q-exps and topics used in this study. Neither do their beliefs about the proportion expected by the writer have an influence.

(2) The proportion which subjects believed the writer to have expected appears to be influenced by their own prior expectations, and by the q-exp which the writer used in her description. This does not affect the denotation of the q-exp, but doubtless has some effect on a listener's understanding of a situation and on what is being communicated in that situation. This conclusion is not trivial, therefore. It suggests that an account of the function of q-exps in natural language must consider such factors as information about what the person uttering a q-exp expects.

Chapter 5

Experiment 5, and General Discussion

In experiment 4 it was shown that subjects' estimates of the proportion expected by the writer are reliably lower than baseline when the quantified noun phrase contains the word 'few'. These phrases also denote lower proportions. Therefore, it is possible either that there is some aspect of the meaning of 'few' which leads one to believe that a low proportion was expected, or that q-exps which denote small proportions lead one to believe that a low proportion was expected. The results of experiment 4 cannot distinguish between these possiblities since all of the q-exps which denoted relatively small proportions in this experiment contained 'few'. Before discussing the results of exp 4, another experiment (exp 5) will be reported which does separate the two possibilities.

Experiment 5

Expectation and Interpretation under 'Not many'

This study compares the effects of 'not many' and 'few' on the proportion expected and the proportion interpreted by subjects. 'Not many' was found to denote a small proportion in experiment 1, but contains the word 'many' which, by itself, denotes a larger proportion. If the proportion expected by the writer is estimated to be low by subjects presented with 'not many', then the hypothesis that q-exps which denote small proportions lead to low expectations is supported. If, on the other hand, estimates of the proportion expected are high, then it is clear that denoting a small proportion is not a sufficient condition for a q-exp to lead to low expectations. Perhaps only phrases with 'few' lower estimates of the proportion expected by the writer. The 'few' conditions in experiment 5 were included as a check on the replicability of these in experiment 4.

Method

The design and procedure for this study were essentially the same as for experiment 4. The only difference was that only 2 q-exps were presented ('few' and 'not many') rather than the 8 q-exps presented in experiment 4. The same two contexts were used, and there were 8 subjects in each of the 4 independent conditions. The 32 subjects were students on the B.N. course at the University of Glasgow.

Results

As before, subjects' responses to questions (1) and (2) were converted into the proportion in the middle of the range of proportions they had circled. The mean proportions for each condition are shown in table 5.1.

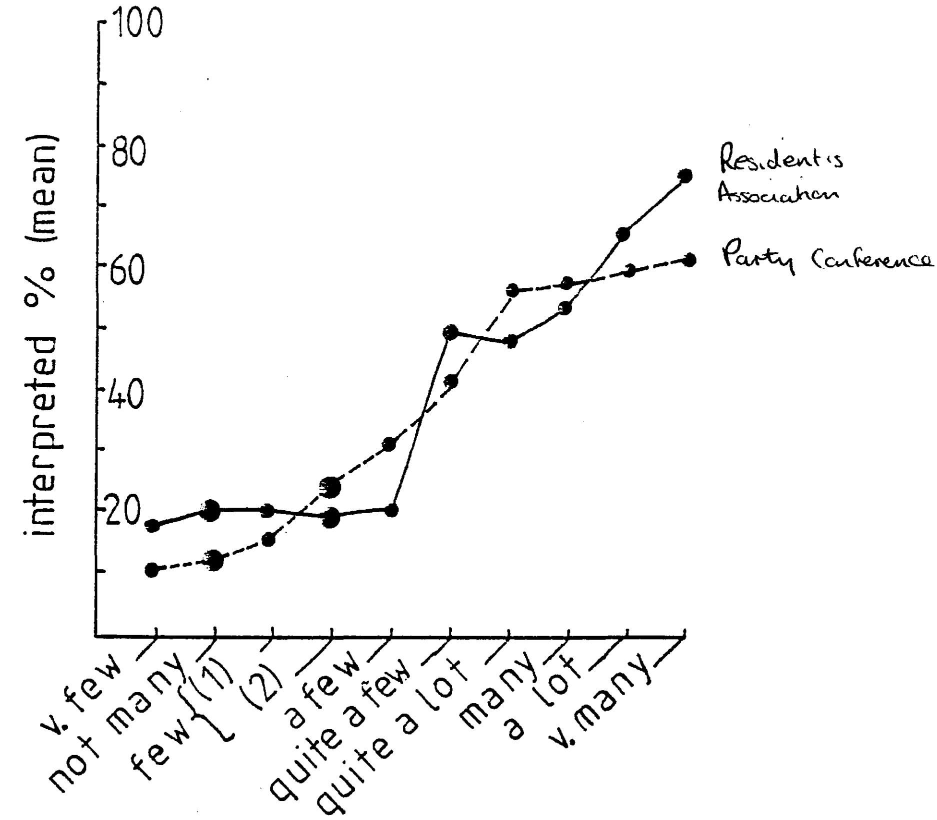
Table 5.1 - mean proportions from the 4 conditions

	Residents Assoc. Interpreted	Residents Assoc. Expected	Party conference Interpreted	Party conference Expected
Few	18.75%	53.75%	25%	37.5%
Not many	20%	75%	12.5%	22.5%

Interpretation

Figure 5.1 shows the mean proportion interpreted for each q-exp condition in experiments 4 and 5. (This figure is the same as figure 4.1, with 'few(2)' and 'not many' added). Note that few(1) is the mean of the experiment 4 'few' condition and few(2) is the mean of the experiment 5 'few' condition. Again there is no evidence of any context-dependent difference between the means of the proportions interpreted, as the strong relationship between proportion interpreted lines remains intact. The figure shows that 'few(1)' and 'few(2)' are similar and that 'not many' denotes a small proportion regardless of context.

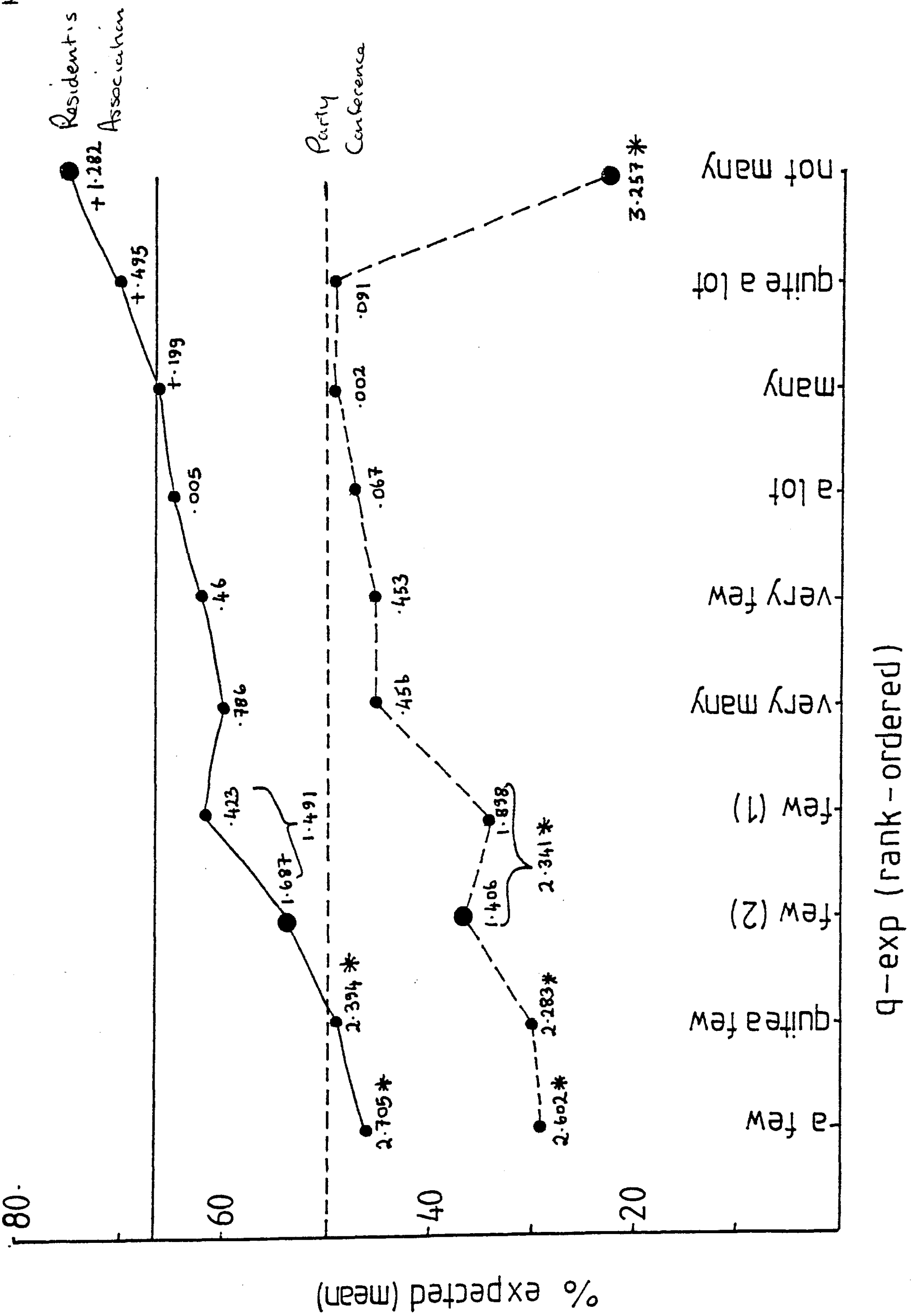
Figure 5.1 - The mean proportion interpreted for each condition in experiments 4 and 5



Proportion Expected

The results of experiment 4 suggest that estimates of the proportion expected by the writer may be a function of prior expectations and of expectation information given by the q-exp. Figure 5.2 shows the results shown in figure 4.3 with the addition of the two q-exps presented in experiment 5. That is, the figure shows prior expectations given the settings alone, without q-exps (exp 3), and expectations given all of the q-exps presented in experiments 4 and 5.

Figure 5.2 - the mean proportion expected when no q-exp is presented, and the mean expected for each q-exp in experiments 4 and 5



The z scores for few(1) and few(2) shown in figure 5.2 appear to be reasonably similar. The z-score for the party conference setting is slightly reduced at -1.406. However, it is appropriate to combine this result with that of the z score from experiment 4 which gives a combined z of 2.341, a reliable effect. Thus, the additional subjects have the effect of showing that 'few' leads to expectations which deviate from the baseline, in the context of the party conference. Unfortunately, this does not hold for the residents association setting (combined z = 1.491). The means of the proportion expected for the two 'not many' conditions are quite obviously different from each other. Unlike context differences with other q-exps, the data suggest a strong interaction with context. That is, although the proportion expected with other q-exps is dependent on prior expectation and on the q-exp, it would appear that prior expectations provide a base line and that any particular q-exp moves expectation by a similar amount from this baseline. With 'not many' the proportion expected is not a similar distance from prior expectations: when prior expectation is 66% (the residents association context), the proportion expected increases (although this is not statistically significant, z = 1.282), or at least remains the same; when prior expectation is 50% (the party conference context), the proportion expected decreases dramatically (z = -3.257, p<.05). Curiously, 'not many' is the only q-exp which shows this apparent interaction with baseline proportions expected.

It is quite clear from figure 5.2 that 'few' is not the only q-exp which can lead to greatly reduced estimates of the proportion expected. 'Not many' used in the party conference context does reduce the proportion expected. However, it is still possible that 'few' is the only q-exp which given particular modifiers ('A', 'Quite a', and perhaps no modifier) will reduce the proportion expected <u>regardless</u> of context. 'Not many' used in the residents association context <u>does</u> <u>not</u> reduce the proportion expected.

The idea that q-exps which normally denote a small proportion will reduce the proportion expected is clearly false. That is, 'not many' denotes a small proportion yet it does not reduce the proportion expected in all contexts.

General Discussion of Experiments 4 and 5

The results of experiments 4 and 5 will now be taken together, and the entire issue of interpretation and expectation will be discussed.

Interpretation

The most complicated proposition (4) which was investigated in the previous chapter, was as follows:

(4) % APE and % E q-exp influence % CPE, which in turn, along with % D q-exp influences % INTERPRETED.

It has been shown in experiments 4 and 5 that the proportion expected with or without q-exps does not influence the proportion interpreted. The only significant factor determining the proportion interpreted is the q-exp used by the writer. In other words, proposition (4) is incorrect. This finding is most pleasing in that it suggests that the denotation of a q-exp is at least independent of context, even if it is inherently vague. Although both prior expectations and the speaker's choice of a q-exp can influence our beliefs about the speaker's expectations, only the q-exp will influence our interpretation of the proportion being described.

There is a slight problem with this conclusion, however. The following two statements might seem contradictory, on the assumption that no Libyans feel indifferent towards Americans:

(1) Few Libyans like Americans.

(2) Few Libyans dislike Americans.

Nevertheless, one can imagine each of these statements being spoken by the same speaker on different occasions. Suppose that 50% of Libyans like Americans, and 50% dislike Americans. If some particular individual believes that <u>all</u> Libyans or <u>almost all</u> Libyans like Americans, another individual might utter (1) to this person in order to inform her that the proportional information she believes is far too high. If on the other hand, a listener believes that all, or almost all, Libyans <u>dislike</u> Americans, the same speaker may use (2), also to indicate that the listener's expectations are too high. The speaker will be successful in both cases, if it is true that the listener interprets a q-exp relative to her expectations, and to those which she believes the speaker to have held. That is, if one believes that 90% of As are Bs, and this is described by some informant as 'few As are Bs', one is more likely to end up believing that 40-50% of As are Bs than that 10% of As are Bs. Hence, although the experiment reported here provides no evidence to the effect that expectations influence interpretation, there may yet be some contexts in which such an influence is evident.

The contexts described for sentences (1) and (2) are persuasive - in both cases the speaker was attempting to convince the listener that she was wrong and the listener is likely to be aware of this. In persuasive contexts such as this, one's own beliefs are likely to play a larger role than in less persuasive contexts simply because one is reluctant to change one's beliefs and it is quite possible that many words, including q-exps, are used in a different way. It might be argued that the short passages presented in experiments 4 and 5 are not persuasive enough to show any influence of the proportion expected on the proportion interpreted. The major problem is that it is difficult to design an experiment which does allow clearly persuasive contexts. One would require subjects to hold strong but different opinions about some proposition in order to make appropriate comparisons. This could be controlled by asking subjects to state their opinions in some formal way <u>after</u> they had completed a task similar to that in experiments 4 and 5, but with the more persuasive contexts. Such experiments have been reported in social psychological literature (see for example D. Thistlewaite, 1950 and Shelley and Davis, 1957, on the effects of attitudes on the ability to reason logically). However, reliable results require large numbers of subjects, and the use of response scales which are often difficult to interpret.

It is not possible to arrive at a general conclusion about the effect of the proportion expected on interpretation, given the data collected here. However, it is possible to conclude that at least in the non-persuasive contexts used, neither the proportion expected by the listener nor the proportion which the speaker is believed to expect will influence the proportion which the q-exp is taken as denoting. Given such a conclusion, one might argue that neither the proportion one expects nor the proportion one believes the speaker to expect are relevant aspects of q-exp meaning. If expectation does not influence the proportion interpreted by a q-exp, then why bother about the effects of the q-exp on beliefs about the speaker's expectations? The answer is quite simple. The words chosen by the speaker may reveal all sorts of information about her beliefs and expectations, as well as about the state of affairs being described. What is more, it may be necessary to understand the beliefs and expectations of the speaker if one wishes to understand fully the situation being described. The purpose of much of communication is not merely to inform the listener of the proposition being asserted. That is, a speaker may indeed utter 'few Libyans like Americans' so that the listener will then know that a small proportion of Libyans like Americans. However, this is very rarely all that is being communicated (unless a teacher is speaking to pupils, perhaps). Everything one says is said in a context which can influence both what is said and what is understood. An example is the way in which the difference in the background knowledge of speaker and listeners can allow sentences (1) and (2) to be uttered 'truthfully' by the same speaker on two different occasions.

Expectation

The first part of proposition (4) introduced in connection with experiments 4 and 5 was:

(6) % APE and % E q-exp influence % CPE.

The finding that both context and q-exps had some influence on the assessment of the proportion expected by the writer supports this proposition. On closer inspection however, it is clear that different q-exps have a differential impact: indeed the only q-exps which play a statistically significant role in this function are 'a few', 'quite a few' and, in at least one context, 'not many' and 'few'. Also, since the effects of each q-exp are consistent over contexts (apart from 'not many'), the role of the proportion expected, given the q-exp, would appear to be roughly additive, except when the q-exp is 'not many'. An approximation to the function may be:

(7) % APE - X% = % CPE,

where the value of X is determined by % E q-exp.

Of course, proposition (7) does not <u>explain</u> the effect. One rather obvious and potentially uninteresting explanation can be easily eliminated. It may be argued that the % CPE information is based on the straightforward proportional interpretation of the q-exp used. In a different area of research, Tversky and Kahneman (1974) have shown that people often use <u>anchor</u> information when asked to make probablistic judgements. Suppose that subjects are asked to estimate the proportion of African countries in the United Nations, as in Tversky and Kahneman's example. A wheel of fortune was then spun to produce a random number between 0 and 100. The subjects were asked to state whether their estimate was lower or higher than the random number, thus creating an anchor in the random number. They were then asked to give their own estimates. It was found that when the anchor was low, the estimate was low and when the anchor was high, so was the estimate. Similar anchor effects have been found in other areas (see eg. Poulton, 1968). However, this effect cannot explain the present data since there is no apparent relationship between subjects' estimates of the proportion expected by the writer and the proportion interpreted. The fact that such a relationship was not detected is not due to noise since the effects of q-exps on the proportions expected and on the proportions interpreted are consistent over contexts. Thus, the adjustment-from-an-anchor mechanism must be rejected as an explanation.

The example used earlier (page 105) to illustrate how q-exps may affect expectation and interpretation was based on the phrase 'very few'. It was argued that where prior expectations were 10%, the listener would decide that the speaker had expected more, or that the proportion being described was much <u>less</u> than 10%, or both of these. The proportion expected function was intended as an hypothesis about the difference between the listeners' expectations and those of the speaker. That is, it will determine the extent to which 'very few' changes the proportion expected by the writer from prior expectation, which is 10%.

In the present study, prior expectations were either 50% or 66%. Therefore, if the above suggestion is correct, one would expect q-exps which denote proportions around 50% to increase the proportion expected when prior expectations are 50%. Q-exps which denote proportions around 66% should likewise increase the proportion expected when prior expectations are 66%. According to the interpretation data, 'quite a few' and 'quite a lot' denote around 50% and 'a lot' and 'very many' denote around 66% However, figure 5.2 shows that these q-exps do not significantly increase the proportion expected by the writer compared with prior expectations. In fact, 13 of the 16 mean proportions expected fell below prior expectation.

The estimates of proportion expected thus raise the following question: Why do q-exps tend to lower expectations, insofar as they influence estimates of expectation? One possible reason why the q-exp conditions produce lower proportions expected than prior expectations has nothing to do with the q-exp. Perhaps the reason concerns the fact that there is a writer involved. Suppose for example, that when subjects are asked about the proportion expected by the writer they invoke all sorts of information about newspaper journalists. It is possible that stereotypiccal knowledge of such people is that they are cynical and somewhat pessimistic. The presence of the writer may then reduce expectations because _the writer_ is pessimistic and is likely to expect less than the subjects' prior expectations.

This cannot be the whole story however. If it were, there would be no difference between individual q-exp conditions, even though there would be an overall difference between prior expectations and estimates of the proportion expected by the writer.

Another possible explanation is that the use of a q-exp in itself is sufficient to lower expectations. This may result directly from the purpose a writer has in even making a quantified statement. Given that the context provides subjects with prior expectations, it is unlikely that the writer would have made a proportional statement if the actual proportion was around the proportion expected, since this would be essentially uninformative, and in violation of Gricean principles. The use of a quantified statement may automatically lead one to doubt the proportion expected _a priori_. For example, given a statement beginning with "Guests...", one is not likely to think of 100% of guests or any other proportions. Proportional information is not of primary concern. Given 'a few'/'a lot' etc "of the guests" on the other hand, one is likely to think of the set of guests divided in some non-arbitrary way. This 'focus' or concern with the subset of guests, and the proportion of the set belonging to this subset, places emphasis on proportional information, which is not normally in focus in the absence of a q-exp. Hence, estimates of the proportion expected will be different because different information is used in assessing what is expected. For example, estimates of the proportion of guests who enjoy a party in the absence of a q-exp are likely to be based on one's experience of parties and the people who enjoy them. The presence of a q-exp may emphasise, to some extent, the division between those who did and those who did not enjoy the party. Estimates may then sometimes be based on one's experience of parties and the number of people who <u>do not</u> enjoy them. The degree to which the information used by subjects is different when a q-exp is used will depend on the particular q-exp, and, perhaps in most cases, upon the presence of explicit proportional information reduces the proportion expected.

Words forming the Quantity Expression

The basic hypotheses of experiments 4 and 5 concerned the roles of various types of proportional information in communication. However, the particular q-exps presented were chosen so that more could be discovered about the meanings of the particular words of which the expressions are comprised. At the end of the present chapter there will be a summary of all that is known from experiments 1 to 5, about the proportional aspects of the meanings of the various expressions. Before this, the effects of these phrases in experiments 4 and 5 must be assessed.

The q-exp presented was found to be the only statistically significant factor in determining the proportion interpreted by subjects in experiments 4 and 5. Figure 5.1 shows the proportions interpreted for each q-exp in each of the contexts. The proportion interpreted mean for each condition fell within the range of proportions denoted by these expressions in experiment 1, except for 'very many' and 'a few' in the context of the party conference. In experiment 1 'a few' was found to denote 10-25%. Although the mean proportion interpreted for this expression in exp 4 is 20% for the residents association topic, it is 31.25% for the party conference topic. 'Very many' was used to denote 75-90% in experiment 1, and although the mean proportion interpreted in experiment 4 is 77.5% for the residents association topic, it is only 62.5% for the party conference topic. Given that these means (31.25% and 62.5%) are less than 8% outside of the q-exp ranges, it is unlikely that they represent any real differences.

What is striking about figure 5.1 is that none of the q-exps used in experiments 4 and 5 are interpreted as less than 10% or more than 80%. Perhaps dimension-anchored phrases such as 'nearly all' or 'hardly any' are more appropriate descriptions of such extreme amounts.

The proportion which the writer is thought to expect has been found to be influenced by the q-exp as well as by prior expectations.

Hence the effects of each q-exp on the proportion expected by the writer must be assessed. Table 5.2 shows the order of q-exps from lowest to highest proportion expected. '+' indicates a proportion above prior expectation and '-' indicates a proportion below prior expectation.

Table 5.2 - Q-exps rank-ordered from lowest to highest % expected

Residents Assoc	Party Conference
- a few	- not many
- quite a few	- a few
- few	- quite a few
- very many	- few
- very few	- very many
- a lot	- very few
many	- a lot
+ quite a lot	- many
+ not many	- quite a lot

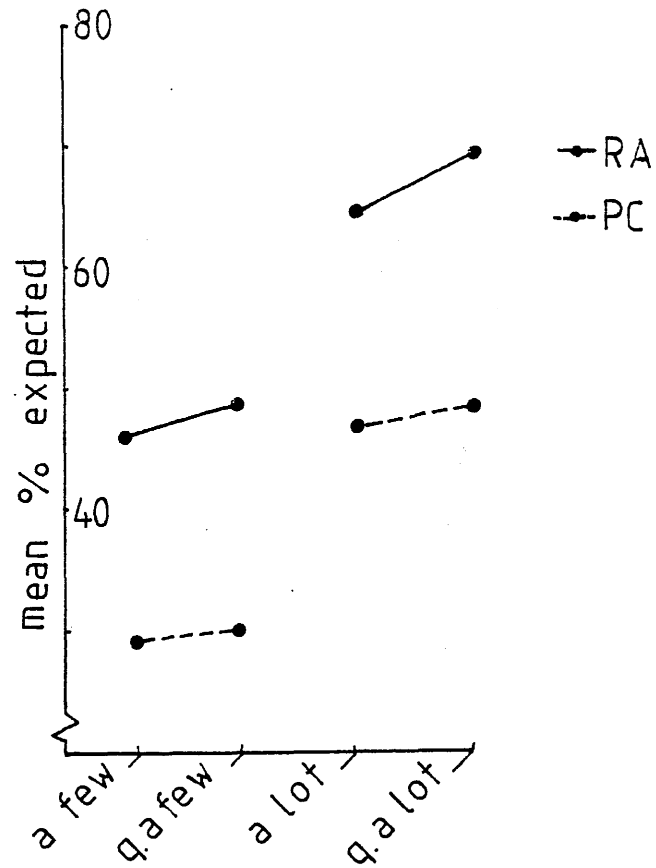
The order of q-exps is identical for each context except for 'not many' which has the lowest proportion expected for the party conference context and the highest for the residents association context. Given that neither 'many' nor 'very many' have different orders between contexts, the effect must be due to 'not'. It is difficult to speculate about the way in which 'not' interacts with the context in estimates of the proportion expected, since only 2 contexts were presented. It is clear, however, that there is an interaction.

The fact that all of the remaining q-exps have identical orders in each context is quite striking. The proportions expected given the q-exps are quite consistent in the extent to which they differ from prior expectations. From table 5.2, the following points may be stated about the individual words used in the q-exps:

(1) 'A few/Quite a few + A lot/Quite a lot'

From figure 5.3 it is clear that 'quite' has little effect on the proportion expected regardless of the q-exp following it, or the context. If anything, 'quite' appears to increase the proportion very marginally in all cases. Also, the proportion which the writer is thought to expect is about 15 to 20% higher for 'a lot' than for 'a few'.

Figure 5.3 - the mean proportions expected for 'a few', 'quite a few', 'a lot' and 'quite a lot'



(2) 'Few/Very few + Many/Very many'

Figure 5.4 shows that the effect of 'very' on the proportion expected is greater than the effect of 'quite'. 'Very few' leads to higher expectations than 'few', while 'very many' leads to lower expectations than 'many'. In fact, the proportions expected for 'very many' and 'very few' are similar (in the party conference setting they are the same). One might argue that since 'few' and 'many' lead to quite different expectations (8 to 13% more for 'many' than for 'few'), 'very' functions to moderate the proportion expected.

(3) 'A few' + 'Few'

Figure 5.5 shows that 'few' leads to 7 to 12% greater expectations than does 'a few'.

Figure 5.4 - the mean proportions expected for 'few', 'very few', 'many', and 'very many'

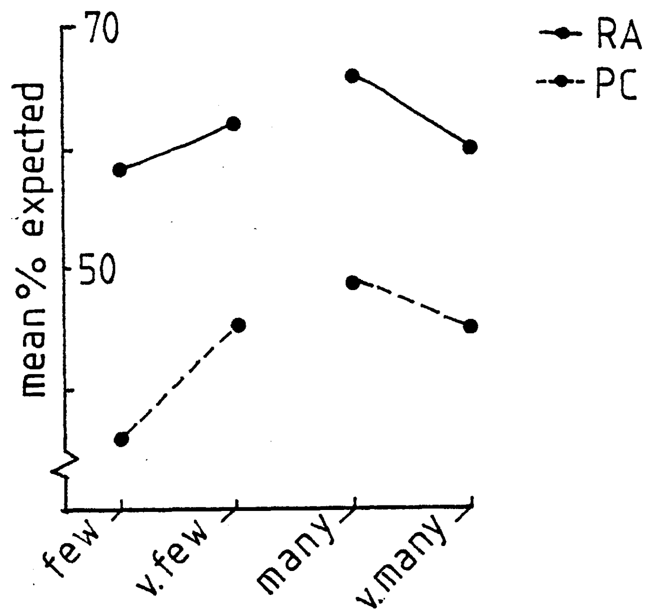
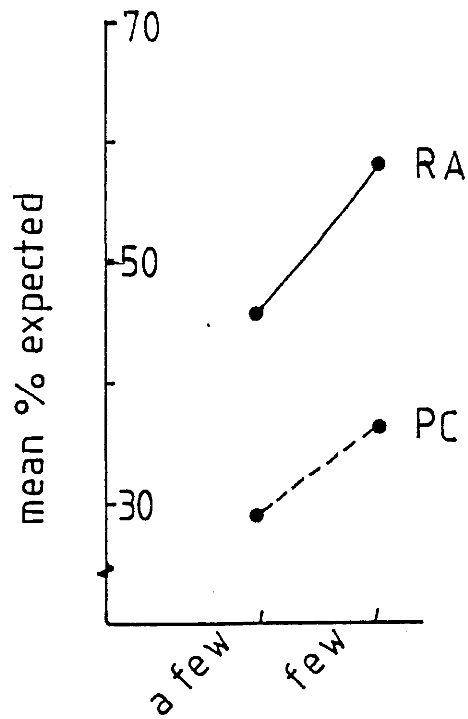


Figure 5.5 - the mean proportions expected for 'few', and 'a few'



In subsequent chapters, aspects of q-exp meaning will be considered which do not concern the direct relationship between the q-exp and the proportion it is taken to denote. More emphasis will be placed on the processing consequences of using any particular expression and the effects of a q-exp on subsequent discourse. The summary which follows, and which concludes this chapter, gives details of all the proportional information which has been found to relate to each of the words used in experiments 4 and 5.

Summary

A few general points have been made about the use and interpretation of q-exps:

(1) The degree to which information to be described is consistent with what is expected partly determines whether the large or the small subset will be described. If the information being described is consistent with what was expected, the smaller subset is more likely to be described than if the information being described is inconsistent with expectation (experiment 1).

(2) It appears that subjects will accept a q-exp as describing a proportion in some cases when that proportion is outside of the normal range denoted by the q-exp (experiment 2). This indicates the need of a listener to make sense of what is being said.

(3) Although certain q-exps influence estimates of the proportion expected (generally reducing them), neither prior expectations nor the proportion expected by the writer influence the proportion <u>interpreted</u> in the contexts examined. Hence, it seems that the proportion interpreted is independent of what was expected, although there may be some contexts where this is not so.

(4) Q-exps which do influence the proportion expected, have a similar influence in different contexts, and this constitutes a reduction in the proportion expected by a constant amount. This effect does not appear to be an adjustment from some anchor which is determined by the proportion interpreted.

The nine quantified noun phrases compared in experiments 4 and 5 contain the following 7 words: a, few, lot, many, not, quite, and very. The results of experiments 1 to 5 allow the following points to be made about the function of each of these individual words:

'<u>A</u>': This word was found not to influence the proportions denoted by q-exps following it in experiment 1. Phrases containing 'a' in experiments 4 and 5 are 'a few', 'quite a few', 'a lot' and 'quite a lot'. These phrases affect the proportion expected to different extents (see figure 5.2), so that it is unlikely that 'a' has an effect on the proportion expected per se. The difference between prior expectation and the proportion expected by the writer, however, is greater for 'a few' than for 'few'. This difference may be due to the presence of 'a', but it is difficult to speculate about this effect since no comparison was made between 'a lot' and 'lots'. Phrases containing 'a' were also interpreted as different proportions. Since these differences appear to be due to the q-exps accompanying 'a' than to 'a' itself, it is unlikely that 'a' affects the proportion interpreted.

'<u>Few</u>': Phrases containing 'few' were found to denote low proportions (10 to 40%) in experiment 1, with the exception of 'quite a few'. Figure 5.1 shows that they are also interpreted as low proportions. As figure 5.2 shows, these phrases tend to produce low estimates of the proportion expected by the writer, when compared with prior expectations. The general influence of 'few' is then to denote a small proportion and to indicate that a small proportion was expected.

'Lot': Phrases containing 'lot' were found to denote medium to high proportions (25-90%) in experiment 1, and figure 5.1 shows that they are also interpreted as medium to high proportions. They appear not to influence the proportion expected (see figure 5.2).

'Many': Phrases with 'many' denoted medium to high proportions in experiment 1 (25 to 90%), with the exception of 'not many'. They are also interpreted as medium to high proportions (see figure 5.1). Figure 5.2 shows that these phrases have various effects on the proportion expected. However, 'many' without a modifier clearly has no effect, and it is likely that any influence from other phrases with 'many' is not due to the word 'many' itself.

'Not': This word has only been considered within the phrase 'not many'. This phrase has been found to denote only small proportions (in experiments 1 and 5). It can have a fairly strong influence on the proportion expected, but the direction and extent of this depends very much on the context (see figure 5.2).

'Quite': This word has been considered as a modifier of 'a few' and 'a lot'. It appears to affect the proportions denoted by these q-exps, by making them less extreme (see chapter 2 and figure 5.1). In fact, figure 5.1 shows that both q-exps denote proportions between 40 and 60% when accompanied by 'quite'. 'Quite' does not appear to influence the proportion expected. As figure 5.2 shows, any influence on expectation appears to depend more on 'a few' and 'a lot' than it does on the word 'quite'.

'<u>Very</u>': Both experiments 1 and 4 suggest that 'very' makes the proportions denoted by 'many' and 'few' more extreme (see figure 5.1). That is, 'very many' denotes larger proportions than 'many', and 'very few' denotes smaller proportions than does 'few'. This word also appears to have some influence on the proportion expected. 'Few', which greatly reduces the proportion expected, reduces it only slightly when accompanied by 'very'; 'many' which appears to have no influence on the proportion expected, also reduces expectations slightly when accompanied by 'very'.

Chapter 6

Nonproportional Aspects of Quantity Expression Meaning

Introduction

The first part of this thesis has been an attempt to evaluate the relationships between proportions and q-exps. However, q-exps may not always be used simply to describe proportions. Indeed, they are sometimes so vague that the relevant proportional information provided is simply that the proportion is either small or large. The second part of the thesis is an attempt to evaluate other aspects of q-exp meaning, which do not provide proportional information.

The question being asked is: what function(s) does a q-exp carry out within a sentence or a larger piece of discourse. If we adopt a processing point of view, what roles do particular q-exps carry out in natural language understanding? In particular, the following chapters ask whether and how the individual words within a quantified noun phrase can influence what is 'focus' for the listener/speaker.

Whereas the starting point for the work on proportions was psychological work relating q-exps to proportions and amounts, ideas about other aspects of q-exp meaning have come from logical, linguistic and processing approaches to language understanding. Logicians have tended to consider the meaning of q-exps in terms of the truth values of sentences containing them. The present work has a similar aim in that it attempts to evaluate the effects of different q-exps on non-proportional aspects of interpretation, although differences in truth value will not be of major concern. At this point, a brief review of some logical work is in order. There are doubtless many ways in which one might go about dealing with q-exps in logic. There follows a very brief account of a rather traditional approach, followed by some ideas about the meaning of q-exps put forward by two particular logicians.

Logical versus Non-logical Quantifiers

A distinction is often drawn between logical q-exps and non-logical q-exps (e.g. Barwise and Cooper, 1981, Fodor, 1982; Johnson-Laird, 1983). Logical q-exps are those whose interpretation is not dependent on contextual factors such as the set to which the q-exp is attached; non-logical q-exps have interpretations which may vary from one situation to another. For example, Barwise and Cooper consider the following q-exps (these authors refer to q-exps as "determiners") to be logical: 'some', 'every', 'no', 'the', 'both', 'neither', plus numbers such as 'three'. Non-logical q-exps include 'most', 'many', 'few', and 'a few'.

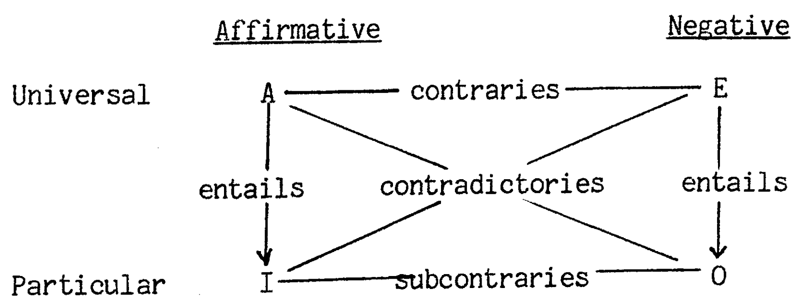
Numerical expressions, and the terms 'the', 'both' and 'neither' are used to describe somewhat special situations where the specific number of elements is known and is being described. The remaining logical q-exps correspond to the logical q-exps $\forall$ (the Universal quantifier) and $\exists$ (the Existential quantifier). McCawley (1981) refers to these as the logician's "favorite quantifiers". The following table illustrates the approximate meaning of these symbols in English:

Symbol	English equivalents
$\forall$	All, Every
$-\forall$	Not all (ie. some not)
$\exists$	Some (at least one)
$-\exists$	None, no

As Barwise and Cooper (1981) argue, many q-exps (non-logical quantifiers) cannot be defined using the logical symbols $\forall$ and $\exists$. The result of this is that logicians have tended to concentrate on the properties of logical quantifiers.

The four symbols in the above table and the relationships between them, make up Aristotle's classic 'Square of Opposition':

Table 6.1 Aristotle's Square



The letters A, E, I and O in the Square of opposition, represent different proposition forms:

A($\forall$) -> All X are Y

E($-\exists$) -> No X are Y or All X are not-Y

I($\exists$) -> Some X are Y

O($-\forall$) -> Some X are not-Y

The relationships between these forms can be summarised as follows:

(1) A and O are <u>contradictories</u>, as are I and E.

That is, All X are Y and Some X are not-Y cannot both be true, nor can they both be false. Likewise with the forms Some X are Y and No X are Y.

(2) A and E are <u>Contraries</u>.

That is, All X are Y and No X are Y, cannot both be true, but they can both be false. For example, if only Some X are Y, then these forms would be false.

(3) I and O are <u>Sub-contraries</u>.

That is, Some X are Y and Some X are not-Y cannot both be false, but they can both be true. For example, if 50% of X are Y and 50% of X are not-Y, these propositions would both be true.

(4) A <u>entails</u> I and E <u>entails</u> O.

That is, if it is true that All X are Y, then it must be true that Some X are Y and if it is true that No X are Y then it must be true that Some X are not-Y.

What the Square of Opposition allows one to do is to define the forms A, E, I and O in terms of the conditions which must hold for them to be true. For example, 'All X are Y' is true, just in case there are no Xs which are not-Ys (I and O are false). Peterson (1979) utilised this method with non-logical quantifiers, proposing that the basic logic of 'few', 'many' and 'most' can be defined in a similar manner. Tables 6.2 and 6.3 show some Squares of Opposition constructed by Peterson to define these terms.

Table 6.2 - the relationships between 'most' and 'many'

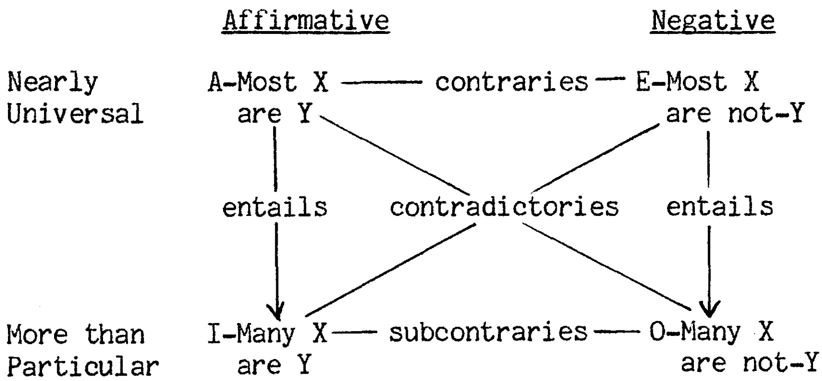
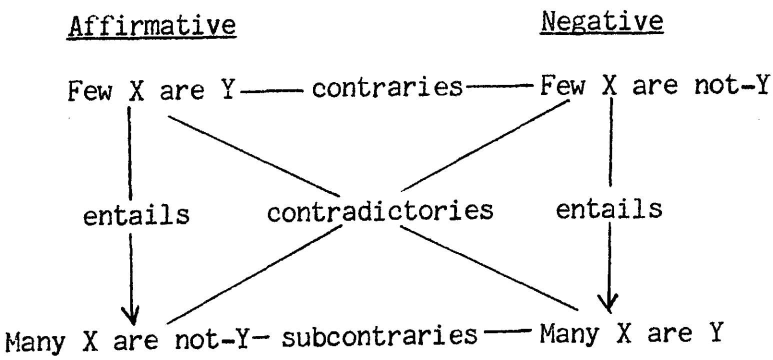


Table 6.3 - the relationship between 'few' and 'many'



According to Peterson, the relationships presented in table 6.2 hold if the following are true:

(Most X are Y) if and only if (Few X are not-Y)

and (Most X are not-Y) if and only if (Few X are Y).

Thus, if it is true that Most X implies that Few not-X, then it is also true that,

(a) Most X entails Many X,

(b) Most X and Most not-X cannot both be true, but they may both be false.

and (c) Many X and Many not-X cannot both be false, but they can both be true.

For tables 6.2 and 6.3, Peterson assumes that it is possible for 'Many X' and 'Many not-X' to be true of the same state of affairs. Given that the following statements are true, this assumption seems justified:

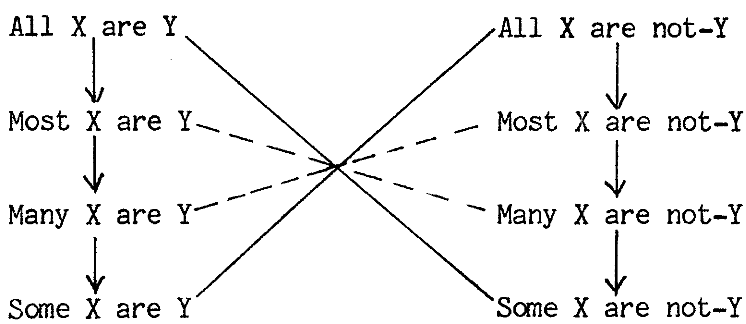
(a) Many people are male.

(b) Many people are female.

For the relationships in table 6.3 to hold, Peterson also states that 'few' cannot be taken as meaning 'a few' (this latter he equates with 'some') but rather it must be interpreted as "just a few, only a few, or not many". If one assumes that 'few' and 'most not' are equivalent, then table 6.2 follows from table 6.3.

In order for 'most X' to entail that 'many X', Peterson recognises that 'many' must be interpreted as 'many or more', whereas for I and O to be sub-contraries 'many' must mean a more precise amount. That is, if 'many' means more than 50%, then 'many X' and 'many not-X' cannot both be true. However, as Peterson points out, the same assumptions must be made about Aristotle's Square. If 'all X' is to entail that 'some X', 'some' must be interpreted as 'some or more' rather than 'exactly some' or 'a few'. Yet for 'some X' and 'some not-X' both to be true, 'some' cannot be interpreted so liberally.

Peterson relates the Square of Opposition in table 6.2 to Aristotle's Square in the following way:



Hence All -> most -> many -> some. This differs from the traditional view of 'many' and 'most' which treats them both in the same way as 'some'.

The greatest problem with this approach to the meaning of non-logical quantifiers is that the relationships depicted in tables 6.2 and 6.3 only hold if these statements are uttered by the same speaker in the course of the same conversation. That is, the logical relationships between 'few', 'many' and 'most' which are suggested by Peterson, can only hold when they are used within the same particular context. This is less true of the relationships depicted in Aristotle's Square, simply because the quantifiers in that Square are logical. That is, there is a sense in which all, no, some and some-not have the same meanings regardless of the situation.

In previous chapters, it has been shown that these last four expressions can denote ranges of proportions even when they are used to describe the same situation. Also, for the relationship in tables 6.2 and 6.3 to hold, Peterson has had to assume that certain senses of these words were not considered. For example, 'most' must be equivalent to 'few not'. He states that it must be interpreted as 'nearly all' rather than 'more than half'. And 'few' must be interpreted as 'not many' rather than as 'a few', which according to Peterson is, for all intents and purposes, equivalent to 'some'. The problem is that natural language is used in situations where such severe restrictions are not introduced. It would be most unusual to be told 'Most, where this means nearly all rather than more than half, people like sunshine'. One cannot, therefore, assume that most -> few not, nor that most entails that many etc., in the course of a normal conversation. If, for example, 'most ordinary psychology students will pass the class examination' is true, it does not follow that 'few ordinary psychology students will fail the class examination'. Perhaps 40% will fail. Neither does it mean that 'Many ordinary psychology students will pass the class examination'. Suppose that in previous years, 80% of the students have passed and that 80% were expected to pass this year. It would then seem inappropriate to describe the 60% who passed this year, as 'many'.

This relates to a more general problem with some logical approaches to non-logical quantifiers. There is a strong tendency to define one quantifier as equivalent to another. Peterson (1979) states that "few means what, or functions like not many does", and argues that 'not a few' minus the negation is equal to 'few' rather than 'a few'. Hence 'not a few' is equivalent to 'many'. Smith (1975) also treats 'not many' and 'few' as equivalent, and argues than 'not many' implies 'most not'. Such assumptions may be quite reasonable on the grounds that sentences containing one word might always (or even mostly) yield the same truth value as the same sentences containing the other word. However, this does not necessarily mean that their functions and meanings are equivalent. Indeed, experiment 5 has shown that 'not many' and 'few' can have radically different effects on the proportion which one perceives the speaker as expecting, depending on the context. While this point may appear trivial given that these expressions have similar denotations, it is very important when one's aim is to discover how various expressions can convey information, of all sorts, from one person to another. Any difference in the meaning of two words might have radical psychological effects on interpretation.

Are Logical Quantifiers Logical?

So far, no real problems have been raised about the logical account of the so-called logical quantifiers. However, even 'all', 'no', 'some' and 'some-not' may not always be interpreted logically. That is, their use and function in everyday conversation does not necessarily comply with Aristotle's square of opposition.

Although the 'every' in "everybody passed the examination" can be taken to imply that no-one has failed (when interpreted logically), this state of affairs may not be implied at all. Whether or not a logical q-exp appears to be interpreted logically depends on the context of its use. If, for example, the statement "everybody passed the examination" is uttered to someone who did not pass the examination, where the speaker's intentions are apparently to make the listener feel ashamed of her failure, 'every' may be interpreted as 'all but one' (namely, all but the listener). In one of the experiments to be described later (exp 6), one of the subjects produced a nice and natural example of "all" being used non-logically. This subject had been asked to complete the following: "Few MPs were at the meeting. They --------------". The subject continued "were all elsewhere doing other things". Given that "few MPs" were at the meeting those elsewhere doing other things i.e. "all" must refer to all the MPs minus the few at the meeting.

Newstead and Griggs (1984) suggest that although previous work involving reasoning with the q-exp 'all' seems to show that subjects interpret 'all' logically, 'all' is sometimes interpreted 'fuzzily', or non-logically. They presented subjects with statistical information about the inhabitants of a small country, followed by 6 statements containing 'all', 'some' or 'no'. Subjects were asked to judge the statements with respect to their appropriateness as descriptions of the state of affairs given the statistical information. The results show that subjects vary with respect to the degree of appropriateness of 'all' where there are one or two exceptions, i.e., with respect to whether or not 'all' is interpreted logically in cases where the statement is true of all but one or two of the population. Only 13 out of 30 subjects saw 'all' as totally inappropriate. It was also found that 'no' was sometimes interpreted fuzzily.

One might argue that restricting the available q-exps to 'all', 'some' or 'no', forced some subjects to judge 'all' and 'no' as more appropriate than would be the case if more q-exps had been presented. Perhaps the results obtained by Newstead and Griggs would have been quite different if additional q-exps such as 'nearly all' had been presented. Given that in natural language many q-exps are available, the results of this study may be misleading.

The following examples show that even when people can use any description they care to use, there are still instances of 'all', 'every', 'no' etc. which appear to be non-logical.

(1) <u>Everyone</u> has heard of Bob Dylan.

(2) Few MPs were at the meeting. They were <u>all</u> elsewhere doing other things.

(3) <u>No</u> student can afford to run a BMW.

Although it is easy to imagine situations where one might utter (1), (2) or (3), these statements are clearly false where, respectively, everyone = 100% of people, all = 100% of the MPs and no = 0% of students. The problem is that one cannot assume that 'everyone' does refer to 100% of people, for example. In fact, when (1) to (3) are rewritten with more specific information about the set being referred to, it is clear that the logical meaning of 'all', 'every' and 'no' may have been intended.

(4) a Everyone (who is anybody has heard of Bob Dylan.
(who I like
(who is intelligent

versus

b Every person in the world has heard of Bob Dylan.

(5) a Few MPs were at the meeting. They (those who did not attend), were all elsewhere doing other things.

versus

b Few MPs were at the meeting. They (all MPs) were all elsewhere doing other things.

(6) a No student (that I know of
(who does not have rich parents

can afford to run a BMW.

versus

b No student in the world can afford to run a BMW.

Each of the (a) sentences above may be (and are presumably) true from the speaker's point of view; the (b) sentences are false, unless 'all', 'every' and 'no' are interpreted non-logically. It seems reasonable to argue that, in some situations, some people find it useful to use a universal without specifying the set to which it applies, specifically, in order to increase the force of the statement. In such situations, 'all', 'every' and 'no' are still used logically, although the fact that the set is not given explicitly may lead one to believe that these words are not being used logically. If one relativises the statements to the right model, they are logical; if one cannot do that, they are not logical (for the interpreter).

The idea that the explicitness of a set determines whether or not a normally 'logical' q-exp is interpreted logically, is similar to an argument produced by Peterson (1979). This argument concerns shifts in "reference class". The Square of Opposition in table 6.2 assumes that 'Most X are Y' is not consistent with 'Many X are not-Y'. However, for these two statements to be contradictories, one must assume that there is a constant reference class. Suppose that there are one million United States soldiers and that 900,000 of them are abroad. It is then true that 'Most US soldiers are abroad'. Given that 100,000 soldiers are still in the United states, is it not also true that 'Many US soldiers are not abroad'? Peterson argues that this statement is only true if there is a shift in reference class. That is, if the reference class remains the same, the statement can be paraphrased 'Many of the one million soldiers are not abroad'. Since 100,000 is not many out of 1,000,000, the statement is false. Thus, if the reference class is kept constant, then 'most' is indeed inconsistent with 'many not'. If, however, the reference class changes, then the statement may mean something like 'many soldiers (compared with imaginable numbers of American soldiers) are abroad'. In this case the statement may be judged true. What is clear is that it is not always obvious to which set a q-exp is being applied in natural language usage.

Peterson's example also highlights another difference between uses of q-exps which has not so far been considered. That is, q-exps are sometimes used to denote absolute amounts of entities and sometimes to denote proportions of entities. The following examples will help to clarify this distinction:

(7) A few carol singers came to my door last night.

(8) A few (of the) children managed to eat their ice-cream.

In (7) it does not seem relevant to ask what proportion of all carol singers, people, or anything else, came to the door last night. It may be relevant to ask, if anything, what number, or approximate number, of people there were. It is more plausible with (8) however, that the proportion of children who ate their ice cream is relevant (although the number may be important as well). Peterson's example of a constant reference class requires a proportional interpretation of 'many' (a proportion of all US soldiers); the example of a shift in reference class requires that 'many' denote an absolute amount (100,000 soldiers).

It must be noted that it is possible for any q-exp to be seen as denoting a proportion or an amount, since q-exps are followed by sets rather than individual elements, and any subset can be seen as a proportion of the set or as a number of elements. The carol singers in (7) are likely to be interpreted as an absolute amount of singers, but they may still be seen as a proportion of some set. If they are seen as a proportion of the entire set of carol singers, then no matter how many were at the door, the proportion is likely to be so small as to be meaningless. They may be seen as a proportion of some other set, for example the set of all people who came to the door. But this is not obvious from (7), and so the interpretation of 'a few' in (7) is likely to be an absolute amount. In (8) the interpretation may well be proportional because of the circumstances under which children are likely to eat ice cream. Since the statement would be meaningless if the set 'children' meant children who were not presented with ice cream, at a party for example, one is likely to assume that some limited group of children is being denoted by 'children'. A proportion of such a set is just as meaningful, and perhaps more meaningful, than an absolute amount.

It must also be noted that the q-exp used, as well as the context, can influence whether the interpretation is likely to be a proportion or an amount. 'Most' and 'few', for example, seem almost always to denote proportions, while other q-exps, including 'a few' and 'many', are often used to denote absolute amounts (albeit vaguely). This difference between types of interpretation will appear again later in this chapter. Note, however, that the experiments reported in this thesis have exclusively concerned the relationship between q-exps and proportions. The relationship between these expressions and the absolute amounts which they may denote has not been investigated.

Categories of Quantity Expressions

It is clearly quite difficult to define non-logical q-exps in a traditional logical system. However, logicians have attempted to find different systems in which these terms can be defined (for example, Barwise and Cooper, 1981). The actual logical system described by these authors is of less concern here than the categories of q-exp which they have identified. Three different basic categorisations are suggested: strength, monotonicity, and persistence. Each will be considered in turn:

1. "Strength":- Quantity expressions are divided into those which are "positive strong", those which are "negative strong" and those which are "weak". (Barwise and Cooper refer to q-exps as "determiners" and to quantified noun phrases such as 'most people' as "quantifiers").

The test for "strength" depends on the quantifier. The test statement is as follows:

D + D -> D N is a N or

D N are N

e.g. some man -> some man is a man

most people -> most people are people

If the outcome of placing a quantified noun phrase in the test statement is automatically valid (as with "most people"), then the q-exp is positive strong; if the outcome is contradictory (as with "neither person"), then the q-exp is negative strong; if the outcome depends on contextual factors, then the q-exp is weak. According to Barwise and Cooper, 'many' and 'few' are examples of weak determiners. If, for example, the context contains 'many people', then the statement is automatically valid, but if the context does not contain many people, then the statement is false.

It is not clear that a sentence such as 'many people are people' is interpreted differently depending on whether or not there are, in fact, 'many people'. If 'Many people' refers to a proportion (or range of proportions) of the set of people, then this proportion will always mean at least one member of the set and less than 100%. The information provided by 'many' implies that <u>not</u> <u>all</u> members of the set are involved, which in turn might imply that the rest of the people are not people. In fact the sentence does not say anything about whether or not the set of people, minus 'many' people, are people. But it seems to me that the sentence 'many people are people' is odd, because when one asserts that some state X is true of a proportion of the set A, it will be interpreted as both 'X is true of %A' and 'X is not true of A - %A'. If 'Many people' refers to an absolute number, when such a number of people does not exist, then the statement is simply nonsensical.

The argument that the truth of the sentence depends on the existence of many people is consistent with the way some logical systems might handle such a sentence. For example, the following:

$\exists x$ [set of people (x) + many (x) -> people (X)]

This means that if x is a set of people, and if there are many members in x (i.e. there are many people), then members of x are people. However, it seems clear that 'many people' implies in itself that there is a set of people, and refers to a proportion (indicated by 'many') of that set. In fact, Peterson (1979) argues that logicians tend to treat 'few', 'many' and 'most' in the same way as 'some' <u>because</u> there is less need to presuppose existential import with these expressions than with the universal 'all'. Thus, "most soldiers are heroes" implies that there exist soldiers, while many logicians argue that "all soldiers are heroes" does not necessarily imply that there exist soldiers.

If one assumes that 'few people' entails that there are few people, then Barwise and Cooper would presumably see 'few' as negative strong because the sentence "few people are people" would be judged contradictory. However just, as "many people are people" implies that there are people who are not people, "few people are people" implies that there are people who are not people. The only difference is that the latter sentence seems to emphasize more strongly those people who are not people. The reason for this strong emphasis may be that 'few' denotes a smaller proportion than 'many' or 'most'. Perhaps it is more informative to speak of properties of larger subsets rather than smaller ones. After all, knowing the properties of larger subsets allows one to make more accurate predictions about members of the set as a whole. Hence, when a q-exp which denotes a small proportion is used, the implications which are carried for the remainder of the set are of more interest than they would be with a q-exp which denotes a large proportion. This issue, among others, is explored empirically in experiment 6.

Perhaps "strength" depends on the strength of implications about the truth of X with respect to A - %A. However, Barwise and Cooper assert that 'most' is positive strong since "most people are people" is judged automatically valid. Again, I would argue that "most" is rarely judged as 100% of the set to which it is attached and so it may imply that 100% of the people minus 'most' people are not people. Just as with "many people", the sentence seems contradictory but the implication required to make it seem contradictory is less strongly emphasied than with 'few people' and perhaps also 'many people'.

Here I am suggesting that what Barwise and Cooper call positive or negative strength relates (a) to the <u>emphasis</u> which a q-exp gives to the proportion of the set given by the q-exp versus the set minus the proportion given by the q-exp or (b) to the <u>size</u> of the set minus the proportion of the set indicated by the q-exp. ((a) and (b) are probably linked). Whatever the use of a particular q-exp implies about the set, about the proportion of the set indicated by the q-exp and about the set minus the proportion of the set indicated by the q-exp must be established empirically rather than logically.

2. "Monotonicity" divides q-exps into those which are montone increasing (mon inc), those which are monotone decreasing (mon dec) and those which can be both mon inc and mon dec depending on the contextual meaning.

If the quantified nounphrase plus the predicate X is true, and those entities which belong to the set denoted by X are a subset of the set denoted by the predicate Y, <u>and</u> if the quantifier plus the predicate Y is true, then the q-exp is mon inc. For example, if "some men entered the race early" is true, it is also true that "some men entered the race", and those who entered the race early are of course a subset of those who entered the race. Hence, 'some' is mon inc. Note that "some men entered the race early" implies that all men minus some men did not enter the race early, although all men may have entered the race at some point. Suppose that 'some', here, has the value N. It is known that <u>at least</u> N men entered the race (whether it was early or later) and that not more than all men entered the race. Unless 'some' in the statement "some men entered the race" is taken to mean anywhere between N and all - not just N - then the inference that some men entered the race is not strictly valid. That is, <u>more</u> than some men may have entered the race.

If the quantified nounphrase plus the predicate X is true and members of the set denoted by the predicate Y are a subset of those in the set denoted by the predicate X, <u>and</u> if the quantified noun phrase plus the predicate Y is true then the q-exp is mon dec. Hence 'few' is mon dec. That is, if "few men entered the race" is true, then it is true that "few men entered the race early" and again those who entered the race early must be a subset of those who entered the race. Again, note that "few men entered the race" implies that all men <u>minus</u> few men did not enter the race, and that <u>no</u> <u>more</u> than few men entered the race early. Perhaps <u>no</u> men entered the race early. Suppose that 'few' here denotes the value N, then the number of men entering the race early could be anything between 0 and N. For the inference "few men entered the race early" to be accurate, one must suppose that 'few' in the inference denotes the range of values from 0, and includes 0, to N.

According to Barwise and Cooper, some, every, most and many are mon inc; no, few, and neither, are mon dec; and exactly 2 men and exactly half the men, are not monotone.

3. "Persistence":- This divides quantity expressions into those which are persistent and those which are not persistent. The truth value of a statement containing a persistent quantifier can be evaluated on the basis of a "witness set" i.e. a sample subset of the set concerned. For example, if one is asked whether it is true that "several shops are closed on Mondays" one can select some subset from the set of shops, and, if there are several shops in that subset which are closed on Mondays, then it is true of the

entire set that several shops are closing on Mondays. This is not true of a quantifier which is not persistent, such as 'every'. Thus, given that "every shop is closed on Mondays" is true of a subset of the set of shops, it is not necessarily true of the set as a whole. There may be no shops which are closed on Mondays outside of the "witness set".

The following q-exps are said to be persistent:- some, at least n, infinitely many, uncountably many. Several and many may also be persistent. Every, no, at most n, finitely many, and perhaps few are included as anti-persistent. It must be noticed that persistent q-exps tend to be dimension-unanchored, non-logical, and to have less specific denotations than the anti-persistent q-exps. They denote ranges of proportions rather than specific proportions. The question of persistence relates closely to the question of whether a q-exp is seen as denoting a proportion or an absolute amount. If a q-exp denotes an absolute amount of N or more, and N or more are present in the witness set, then the q-exp can be shown to be persistent. If a q-exp denotes an absolute amount of N or less, or if it denotes a proportion, then the q-exp cannot be shown to be persistent, because the whole set may contain more than the witness set, and this may be more than N or it may alter the proportion.

Like Peterson's work, the categorisation of q-exps described by Barwise and Cooper takes little account of language understanding as a process. Words are categorised according to the inferences one could make, given the truth value of sentences containing them. A processing account, on the other hand, must explain how the speaker/listener processes language input, and this must include not only an analysis of word meaning but also an analysis of the interaction between word meaning and context. In attempting to explain how language might be processed and understood, it has been necessary to consider such notions as 'focus'. This notion has already been discussed in chapter 1 and may be described as whatever one is attending to in the course of processing.

There are some interesting ideas which arise from the logical analyses of q-exps just discussed. First, there is the idea that certain q-exps are logically equivalent, or that certain meanings of particular q-exps are logically equivalent. Thus, Peterson argues that when 'most' is taken to mean 'nearly all' rather than 'more than a half', 'most' is equivalent to 'few not' and 'most not' is equivalent to 'few'; 'some' may be taken to mean 'some or more' or to mean 'a few' or 'exactly some'. So there is a sense of 'some' which is equivalent to 'a few'; 'few' is equivalent to 'just a few', 'only a few' or 'not many', but is different from 'a few'. It will be interesting to test empirically the equivalence of some of these expressions, in language understanding.

It is also interesting to note that Peterson's discussion of constant and shifting reference classes, used an example of a q-exp denoting in the first instance a proportion, and in the second, an amount. It has been argued that the difference between Barwise and Cooper's persistent and anti-persistent q-exps depends at least partly on whether the q-exp is easily interpreted as an amount. The following example shows that some q-exps can be used interchangibly as proportions versus amounts.

(1) Car salesman: Many cars have 1 year guarantees.

(2) Customer: There aren't that many here. But you mean there are a few which are guaranteed?

(3) Car salesman: Yes indeed. A few of our cars do have guarantees. Would you care to see them?

(Points to a set of cars)

(4) Customer: Oh I see, there's quite a selection. Actually most of your cars must be guaranteed.

'Many' is a proportion in (1) and an amount in (2); 'A few' is used as an amount in (2) and as a proportion in (3). Clearly the context does not always allow one to determine exactly how a q-exp is being used, but it would be interesting to discover how the context may influence proportional versus amount interpretations. For simplicity however, work in this thesis concerns only proportional interpretations of q-exps.

Another interesting point which has come to light is that the set following a q-exp is not always exactly the same set to which one must apply the q-exp. Thus, if 'everyone has heard of Bob Dylan' is to be given an appropriate interpretation 'everyone' cannot be interpreted as 'every person' but as 'every person (who ....)'. The exact specification of the set must be left to the listener's imagination given all that can be inferred about the speaker, the situation, etc. This is not only important for the logical analysis of q-exps. It also reveals the necessity of a notion of focus, which must at least partly determine the appropriate set to which the q-exp should be applied.

The importance of the relationship between a q-exp + set combination and the set of entities in focus becomes even greater when one considers what is in focus after the q-exp + set have been interpreted. Not only can q-exps be seen as denoting proportions or quantities of sets. They can be seen as dividing or partitioning sets into the subset of which the predicate is true and the subset of which the predicate is not true. Thus, 'most chairs have 4 legs' not only asserts something like '60-80% of chairs have 4 legs', but also that the set of chairs has two subsets. Chairs in the larger subset have 4 legs; chairs in the smaller subset do not have 4 legs.

It would be natural to suppose that the set of entities in focus after 'most chairs have 4 legs' would be the large subset of the set of chairs, all of which have 4 legs. One would expect, for example, that the next sentence will be about this larger subset. It was mentioned in chapter 1 that the resolution of pronoun anaphora depends on 'focus'. For example, the pronoun 'she' is more likely to refer to a female singular entity in focus, than to any other entity. In fact, focus is a very useful mechanism for the explanation of pronoun resolution. Also, if a particular instance of a pronoun is taken to refer to some entity or set of entities, then one can infer that this entity or set of entities is in focus. If 'she' appears when there is no female singular entity in focus, or if there is more than one, then this pronoun will be very difficult to interpret. If 'they' appears after 'most chairs have 4 legs' it will refer to a set of chairs. But which set of chairs? All the chairs, those with 4 legs, or those without 4 legs? Consider the following examples:

(1) Most chairs have 4 legs. They are usually painted or varnished.

(2) Most chairs have 4 legs. They are designed that way.

?(3) Most chairs have 4 legs. They have one leg.

In (1) 'they' refers to all chairs; in (2) 'they' refers to the subset of chairs with 4 legs; in (3) 'they' refers to some subset of chairs without 4 legs. In fact (3) makes no sense, as it seems impossible to use 'they' to refer to a subset which has not been explicitly mentioned. This may be taken as evidence that the subset of chairs without 4 legs is not in focus.

With 'few', and possibly some other q-exps, it is not the case that the subset which has not been mentioned explicitly is not in focus. Consider the following sentences:

(1) Few children ate their ice-cream. They only ate it out of greed.

(2) Few children ate their ice-cream. They decided to throw it around the room instead.

(3) Few children ate their ice-cream. They can be very fussy

eaters.

These sentences are similar to sentences used by Gareth Evans (1980) to illustrate what he has called 'E-type' pronouns, except that Evans' sentences included a connective between the first sentence and 'they'. An E-type pronoun differs from other pronouns in that it is preceded by a quantity expression but is not bound by that q-exp (Evans). For instance, 'few MPs came to the party but they had a good time' contains an E-type pronoun. The pronoun 'they' in 'Few MPs enjoy the parties they attend' is bound by the quantified noun phrase, and is not, therefore, an E-type pronoun. Evans argues that the pronoun in this latter sentence does not refer to anything, whereas the E-type pronoun refers to the MPs who came to the party for constituents ("the object(s) which verify the antecedent quantifier-containing clause"). Sentences (1), (2) and (3) show that the relationship between such pronouns and their referents is not quite so simple. In each of these cases, the first sentence is identical and one would expect that the set of things in focus (that is, the set of things being talked about) would be the same. If the word 'they' (which follows the first sentence in each case) is taken to refer to whatever group of entities is in focus, it is clear that the group in focus differs amongst (1), (2) and (3). In (1) 'they' seems to refer to those children who ate their ice-cream. This is the same set denoted by 'few children' (call it the <u>reference</u> <u>subset</u> or <u>ref</u> <u>ss</u>). In (2) 'they' seems to refer to those children who did not eat their ice-cream. This is the entire set of children minus those denoted by 'few children' (call it the <u>complement</u> <u>subset</u> or comp ss). In (3) 'they' seems to refer to children generally (the whole set) and does not seem to relate to 'few' at all. Thus one might argue that after 'few children' the whole set of children, and the two subsets (those who ate their ice-cream and those who did not) are all potentially in focus as separate sets to which a pronoun can refer.

It has been suggested that Barwise and Cooper's 'strength' categorisation may be explained in terms of the size of the explicitly mentioned subset (ref ss) or the emphasis which is placed on the comp ss. Perhaps then, it can be explained in terms of what is emphasised in focus. Thus, 'most A are A' is positive strong because the comp ss is not in focus. If 'few' is not weak (see discussion on page 174), then 'few A are A' is likely to be categorised as negative because the comp ss is in focus, and can be quite strongly emphasised as with sentence (2) above.

It should also be noted that the only non-logical q-exp which Barwise and Cooper call monotone decreasing, is 'few' (the other q-exps denote 0%). From the discussion of this categorisation (page 176), it seems that the meaning of 'few' must expand to incorporate 0%. Why should this be? Perhaps, in some situations the comp ss is so strongly emphasised after 'few', that the ref ss is not in focus at all, just as the ref ss is so strongly emphasised after 'most' that the comp ss is not in focus. Hence, just as 'most' appears to mean 100%, 'few' appears to mean 0%.

The capacity of 'few' to place the comp ss in focus may be related to the description of 'few' as a negative q-exp (for example, by McCawley, 1981). If this were so, one would expect 'not many' which is also described as negative, to place the comp ss in focus. The intuitive acceptability of the following example supports this notion.

(1) Not many children were eating their ice-cream. They were throwing it around the room instead.

Later, there will be more discussion of implicit and explicit negativity.

<u>Preliminaries to the Experiments</u>

The experiments reported in the remainder of this thesis are empirical investigations of what is in focus after encountering sentences containing a q-exp + set + predicate, and this includes questions of which subset is in focus. As with previous experiments, the main purpose of these experiments is to discover what are the <u>actual</u> consequences of using or interpreting certain expressions. Access to these consequences is gained by analysing the ways in which subjects construct continuations from a given sentence of piece of discourse.

It would take a very long time to uncover <u>all</u> of the consequences of *every* q-exp. For this reason the studies which will be reported compare the consequences of only a limited number of expressions. These are 'a few', 'only a few', 'few', 'very few' and later 'not many'. Expressions with 'few' were chosen because of the relationships between them, as pointed out by Peterson. That is, 'few' is more like 'only a few' than 'a few' (which, it is claimed, can be the equivalent of 'exactly some').

Since 'few' is logically similar to 'only a few', but not to 'a few', one might hypothesise that 'few' and 'only a few' will have similar consequences, and that those will differ from the consequences of using 'a few'. 'Very few' was included for different reasons. It has been shown that 'very few' denotes smaller proportions than 'few' and that 'very many' denotes larger proportions than 'many'. From this one might argue that 'very' makes more extreme the proportional meaning of a q-exp. Lakoff (1972), amongst others, argues that 'very' intensifies the meaning of other words. For example 'very tall' is taller than 'tall'. His explanation of the function of 'very' is more complicated than is suggested here. However, given that the basic function of 'very' seems to be to intensify, it is possible that every aspect of the meaning of 'few' will be intensified when 'few' is preceded by 'very'. Hence, if 'few' leads one to focus on the comp ss, 'very few' should have an even stronger tendency to focus on the comp ss.

Finally, 'not many' is interesting because if negative q-exps lead one to focus on the comp ss, then one would expect 'not many', as well as 'few', to emphasise the comp ss.

The q-exps just described were also chosen because they allow an analysis of the function of each word within the q-exp. Function(s) of the word 'few' can be discovered by analysing what subjects do with sentences containing 'few' as the q-exp. The effect(s) of 'very' can then be assessed by comparing 'very few' with 'few', etc. The effects of words in expressions containing 'few' can be analysed as follows:

few = few

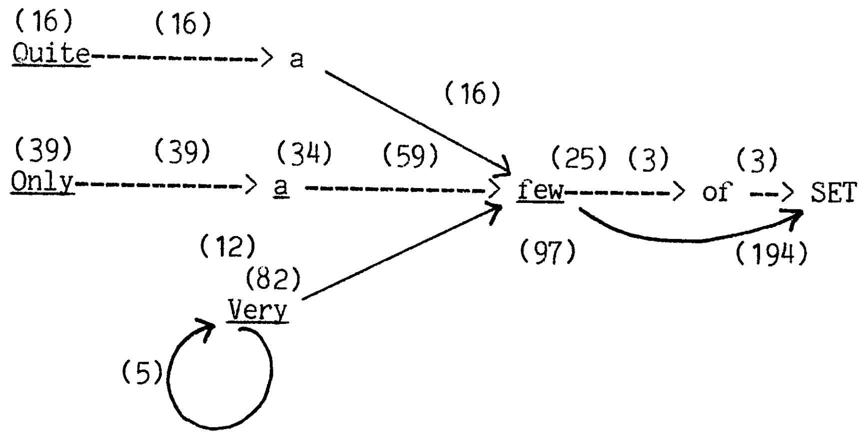
Very few - few = very

A few - few = A

Only a few - a few = only

This may seem a strange set of assumptions to make. However, it seems less strange when one considers the structure of phrases containing 'few' which were produced in experiment 1. The structure of all phrases containing 'few', 'most(ly)', 'lot(s)', 'all' and 'many' are listed along with their frequencies in Appendix A. Diagram 6.1 shows the structure of all phrases containing 'few'. The notation of the diagram is as follows: words which can appear at the start of a phrase are underlined, and the number of times which they were used at the start of a phrase appears in brackets above the word; arrows point to words which can immediately follow the word at which the arrow originates and the frequency of this association is given in brackets above the arrow; SET represents the entities denoted by a noun following the q-exp.

Diagram 6.1 - the stucture of phrases containing 'few' in exp 1.



Note that there are two 'a's' in diagram 6.1. One follows 'quite', and the other follows 'only'. The reason for this is that the arrow from 'a' to 'very' does not occur when 'a' is preceded by 'quite'. That is, no-one produced a sentence with the phrase 'quite a very'. One might argue that 'quite' and 'very' are contradictory in some sense. Earlier it was shown that 'quite' moves the range of proportions denoted by a q-exp to more moderate proportions, making 'a few' greater and 'a lot' smaller. In the same way, 'very' apears to give more extreme proportions than those denoted by the q-exps following it.

From the diagram, it is clear that when a 'few' phrase contains 'only', 'only' is always the first word. The only word which can occur between 'a' and 'few' is 'very' and this does not occur often. 'Very' always precedes 'few' immediately, unless it is followed by another 'very'. Given that the position of these words within the quantified noun phrase is so constant, it can be argued that, to be meaningful, they must be spoken/written in a particular order. For example, since 'only' is always the first word, perhaps it must be interpreted first in order to achieve the intended effects or consequences. Thus, one might even suppose that the effects of 'only a few' compared with those of 'a few' reveal the effects of 'only'.

Given the relationships between 'few', 'very few', 'only a few' and 'a few' which have so far been discussed, it is to be expected that 'few', 'only a few' and 'very few' will have similar effects on subjects' interpretations and on focus, and different effects from those of 'a few'. The experiments in the following two chapters are a test of these ideas. In summary, the results of these experiments will provide valuable information about the effects of various q-exps on the contents of focus, and hence about the way in which these expressions partition sets.

CHAPTER 7

Experiment 6 - Part One

Introduction

In the last chapter, it was argued that 'few', and perhaps certain other q-exps, may allow one to use the pronoun 'they' to refer to the comp ss. This would indicate that after intepreting a sentence with 'few', the set following 'few' is partitioned to make two subsets. The whole set and/or <u>both</u> of these subsets may be in focus.

Hypotheses can be produced to explain why 'few' might partition sets in a different way from other q-exps.

H1 - 'Few' denotes a small proportion of a set. It has been argued that information about large numbers of things may be more informative than information about small numbers of things, since information about a large proportion of a set will usually allow more accurate predictions etc. Since 'few people do X' normally implies that a large number of people do not do X, focus will be put on the more <u>informative</u> information (the comp ss).

H2 - Part of the meaning of the word 'few' may suggest that a larger number or percentage than that being asserted was expected (by the listener or speaker) and this may act as a cue for us to look for a reason why there are not more than 'few'. Since a reason for not doing X is often that one is doing Y, where X and Y cannot both be done, the (expected) reason may be that 'all minus few' are doing Y. The expectation of a reason would then make it easy to place focus on 'all minus few' of the set (the comp ss).

If H1 were true, then one would expect that other q-exps which denote small proportions would lead people to focus on the comp ss as well as the ref ss. One would therefore expect 'a few' which denotes a small proportion (similar in magnitude to 'few' - see chap 2), also to lead to some focus on the complement subset. Intuitively, this does not seem to be the case however, since (6) seems unacceptable:

?(6) A few children ate their ice-cream. They decided to throw it around the room instead.

It seems as if 'they' in (6) refers to the ref ss (those children who ate their ice-cream), and that the throwing of ice-cream was carried out by the same children perhaps at a later time. Thus, simply denoting a small proportion is most unlikely to be a sufficient condition for a q-exp to lead to focus on the comp ss, though it may be a necessary condition.

If H2 were true, one would expect that other q-exps which seem to suggest that a larger proportion was expected, would lead people to place some focus on the comp ss. 'A few' does not appear to say anything about what was expected. 'Only a few' on the other hand, does suggest that a larger proportion was expected. According to H2 therefore, 'they' in the following sentence should be interpretable as referring to the comp ss:

"Only a few children ate their ice-cream. They decided to throw it around the room instead."

Before carrying out the experiment to be described in this and the following chapter, a pilot study was carried out to investigate the hypotheses above. The pilot study compared the interpretations of 'Few', 'A few' and 'Only a few' in the same contexts. If H1 were true, all three should affect focus in the same way, since all three denote small proportions (experiments 1, 2 and 4); if H2 were true, 'Few' and 'Only a few' should have a similar effect on focus, and 'A few' should have a different effect.

In the pilot study (which is described fully in Appendix B) subjects were presented with sentences containing one of the three q-exps followed by a SET + predicate. The sentences were followed by ". They...", and subjects were asked to complete the sentences which were headed by the pronoun. It was assumed that the subjects continuations would reveal their interpretations of 'they'. That is, one should be able to judge whether 'they' had been interpreted as referring to the ref ss, the comp ss, the whole set or something else.

There were three variables in the experiment: Q-exp topic, and time difference between the events described in the first sentence and the sentence to be completed. That is, after the q-exps the sentence continued either "...MPs were at the meeting..." or "...football fans were at the match..." (topic) followed by ". They" or ". Last week they". The purpose of the first of these variables has already been explained.

The second variable (topic), was included to control for some differences between the sets to which q-exps may be attached. The maximum number of MPs at a meeting is likely to be relatively small whereas the maximum possible number of football fans is likely to be large; MPs are likely to attend meetings out of obligation whereas football fans are likely to attend matches for their own pleasure etc. These factors are not being tested individually, but it is important to know whether the effects of a q-exp hold for more than one context.

The third variable has been described as the time difference between 'events' in the first and second sentences, and has two levels - '. They' and '. Last week they'. The purpose of this variable was basically to investigate the effects of context-change on the reference of 'they'. The temporal manipulation is explained fully in appendix B.

The pilot study revealed no differences between the 'MP' and 'football fan' conditions. 'They' was nearly always taken to refer to the ref ss after 'a few' and 'only a few', although it clearly referred to the comp ss on one occasion after 'only a few'. 'Few', on the other hand, led subjects to interpret 'they' as referring to the comp ss more than 50% of the time. The temporal manipulation (the third variable) was ineffective, so that no comparison could be made between the two levels (see Appendix B).

It was decided that an analysis of the <u>causal content</u> of subjects completions would be useful since the second hypothesis concerns the need for explanation. Such an analysis may also reveal other effects or consequences of using one q-exp as opposed to another. The content categories used in the pilot study (see Appendix B) were useful for the construction of categories for experiment 6. They also revealed that 'few' often led subjects to give some explanation or reason. This was also true, to a lesser extent, of 'only a few', but it was not true of 'a few'.

Experiment 6 was designed to investigate the same questions in more detail, and to avoid some of the problems which arose with the pilot study. First of all, in the pilot study, subjects' completions did not always make it possible to infer the referent of 'they', resulting in 20 of the sentences being judged 'unclear'. Therefore, in experiment 6, it was decided that in addition to their completions, subjects should be asked to look at their completions, and report which group of people they had taken as the referent of 'they'.

Second, the temporal manipulation was discarded since it was not clear whether all subjects had understood "Last week.." in the same way. The purpose of the temporal manipulation had been to move the focus of the text in such a way that a reason would no longer be expected. In experiment 6, another manipulation was introduced to create this effect. Different connectives were introduced between the first sentence and 'they'. The connectives used were 'and', 'but', 'because' and '.'. It was hoped that these connectives would affect the degree to which the focus of the second sentence was influenced by the causal 'background' of the first sentence. A tentative hypothesis is that 'and' and 'but' will prevent any mention of the causal background of the first sentence from appearing in the second sentence. These connectives indicate temporal continuations, or consequences, of whatever precedes them, so that with these connectives we expect 'they' to refer to the ref ss, which is the subject of the first sentence. The connective 'because', however, is an explicit indicator that whatever follows will be an <u>explanation</u> of what has gone before. This should act as a release from continuations in time, and from the reader's model of what is happening in the narrative present, so that an explanation can be given. Furthermore, the release from continuation in time based on the first sentence should not only encourage mentions of the causal background of the first sentence, but should also encourage interpretations of 'they' as referring to the comp ss (if indeed it is reasonable to suppose that the need of an explanation for a small ref ss might lead to focus on the comp ss). The '.' condition, which is also included in the connective manipulation, should be neutral in terms of its influence on what follows. When the first sentence is followed by '.', the content of the second sentence and the interpretation of 'they' should be determined by factors other than the connective. This will, of course, include the q-exp.

Unlike the pilot study, experiment 6 included the q-exp 'Very few'. The reason for this has already been explained. Another difference between the pilot study and experiment 6 is that six independent judges were used, in experiment 6, to categorise all the sentences into various 'content' categories before the content analysis was carried out. This part of the experiment will be described in the next chapter.

Experiment 6

Design and Procedure

The discourse fragments to be completed by the subjects in this experiment contained 3 variables:

(1) Quantity expressions (4) - Few, Very few, A few and Only a few.

(2) 'Topic'(2) - MPs who attended a meeting or football fans who attended a football match.

(3) Connectives (4) - ., and, but, and because.

The following diagram illustrates these three factors and their various levels:

```
                      MPs/   /   /   /   / /
         football fans/   /   /   /   /1 /
                      Q1 1___1___1___1___1/1/
                      Q2 1___1___1___1___1/1/
                      Q3 1___1___1___1___1/1
                      Q4 1___1___1___1___1/
                          C1  C2  C3  C4
```

Each of the 24 cells in this diagram represents a condition in the experiment, and in each condition there were 20 independent subjects, giving a total of 640 subjects.

Subjects were presented with sentences made up of configurations of the following segments:

First part	Middle	End part
Few	Mps were at the meeting	. They____
Very few	football fans were at the match	and they__
A few		but they__
Only a few		because they__

A given subject saw only one configuration. The procedure and results for the judge's categorisations of continuations will be dealt with in the next chapter. In the remainder of this chapter, the procedure for collecting completion data will be described, and the results and analysis of the pronoun reference aspect of the study will be presented.

Part One - Referent of 'they'

The design was such that each subject completed only one sentence of the 32 possible sentences, thus, the 32 conditions were independent. Subjects were presented with the sentence on a piece of paper and asked to complete it. They were then asked to answer a question about their completion on a separate sheet of paper. The question read as follows:

Please answer the following question about the sentence you have just completed, by ticking (a), (b), (c), (d) or (e):

In the second sentence, did you use "they" to refer to:

(a) those MPs who were at the meeting or those football fans who were at the match.

(b) those MPs who were not at the meeting or those football fans who were not at the match.

(c) All the MPs or all the football fans.

(d) MPs generally or football fans generally.

(e) something else

If your answer was (e) say what "they" was used to refer to here:

____

Subjects were presented with this question after they had completed the continuation, so that their continuations should not be biased in any way.

Results

Subjects had been asked to put their names on both sheets of paper (the completion sheet and the question sheet), so that the two sheets belonging to each subject could be paired together once everything was collected in. Each completion was placed in one of the following categories:

(1) REF - where 'they' referred to the ref ss.

(2) COMP - where 'they' referred to the comp ss.

(3) ALL - where 'they' referred to all MPs/football fans or to MPs/football fans generally.

(4) OTHER - where 'they' referred to something other than (1), (2) or (3).

(5) UNCLEAR - where it was not clear what 'they' referred to.

Once the completions had been categorised in this way, they were checked against each subject's own judgements of the category to which their sentence belonged. In cases where the experimenter and the subject were in agreement, the sentence was placed in the agreed category; where the experimenter judged the completion 'unclear', the sentence was placed in the category assigned by the subject for that sentence unless, in the opinion of the experimenter, the category assigned by the subject was inappropriate. In this case the sentence was placed in the 'unclear' category. For example, one subject's completion read "Only a few football fans were at the match because they...had received orders not to attend if they intended to cause trouble". The experimenter judged this completion 'unclear' since 'they' may refer either to all football fans or perhaps to those football fans who did not attend the match. The subject however, put this sentence in the REF category where 'they' refers to those football fans who <u>did</u> attend the match. Since this is an unlikely state of affairs the sentence was placed in the 'unclear' category. Where the experimenter and the subject disagreed over the assignment of a category to a sentence, the sentence was also placed in the 'unclear' category. An example is the completion "Few MPs were at the meeting because they...were in the Houses of Parliament at the time, voting on the 'hanging' issue". The subject placed this sentence in the REF category which would imply that the same group of MPs were in two places at the same time. The experimenter had judged the sentence COMP (where 'they' refers to those MPs who were not at the meeting). Since the experimenter felt that 'they' could not refer to the reference subset, the sentence was placed in the 'unclear' category.

Once all the sentences had been categorised, the number of sentences of each type was calculated for each condition of the experiment. The total number of sentences judged 'unclear' was only 14 out of a total of 640 sentences. Since there were only 33 sentences in the 'All', 'other' and 'unclear' categories, these three categories were placed in one 'Other' category without losing much information. These results are shown in Table 7.1.

TABLE 7.1 - the frequency of 'ref', 'comp' and 'other' referents of 'they' in experiment 6 continuations

			REF	COMP	OTHER	TOTAL
Few	MP	.	5	14	1	20
		and	19	0	1	20
		but	15	4	1	20
		bec	0	18	2	20
	FF	.	9	11	0	20
		and	19	0	1	20
		but	14	6	0	20
		bec	2	16	2	20
Very few	MP	.	3	15	2	20
		and	15	3	2	20
		but	11	8	1	20
		bec	0	18	2	20
	FF	.	5	14	1	20
		and	18	1	1	20
		but	17	2	1	20
		bec	0	18	2	20
A few	MP	.	18	0	2	20
		and	20	0	0	20
		but	20	0	0	20
		bec	19	1	0	20
	FF	.	20	0	0	20
		and	20	0	0	20
		but	20	0	0	20
		bec	17	1	2	20
Only a few	MP	.	18	2	0	20
		and	20	0	0	20
		but	20	0	0	20
		bec	5	11	4	20
	FF	.	20	0	0	20
		and	19	0	1	20
		but	19	0	1	20
		bec	4	13	3	20
			431	176	33	640

An analysis of variance for contingency tables, based on Chi-square, was carried out to compare the frequency of ref ss assignments between all conditions. Given the small number of sentences in the 'other' condition, any difference in the frequencies of ref ss assignments (to the 'they' in subjects completions) between conditions, will reflect similar (reversed) differences in the frequencies of comp ss assignments. Direct analysis of comp ss frequencies is not possible because of the low expected frequencies in this class. The frequencies of sentences with 'they' judged as referring to the ref ss are shown in table 7.2 for each condition; the results of the Chi-square test are shown in table 7.3.

TABLE 7.2 - frequency of ref ss referents of 'they'

	MP				FF				total
Connectives:	.	and	but	bec	.	and	but	bec	
Few	5	19	15	0	9	19	14	2	83
Very few	3	15	11	0	5	18	17	0	69
A few	18	20	20	19	20	20	20	17	154
Only a few	18	20	20	5	20	20	19	4	125
	44	74	66	24	54	76	70	23	431

TABLE 7.3 - Analysis of variance based on Chi-square

Source	Chi-square	Df	P
topic(MP/FF)	.52	1	NS
Quantity expression(Q)	42.23	3	<.001
Connective(C)	59.09	3	<.001
topic X Q	.85	3	NS
topic X C	.67	3	NS
Q X C	21.87	9	<.01
topic X Q X C	1.03	9	NS

These results suggest that 'topic' (MPs vs. football fans) has had no significant effect, nor is there any significant interaction between 'topic' and the other factors. The q-exp at the beginning of the sentence has affected the referent assigned to 'they' ($X2=42.23$, $p<.001$), as has the type of connective preceding 'they' ($X2=59.09$, $p<.001$). There is also a significant interaction between these two factors ($X2=21.87$, $p<.01$).

In order to investigate the results further, individual Chi-square tests were carried out. First, comparisons were made between pairs of q-exps (Few vs Very few, Few vs A few, Few vs Only a few, Very few vs A few, Very few vs Only a few and A few vs Only a few). Table 7.4 shows the results of these comparisons.

TABLE 7.4 = Individual comparisons of ref ss assignments by conditions

Note - all these comparisons have df = 3; Chi-square given above significance levels.

	Very few	Few	A few	Only a few
Very few	-	2.74 NS	30.36 $p<.001$	16.03 $p<.01$
Few	-	-	24.18 $p<.001$	8.88 $p<.05$
A few	-	-	-	13.36 $p<.01$
Only a few	-	-	-	-

No significant difference was found between the frequency of ref ss referents in conditions with the q-exps 'Very few' and 'Few'. All other comparisons were significant. What is more, all these differences in the frequencies of ref ss referents of 'they' reflect differences in the frequencies of comp ss referents of 'they'. That is, a condition with a large number of sentences in the ref ss category must have a small number (if any) in the comp ss category, and a condition with a small number of sentences in the ref ss category is likely to have a large number in the comp ss category. Table 7.5(a) shows the ref ss frequencies for all combinations of q-exp and connective; table 7.5(b) shows the comp ss frequencies for the same conditions. An examination of these tables makes clear the relationship between the two categories.

TABLE 7.5 - Comp ss references partitioned by q-exp and connectives; maximum score = 40 cases.

(a) - the frequency of reference subset referents of "they"

	.	and	but	because
Few	14	38	29	2
Very few	8	33	28	0
A few	38	40	40	36
Only a few	38	39	39	9

(b) the frequency of compliment subset referents of "they"

	.	and	but	because
Few	25	0	10	34
Very few	29	4	10	36
A few	0	0	0	2
Only a few	2	0	0	24

The pattern of results for 'Few' and 'Very few' appears to be very similar, although 'Very few' shows a slightly greater tendency towards comp ss referents than does 'Few'. This tendency is affected by the connective preceding 'they' however. 'And' appears to remove the tendency almost completely, 'but' reduces it slightly less than 'and', '.' makes the referent of 'they' more likely to be the comp ss than the ref ss, and 'because' makes the referent of 'they' almost certain to be the comp ss. 'A few' appears to result in 'they' referring to the ref ss regardless of the connective preceding 'they', and 'Only a few' results in 'they' referring to the ref ss when preceded by '.', 'and' and 'but', but not when preceded by 'because'. 'Only a few' + 'because' results in the comp ss being the referent of 'they'.

In order to verify these individual effects of q-exps and connectives, eight further Chi-square tests were carried out. The first four tested for significant changes in the referent of 'they', depending on the q-exp at the beginning of sentences containing each of the four connectives. That is, a Chi-square test was carried out for differences between the q-exps when the connective was '.', another was carried out for 'and' etc. There was no significant difference in the referent of 'they' between the 4 q-exps when the connective was 'and' ($X2=.78$, $df=3$), or when the connective was 'but' ($X2=3.58$, $df=3$). Significant differences did occur however, when the connective was '.' ($X2=30.49$, $df=3$, $p<.001$) and when the connective was 'because' ($X2=70.53$, $df=3$, $p<.001$). The other four Chi-square tests tested for significant changes in the referent of 'they' depending on the connective preceding 'they' in sentences which began with each of the four q-exps. That is, a Chi-square test was carried out for differences between connectives when the q-exp was 'Few', another for 'Very few' etc. There was no significant difference in the referent of 'they' between the 4 connectives when the q-exp was 'A few' ($X2=.29$, $df=3$), but there were significant differences when the q-exp was 'Few' ($X2=36.75$, $df=3$, $p<.001$), 'Very few' ($X2=43.29$, $df=3$, $p<.001$) or 'Only a few' ($X2=21.14$, $df=3$, p<.001).

The results of these tests are represented systematically in Table 7.6, where Q indicates that any change is due to the q-exp, C indicates that any change is due to the connective and QC indicates that any change is due to both the q-exp and the connective or to some interaction between these two factors. The table also gives the direction of the changes. The corresponding cells in tables 7.5(a) and 7.5(b) were compared and that the table whose cell has the largest frequency was taken to represent the direction of the change. For example, if the ref ss table has a higher frequency than the comp ss table, the direction of change is towards the ref ss being the referent of 'they' and vice versa.

TABLE 7.6 Key: REF - any change is towards the reference subset
COMP - any change is towards the complement subset

	.	<u>and</u>	<u>but</u>	<u>because</u>
Few	QC comp	C ref	C ref	QC comp
Very few	QC comp	C ref	C ref	QC comp
A few	Q ref	ref	ref	Q ref
Only a few	QC ref	C ref	C ref	QC comp

From table 7.6, it appears that the q-exp does not influence the effects of 'and' or 'but' on the referent of 'they', and the connective does not influence the effects of 'A few' on the referent of 'they'. The table allows a few generalisations or heuristics to be used concerning the group of entities in 'focus' after a simple sentence beginning with any of the four q-exps above:

Few SET - 'focus' will be on the complement subset unless the sentence is connected by 'and' or 'but' to another sentence.

Very few SET - 'focus' will be on the complement subset unless the sentence is connected by 'and' or 'but' to another sentence.

A few SET - focus on reference subset regardless of the connective.

Only a few SET - focus on reference subset unless connective is 'because'.

Certainly, H1 does not explain these results, since all four q-exps denote similarly small proportions, yet they do not affect 'focus' in the same way. Nor do they influence the effect of connectives on 'focus' in the same way. H2 may explain the results in part. 'Very few', 'Few' and 'Only a few' all seem to imply that more than this proportion was expected, whereas 'A few' does not seem to imply anything about the proportion expected. From table 7.6, 'A few' always makes it most likely that 'focus' will be on the ref ss. This is not the case for the other q-exps which, depending on the connective, can place focus most readily on the comp ss. Except for those simple sentences followed by 'and' or 'but', 'Few' and 'Very few' make it most likely that 'focus' will be on the comp ss, as does 'Only a few' when the connective is 'because'. H2 may explain the difference between q-exps when the connective is 'because', and it may explain the difference between 'Few'/'Very few' vs 'A few' when the sentence ends with '.', but it does not explain the difference between 'Few'/'Very few' vs 'Only a few' when the sentence ends with '.'.

In order to explain these results further, it is necessary to find out more about the effects of the four q-exps and the four connectives. The results presented in this chapter followed from an analysis of the 'referents' of 'they' in subjects completions, and this has provided some explanation of the differences between the four q-exps and connectives. Neither H1 nor H2 can explain these results fully. Earlier, it was mentioned that H2 might be more thoroughly explored, if an analysis was carried out on the causal content of subjects completions. H2 states that some q-exps may carry information to the effect that the predicate is true of a smaller proportion of the set than the proportion expected. This will often lead the interpreter to place focus on the comp ss because the violation from expectation will increase the likelihood that a <u>reason</u> will be given in subsequent discourse.

In the next chapter, the second part of this experiment is described. This part of the experiment was designed to look at the content of subjects completions, and to test for differences dependent on the three factors of the experiment - q-exp, connective, and topic. The results of the second part, along with the results presented in this chapter, will provide a more detailed account of the effects of q-exps (and connectives), and allow a more direct test of H2.

CHAPTER 8

Analysis of Content, and a Supplementary Experiment

Introduction

This chapter describes an analysis of the content of the continuations produced by the 640 subjects, in the experiment discussed in the last chapter. Particular attention is paid to statements of cause and reason. The purpose of the present analysis is to discover any difference in the content of completions which is dependent on any of the experimental variables of q-exp, connective, and topic.

In one of the hypotheses considered in the last chapter, H2, it is assumed that certain q-exps are more likely than others to be followed by completions which provide causal information as an explanation for the relationship between the (sub)set and the predicate. Potentially, this tendency to complete the sentence with a 'reason' could explain the finding that when certain q-exps are followed by 'they', the referent of 'they' is more likely to be the comp ss than the ref ss. If a 'reason' is to be given, it will often concern properties of those set members of whom the predicate is not true (the comp ss). To the extent that this is the case, the comp ss will be in focus, and will be the referent of 'they'.

In the last chapter it was assumed that 'Few', 'Very few' and 'Only a few' all implied (to some extent) that the proportion of the set for which the predicate is said to be true is smaller than the proportion of the set for which one would expect the predicate to be true. It was shown that 'Few' and 'Very few' did in fact lead to comp ss referents of 'they', which in accordance with the above argument, might be explained by their tendency to require explanations. 'Only a few', however, did not often lead to comp ss referents of 'they'. The second part of the experiment is an investigation of the relationship between the use of causal information in completions and the use/interpretation of 'they' as referring to the comp ss. The results of the content analysis may also explain the difference between 'Only a few' and 'Few'/'Very few'.

Information and Categories presented to Judges

The judges were presented with the following:

"There are five major categories and two questions to be filled in for each completion. Within each of the categories there are a few sub-categories which can be put into the "Remarks" column.

Categories

Categories are chosen by ticking the appropriate one and putting a cross in all the other boxes. Only one major category should be ticked. Some of the sentences will fit more than one of the categories, in which case you should pick the one you think is the most obvious.

Subcategories are just an attempt to get more information. After ticking a major category, write the number of the major category in the "remarks" column (on the record sheet) and then put the relevant subcategories. The number of subcategories you want to put may vary from one to all! Feel free to put as many as you think are necessary.

1. Reason (there) - This category should be chosen if the subject's sentence provides a reason why the MPs/football fans attended the match. The subcategories for this category are:

(a) If the reason is attributable to the MPs or football fans eg, preference, personality, etc.

(b) If the reason involves some property of this or previous meetings or matches.

(c) If the reason concerns physical circumstance eg. the weather, duties elsewhere, etc

(d) If the reason has nothing to do with any of the above.

2. Reason (not there) - This category should be chosen if the subjects sentence provides a reason why the MPs/football fans DID NOT attend the meeting/match. The subcategories for this category are:

(a) If the reason is attributable to the MPs or football fans eg, preference, personality, etc.

(b) If the reason involves some property of this or previous meetings or matches.

(c) If the reason concerns physical circumstance, eg, the weather, duties elsewhere, etc.

(d) If the reason has nothing to do with any of the above.

3. Conseq. number - This category should be chosen if the subjects sentence tells of some consequence of the number of MPs or football fans who did/did not attend, or of something which happened in spite of the number attending. The subcategories for this category are:

(a) If the MPs or football fans took some action, felt something or if something happened to the MPs or football fans as a result of the number who attended.

(b) If something happened to the meeting, eg, it was cancelled.

(c) If whatever happened was IN SPITE OF the number of MPs or football fans who attended.

(d) If none of the other subcategories fit.

4. Consequence - This category should be chosen if the subjects sentence tells of some consequence of the meeting or match or some consequence of the circumstances, (or in spite of them). The subcategories for this category are:

(a) If the consequence was an action or feeling on the part of the MPs/football fans or if something happened to them as a result of the meeting/match/circumstances.

(b) If something happened to the meeting/match.

(c) If whatever happened was in spite of the meeting/match.

(d) If none of the other subcategories fit.

5. Other - This category should be chosen if none of the other categories seem appropriate.

Columns 6 and 7 are questions to be answered for each subject:

6. People - If you think that the meeting attended by the MPs was also attended by non-MPs eg. the public, tick this box. Likewise if you think there were non-football fans at the match (except the players etc.) then tick this box. Otherwise put a cross.

7. Overall - If you think that the whole sentence(s) are quite positive eg. happy, optimistic, cheery etc. put +ve; if you think they are negative eg. miserable. pessimistic, depressing, put -ve; otherwise put a dash.

I hope these categories are easy to use. Try to make a few inferences from what subjects have said, but don't abstract too much or every sentence will be in every category! Thanks very much for doing this."

The five major categories were chosen so that causal content could be compared between conditions; the subcategories were introduced in order to look at the kinds of attributions made in case there is any consistency at this level. The first question, (6), was included in order to discover any completions which did not treat the q-exp as a proportion, but as an amount. For example, it is possible to interpret the first sentence as involving a meeting which some MPs and some non-MPs attended, so that the q-exp + set represents the absolute number of people who are MPs at a public meeting rather than a proportion of MPs at an MPs meeting. This is less likely with a football match, but it is possible that for example, there were a lot of rugby fans at the football match. If many subjects had interpreted the first sentence in this way, the results may be distorted since with this sort of interpretation 'they' will or at least could refer to a different variety of things.

The second question, (7), was included as a measure of the positive or negative <u>tone</u> of the q-exp and connectives. It was felt that some q-exps may be more likely to accompany 'positive' information than others. It may be, for example, that q-exps containing the article 'a' eg 'Only a few MPs' or 'A few MPs' will be followed by 'positive' information about the MPs denoted by them (the ref ss), whereas 'few' and 'Very few' are more likely to be followed by 'negative' information about MPs other than those denoted by them (the comp ss). 'A few' and 'Only a few' lead to more ref ss focus than 'Few' or 'Very few'. Also, in this experiment, those who attended the meeting/match are likely to have positive information associated with them (where they are mentioned) whereas those who did not attend the meeting/match are likely to have negative information associated with them (where they are mentioned). If these assumptions are correct, a difference in positive/negative scores between 'Only a few' vs 'few'/'very few' conditions may explain the difference in ref ss focus between these conditions. That is, 'Only a few' may carry with it a positive <u>tone</u>, which leads to completions containing positive information about those who attended the meeting/match, which in turn leads to focus on the ref ss. In other words, H2 may be correct insofar as q-exps which imply that more was expected lead to comp ss referents of 'they', with the exception of q-exps containing 'a', since this article places focus on 'positive' information and hence, in this experiment, on the ref ss.

Experiment 6, Part two

Procedure and Design

Six independent judges were provided with the categories discussed above, and with record sheets on which all categories and answers were to be recorded for each of the 640 completions. The completions were put into alphabetical order according to the subjects names, and numbered from 1-640, so that judges were not given the completions in an order related to the conditions of the experiment. The completions were put into batches of 100, and judges were given one batch at a time until each judge had categorised all 640 completions. The entire task took each judge about six hours to complete, for which they were paid 20 pounds.

Results

Before looking at the results of the analyses of the categories, it is important to know whether the results of experiment 6 have been affected by the possibility of non-MPs attending the meeting or non-football fans attending the match (see the explanation for number 7 of the judges categories on page 217). The following table shows the number of sentences thought to involve non-MPs/non-football fans, and the number of judges who made this judgement in each case:

Number of sentences		Number of judgements
60	@	1
14	@	2
4	@	3
1	@	4
0	@	5
0	@	6
(max. possible = 640)		(max. possible = 6)

Very few sentences were judged to imply the presence of non-MPs/non-football fans at the meeting/match by more than 2 judges and no sentence was judged in this way by more than four of the six judges. It is therefore unlikely that the results have been affected by interpretations involving the presence of non-MPs or non-football fans within the set of people at the meeting or match.

The first analysis in this section will be of the way in which completions were assigned over the five major categories. These categories were designed to assess the causal content of sentences so that any relationship between this and the 'referent of they' analysis can be discovered. After this analysis, the subcategories and the positive/negative scores assigned to subjects sentences will be considered.

Major Categories

The judges' categories for the completions were sorted into the 32 conditions of the experiment. The number of judges selecting each particular category for each sentence was calculated, so that the minimum score per sentence was 0 (if no judge placed the sentence in the category), the maximum score was 6 (if all the judges placed the sentence in the category), and the total for each sentence across all major categories was 6. The sum of scores in each category was calculated for all the sentences in each of the conditions. Categories 4 (Consequence) and 5 (Other) on the judges category sheet were collapsed since neither of these categories contain completions with causal information related to the first sentence, and it is the presence of this type of information which is of interest. All of the information about the major categories provided by each of the judges was included in this analysis. That is, the number of judges who categorised each sentence in a particular way was recorded and used in the analyses. Hence, it was felt that a test of concordance between judges was unnecessary.

The mean scores for the four categories analysed ((1) Reason there, (2) Reason not there, (3) Consequence of number and (4) Other (4 and 5 collapsed)), are shown in Table 8.1 (a) - (d).

TABLE 8.1 - The mean scores for each category, in all conditions of the experiment (the maximum score for each cell is 6.

(a) Reason there - completions judged to contain a reason why MPs/FFs attended the meeting/match.

	MPs				Football fans			
	.	and	but	bec	.	and	but	bec
Few	.15	0	.35	.25	.85	0	.1	.1
Very few	.05	.25	1	.05	.2	.2	.05	0
A few	.8	.2	.5	5	1.35	.35	.3	4.6
Only a few	2	.4	.2	1.35	2.15	.15	.3	.9

(b) Reason not there - completions judged to contain a reason why MPs/football fans DID NOT attend the meeting/match.

	MPs				Football fans			
	.	and	but	bec	.	and	but	bec
Few	4.3	.6	.55	5.7	3.35	.25	1.45	5.8
Very few	4.8	.55	1.4	5.95	4.7	.65	.65	6
A few	.25	.15	.3	.9	.3	.2	.35	.95
Only a few	.9	.25	.25	4.6	.4	.15	.1	4.7

(c) Conseq. no. - completions judged to contain some consequence of the number of MPs/football fans who attended the meeting/match.

	MPs				Football fans			
	.	and	but	bec	.	and	but	bec
Few	.4	1.9	3.75	0	.5	2.7	3.95	0
Very few	.4	2.45	2.2	0	.55	1.45	3.5	0
A few	.75	.9	1.4	.05	.7	1	2.5	.25
Only a few	.6	1.65	3.75	0	.75	1.6	4.2	.05

Table 8.1 continued...

(d) Other - all completions not judged as (a), (b) or (c).

	MPs				Football fans			
	.	and	but	bec	.	and	but	bec
Few	1.15	3.5	1.35	.05	1.3	3.05	.5	.1
Very few	.75	2.75	1.4	0	.55	3.7	1.8	0
A few	4.2	4.75	3.8	.05	3.65	4.45	2.85	.2
Only a few	2.5	3.7	1.8	.05	2.7	4.1	1.4	.35

Four parametric Anovas were carried out, one on each of the four categories. Each Anova had 3 between subjects factors: Q-exp (4 levels), Connective (4 levels) and topic (MPs vs football fans ie. 2 levels). An arcsin transformation was carried out on the data before calculating the Anovas, since the data is binomial. Table 8.2 (a) - (d) shows the results of the Anovas.

TABLE 8.2 - Anova tables for each of the 4 major categories

Key - A = Q-exp
B = Connective
C = Topic
E = Error

(a) Reasons there - completions judged to contain a reason why MPs/football fans attended the meeting/match.

Source	SS	DF	MS	F	P
Total	199.3094	639			
A	24.6372	3	8.2124	50.7827	0.000000
B	20.3420	3	6.7807	41.9293	0.000000
AB	53.4231	9	5.9359	36.7055	0.000000
C	0.0461	1	0.0461	0.2848	NS
AC	0.2469	3	0.0823	0.5089	NS
BC	1.3870	3	0.4623	2.8589	0.034253
ABC	0.9033	9	0.1004	0.6206	NS
EABC	98.3238	608	0.1617		

(b) Reason not there - completions judged to contain a reason why MPs/football fans DID NOT attend the meeting/match.

Source	SS	DF	MS	F	P
Total	460.2951	639			
A	82.0117	3	27.3372	127.9739	0.000000
B	181.1975	3	60.3992	282.7468	0.000000
AB	63.9727	9	7.1081	33.3751	0.000000
C	0.1948	1	0.1948	0.9118	NS
AC	0.1709	3	0.0570	0.2667	NS
BC	0.6326	3	0.2109	0.9871	NS
ABC	2.2366	9	0.2485	1.1634	0.315005
EABC	129.8783	608	0.2136		

(c) Conseq. number - completions judged to contain some consequence of the number of MPs/football fans who attended the meeting/match.

Source	SS	DF	MS	F	P
Total	287.3948	639			
A	6.0529	3	2.0176	7.5518	0.000158
B	101.1380	3	33.7127	126.1824	0.000000
AB	12.0124	9	1.3347	4.9957	0.000017
C	0.7859	1	0.7859	2.9415	0.081168
AC	0.1413	3	0.471	0.1763	NS
BC	2.0337	3	0.6779	2.5373	0.050600
ABC	2.7885	9	0.3098	1.1597	0.317521
EABC	162.4420	608	0.2673		

Table 8.2 continued...

(d) Other - All completions not judged as (a), (b) or (c).

Source	SS	DF	MS	F	P
Total	346.8757	639			
A	32.8049	3	10.9350	39.1733	0.000000
B	122.2136	3	40.7379	145.9389	0.000000
AB	17.6717	9	1.9635	7.0341	0.000001
C	0.0653	1	0.0653	0.2339	NS
AC	1.6228	3	0.5409	1.9379	0.119017
BC	1.0647	3	0.3549	1.2714	0.281801
ABC	1.7135	9	0.1904	0.6820	NS
EABC	169.7192	608	0.2791		

The four Anovas in Table 8.2 are statistically related, since the four categories on which they are based are related. That is, the sum of all corresponding cells in table 8.1 (a)-(d) is 6, corresponding to the number of judges. All four Anovas show that categories assigned to sentences are significantly different for different q-exps (factor A) and for different connectives (factor B). They also show a significant interaction between these two factors. Topic (factor C) is never a significant factor, and neither are any of its interactions with q-exp and connective. Since there is no significant difference between MP and football fan conditions, we can represent the results more simply by omitting the topic factor. Table 8.3 (a)-(d) shows the mean judge-scores for completions in each of the conditions for each of the four categories.

TABLE 8.3 - The mean scores for each category, in each condition of the experiment when the topic factor is omitted.

(a) Reasons there - a reason why they attended.

	.	and	but	bec
Few	.5	0	.225	.175
Very Few	.125	.225	.525	.025
A Few	1.075	.275	.4	4.8
Only a Few	2.075	.275	.25	1.125

(b) Reasons not there - a reason why they DID NOT attend.

	.	and	but	bec
Few	3.825	0.425	1	5.75
Very Few	4.75	.6	1.025	5.975
A Few	.275	.175	.325	.925
Only a Few	.65	.2	.175	4.65

(c) Consequence of number attending.

	.	and	but	bec
Few	.45	2.3	3.85	0
Very Few	.475	1.95	2.85	0
A Few	.725	.95	1.95	.15
Only a Few	.675	1.625	3.975	.025

(d) Other

	.	and	but	bec
Few	1.225	3.275	.925	.075
Very Few	.65	3.225	1.6	0
A Few	3.925	4.6	3.325	.125
Only a Few	2.6	3.9	1.6	.2

Mean scores of two and over are underlined in Table 8.3 , so that it is easier to recognise those conditions whose completions were most likely to be judged as belonging to each category. By comparing cells in table 8.3 (a)-(d), one can assess the most likely category assigned to sentences in each of the conditions. For example sentences with 'Few' followed by '.' were most likely to be followed by reasons why the MPs or football fans did not attend the meeting/match (category 2 - reasons not there); sentences with 'Few' and 'but' were most likely to be followed by some consequence of the number of MPs or football fans who attended (category 3 - conseq. number) etc. Table 8.4 was constructed by assessing the most likely category for each cell in this way. The names of the most likely categories are written in the cells along with the mean score for that category in the condition corresponding to the cell. Note that some cells have two 'most likely' categories, because the mean scores for both categories were over 2.

<u>TABLE 8.4 - The 'most likely' categories assigned to sentences in each of the experimental conditions</u>

Key : R - reason there
RNT - reason not there
Conseq. - consequence of number

	<u>.</u>	<u>and</u>	<u>but</u>	<u>bec</u>
Few	RNT (3.825)	Other (3.275) Conseq (2.3)	Conseq (3.85)	RNT (5.75)
Very few	RNT (4.75)	Other (3.225)	Conseq (2.85)	RNT (5.975)
A few	Other (3.925)	Other (4.6)	Other (3.325)	R (4.8)
Only a few	Other (2.6) R (2.075)	Other (3.9)	Conseq (3.975)	RNT (4.65)

Compare Table 8.4 with Table 7.6 (page 208), which is reconstructed here:

	.	and	but	bec
Few	QC comp	C ref	C ref	QC comp
Very few	QC comp	C ref	C ref	QC comp
A few	Q ref	ref	ref	Q ref
Only a few	QC ref	C ref	C ref	QC comp

All the cells in this table which indicate a change in the direction of 'they' referring to the comp ss, correspond exactly with all the cells in Table 8.4 where sentences were judged most likely to contain a reason why MPs/football fans did not attend the meeting/match. This shows a strong relationship between the need for providing a reason for not attending and the referent of 'they' being those who did not attend (the comp ss). This may or may not be a necessary relationship and it is difficult to find any logically necessary connection between the comp ss and 'reason not-there' continuations. Intuitively however, there is a necessary relationship. If one wishes to explain why those who did not attend did not attend, and one makes reference to some subset of MPs, then surely this subset has to be the MPs who did not attend (the comp ss). If one does make reference to the comp ss, the most coherent continuations will surely contain a reason why the comp ss did not attend. However, this relationship from comp ss to 'reason not-there' is not <u>necessary</u>, as (1) shows:

(1) Few MPs were at the meeting. They sent their apologies however.

All the ref ss cells in the above table correspond with 'Reason there', 'Conseq. number', and 'Other' cells in Table 8.4. The relationship between table 8.4 and table 7.6 will be discussed more fully in the discussion section. Note, however, that the correspondence between comp ss referents and causal information is consistent with the assumption made in H2, ie., that the need for an explanation makes focus on the complement subset more likely.

<u>Positive/negative Scores</u>

Before embarking on the discussion, the positive/negative scores assigned by judges to subjects completions must be considered. These were introduced as a measure of the positive and negative <u>tone</u> of the q-exps. It has been suggested that the article 'a' may create a positive tone in the phrases 'a few' and 'only a few', thus leading to continuations containing positive information about the ref ss. If 'a' does have such an influence, this may explain the difference in frequencies of ref ss referents between 'only a few' conditions and 'few'/'very few' conditions. It will also be interesting to discover any relationship between the positive/negative scores and the information contained in the two tables (8.4 and 7.6) just discussed.

The judges were asked to state whether each sentence was 'positive' or 'negative' in <u>tone</u>, by marking +ve (positive), -ve (negative), or - (don't know) under question 7 on the record sheet. Almost 50% (1834 out of 3840) of all the judges scores for all the sentences were 'negative'. Hence, by looking at the differences in mean negative scores between conditions, one should be able to infer any differences in the positive/negative tone of sentences in different conditions. The means were calculated in the same way as the means for each category in the major category analysis, and they are shown in Table 8.5. After carrying out an Arcsin transformation, an ANOVA was applied, and the summary is shown in table 8.6.

TABLE 8.5 - The mean negative-scores for sentences in all conditions

	MPs				Football fans			
	.	and	but	bec	.	and	but	bec
Few	3.45	3.65	1.1	3	3.05	3.75	1.35	4.15
Very few	2.95	4.4	1	3.05	2.35	4.15	1.45	4.55
A few	2.9	1.95	4.2	1.6	2.4	2.2	3.7	2.55
Only a few	2.25	3.25	1.85	3.15	2.9	4.2	1.4	3.8

TABLE 8.6 - Key: A - Q-exp
B - Connective
C - topic
E - error

Source	SS	DF	MS	F	P
Total	367.7383	639			
A	0.7886	3	0.2629	0.5512	NS
B	22.7024	3	7.5675	15.8697	0.000001
AB	44.7769	9	4.9752	10.4335	0.000000
C	1.4659	1	1.4659	3.0742	0.074504
AC	0.3999	3	0.1333	0.2795	NS
BC	4.5393	3	1.5131	3.1731	0.022375
ABC	3.1403	9	0.3489	0.7317	NS
EABC	289.9249	608	0.4769		

Of the three major factors, q-exp, connective and 'topic', only the connective factor was significant. That is, the connective preceding 'they' influences judgements of the positive/negative tone of the sentence. The interaction between q-exp and connective is also significant, suggesting that effects produced by the connective are influenced by the q-exp at the beginning of the sentence. The interaction between connective and topic was significant also, to a lesser extent ($F=3.1731, df=3, p=.022375$), suggesting that the effects produced by the connective are also influenced by the topic (that is, whether the topic was MPs at a meeting or football fans at a match).

From table 8.5, '.' appears to be between negative and positive in tone, and this does not seem to be affected by the q-exp or the topic. 'and' is fairly negative except when the q-exp is 'a few', and especially when the q-exp is 'very few'. Again, this does not seem to be affected by the topic. 'but' produces a fairly positive tone regardless of topic, but when it is preceded by 'a few', the tone becomes more negative. 'because' produces a negative tone which seems more extreme when the topic is football fans at a match than when the topic conerns MPs at a meeting. Again, the presence of 'a few' as q-exp seems to reverse the overall tone to positive. These results can be summarised: 'and' and 'because' produce a negative tone ('because' more than 'and'), and 'and' is more negative with 'very few'; 'but' produces a positive tone and '.' is fairly neutral. 'A few' reverses the tone produced by the connective, and the negative tone produced by 'because' may be more or less extreme depending on the topic.

The main purpose behind this analysis was to discover any differences in positive/negative tone between q-exps. It was felt that perhaps the presence of the article 'a' in a q-exp would make it more positive, and hence make focus on the ref ss more likely. Since the q-exp has had no significant effect on the positive/negative tone, and since its influence on the effects of the connective appears to be due only to 'a few' rather than '<u>a</u> few' and 'only <u>a</u> few' it must be concluded that the article 'a' does not in itself affect positive/negative tone.

Subcategories

Although the subcategory data has been analysed, it has not been included here since the information provided by these analyses is not relevant to the arguments being made here.

In the next chapter, information from the various analyses carried out in this chapter will be put together to produce a more integrated picture of how the different q-exps and connectives have been made to function in this experiment. The greatest attention will be given to the 'referent of 'they' and the 'major category' analyses, since these are more general and less speculative that the positive/negative scores.

Reference Patterns and Continuation Content for 'Not many'

Before discussing the results of experiment 6 part 2 any further, a report is given of a supplementary experiment (experiment 7) which was carried out in order to test an idea suggested earlier, in chapter 6. It has been argued that 'few' is a negative q-exp (eg. McCawley, 1981). Experiment 6 has shown that 'few' and 'very few' can lead to focus on the comp ss, while 'only a few' and 'a few' almost exclusively lead to focus on the ref ss. Also, when the connective presented was '.', 'few' and 'very few' were usually followed by a 'reason not-there' continuation. 'Only a few' and 'a few' were followed by 'reason there' continuations. This state of affairs is not consistent with H1 which states that q-exps denoting small proportions will lead to focus on the comp ss. If H1 were true all four q-exps would lead some subjects to use 'they' as a referent of the comp ss. H2 may explain the results in part. This hypothesis was that q-exps which denote proportions smaller than the proportion expected will lead to focus on the comp ss. Since 'only a few' did lead to focus on the comp ss on one occasion, one might argue that this supports H2. However, H2 does not explain why 'few' and 'very few' place focus on the comp ss so much more often than does 'only a few'. Also, 'only a few' is followed by 'reason not-there' continuations if the connective is 'because', but not if the connective is '.'. H2 does not explain the continuations after 'only a few' + '.'.

In addition to H1 and H2, let us consider another hypothesis:

H3 - Negative q-exps will allow the pronoun 'they' to refer to the comp ss, thus placing focus on the comp ss.

If one can assume that 'very few' as well as 'few' is a negative q-exp, then the results of experiment 6 support this hypothesis. Given the ad hoc nature of this argument H 3 is not very convincing. However, McCawley (1981) also states that 'not many' is a negative q-exp. Indeed, Peterson (1979) has argued that 'not many' is equivalent to 'few'. If McCawley is correct, then according to H3 'not many' should place the comp ss in focus. If Peterson is correct, then 'not many' should not only place the comp ss in focus, but it should do this with approximately the same frequency as 'few'.

The following example shows that 'not many' can place focus on the

comp ss, since 'they' can be used to refer to the comp ss:
Not many children ate their ice-cream. They prefered to throw it around the room instead.

The phrase 'not many' contains <u>explicit</u> negation, and an explicit reference to a large proportion ('many'). This q-exp therefore differs from 'few', which does not explicitly refer to a large proportion nor does it contain explicit negation. If 'few' is negative, this aspect of it's meaning is <u>implicit</u>. It seems likely then, that although 'not many' and 'few' can place focus on the comp ss, they will do this in different ways, and possibly to different extents. If this turns out to be the case, then 'few' and 'not many' cannot be taken as precisely equivalent in this respect (it has already been shown by exp 3 that these q-exps also lead to different expectations).

<u>Part One</u>

<u>Materials</u>

The materials used in this experiment were the same as those used for experiment 6, except that the q-exp was always 'not many'. That is, there were two topics (football fans and MPs) and four connectives (., and, but and because). Subjects were presented with uncompleted sentences in the same way as before, and they were asked to complete the sentence and answer a question to clarify the referent of "they", as before.

Subjects

Subjects were 96 students from the ordinary psychology class at the University of Strathclyde, the B.N. course at the University of Glasgow, and the first year engineering class at the University of Glasgow. Each subject completed only one sentence so that the 8 conditions were independent with 12 subjects in each condition.

Results

The frequency of comp ss and ref ss referents of 'they' were calculated for each of the 8 conditions, as they were for experiment 6. A 2x2 Chi Square test was carried out on the data to check for any differences in the frequency of ref and comp ss referents between MP conditions and football fan conditions. No significant difference was found ($X2 = 1.02$, $df = 1$). Table 8.7 therefore shows the number of comp ss and ref ss referents for experiment 7 when the two topics (MPs and football fans) are collapsed.

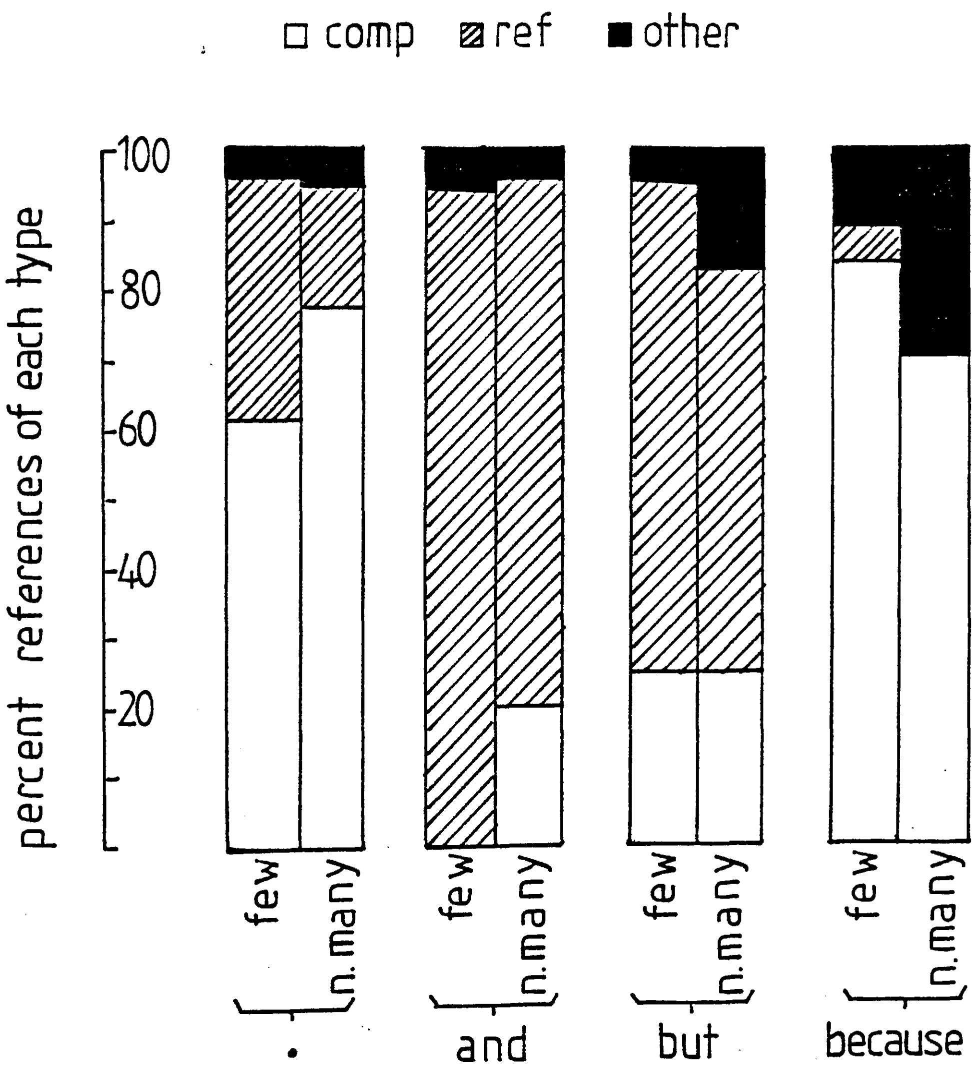
Table 8.7 = Frequency of ref and comp ss referents of 'they' for the four connectives in exp 7.

	REF SS	COMP SS
.	4	19
and	18	5
but	14	6
because	0	17
	36	47

The Chi Square test makes it possible to compare the frequencies of comp and ref ss referents between experiment 7 and the 'few' conditions of experiment 6, although the number of subjects in each cell of these experiments is different (when the topic factor is ignored exp 6 has N = 40 in each cell, and exp 7 has N = 24). The difference in Ns means that a table showing the absolute frequencies for 'few' conditions and 'not many' conditions would be difficult to interpret. Figure 8.1 therefore shows the comp and ref ss referents for 'few' and 'not many' expressed as proportions of the total frequency for each cell, rather than as absolute frequencies.

Figure 8.1 shows that, like 'few' and 'very few', 'not many' tends to place focus on the comp ss when the connective is '.' or 'because'. Indeed a 2x2 Chi Square test shows that there is no significant difference in the number of ref versus comp ss referents between the 'few' and the 'not many' conditions ($X2 = 2.2787$, $df = 1$, $p < .1$). However the X2 value has less than a 10% chance ($P < .1$) of occurring by chance, which means that the difference between 'few' and 'not many' is almost significant, and one cannot assume that in this respect 'few' and 'not many' are equivalent.

Figure 8.1 - comp and ref ss referents for 'few' and 'not many' as proportions of the total frequency for each condition.



Another Chi Square test was carried out to test the differences between 'not many' conditions depending on the connective. The connective was found to be a very significant factor ($X2 = 36.52$, $df = 3$, $p < .001$). What is more, figure 8.1 suggests that the influence of each connective is in the same direction for 'not many' as for 'few'. That is, '.' and 'because' lead to many comp ss referents and 'and' and 'but' lead to hardly any comp ss referents.

This result lends some support to all three hypothesis, since 'not many' denotes a small proportion (H1), at least in some contexts it indicates that the proportion denoted is smaller than was expected (H2), and it is a negative q-exp (H3). However, the most specific hypothesis,H3, can explain the results of experiments 6 and 7 more convincingly than H1 or H2 alone. H1 is not supported by the 'a few' and 'only a few' conditions; H2 is not supported by the 'only a few' condition where only one subject used 'they' to refer to the comp ss when the connective was '.'.

Part Two

Judges Categorisations

As with the completions produced by subjects in experiment 6, judges were asked to categorise the sentences completed in experiment 7. The same major categories were used (see page 214), but only 2 judges were asked to carry out the task. Both had been judges in the earlier study. Since both judges agreed on the category assigned for each of the 96 completions, the results will be represented according to the category assigned to each sentence rather than the number of judges who assigned a particular category to each sentence. Table 8.8 shows the number of sentences in each condition of experiment 7, placed in the four major categories (categories 4 and 5 were collapsed as they were in experiment 6).

The total frequencies for each category in table 8.8 show that the 'reason not-there' category is by far the most common category for completions of sentences containing 'not many'. That is 46 of the 96 sentences continued with a reason why MPs/fans did not attend the meeting/match. Also note that this effect is due to sentences with the connectives '.' and 'because' just as with 'few' and 'very few' in experiment 6.

Table 8.8 - Frequency of sentences assigned to each category in exp 7

Key: 1 - Reason there
2 - Reason not-there
3 - Conseq. number
4 - Other

		1	2	3	4
.	MP	0	10	0	2
	fans	0	10	1	1
and	MP	0	0	7	5
	fans	0	0	3	9
but	MP	0	2	7	3
	fans	0	0	5	7
because	MP	0	12	0	0
	fans	0	12	0	0
		0	46	23	27

A 2x2 Chi Square was carried out to test for differences in the 'reason not-there' versus all other categories (1, 3 and 4) between MP and fans conditions. No significant difference was found (X2 = .042, df = 1). After collapsing the topic conditions, another X2 was carried out to test differences between connectives. These were found to be very significantly different (X2 = 75.84, df = 3, p < .001). As table 8.8 suggests, '.' and 'because' affect focus after 'not many' in the same way as they do after 'few' and 'very few'. This supports the conclusion of Part one for H3.

Conclusion and Comment on Experiment 7

The clear support for H3 indicates that q-exps with a negative component somehow put emphasis on the comp ss. Of course, because of practical constraints, the number of 'negative' expressions is necessarily restricted, as is the number of settings tested. The results of experiment 7 also reinforce the idea that 'reason not-there' continuations and comp ss referents of 'they' are related. It is still not clear what this relationship is. The type of information in focus (reasons not-there) may 'cause' the entities in focus to be the comp ss, or vice versa. Alternatively, some other factor may cause both the comp ss to be in focus, and this particular type of information to be in focus. In the next chapter, the results of experiments 6 and 7 will be discussed more fully, and the relationship between the comp ss and reasons not-there will also be discussed and explored as part of a final experiment.

Chapter 9

Steps Toward a Process Description

Introduction

The aim of this chapter is to discuss the implications of experiments 6 and 7 for the process of understanding q-exps. In order to explain more fully how sentences in experiments 6 and 7 were understood, it will be necessary to carry out another small experiment, which is also reported in this chapter. Finally, one possible process through which the sentences in these experiments may be understood, and which takes account of the data, is described. This description is rather informal, and makes use of informal representations of the various <u>types</u> of information necessary to understand the sentences presented to subjects. The description does reflect a theory of the understanding process, and this theory does play a part in what is represented, but the representations themselves function only to simplify or summarise what is presented to the reader. In the next chapter, a more formal representation of a possible language understanding process will be presented which takes into account all the findings of experiments 1 to 8.

Rather than discuss various points about the results of each part of experiments 6 and 7 in turn, this discussion will centre around the implications of the results for a language processor encountering any of the sentences presented to subjects for completion. This reflects not only an interest in the meaning of a word as it may be represented in, say a dictionary-like semantics of some sort, but also in those broader aspects of meaning which have consequences for the interpretation of subsequent words. These consequences may not follow rigid rules. They may be indirectly related to subsequent processing, and produce only tendencies to interpret things in a particular way. Nevertheless they are of interest since they add to our knowledge of how q-exps are understood.

Sentences presented to subjects began with one of four q-exps, continued with a simple statement concerning one of two sets of entities (MPs or football fans), and led to subjects' completions with one of four connectives followed by 'they'. Suppose that one can take each of the phrases presented to subjects, and represent what is known to a language-processor on the basis of the results of the experiment, given any one phrase. It is possible that, having read the q-exp at the beginning of the sentence, the following information is available to the system processing it:

(a)<u>If the quantity expression is "Few...", it may be known</u>:

(1) that a SET will be denoted by the next word(s), and that the predicate following this will concern a small proportion of the SET.

(2) that 'few' emphasises, to a large extent, information to the effect that the predicate is not true of the SET minus those of its members denoted by 'few' (the comp ss). Also, 'few' tends to be followed by retrieval of causal information such that,

(3) a reasonable continuation may provide a reason why the predicate is not true of the comp ss.

(4) that the group of entities in focus after processing the predicate is most likely to be the comp ss, but may be the ref ss or the whole SET.

(b) <u>If the quantity expression is "Very few...",</u> the same things are known as are known after 'few', but (a) (3) and (4) become even stronger tendencies.

(c) <u>If the quantity expression is "A few...", it may be known</u>:
(1) that a SET will be denoted by the next word(s), and that the predicate following this will concern a small proportion of the SET. It may also denote a small number of set elements, although in experiments reported in this thesis only proportional denotations are considered.
(2) that 'A few' does not emphasise information to the effect that the predicate is not true of the comp ss and no causal information is retrieved by it. Thus subsequent discourse is not likely to contain a reason for the state of affairs described by present discourse.
(3) that after processing the predicate, the group of entities in focus will still be the ref ss (the group denoted by 'A few' + SET).

(d) <u>If the quantity expression is "Only a few...", it is known</u>:
(1) that a SET will be denoted by subsequent word(s), and that the predicate following this will concern a small proportion of the SET.
(2) that 'Only a few' emphasises (slightly) that the predicate is true of a <u>small</u> proportion (the ref ss), and is sometimes associated with the retrieval of causal information, such that,
(3) an expected continuation may provide a reason why the predicate is true of the ref ss. However an equally expected continuation would not provide any reason for the state of affairs.

(4) that regardless of the use of causal information in understanding, the group of entities in focus after processing the predicate will be the ref ss.

(e) <u>If the quantity expression is "Not many ...", it is known</u>:

(1) that a SET will be denoted by subsequent word(s), and that the predicate following this will concern a small proportion of the SET.

(2) that 'not many' emphasises information to the effect that the predicate is not true of the comp ss. 'Not many' also tends to be followed by the retrieval of causal information such that,

(3) a reasonable continuation may provide a reason why the predicate is not true of the comp ss.

(4) that the group of entities in focus after processing the predicate is most likely to be the comp ss.

At this point, it must be emphasised that there are two things which these five q-exps have in common. First, they are all q-exps denoting proportions of sets; and second, they all denote similarly small proportions of sets. In addition, four of them contain the word 'few'. It is reasonable to argue that the word 'few' is responsible for information available after processing the q-exp, where that information is common to all four q-exps with 'few'. Equally it has been argued (see chapter 6) that <u>differences</u> in information available after processing the four q-exps are due to differences in the other words contained in the q-exps, and not to 'few' itself. Thus, the differences between 'few' and 'very few' reflect the influence of 'very' (at least when it precedes a q-exp);

the differences between 'few' and 'a few' reflect the influence of 'a' (at least when it precedes a q-exp); and the differences between 'a few' and 'only a few' reflect the influence of 'only' (at least when it precedes a q-exp).

From these arguments, one can assume that 'Very' + q-exp intensifies the emphasis on things already emphasised by the q-exp. The exception is with proportional expectation, since it has been shown that proportional expectations after 'very few' deviate less from baseline expectations than proportional expectations after 'few'. Thus, 'very' appears to make more moderate the proportional expectations given by 'few'. One can also assume that 'A' + q-exp reduces emphasis on anything emphasised by the q-exp - at least those concerning the truth of the predicate for entities not denoted by the q-exp (the comp ss). This alters expectations about subsequent discourse, which are based on the q-exp following 'a'. Finally, 'Only' + q-exp slightly emphasises the small size of the proportion denoted by the q-exp, so that an explanation for this in subsequent discourse is possible. Note that since 'Only' precedes 'a few', and since expectations produced by 'few' are 'cancelled' by 'a', causal information associated with 'only' is not likely to be influenced by causal information associated with 'few'.

There is a possible problem with the above analysis however. The aim of the analysis was to outline what information might be available to a language processor given any phrase, in this case any one of the q-exps. In each case (1) to (4) are true for sentences containing these particular q-exps. It is also quite clear that (1) is true because of the q-exp alone. The problem is that (2), (3) and (4) are only true when the q-exp is followed by some connectives, but not others. That is, the influence of the q-exp interacts with the influence of the connective on the set of entities in focus, and on the type of information in focus.

The present aim is to discover what can be known given the q-exp <u>alone</u>. It is therefore important to find out if (2), (3) and (4) are used as soon as the q-exp is processed, only to be ignored if particular connectives ('.' and 'because') are processed soon afterward. Alternatively, (2), (3) and (4) may not be used as soon as the q-exp is processed. Perhaps this type of information becomes relevant on reading particular connectives, which then leads one to take the preceding q-exp into account.

It has been assumed, both in the design and the analysis of experiments 6 and 7, that '.' is a neutral connective, not restricting focus in any way. Hence, in conditions where the connective was '.', it was assumed that any effects on focus were due entirely to the q-exp. When the connective was '.', it was then possible to discover differences between q-exp effects. In other conditions, where the connective was not '.', it was possible to discover differences dependent on the connective, and on the interaction between q-exp and connective. It is possible, however, that '.' is not 'neutral', in that q-exps are influenced by the presence of '.'. Perhaps some other connective could be considered neutral (eg. 'and'), or perhaps none of them are properly thought of in this way, each exerting some influence. If '.' is not neutral, then it becomes very difficult to disentangle the effects of the q-exp from those of the connective. Experiment 8 was designed to discover the effects of the q-exp when no connective is presented. By looking at the connectives which subjects themselves produce, it will be possible to assess the influence of the q-exps alone. Suppose, for example, that the most common connective which subjects produce after 'few' is 'because'. This would show that the tendency to provide causal information _is_ a function of 'few', even if other continuations are possible, and even if what follows 'because' is seen as a function of 'because' and 'few'. Also, if '.' is indeed neutral, one would expect it to occur after all q-exps with approximately the same frequency.

Another problem with the analysis at the start of this section is that the relationship between the type of information in focus and the set of entities in focus is not explained. Does the emphasis on the comp ss lead one to focus on 'reasons not-there', or is it the other way round? Alternatively, are these factors both determined by something other than each other?

Subjects in experiment 8 were asked to complete sentences similar to those used in experiments 6 and 7, except that the connective and the word 'they' were omitted. Since 'they' was not presented, subjects were not forced to put any group of entities in focus. Also, the lack of a connective which is explicitly causal ('because') means that subjects are never forced to include causal information in their continuations. By observing the degree of occurrence of causal information, and the occurrence of comp ss referents in subjects' continuations, it should be possible to find out more about the relationship between these two things. For example, if subjects presented with 'few' always continue with a reference to the comp ss, and with a 'reason not-there', then it is possible that 'few' emphasises the comp ss, which in turn leads to 'reasons not there', although this is clearly not a necessary conclusion. If 'few' is often followed with a 'reason not-there', but not with a comp ss reference, it is possible that 'few' alters the type of information in focus (to reasons not-there), which in turn makes it possible for 'they' to refer to the comp ss. It is not possible in this case, to argue that an emphasis on the comp ss leads to a 'reason not-there' in continuations.

Experiment 8. 'Free' Continuations

Design

Subjects were presented with a sheet of paper on which was typed one sentence. Sentences began with one of the following q-exps: Few, Very few, a few or only a few, and continued with either 'MPs were at the meeting___' or 'football fans were at the match___'. They were asked to continue from what was presented to produce a piece of discourse which would be seen as sensible by a reader.

Subjects were not asked to answer a question about the set of entities in focus in their completions since no 'they' was presented. 40 subjects were presented with one of 8 sentences to complete. There were 5 subjects in each condition, and each condition was independent. None of the subjects had participated in experiments 6 or 7.

Results

Continuation sentences were coded in three ways by the experimenter, following a preliminary pass through the data:

(1) Connectives. These were categorised as CAUSAL (because, due to or on account of), NEUTRAL (, or .) or OTHER (everything else).

(2) Entity/entities in focus. These were categorised as follows;

(a) REF ss, where focus was on those who attended.

(b) COMP ss, where focus was on those who did not attend.

(c) SET, where focus was on the whole set (of MPs or fans).

(d) M/M, where focus was on the meeting or match itself.

(e) Event(n), where focus was on the event depicted in the sentence presented with emphasis on the number who attended.

(f) Event, where focus was on the event depicted with no emphasis on the number attending.

(g) Circumstance, where focus was on the circumstances under which the event depicted took place.

(3) Type of information. Completions were categorised as follows:

(a) REASON, where the completion gave a reason for attending.

(b) REASON-NOT, where the completion gave a reason for not attending.

(c) CONSEQ NUMBER, where the completion gave a consequence of the number of people attending.

(d) DESPITE NUMBER, where the completion described something which happened in spite of the number attending.

(e) DESCRIPT M, where the completion described the meeting or match, or events at the meeting or match not covered by the above categories.

(f) DESCRIPT EXPECT, where the completion described the number expected to attend.

Just as with experiments 6 and 7, there is little difference between the two topics and so the conditions were collapsed into four groups of 10 subjects, each of these corresponding to a different q-exp. The results are presented in tables 9.1 - 9.3.

Table 9.1 - Frequency of sentences in the connective categories (max = 10).

	Causal	Neutral	Other	Total
Few	4	2	4	10
Very few	5	2	3	10
A few	0	3	7	10
Only a few	4	3	3	10
	13	10	17	40

Table 9.2 - Entity/entities in focus in experiment 8.

	REF	COMP	SET	M/M	event(n)	event	Circum.	TOT
Few	0	4	0	2	4	0	0	10
Very few	0	0	0	4	4	0	2	10
A few	5	0	0	2	2	0	1	10
Only a few	0	2	0	4	1	0	3	10
	5	6	0	12	11	0	6	40

Table 9.3 - Type of information categories for experiment 8.

	REASON	REASON-NOT	Cons(n)	Despite	Des(m)	Des(exp)
Few	0	6	1	1	2	0
Very few	0	7	0	1	2	0
A few	1	0	1	0	7	1
Only a few	0	6	3	0	1	0
	1	19	5	2	12	1

Table 9.1 shows that the frequency of 'neutral' connectives (, and .) is indeed approximately the same for each of the four q-exps. There is however a difference in the frequency of 'causal' connectives (because, due to, and on account of). That is, 'a few' was never followed by a causal connective while the other three q-exps were, in approximately 50% of the completions.

Table 9.2 shows that only 11 out of the 40 completions made any reference to a set or subset of MPs or fans. Focus was most commonly on the meeting or match itself (12 completions) or on the event with emphasis on the number who attended (11 completions). Given that around 50% of sentences beginning with 'few', 'very few' and 'only a few' included a causal connective, this would seem to suggest that it is not focus on the comp ss which leads to continuations containing causal information. Where reference was made to the MPs or fans, the q-exp does appear to have played a part however. All sentences which focussed on the ref ss began with 'a few', and sentences which focussed on the comp ss began with 'few' or 'only a few'. 'Very few' completions do not appear to have made reference to MPs/fans at all. It is difficult to speculate about these results given that only 11 completions focussed on a subset of MPs/fans, but at least it is clear that the q-exp does not directly place either the ref ss or the comp ss in focus. If focus _is_ on some subset, then the q-exp will determine, at least in part, whether that subset is the ref ss or the comp ss.

Table 9.3 shows the frequency with which sentences contained different types of information. The most common category is 'reason-not' (reason not-there) which contains 19 of the 40 completions. All of these sentences began with 'few', 'very few' or 'only a few'; none of them began with 'a few'. The next most common category, Des(m), was assigned to completions which contained descriptions of what happened at the meeting or match. 12 of the 40 completions were assigned to this category, 7 of these being sentences which began with 'a few'.

The number of subjects who participated in this experiment was necessarily small. The small number of subjects makes it impossible to perform suitable statistical analyses of the results, because of limitations on expected frequencies under the null hypothesis. Nevertheless, some important notes can be made. At the very least these notes deserve to be tested in a larger study.

First, the q-exp at the beginning of the sentence appears to influence the likelihood that continuations will contain a causal connective. It has previously been argued that focus on causal information in completions may be due to the connectives ('.' and 'because') rather than to the q-exp. Table 9.1 supports the idea that the q-exp does influence the type of information in focus, since 3 of the 4 q-exps were more likely to be followed by a causal connective that the other q-exp ('a few'). However, for both 'few' and 'very few' combined, this happens only 45% of the time.

Second, continuations after 'few', 'very few' and 'only a few' were most likely to consist of a 'reason not-there'. In fact there are more 'reason not-there' continuations than there are causal connectives in continuations. If anything, it appears that the expectation of a reason after certain q-exps (and hence the need for the speaker to provide one) may result in the use of a causal connective in many instances.

Finally, the ref ss and comp ss results (part one of experiments 6 and 7), are likely to be due to the fact that subjects were presented with 'they'. Subjects were thus forced to focus on some set of MPs or fans. Experiment 8 shows that when 'they' is not presented, there is no strong tendency to use a pronoun. When reference is made to a subset however, the results are consistent with those of previous experiments. It is quite clear that 'reasons not-there' and causal connectives occur when the comp ss is not in focus, since there are more 'reasons not-there' than comp ss references. Hence if there is any direct relationship between 'reasons not-there' and the comp ss, it is likely that the expectation of a reason why MPs/fans did not attend leads subjects to focus on the comp ss, if on any sub(set).

Given these results, the description of what it is possible for a language processor to know after processing one of the q-exps (see pages 244 to 246), seems quite reasonable. One might however wish to alter (2), (3) and (4). Q-exps such as 'few' lead one to expect a reason for the small proportion. This in turn means that the <u>type</u> of information in focus is likely to be causal (specifically, the 'reason not-there' type), presumably because the q-exp sets a processor goal of seeking a reason for the small numbers. This increases the likelihood of a causal connective, and where focus is on the people rather than on the situation, it will be on the comp ss rather than the ref ss.

<u>The State of the Processor later in the Sentences</u>

Following the q-exp, the sentences in experiments 6, 7 and 8 continued with "MPs were at the meeting.." or "football fans were at the match..". In both cases the q-exp was followed by a SET which in turn was followed by a predicate introducing a location which is associated with the SET. When a set has just been processed, it is likely that the <u>set</u> is in focus, along with all sorts of information about the set. For example, distinguishing features of the set, the activities of its members etc.

After the set, sentences continued either with 'were at the meeting' or with 'were at the match', at which point one would expect information about going to meetings or matches to be available. This would be constrained by information which is already in focus. For example, rather than simply having information about meetings in focus, the processor is likely to have information about meetings attended by MPs, about what sort of things usually happen at these meetings etc. It has been shown that 'few' tends to emphasise that the predicate is not true of the comp ss. Hence when the processor interprets 'were at the meeting', focus is likely to be on information about why people do not attend meetings, or more specifically why MPs do not attend meetings, since the processor goal is to explain small numbers. In this way, although denotations of the SET and the predicate may not be greatly influenced by the q-exp preceding the set, the <u>kind</u> of information available once these are interpreted may be dramatically affected by the q-exp. What is more, if there is a subset of MPs or fans in focus, it is likely to be the comp ss because of the type of reason which 'few' leads on to expect. Indirectly 'few' <u>may</u> thus influence the content of focus.

The four connectives following the first simple sentence were '.', 'and', 'but' and 'because', and these will (a) be affected by information already in focus, and (b) themselves affect what information is in focus. Since '.' is not really a connective, but rather it indicates the end of a sentence, its interpretation is not likely to be affected by what is already in focus, nor is it likely to affect what is now in focus. If this argument is correct, as experiment 8 suggests, and if what is in focus after '.' differs from what is in focus after another connective, this difference can be attributed to some aspect of the meaning of the other connective.

Empirically, the connective 'and' prevents continuations containing causal information about the set and the predicate, and the group in focus after 'and' is the ref ss. Any implication of cause produced by a q-exp is 'cancelled' by the presence of 'and'. For instance, if 'Very few football fans were at the match' is followed by 'and', the implication of 'very few' which led to focus on the comp ss and on causal information will no longer have an effect. Causal information associated with the first part of the sentence may still be available, for use later on, but it cannot be used immediately after 'and they'. Perhaps this can be explained by the idea that 'and' connects statements in continuous time or space, always onward and outward. An explanation or reason reason requires a step back or away from the narrative present, while 'and' must remain in the present or move forward in time.

The results show that 'but' also seems to prevent continuations containing causal information and to place focus on the ref ss. Q-exps associated with causal information lead to continuations containing some <u>consequence</u> of the proportion of the set of which the predicate is asserted, when followed by 'but'. That is, 'Very few' and 'Few', (which lead to reasons why the predicate <u>is not true</u>

of the comp ss when followed by '.') and 'Only a few' (which often leads to reasons why the predicate is true of the ref ss when followed by '.'), all lead to consequences of the proportion attending when they are followed by 'but'. (Note that the 'consequence of number' category of experiments 6 and 7 includes consequences in spite of the proportion attending; - subcategory 3(c). In fact this subcategory was chosen more than any other subcategory of category 3). The effects of 'A few', which does not lead to causal continuations when followed by '.', are not altered when the sentence continues with 'but'. Regardless of the q-exp at the beginning of the sentence, 'but' reduces any focus on the comp ss. Consequences of the first part of the sentence are in terms of the ref ss. This is not surprising given the relationship between causal information and the comp ss which is suggested by the results of experiment 8.

The connective 'because' clearly indicates that whatever follows it will explain whatever has preceded it. Hence, when causal information is already likely to be in focus as is the case with 'Very few', 'Few' and to some extent 'Only a few', it is even more likely to be in focus when the sentence continues with 'because'. What is interesting is that 'Only a few' + 'because' results in reasons why the predicate is not true of the comp ss. 'Only a few' + '.', on the other hand, results in reasons why the predicate is true of the ref ss. This alteration means that 'they' following 'Only a few' + 'because' will be taken to refer to the comp ss, whereas it is taken to refer to the ref ss following 'Only a few' +

'.'. Perhaps this relates to the positive/negative score results of experiment 6 which show that 'because' creates a negative tone. Although 'and' also produces a fairly negative tone, 'and' does not indicate the appropriateness of causal information while 'because' undoubtedly does. It seems reasonable to suppose that reasons for not attending meetings are more likely to be negative (since meetings are generally held for positive purposes), whereas reasons for attending meetings are more likely to be positive. In the context of this experiment, where sentences described the fact that a small proportion of people attended, 'because' will be followed by an explanation of the negative information which preceded it. One could argue that given a negative situation to explain, 'because' will result in an overall negative tone. Thus 'Only a few' + 'because' will produce reasons why the predicate is not true of the comp ss, because what follows must have a negative tone, and this type of reason is more negative than a reason why the predicate is true of the ref ss.

If 'because' does in fact create a negative tone when preceded by negative information, and this does lead to reasons for not attending (and thus to comp ss referents of 'they'), then why is it that 'A few' + 'because' leads to reasons <u>for</u> attending, and 'they' is still taken to refer to the ref ss? Again, this may relate to the positive/negative score results. These results show that the q-exp at the beginning of the sentence does not in itself influence the positive/negative scores. Q-exps did however interact with the effects of the connectives, and as Table 8.5 (page 229) shows, 'A few' tends to reverse the effects produced by the connective. Thus, while 'because' resulted in negative scores for sentences containing the other three q-exps, sentences with 'A few' + 'because' resulted in more positive scores. Either the sentences containing 'A few' are not taken as negative, or they are taken as negative in which case it is not the case that 'because' creates a negative tone when it follows negative information. From table 8.5, 'A few' produces positive scores when it is followed by '.', 'and' and 'because'. With 'but' (which produces positive scores when preceded by the other three q-exps), 'A few' produces negative scores. Clearly, if the information in the first part of the sentence is negative when the q-exp is 'Very few', 'Few' or 'Only a few', then 'but' turns the overall tone to positive. This means that when the first part is positive (which may be true when the q-exp is 'a few'), 'but' turns the overall tone to negative. This seems to fit with intuitions about the meaning of 'but', which seem to imply something like "in spite of this..". On this basis we can argue that 'a few' constitutes positive (or at least not negative) information, and the above argument about the effects of 'because' after negative information, still holds.

In this way we can explain the difference in the type of reason, and hence the referent of 'they', between 'Only a few' + '. They' and 'Only a few' + 'because they'.

The final part of this chapter is an attempt to represent all that has been discovered about the meaning of quantity expressions in the second part of this thesis. A more formal description of how q-exps function in natural language will be presented in the next chapter and this will include the proportional information associated with q-exps which was explored in chapters 2 to 5. The present description is an overview, less formal and hopefully easier to conceptualise. There are doubtless many ways in which information about the meaning of q-exps can be represented. Perhaps it may be argued that there are many ways which are superior to the one suggested here. Nevertheless what follows is one way.

Summary Representation

The approach taken here is to find a way of representing the various states which a language processor might be in as it processes the sentences presented to subjects. This will provide a way of representing not only aspects of word meanings (or denotations) which may be considered the semantics of these words, but also aspects of words which carry implications for subsequent processing, and which are affected by implications from what has already been processed. There are three basic _types_ of information which must be represented - proportional information, emphasis, and information in focus.

Proportional Information

In experiment 6 all q-exps were followed by a SET and a PREDicate. One can safely say that at least part of the function of the q-exp in this experiment was to indicate the proportion of the SET of which the PREDicate is true (see note 1). This reflects the 'proportional meaning' of the q-exp, and it can be represented quite simply with the following sort of diagram:

```
SET        PRED
 s----------p
 s----------p
 s
 s
 s
 s
 s
 s
 s
 s
```

Suppose that the above diagram represents the proportional meaning of 'few'. The symbol 's' represents a set member and '------p' indicates the truth of the predicate for the set member linked to 'p'. This might be the way in which a q-exp would be represented in a 'mental model' (Johnson-Laird, 1983). The diagram represents 'Few' + SET + PRED (20% of SET are linked to PRED in the diagram, and this proportion is approximately the same as the proportion denoted by 'few' in experiment 1, chapter 2). The number of s's linked to p's for 'few' may vary from one context to another, and the interpreter's knowledge of the relationship between the SET and the PREDicate (her expectations, for example) may alter the number of links produced by 'few' in the interpretation. However, a diagram similar to the one above can be made to represent any proportional information interpreted by a language processor, and, _for present purposes_, we can assume that the above diagram represents the proportional information given by 'few'.

Emphasis

Another aspect of the meaning of q-exps that must be represented is the emphasis which they place on various parts of the SET, in terms of the truth of the PREDicate. This _emphasis_ will produce _tendencies_ to focus on one part of the set rather than another, but it will not necessarily prevent the other part of the set or the whole set from being in focus. 'Few' has been found to place more emphasis on the comp ss indirectly (it implies that this subset has a negative relationship with the predicate and that a reason for this is expected). The relationship between the ref ss and the predicate is not necessarily forgotten however, since emphasis can be moved to the ref ss by other factors, such as a connective after the predicate. This information can be represented as follows:

```
(1)                SET       PRED

          Ex       s--------p
                   s--------p

          Ey       s-------not p
                   s-------not p
                   s-------not p
                   s-------not p
                   s-------not p
                   s-------not p
                   s-------not p
                   s-------not p
```

In this diagram, the proportional information is still intact, but a partition has been added to separate ref ss from comp ss information. 'Ex' and 'Ey' represent different degrees of emphasis. 'Few' for example, will result in Ey>Ex to some degree.

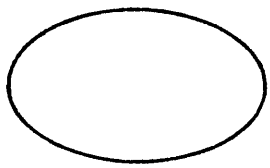
Causal Information and Focus

The basic schema for causal information associated with a q-exp can be represented quite simply:

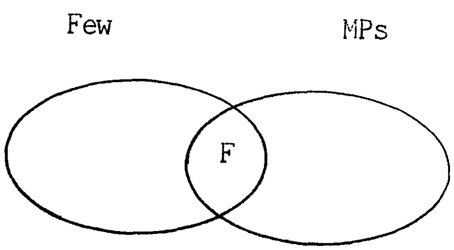
```
                           reason for reference subset/pred
                           => Ex > Ey
Quantity expression
                           reason for complement subset/not pred
                           => Ey > Ex
```

That is, if a q-exp is associated with the expectation of causal information, and it leads one to expect a reason why the predicate is true of the ref ss, then 'reasons there' and the ref ss are in focus; if the q-exp implies a reason why the predicate is not true of the comp ss, then 'reasons not-there' and the comp ss are in focus. The question is, how do we get the causal information? Suppose that we can represent all the information we have available about something called X as follows:

X

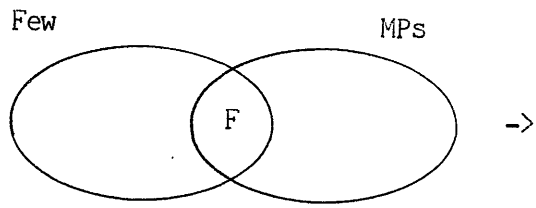


This representation of x does not carry any assumptions about the way in which its information is stored or related. It may contain lists of facts, networks, or any other imaginable or unimaginable organisation of knowledge. Suppose that all available information about 'MPs' can be represented in this way. When the phrase 'few MPs' is processed, the information in focus is likely to be about MPs. 'Few' however, sets up a procedure to retrieve (emphasise) certain kinds of information, so that certain types of information about MPs are more likely to be in focus than others. For example, information about activities which not all MPs will participate in. Now 'few' also denotes a proportion and emphasises one subset rather than another. Where F represents what might be in focus, its contents can be represented as follows:

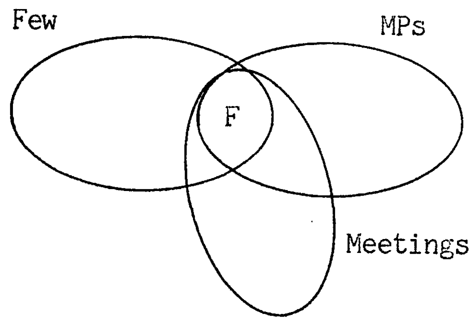


Thus 'F' represents the subset of information about 'Few' and 'MPs' which may be in focus after 'Few MPs' is processed.

Information made available on processing the predicate 'were at the meeting' will be integrated with information already in focus. This new knowledge, if presented alone, may lead to focus on available information about going to meetings, meetings generally, etc. However, the predicate must be integrated as far as possible with what is now in focus. First, 'few' has placed emphasis on the relationship between the comp ss and the predicate (that is, where the predicate is not true). Hence, information about <u>not</u> going to meetings is likely to be emphasised. What is more, the retrieval of causal information is an active goal state, so that information now in focus will include reasons why MPs might not go to meetings. The following diagram illustrates what may now be in focus:



(2)



The 'information' labelled 'meetings' represents knowledge available about going to meetings etc, and the section labelled 'F' represents what is now in focus, which is likely to include reasons why MPs might not attend meetings. The subset of MPs which is most likely to be emphasised in F, given the type of information in F, is the comp ss.

On the assumption that diagrams (1) and (2) above together can represent information available after processing 'Few MPs were at the meeting', the effects of the various modifiers ('Very', 'A' and 'Only a'), can be represented using the same sort of representation. Suppose for a moment that all of the q-exps carry the same proportional information:

```
          SET         PRED

Ex        s---------p
          s---------p

Ey        s---------not p
          s---------not p
          s---------not p
          s---------not p
          s---------not p
          s---------not p
          s---------not p
          s---------not p
```

The results clearly show that the modifiers attached to 'few' can change emphasis, and a change of emphasis will alter the type of information available as the processor goes through the remainder of the sentence, and hence alter what is in focus at the end of the sentence. By considering how 'Very few'/'A few'/'Only a few' + SET + PRED might be represented in a similar fashion to the diagrams representing 'few', it will be possible to express the function of the various modifiers in terms of differences between the diagrams.

Let diagram (1) represent what is known about 'Very few', where Ey > Ex. The difference between Ex and Ey will be greater for 'very few' than for 'few'. Thus, 'very' can be expressed through the following rule:

(1) If Ey = Ex, where a>1, represents the difference in emphasis for a q-exp Q, then 'Very' + Q will have a difference in emphasis represented by Ey = bEx, where b>a.

The values of a and b are not known, nor is it clear how they might be discovered at this point. 'Very' also increases the liklihood of 'reasons not-there', so that F in diagram (2) is even more likely to contain this type of information than it is with 'few'. This is expressed in the following rule:

(2) If a q-exp Q, -> ka, where k represents a type of information in F and a represents the extent of k implied, then 'very' + Q -> kb, where b represents the extent of k, and b>a.

Let 'A few' also be represented by diagram (1). Unlike 'Few' and 'Very few', the representation for 'A few' will show Ex to be greater than Ey. Thus, the effect of 'A' on emphasis might be represented by:

(3) If 'a' is followed by a q-exp Q, Ex = aEy, where a>1, and ignore information emphasised by Q. That is, if 'few' follows 'a', then the emphasis indicated by 'few' (Ey = aEx) is to be ignored leaving Ex = aEy.

The greater emphasis on Ex affects the sort of information likely to be in F of diagram 2 when 'few' is preceded by 'a'. 'A few' is less likely to invoke causal information about MPs, meetings etc., so that F is less likely to include causal information linking MPs and meetings. This aspect of the effect of 'a' can be represented as follows:

(4) If 'a' is followed by a q-exp Q, and Q ->ka, where k represents causal information in F to a degree indicated by a, then 'a' + Q ->k0, where b < a. The degree attached to k by the q-exp will be ignored. That is, 'A' + 'few' indicates little if any causal information.

'Only a few' also has Ex > Ey in diagram (1). Since in the materials used, 'Only' always precedes 'a few' and 'a' makes Ex > Ey, it can be assumed that either 'Only' does not affect the emphasis on Ex or Ey, or that rule (3) also applies to 'only'. 'Only' does have a slight association with causal information however, which will affect the type of information in F after processing 'Only a few'. This causal information however will concern the relationship between MPs and attending meetings as opposed to MPs and not attending meetings. It must also be noted that the extent to which 'Only' leads to causal information is not as great as that of 'few'. In many cases 'only a few' did not lead to completions containing reasons why the MPs attended the meeting or the fans attended the match. Taking these factors into consideration, the following rule might be appropriate for 'only':

(5) If 'only' is followed by a q-exp Q, then 'Only' + Q -> kc, where k represents causal information, c the extent to which k is indicated, and c is smaller than the extent indicated by 'few' or 'very few'. Here again, the extent fixed by 'only' is set such that the causal information associated with the (basic) Q is ignored.

The connectives are unlikely to alter the proportions depicted in diagram (1). They can however, alter the part of the set which is emphasised and in this way alter what sort of information is in focus. 'and' almost always places focus on the ref ss, and therefore on instances where the predicate is true. That is, 'and' -> Ex > Ey. Let us therefore assume that Ex can be less than Ey at one point in processing, and greater at a much later point. In this context, the effect of 'and' can be expressed as follows:

(6) If Ey = aEx, where a>1 and new input = 'and', set Ex = bEy, where b>1.

If 'and' does alter emphasis by this rule - as it would after 'few' or 'very few' it will also alter the contents of focus. 'And' also breaks any causal associations produced earlier in the sentence, and this will affect both the type of information in focus, and the subset in focus (to the ref ss) if one is present.

It has been assumed so far that the contents of F in diagram 2 are determined as the sentence is processed, and that F becomes more specific, narrowing its scope, as the amount of information processed increases. If the processor has processed the sentence 'Very few MPs were at the meeting' in the manner suggested above, F will now contain causal information about the relationship between MPs and not attending meetings. That is, the type of information in F has become more specific as the processor processes more information. If 'and' then changes the part of the set emphasised, F must now include information about attending meetings, and if 'and' prevents the inclusion of causal information, then F must now include non-causal information. The contents of F before processing 'and' cannot be <u>reduced</u> to focus on non-causal information about <u>attending</u> meetings. Perhaps it may may be seen as expanding not only to include non-causal information about attending meetings, but to a point where most of the information in F is non-causal information about attending meetings. Perhaps F is best seen as expanding or reducing as a result of new information being processed.

If the behaviour of F is viewed in this way the decision as to whether F reduces or expands must depend entirely on what one has allowed oneself to place in focus. For example, if what is now in F overlaps with new input, then reduce F to that subset of itself which consists of the overlap with new information; if there is no overlap with new input, expand F to such an extent that there <u>is</u> some overlap with the new input or to such an extent that this overlap is emphasised. In this way the understanding process will make as much use of prior knowledge in integrating new information as possible. In situations where an entirely new topic is introduced, focus will have to expand greatly to identify an overlap, so that the context will be broad and the scope for subsequent discourse within that context will be very large. On the other hand, situations where a related topic is introduced will not require such great expansion of what is in focus before finding some overlap, so that the context will be less broad and the scope for subsequent discourse within the same context will be much smaller.

One way of expressing the relationship between new information and the contents of F, is by the following rules:

(7) If a new piece of information, I, -> k, where k is the type of information associated with x and k n F (k does not overlap with F), then expand F until k n F = a, where F - (k n F)= b, and a>b. For example, if 'and' implies non-causal information about MPs attending meetings, and there is no such information in focus, then

expand focus until the overlap between this new type of information and the contents of focus , consists of more information than the information in F which does not overlap with the new type of information.

(8) If a new piece of information, I, -> k, where k is the type of information associated with I, and k n F, then reduce F until F - (k n F) = 0. For example, if 'and' implies non-causal information about MPs attending meetings and F already contains this type of information, then reduce F until it contains only this type of information.

'And' should, according to these rules, cause F to expand when preceded by 'few' or 'very few' and to reduce when preceded by 'A few' or 'only a few'.

The connective 'but' also emphasises Ex more than Ey, regardless of the q-exp preceding it. This can be expressed by the same rule as for 'and' (rule 6). Again, if there is a change of emphasis, the type of information in focus will change, so that focus contains more information about attending meetings than about not attending meetings. 'but' also breaks any causal associations between the set and the predicate, so that after processing 'but', focus will be on non-causal information about MPs and attending meetings. However the contents of F after processing 'but' are not the same as its contents after 'and'. When preceded by 'Few', 'very few' or 'only a few', 'but they' was generally followed (in subjects completions) by some consequence of the number of MPs at the meeting, and this was usually a consequence <u>in spite of</u> the number attending (eg. "but they voted on the issue anyway"). After 'A few', 'but' was not followed by reasons or consequences. This difference in 'but' after 'Few'/'Very few'/'Only a few' versus 'A few' may reflect the difference between these q-exps in terms of their association with causal information. Although 'but' does break any causal associations in focus, it nevertheless affects what is in focus depending on whether the q-exp preceding it leads one to expect causal information. The focus rules for 'but' may therefore be expressed as follows:

(9) If F contains causal information (whether this concerns attending meetings of not attending meetings), and new input = 'but', expand F until F n C=a, where C is information related to the consequence of the proportional information in diagram (1), or to events which may happen <u>in spite of</u> the proportions in Ex (the ref ss); where F - (F n C) = b, and a>b.

(10) If F does not contain causal information and new input = 'but', apply rules (7) and (8).

Finally, 'because' places emphasis on the comp ss except when the q-exp preceding it is 'a few'. This was explained earlier in terms of the degree to which the information given q-exp + SET + PRED had a 'negative tone'. This can be expressed as follows:

(11) If F contains information which is 'negative' in tone (by some criterion), and new input = 'because', make Ey = a Ex, where a>1 (that is place emphasis on the comp ss and not-PRED).

In expressing this rule, it is assumed that information in F can shift emphasis, just as new input can. Rule (11) would mean that 'A few' + 'because' places emphasis on Ex, while other q-exps + 'because' would place emphasis on Ey. The change of emphasis for 'only a few' (N.B. the emphasis would not <u>change</u> for 'few' and 'very few') would in turn alter the contents of F from information about attending meetings to information about not attending meetings, and this would be done by expanding F to a point where it included more information about not attending meetings than about attending meetings. 'because' also places focus on causal information, whether or not there was such information in F already. This can be expressed as follows:

(12) If F already contains causal information, and new input = 'because', reduce F until it contains only this type of information.

(13) If F does not contain causal information, and new input = 'because', expand F until it contains mostly this type of information.

Rules (1)-(13) set out in this chapter are intended to summarise the findings of chapters 6 - 8, and to suggest one <u>possible</u> way in which certain words may be made to function in language understanding. Basically, these rules assume that there are differences in the interpretation of discourse which are dependent on expectations set up by previous words/phrases. Rather than simply map out the various interpretations, the present approach allows us to look at 'meaning' as a function between what sort of information was in focus and what sort of information is now in focus. For this approach, the 'meaning' of a q-exp is it's total effect on the processing system. The present chapter has attempted to show how some of these effects can be represented and understood.

Chapter Notes

Note 1 - It has been argued that certain q-exps, such as 'a few' often denote absolute amounts, but this sort of denotation is not considered here. Experiment 6 was controlled to ensure that all the q-exps were given proportional denotations.

Chapter 10

Simulation and Final Discussion

Introduction

The studies reported in this thesis have considered various aspects of the use and function of q-exps. These expressions have been found to denote proportions within particular ranges, and to partition sets in different ways with different results. In this final chapter, a process is described which takes into account all of the functions of q-exps found in experiments 1 to 8. The description of this process is written in a MULISP program, and represents only <u>one possible</u> process whereby q-exps might be interpreted. However, the program does illustrate how the various aspects of q-exp meaning may have led subjects to respond as they did. It also serves as a formal summary of the functions which q-exps have been found to perform in this thesis.

Before describing the program itself, and entering into a more general discussion, one should consider the utility of writing a MULISP program as an illustration of the process. After all, it is possible to describe a process in a formal way without the use of a computer language. The first major reason for the use of the MULISP program is that, provided the program actually does what it is intended to do, the description of the process which it illustrates must be complete. If the process being proposed did not, in fact, produce the appropriate output given what was put into it, then the program simply would not work. In other words, errors in the program can reveal problems in the proposed process. Such problems may be far less evident in alternative kinds of description.

The second reason for using a program as opposed to another form of description is that it may be seen as the beginnings of a model of how q-exps are understood. Not enough is known at present to develop a full model of q-exp interpretation, and the program presented here is far from adequate in many ways. Nevertheless, it may be possible to extend the program from mere illustration to a model capable, for example, of making predictions about how a given statement will be understood.

The sorts of prediction which it may be possible to make from a model of q-exp interpretation will be discussed later. First, the program itself must be presented. Perhaps the best way to give an overview of the program is to show what happens using an example piece of input. This will be followed by a full description of the functions which the program calls upon as the sentence is processed. Before proceeding further, however, a note on the limitations of the program is in order.

Limitations

The program is limited in a number of ways. First, and perhaps most important, the number of words which it knows is very small. It can process the modifiers 'quite', 'very' and 'a', the q-exps 'few', 'many' and 'lot', the relation 'go-to', and the sets 'MPs', 'fans', 'meetings' and 'matches'. The first reason for this limitation is that the program is simply an illustration of how the process described in the last chapter may operate, and so it deals with the sentences used in experiment 6. It would be a simple, if time-consuming, task to extend the vocabulary of the program. The second reason for this limitation is that the empirical evidence is limited in its generality.

An Illustration of the Program in Use

Given a sentence, the program will return a list of the information which may be in focus after the sentence is processed. Of course, this information may vary for different individuals at different times, but the program which is described here attempts to illustrate how the general content of subjects' continuations in experiment 6, might come to be in focus. Suppose for example, that the sentence 'Few MPs go-to meetings' is to be processed. This would be typed into the system as follows:

```
(INPUT '(few mps go-to meetings))
```

The function INPUT will be explained in detail shortly. The following information is returned by the function:

```
1 (((there 10 25) (yexp 10) (pexp 50))

2 ((E comp/not-pred) (reason not) (ss comp))

3 (meetings (attend 50)
            (discuss cuts)
            (vote on bills)
            (get bored)
            (reason (to (are interested in topic)
                        (like speaker)
                        (have duty)
                        (want to argue))
                    (not (are on holiday)
                         (dont like speaker)
                         (are lazy)))))

4 (((there 10 25) (yexp 10) (pexp 50) (you expected) 40)

  ((E comp/not-pred) (reason not) (ss comp))

  (not (are on holiday) (dont like speaker) (are lazy)))
```

Line 1 lists proportional information available, given the sentence. The range of proportions denoted by 'few' is 10 to 25% (rather arbitrary amounts which are in accordance with the findings of the corpus study). The proportion of MPs one would expect a priori to attend meetings is assumed to be 50%, as indicated by the value of <u>pexp</u> (prior expectations). <u>Yexp</u> (your expectations) represents the effect of the q-exp on prior expectations, so that the processor's estimate of the speaker's expectations (yexp) will be 10% away from the processor's own prior expectations (pexp).

Line 2 indicates that <u>E</u>mphasis is on the relationship between the comp ss and not-pred (ie. not going to meetings), that a reason for this relationship is expected, and that if a subset is in focus, it will be the comp ss.

Lines under 3 represent the contents of focus (or some of it), in this case all information about MPs going to meetings. Most of this information needs no explanation. However (attend 50) simply represents the a priori proportional information about the relationship between the two sets. Reasons to attend and not to attend are also included.

The remainder of the output (under 4) repeats much of the information already given. This really represents what is in focus after all the implications about the kind of information in focus have been applied. For example, given that prior expectations are 50%, the processor applies the proportional information given by 'few' (yexp) to this and returns '(you expected) 40'. In other words, the speaker is estimated to have expected 40% of the MPs to go-to meetings. The specification for information in focus is repeated, and is followed by the result of reducing the type of information in focus (ie. increasing specificity), according to this specification. Focus now contains reasons why MPs do not go-to meetings and this is exactly what most of the continuations suggest was in focus for the subjects of experiment 6.

The concept 'focus' has been introduced as meaning something like 'the focus of attention'. The amount of information in focus is therefore subject to capacity constraints, dependent on the processor. Focus reduction and expansion do not therefore indicate that the processor is attending to more or less at any given point. Rather, they indicate that the information in focus will be more or less specific at any given time. That is, when focus is reduced the information in focus is less general and more specific; when it is expanded the information in focus is more general and less determined by the input. In the MULISP program, the amount of information which is in focus increases and decreases at various points in the process. It should be remembered that this reflects decreasing and increasing specificity, respectively.

Table 10.1 lists the output of the program given more example sentences. The input sentences are printed in small letters; the output is printed in capitals. Note that only the last part of the output is given in table 10.1 (ie. the part corresponding to line 4 of the example above). The reason for this is that the information in line 4 of the output represents the final effect of a piece of input.

Table 10.1 - Some input sentences and the resulting outputs

```
input - 'few mps go-to meetings'

output - ((THERE 10 25) (YEXP 10) (PEXP 50)
          (YOU EXPECTED) 40)

         ((E COMP/NOT-PRED) (REASON NOT) (SS COMP))

         (NOT (ARE ON HOLIDAY) (DON'T LIKE SPEAKER)
              (ARE LAZY)))

input - 'very few fans go-to matches'

output - ((THERE 5 20) (YEXP 5) (PEXP 66)
          (YOU EXPECTED) 61)

         ((E COMP/NOT-PRED) (REASON NOT) (SS COMP))

         (NOT (BAD WEATHER) (PREFER TELEVISION)
              (BAD TEAM)))

input - 'many mps go-to meetings'

output - ((THERE 40 70) (YEXP 0) (PEXP 50)
          (YOU EXPECTED) 50)

         ((E REF/PRED) (REASON TO) (SS REF))

         (TO (ARE INTERESTED IN TOPIC) (LIKE SPEAKER)
             (HAVE DUTY) (WANT TO ARGUE)))

input - 'a few fans go-to matches'

output - ((THERE 10 25) (YEXP 10) (PEXP 66)
          (YOU EXPECTED) 56)

         ((E REF/PRED) (REASON TO) (SS REF))

         (TO (LIKE THE TEAM) (WANT TO WIN)
             (HAVE A DAY OUT)))

input - 'quite a few mps go-to meetings'

output - ((THERE 15 30) (YEXP 10) (PEXP 50)
          (YOU EXPECTED 40))

         ((E REF/PRED) (REASON TO) (REF SS))

         (TO (ARE INTERESTED IN TOPIC) (LIKE SPEAKER)
             (HAVE DUTY) (WANT TO ARGUE)))
```

As table 10.1 shows, the output of the program is quite consistent with what has been found in experiments. That is, the proportional information changes in accordance with prior expectations and q-exps, modifiers alter the proportions expected and denoted, and the kind of information in focus is consistent with the contents of subjects' continuations. The major point of the program, however, was to illustrate how the input to output process might actually operate. Hence, the entire program will now be described, beginning with the structures which are used by the program for processing input.

Structures used by the Processor

Before outlining the operation of the program, some of the structures which are used must be explained. The first of these is the WORLD. This produces a frame structure containing all the background 'knowledge' necessary for the kind of interpretations given in the above example. The WORLD provides information about sets within a model. That is, a new piece of information can be added by putting it in a model. For example, (PUT 'MODEL 'MPs '(are crazy)) will make this information the background knowledge about MPs, accessible by functions which include (GET 'MODEL 'MPs). WORLD is in fact a function, which gives the processor this background knowledge before a sentence is processed. The definition of this function is given in Appendix C, which also lists many supplementary functions which are necessary for the running of the program, but which are not sufficiently relevant to this account to justify their inclusion at this point.

A second structure requiring explanation is called CURRENT-KNOWLEDGE. This structure is similar to the MODEL containing background knowledge, except that CURRENT-KNOWLEDGE contains only information which is accessed by the processor in the course of processing a sentence. There are 4 kinds of information which can be stored in CURRENT-KNOWLEDGE - <u>note</u>, <u>%</u>, <u>specification</u>, and <u>information</u>. Items are placed in <u>note</u> when the processor encounters something which was not expected. Rather than report an error, the processor continues with the remainder of the sentence, simply making a note of the error. This system reflects the idea that people attempt to make sense of input even when its syntactic structure is inappropriate, although they will almost certainly be aware that the sentence is somewhat strange. All the proportional information accessed by the processor, whether it is the proportion denoted or the proportion expected, is placed in <u>%</u> using (PUT 'current-knowledge '%). Line (1) in the example given earlier in this chapter, lists (GET 'current-knowledge '%) after that particular sentence. A third kind of knowledge which the processor makes use of, has been called <u>specification</u>. It is quite clear that words result in the addition of relevant background knowledge to knowledge in focus. However, it has also been suggested that words can set up expectancies about such things as the type of information in focus (specifically, whether focus contains reasons why or reasons why not) and the subset in focus (ref ss or comp ss). These expectancies are set up as goals for the processor, and are placed in the specification for knowledge placed in focus. Line (2) in the example, shows the contents of specification for the example sentence. The final kind of knowledge has been called information which contains all background knowledge placed in focus in the course of processing. Line (3) in the example, list the contents of information at the end of the sentence.

The Program

All of the functions used in the program are listed in Appendix C, along with brief statements of their role in the process. The top level function is INPUT, defined as follows:

```
(DEFUN INPUT (LST WORDS CATEG NEXT-WORD FUNC)
      (SETQ WORDS LST)
      (SETQ CATEG NIL)
      (SETQ NEXT-WORD NIL)
      (LOOP ((NULL WORDS) (ANSWER))
            (SETQ FUNC (CAR WORDS))
            (SETQ WORDS (CDR WORDS))
            (EVAL (LIST FUNC))))
```

The first argument for INPUT is a sentence (LST); WORDS, CATEG, NEXT-WORD and FUNC are local variables. The function first places the sentence in a set called WORDS. CATEG is a set which contains the category of each word as it is processed (ie. whether it is a set, a q-exp etc.). At the beginning of the process, this is set to nil. NEXT-WORD is a set which only contains one item - the expected category of the next word, given the present word. This is also set to nil before the sentence is processed. The remainder of INPUT first tests if there are any words left to be processed, and if not it returns an ANSWER. If there is a word (or words) left it places the first of them in a set called FUNC, and the rest of them in WORDS. The contents of FUNC ie. the next word to be processed, is evaluated as a function. Where the sentence contains a word which is not known to the processor, no function will be found. In this way, the program treats each word as an independent function. An alternative would have been to place each word in the same dictionary along with information about the word, or with pointers to information about the word. This would have been a somewhat 'neater' system since all word-meanings or keys to word-meanings would be found in the same place. This system was not used however since it makes additional assumptions about lexical information. That is, it assumes that the label for a word (ie. its name) has a different status from other pieces of information which are associated with the word, because the label is stored in a special place (the dictionary). This may be a perfectly reasonable assumption, but one which is not made in the program described here.

Quantity Expression Modifiers

There are three modifiers known to the processor - 'very', 'quite' and 'a'. These are defined as follows:

```
(DEFUN VERY ()
      (SETQ CATEG (CONS 'Q-MOD CATEG))
      (CHECK-WORD)
      (SETQ NEXT-WORD '((Q-EXP))
      (VERY-CHANGES))

(DEFUN QUITE ()
      (SETQ CATEG (CONS 'Q-MOD CATEG))
      (CHECK-WORD)
      (SETQ NEXT-WORD '(Q-MOD2))
      (QUITE-CHANGES))

(DEFUN A ()
      (SETQ CATEG (CONS 'Q-MOD2 CATEG))
      (CHECK-WORD)
      (SETQ NEXT-WORD '(Q-EXP))
      (PUT 'CURRENT-KNOWLEDGE 'SPECIFICATION
                             '((E REF/PRED)
                               (REASON TO)
                               (SS REF))))
```

VERY first places the item in q-mod in the set categ, indicating that the category of the present word is a q-exp modifier. Next, CHECK-WORD checks to see if the category of 'very' is in violation of the expected category - (the function CHECK-WORD is given in Appendix C). If 'very' is the first word in the sentence, then the process will continue, as no particular category was expected. At this point the item 'q-exp' is placed in the set NEXT-WORD, indicating that the next word (after 'very') is expected to be a quantity expression. Finally VERY-CHANGES notes that subsequent proportional information is to be modified, making the range denoted by the q-exp more extreme, and altering the effects of the q-exp on the proportion which the person uttering the sentence is thought to expect. A version of this function which uses rather arbitrary modifications, is listed in Appendix C. The numbers given in the function VERY-CHANGES may be wrong, or they may alter depending on the individual and the circumstances. These particular numbers were used simply for illustration.

QUITE also places 'q-mod' in CATEG and checks to see if the word violates expectation. It then places 'q-mod2' in NEXT-WORD indicating that a second modifier is expected. This is because 'quite' is followed by 'a few' and 'a lot' rather than 'few' and 'lot'. QUITE-CHANGES is similar to VERY-CHANGES and is listed in Appendix C. The difference is that 'quite' moderates the proportional information of the q-exp by some amount (which is again rather arbitrary for the purpose of illustration).

A places 'q-mod2' in CATEG and checks that this word does not go against expectation. The NEXT-WORD expected is set to 'q-exp'. The processor then notes in CURRENT-KNOWLEDGE, a specification for information in focus, so that the relationship between the ref ss and the predicate is Emphasised, a REASON is expected and if any subset is in focus it will be the ref ss.

After processing any of these words and making the appropriate notes and changes, control is passed back to INPUT, which loops back to check whether any words are left.

It will be noted that the program uses a very simple parser which is based more on semantics than on syntax. A more sophisticated program might use additional syntactic information, but this is not necessary for present purposes. It is assumed that sentences are read from left to right and heard from beginning to end. It is also assumed that the processor interprets each word in turn, taking account of as much information as soon as possible.

It should also be noted that words can lead the processor to access information in two different ways. First, given a word, the processor can simply extract from background knowledge information which is associated with it. Secondly, a word may set up goals for the processor such that certain kinds of information will be extracted from information which is not yet available to the processor. This second assumption parallels one made in the last chapter, which was that a q-exp can lead one to expect a reason why the predicate is not true of the comp ss and that this goal was intitiated even before the set and the predicate were known.

Quantity Expressions

There are three q-exps known to the processor - 'few', 'many', and 'lot'. These are defined as follows:

```
(DEFUN FEW ()
       (Q-INFO)
       (FEW-RANGE)
       ((NULL (GET 'CURRENT-KNOWLEDGE 'SPECIFICATION))
        (PUT 'CURRENT-KNOWLEDGE 'SPECIFICATION
                                 '((E COMP/NOT-PRED)
                                   (REASON NOT)
                                   (SS COMP)))
        (%MODIFY))
       (%MODIFY))


(DEFUN MANY ()
       (Q-INFO)
       ((GET '% 'MMOD)
        (PUT 'CURRENT-KNOWLEDGE 'NOTE
             '(THE WRONG MODIFIER FOR MANY))
        (PUT '% 'MMOD NIL))
       (MANY-RANGE)
       (PUT 'CURRENT-KNOWLEDGE 'SPECIFICATION
                                '((E REF/PRED)
                                  (REASON TO)
                                  (SS REF)))
       (%MODIFY))


(DEFUN LOT ()
       (Q-INFO)
       ((GET '% 'EMOD)
        (PUT 'CURRENT-KNOWLEDGE 'NOTE
             '(THE WRONG MODIFIER FOR LOT))
        (PUT '% 'EMOD NIL))
       (LOT-RANGE)
       (PUT 'CURRENT-KNOWLEDGE 'SPECIFICATION
                                '((E REF/PRED)
                                  (REASON TO)
                                  (SS REF)))
       (%MODIFY))
```

Each of the q-exp functions begins with Q-INFO which adds the category 'q-exp' to CATEG, checks this with what was expected, and sets NEXT-WORD to 'set' so that a set is expected next. Q-INFO is listed in Appendix C, along with FEW-RANGE, MANY-RANGE AND LOT-RANGE. These functions differ between q-exps as they represent the proportional information given by the q-exps. There are two sorts of proportional information which the q-exp may provide - the proportion denoted, and the effect of the q-exp on expectation. The range of each q-exp has been assigned for each q-exp opposite 'there' in proportional CURRENT-KNOWLEDGE eg '(there 10 25)' indicates a range from 10 to 25%. The effects of q-exps on expectation are assigned to 'yexp' (the speakers expectations) in proportional CURRENT-KNOWLEDGE. For example, '(yexp 10)' indicates that prior expectations will be altered by 10% because of the q-exp used. The value of yexp is zero for 'many' and 'lot' since these q-exps were found to have no effect on the proportion expected by the writer in experiment 3.

After FEW-RANGE, the function FEW asks if there is a <u>specification</u> for focus in CURRENT-KNOWLEDGE. <u>If there is not</u>, then <u>E</u>mphasis is placed on the relationship between the comp ss and not-pred, a <u>reason</u> for this relationship is expected, and if a subset is in focus it will be the comp ss. <u>If there is</u> a <u>specification</u>, the existing <u>specification</u> is not altered. The only modifier which has been found to affect the specification of focus in experiments is 'a'. Hence the program places the ref/pred relationship in focus after '<u>a</u> few' and 'quite <u>a</u> few', and the comp/not-pred relationship in focus after any 'few' expression which does not contain 'a' before 'few'. <u>Regardless</u> of changes to the focus <u>specification</u>, the final step is %MODIFY. This function, and the functions which it calls are listed in Appendix C. The basic task of %MODIFY is to integrate the proportional information of the q-exp with any proportional information which has previously been indicated by modifiers. Thus for example, 'very few' denotes a lower range of proportions than does 'few', while 'very many' denotes a higher range of proportions than 'many'. Also, the effect of 'very few' on the proportion expected is smaller than the effect of 'few' while the effect of 'very many' is greater than that of 'many'. Again the values used in functions to illustrate proportional information are rather arbitrary.

The function MANY is similar to FEW. First Q-INFO is carried out. (GET '% 'MMOD) then asks if a modifier has been used which leads to moderating the proportional information of the q-exp. If there is such a modifier, a note is made ('the wrong modifier for many'), since 'many' was never made more moderate in experiments. For example, no subject used the expressions 'quite many' or 'quite a many'. If there is no such modifier MANY calculates MANY-RANGE, sets the specification for focus, and integrates the proportions of the modifiers with those of 'many' using %MODIFY.

LOT is the same as MANY except that this function asks if a modifier has been used which makes more extreme the proportional information of the q-exp (using (GET '% 'EMOD)). If there is such a modifier the note '(the wrong modifier for lot) is placed in CURRENT-KNOWLEDGE. This is because no subject in experiments preceded 'lot' with a modifier which made proportional information more extreme eg. 'very lot' or 'a very lot'.

The following examples show what happens if an inappropriate modifier + b-q-exp combination is processed, or if the order of the combination is incorrect, or if there are too many q-exps in the quantified noun phrase:

(a) (INPUT '(quite a many))

(1) q-exp q-mod2 q-mod

(2) the wrong modifier for many

(3) E ref/pred
Reason to
ss ref

(b) (INPUT '(few very))

(1) q-mod q-exp

(2) I was expecting a (set)

(3) ((there 10 25)
(yexp 10))

(4) E comp/not-pred
Reason not
ss comp

(c) (INPUT '(few many))

(1) q-exp q-exp

(2) I was expecting a (set)

(3) ((there 40 70)
(yexp 0))

(4) E ref/pred
Reason to
ss ref

(d) (INPUT '(very few))

(1) q-mod q-exp

(2) ((there 5 20)
(yexp 5))

(3) E comp/not-pred
Reason not
ss comp

In (a) the processor has not given any proportional information although the specification for focus is in accordance with 'a'. the reason for this is that the proportions given by 'many' cannot be made less by a modifer. The proportions which may be denoted by 'quite a many' are difficult to assess. (b) notes that the processor was expecting a set which inditcates that trouble arose on encountering 'very'. The proportional CURRENT-KNOWLEDGE and the specification are given, and correspond to those of 'few' rather than 'very few' as a comparison with (d) will show. (c) again notes that a set was expected (instead of 'many'). The proportional CURRENT-KNOWLEDGE and the specification for focus have been given by 'many'. It is not clear what, if any, proportional information would be accessed by subjects in this situation, unless 'many' was taken as a correction of 'few'. (d) shows what happens when 'very few' is processed. The range of proportions denoted is lower than with 'few', and the effect on expectations is weaker. Emphasis is on the comp/not-pred relationship. All of this is consistent with the results of experiments 1 to 8.

Sets

Four different sets are known to the processor - MPs, fans, meetings and matches. These are defined as follows:

```
(DEFUN MPS ()
       (SET-INFO 'MPS))

(DEFUN FANS ()
       (SET-INFO 'FANS))

(DEFUN MEETINGS ()
       (SET-INFO 'MEETINGS))

(DEFUN MATCHES ()
       (SET-INFO 'MATCHES))
```

Each set function calls SET-INFO, defined as:

```
(DEFUN SET-INFO (WORD)
       (SETQ CATEG (CONS 'SET CATEG))
       (CHECK-WORD)
       (SETQ NEXT-WORD '(RELATION NIL))
       ((NULL (GET 'CURRENT-KNOWLEDGE 'INFORMATION))
        (PUT 'CURRENT-KNOWLEDGE 'INFORMATION
                       (GET 'MODEL WORD)))
       ((NULL (ASSOC WORD
               (GET 'CURRENT-KNOWLEDGE 'INFORMATION)))
        (PUT 'CURRENT-KNOWLEDGE 'INFORMATION
              (APPEND
               (GET 'MODEL WORD)
               (GET 'CURRENT-KNOWLEDGE 'INFORMATION))))
       (PUT 'CURRENT-KNOWLEDGE 'INFORMATION
             (ASSOC WORD
               (GET 'CURRENT-KNOWLEDGE 'INFORMATION)))
       (PUT 'CURRENT-KNOWLEDGE '%
          (APPEND (GET 'CURRENT-KNOWLEDGE '%)
                  (LIST
                    (LIST* 'PEXP
                     (CDR (ASSOC 'ATTEND
                     (GET 'CURRENT-KNOWLEDGE
                                'INFORMATION))))))))
```

This function adds set to CATEG, checks with what was expected, and expects the NEXT-WORD either to be a relation, or to be nil (this depends on whether or not the set ends the sentence). The remainder of the function may be read as follows:

(1) If no background knowledge has been placed in focus (if this is the first set), place everything that is known about this set in <u>information</u> in CURRENT-KNOWLEDGE (in focus).

(2) If (1) is not the case, and the present set cannot be accessed within the present contents of focus, then add to the proesent <u>information</u> in CURRENT-KNOWLEDGE, everything that is known about this set.

(3) If (1) and (2) are not the case, reduce <u>information</u> in CURRENT-KNOWLEDGE to that subset of the present <u>information</u> which is associated with this set.

(4) If (1) and (2) are not the case, and after (3), find the proportional information relating this set and the previous set (the value of 'attend') and place this value in <u>proportion</u> in CURRENT-KNOWLEDGE, under '<u>pexp</u>' (prior expectations).

When the processor encounters the first set in the input string, there will be no <u>information</u> in CURRENT-KNOWLEDGE since it is only sets which can access background knowledge. Thus the condition of (1) above will be true, and the processor will get all background information about the set and place it in <u>information</u> in CURRENT-KNOWLEDGE. If a set has already been encountered, there will be <u>information</u> in CURRENT-KNOWLEDGE, and the condition of (1) will not be met. The condition for (2) is that there is no subset of the present <u>information</u> associated with the present set. This would be true if, for example, the sets are meetings and MPs, and if there is no information associated with MPs within the background knowledge about meetings. In this case the processor would simply add to the present _information_, all background knowledge about MPs. If there is a subset of the present _information_ associated with the present set the condition for (2) is not met and the processor evaluates (3). This will result in a reduction of _information_ in CURRENT-KNOWLEDGE to that subset of itself which is associated with the present set. If the sets are MPs and meetings, for example, _information_ in CURRENT-KNOWLEDGE will contain all background knowledge of MPs which is associated with meetings. If this information contains a proportional expectation about the relationship between the two sets, this is noted in _proportion_ in CURRENT-KNOWLEDGE, under _pexp_.

Relations

The processor knows only two relations - are and go-to. In fact 'go-to' is the only one which relates to the sentences completed by subjects in experiment 6. These words are defined as follows:

```
(DEFUN GO-TO ()
       (REL-INFO 'GO-TO))

(DEFUN ARE ()
       (REL-INFO 'ARE))
```

The function REL-INFO is defined as follows:

```
(DEFUN REL-INFO (WORD)
       (SETQ CATEG (CONS 'RELATION CATEG))
       (CHECK-WORD)
       (SETQ NEXT-WORD '(SET))
       (PUT 'CURRENT-KNOWLEDGE 'INFORMATION
             (ASSOC
              (WORD
               (GET 'CURRENT-KNOWLEDGE 'INFORMATION))))
```

Thus 'relation' is added to CATEG, this category is checked with what was expected, and the NEXT-WORD expected is set to 'set'. The <u>information</u> in CURRENT-KNOWLEDGE is then reduced to that subset of itself which is associated with the relation. For example, if <u>information</u> contains the background information for Mps, GO-TO will reduce this to a subset of this information which is associated with 'go-to'. It is therefore assumed for the purpose of this program, that a relation is only understood in the context of some background information, and there can only be background information if a set has already been encountered. The relation will be nonsensical if no set has been mentioned, or if the background information associated with the set does not contain information about the relation. (If, for example, it is not known that MPs 'go-to' anywhere).

<u>The Processor's Response</u>

The 'answer' which the program gives in response to INPUT is in two parts. First, the contents of CATEG plus the four kinds of CURRENT-KNOWLEDGE are listed. CATEG will contain the category of each word in the input, and is only really included as a way of checking how much has been processed in the event of an error. If there is a <u>note</u> in CURRENT-KNOWLEDGE the message is printed. The <u>proportion</u> and <u>specification</u> in CURRENT-KNOWLEDGE contain all proportional information known to the processor at this point and all of the goals or expectations which the processor has about the contents of focus. Finally, the <u>information</u> in CURRENT-KNOWLEDGE lists the contents of focus before the goals laid out in the <u>specification</u> are achieved. If no word in the input sets up expectations about the <u>kind</u> of information in focus, then the <u>information</u> now in CURRENT-KNOWLEDGE represents the contents of focus after the input has been processed.

ANSWER2 is the second part of ANSWER. This function first integrates prior proportional expectations with information from the q-exp about the proportion which the communicator is thought to expect. An estimate of the proportion expected by the communicator is calculated on this basis. Since there is no empirical evidence that expectation influences the proportions which a q-exp denotes, the proportions denoted remain the same. ANSWER2 then reduces the type of <u>information</u> in CURRENT-KNOWLEDGE according to the contents of the <u>specification</u>. Limitations in the design of the program mean that only reasons for the set/pred relationship or reasons for the set/not-pred relationship will result in such a reduction. For example, if a reason for the former relationship is expected in the <u>specification</u>, then the <u>information</u> in CURRENT-KNOWLEDGE is reduced to that subset of itself which is associated with this relationship. This reduced <u>information</u> is then printed out be ANSWER2. The second part of ANSWER therefore, shows the contents of focus after the goals and expectation set up by words in the input have been fulfilled.

Discussion

There are various aspects of the program, and of the process which it illustrates, which require discussion. The empirical and theoretical background of the program must be evaluated, and there must be some assessment of what has been learned from the program. The major purpose of reporting the program was to illustrate clearly and precisely a process which interprets quantified statements in ways which are consistent with empirical findings. However, it was noted at the beginning of this chapter that the program may also be seen as a rather inadequate model of the way in which q-exps are interpreted. Clearly, the program must be extended if it is to be treated in this way. The ways in which it might be extended and the capacity of the resulting model will be discussed later in this chapter. Finally, it will be argued that the experimental methods employed in this thesis may be invaluable for the exploration of many aspects of natural language understanding in a manner which is consistent with the approach taken here.

Evaluation of the Program as it Stands

To the extent that the MULISP program returns information which is consistent with experimental findings, the program is consistent with empirical phenomena. However, the degree to which the final interpretations of the program concur with those of subjects must be discussed. The program also makes many theoretical assumptions which are not necessary and are only loosely based on what subjects did in the experiments. It was necessary to make some decisions about the operation of the program however, and some justification for the design of this particular program and the particular assumptions which it makes, will be provided. Before describing ways in which the program might be extended, there will also be a short assessment of the value of writing the program as a learning exercise.

Empirical Evaluation

The program returns three kinds of information about the interpretation of input - knowledge of proportions, of focus specification and of the contents of focus (information). These will be discussed in turn.

Proportional Information

Given a q-exp, the program will return a range of proportions which that q-exp denotes. For example, '(there 10 25)' indicates that the q-exp denotes a proportion between 10 and 25%. These particular values are arbitrary and they are permanent in the sense that the q-exp, if it is not accompanied by a modifier, will always denote this range of proportions. This is consistent with empirical findings which provide no evidence that the proportion denoted by a q-exp is influenced by the context.

Proportional data obtained in the first part of this thesis is of three sorts. The Corpus study (experiment 1) provides information about the q-exps which subjects produce as descriptions of various proportions. Ranges determined on the basis of this experiment represent the range of proportions which each q-exp was used to describe. The Truth and Vagueness study (experiment 2) provides information about the acceptability of various q-exps as the descriptions of different proportions. Ranges determined on this basis would represent the range of proportions which each q-exp is accepted as describing when the description is provided by another speaker. Experiments 4 and 5 provide information about the proportions which subjects interpret each q-exp as denoting. Ranges obtained from these studies would represent the proportions which each q-exp was interpreted as describing. The ranges of proportions obtained in these three ways are shown in table 10.1. Note that there are only four q-exp ranges for experiment 2 since only four q-exps were presented to subjects in this study.

Table 10.1 = Ranges of proportions obtained for q-exps using the three methods

	Data		
	Production (exp 1)	Interpretation (exp 4)	Acceptance (exp 2)
Very few	10-25%	5-35%	-
Few	10-25%	5-45%	-
A few	10-25%	5-65%	30-70%
Quite a few	25-75%	25-75%	30-70%
Quite a lot	25-60%	15-85%	30-70%
A lot	25-90%	45-95%	30-70%
Many	25-90%	25-75%	-
Very many	75-90%	25-90%	-

The proportions presented to subjects in experiments 1 and 2 were restricted. In experiment 1 there were only six proportions available for description since the sketches contained figures which were 10%, 25%, 40%, 60%, 75% or 90% male or female surgeons. The ranges may have been broader for q-exps in this experiment if more proportions had been available for description. The ranges for experiment 2 are even more restricted since only two proportions were used in this study. All four q-exps presented were judged as true descriptions (categorised as 'a' or 'b') of both the proportions by at least some of the subjects. It is therefore not clear whether the interpretation data of experiment 4 provides the best estimates of the proportions denoted or whether the proportions denoted vary between production, interpretation and acceptance.

However, it is clear that the ranges for each q-exp in each experiment are fairly broad.

Whenever background knowledge contains information about the proportion of one set which is expected to hold a particular relation to another set, this information is the prior proportion expected. The program notes the proportion expected (pexp) where such an expectation exists. Again, many factors may influence what this proportion is, although the only factor considered in experiments has been the sets and the relation in question. It has also been assumed however, that the q-exp used by the speaker plus one's own expectations will determine, at least in part, the proportion which one believes the speaker to have expected. The program notes the effect of a given q-exp (yexp) and uses this plus prior expectations to estimate the proportion which the writer had expected after the sentence is processed. The point at which this estimation takes place during the process may not be at the end of the sentence as the program suggests. However, this does seem the most likely time since prior expectations cannot be known until both of the sets have been interpreted. The actual extent of q-exp effects on expectation are arbitrary in the program and better estimates of these could have been made on the basis of experiments 4 and 5. However, the values used by the program are sufficient for the purpose of illustrating how the q-exp plus prior expectations might interact to produce an estimate of the writer's beliefs.

Focus Specification

The focus specification is really just a place to store the goals and expectations of the processor given the input, before these goals and expectations can be realized. The focus experiments (experiments 6, 7 and 8) suggest that sentences with certain q-exps such as 'few' tend to be continued with reference or focus on the relationship between the comp ss and the negation of the predicate. Given that the predicate is not known at the point of processing the q-exp, this expectation will not result in a direct change of the contents of focus (since the predicate is not yet in focus). Therefore a structure such as the specification is necessary as a store for these expectations. The specification is thus justified by the fact that information may be available at some point in processing. The idea that it is available as soon as the q-exp is processed is based on a theoretical assumption which will shortly be discussed.

The Contents of Focus

Provided that one is paying attention to what is said, it is clear that the particular words used by the speaker will influence what one is thinking of at any one point in time. That is, words can alter the contents of focus. Again, the way in which the program alters focus on the basis of the input is determined more by theoretical assumptions than by empirical evidence. Subjects' continuations are however consistent with the contents of focus produced by the program. A sentence about MPs and meetings for example, will result in information about these sets being placed in focus, and subjects contintuations always concerned information about these sets after such a sentence.

Theoretical Evaluation

The simulation embodies three major theoretical assumptions. First, that words can set up goals as a way of guiding subsequent processing, as well as simply denoting things. Second, that the processor deals with each word of the input one at a time from beginning to end, taking note not only of denotations but also of information which will influence the processing of subsequent words. Third, that input directly and indirectly changes the contents of focus. Direct changes are those which concern the sets and relations in focus; indirect changes are those which change the type of information in focus about those sets and relations. Each of these assumptions will be discussed in turn.

The assumption that words set up expectations about subsequent input is easily justified. After all, if the function of words was merely to denote sets or relations between sets, or proportions of sets etc., then sentence (1) would not seem strange. In fact (1) is very strange:

(1) Few bricks eat ski slopes.

One might argue that (1) is odd because bricks do not normally eat and ski slopes are not normally eaten. However, if denotation was all that mattered, one could easily place the denotations of these words in focus and these would represent the meaning of the sentence. The problem is that the search for a denotation is limited by what is already in focus. There must be some sort of overlap between new input and focus if the input is to be understood. This amounts to saying that previous input restricts the interpretation of new input or in other words, present input sets up expectations about subsequent input and these expectations result in restrictions on subsequent interpretation. This kind of <u>selectional restriction</u> has been used in many accounts of language understanding (see for example, Katz and Fodor, 1963, and Schank, 1972).

The program assumes not only that words can restrict the denotations of subsequent words, but also that words can influence the kind of information which subsequent words will bring into focus. That is, the word 'few' will not only lead the processor to expect information about a quantifiable set to be placed in focus, but also to expect that this information is normally expected to concern reasons why the negation of a predicate as yet unknown is true of the complement subset of a set which is as yet unknown. This assumption is more difficult to justify. Subjects' continuations in experiment 6 certainly suggest that this type of information is normally in focus. However, only two contexts were considered, and the results may have been quite different had other contexts been considered. For example, it may be argued that many MPs are normally expected to attend a meeting, and many fans are expected to attend a match. In this case the contexts used in the experiment both violate expectations. Perhaps such contexts always lead the processor to expect a reason why the predicate is not true of the comp ss. Consider sentence (2):

(2) Most of the children hated Santa Claus.

Certainly the information in (2) is unexpected and some sort of explanation seems necessary. However, the explanation is very unlikely to concern those children who do not hate Santa Claus, or reasons for not hating Santa Claus. One might still argue however, that 'few' only leads to reasons why the predicate is not true of the comp ss when the information is unexpected. Perhaps when the information is expected 'few' would behave like 'most', and not lead to causal continuations. Consider sentence (3):

(3) Few children hate Santa Claus.

Given that (3) is entirely consistent with prior expectations, there seems little need to give an explanation. It seems to me, however, that subjects are likely to continue this sentence with something about children who do not hate Santa Claus. What is more, a reason why the other children do not hate Santa Claus is likely to be in focus. One might even argue that the speaker used (3) instead of 'Most children like Santa Claus' in order that the listener would place such reasons in focus. Clearly this is ultimately only decidable on an empirical basis and more evidence is in order before making broad generalisations about this proposed function of 'few'. In my view, however, this idea is an important step towards understanding the relationship between input, expectations and focus and further empirical work on this issue may provide important clues as to how discourse is processed and understood.

The second assumption made was that the processor makes use of as much information as possible as soon as possible in the course of processing. If one wishes to explain subjects' continuations in terms of the processing of sentences presented to them, then there are different kinds of explanation, each of them making a different assumption. One kind of explanation rests upon the assumption made here, namely that the processor acknowledges all changes in the contents of focus which can result from 'few' as soon as 'few' is encountered. Thus, when the sets and the relation between them have been processed, the processor simply applies this information to the contents of focus. Another kind of explanation rests upon the assumption that the processor will backtrack on reaching the end of the sentence in order to find out if any of the previous words provide any clue as to what type of information should be in focus. There are two major reasons why the former assumption (and therefore the former kind of explanation) is preferred. First, in experiment 8 it was shown that the q-exp influences the sort of information in focus even when no connective is presented to subjects. Hence, it is possible for the processor to know which sort of information is expected as soon as the q-exp is processed. Second, human readers are normally aware when they have had to back track. Consider sentence (5):

(5) Very few MPs were at the meeting. They discussed the Prime Minister's policy on unemployment.

If the reader finds (5) slightly difficult or awkward, the problem is most likely to have arisen after reading 'they' in the second sentence. The processor is most likely to have carried out a search for the referent of 'they', having realised that the MPs who were not at the meeting are not likely to have been discussing the policy on unemployment. If, before processing the second sentence, the reader backtracked to find what was expected given 'few', this backtrack is much less obvious than that required to process the second sentence. In my view no backtracking takes place before the second sentence since expectations which arise from the word 'few' are available as soon as 'few' is processed.

The third major assumption was that input directly and indirectly changes the contents of focus. This assumption is related to the assumption that words can set up expectations about subsequent interpretation. A direct change in the contents of focus as a result of the input simply means the incorporation in focus of new information which has been obtained from new input. For example, at the start of a conversation the word 'MPs' will lead the processor to place all sorts of information about MPs in focus. This reflects the idea that when someone says a word, listeners will attend to the word and to information related to it. Any subsequent word will then be interpreted in an existing context, namely in the context of all sorts of information about MPs. For example, 'go to' in the context of MPs will mean the sort of going to which MPs are known to do and the processor will expect subsequent input to contain the sort of place attended by MPs. It has been argued here that the information in focus will become more specific in this case. That is, focus will contain an overlap of 'MP' knowledge and 'go to' knowledge. The degree of overlap between new and old input may vary. In fact there may be no overlap, in which case the information in focus will become less specific rather than more so. For example, if 'MPs' is followed by 'wither' the processor might find no relationship whatsoever between Mps and withering, in which case it is not possible to make the information in focus more specific. Naturally, this will depend on the processor's ability to make sense of what is said. Some people for example, may liken the way an MP feels after losing an election to a withering process in which case it is possible to make focus more specific. In my view understanding is made easier when the processor can make focus more specific, and the extent to which this is possible will depend both on the capacity of the particular processor as well as on the cooperation of the speaker and on the cues available given the circumstances.

It is assumed that information in focus can also be changed as a result of some specification which is laid down by goals set up in the course of processing. Thus the word 'few' at the beginning of a sentence can influence the contents of focus at the end of the sentence, by setting up a goal to be applied after the set and the predicate have been processed. That goal is to focus on reasons why the predicate is not true of the comp ss.

It must be noted that indirect changes to focus which arise from goals are not as necessary for the process of understanding as are the direct changes which arise from the input as it is processed. For example, subjects did not <u>always</u> continue the sentence 'very few MPs were at the meeting' with a reason why the other MPs did not attend. There was merely a strong tendency for subjects to do so. It must therefore be concluded that there are other factors which influence the application of indirect changes. Perhaps the degree to which the subject is attending to the sentence or what was in focus before being presented with the sentence are candidates for these factors. More empirical evidence is required in order to determine the role of indirect changes to the contents of focus.

The Value of the MULISP Program

The program shows that q-exps can provide information about the proportion which the speaker intends to convey, and about the proportion which the speaker is believed to have expected. In assigning ranges of values to q-exps, the only information which could act as a guideline was the empirical data. Hence, the ranges appear arbitrary. Likewise the extent of modifier effects on the proportion denoted, and the effects of q-exps and modifiers on the proportion which the speaker is thought to expect were based entirely on the results of experiments. Therefore, these too are arbitrary. The fact that the proportional values were all written into the program emphasises this arbitrariness. It also emphasises the need for an explanation of how these values are obtained by human language users, given that no-one actually provides humans with such values. For example, given that 'few' has been shown to denote 10% to 25% and to alter prior expectations by a certain amount, how does the processor learn such things? How, for example, would one learn the proportional meaning of a new q-exp? These questions are made more obvious and important by the arbitrary nature of the assignment of values to q-exps in the program.

Another question which is made more obvious by the program concerns the relationship between causal information and certain q-exps. The program illustrates how 'few', for example, can lead subjects to give continuations containing reasons why the predicate is not true of the comp ss. In the program, this is simply part of the function of 'few'. But why does 'few' have this function? Is there some causal principle in operation when we interpret what is said, and if so, what is this principle? It may, for example, relate to some general principle of understanding whereby there must be a reason for every proposition which is uttered and for every state of affairs described. If this is the case, causal aspects of understanding must be incorporated into any theory of how discourse is processed.

It may be argued that these issues do not arise from the program itself. However, in my view the program highlights such issues as questions which require answers. It may be argued that to use the program in this way is to treat it as a model rather than as an illustration. The next section deals with the sort of extension of the program which would make it a more adequate model of how q-exps are understood.

Extending the Program and Prediction for Future Research

If the program is treated as an approximation to a model rather than as an illustration of a possible process, what could one predict on the basis of this model? Also, in what ways should the program be extended to give a more adequate model of q-exp interpretation, and what should such an extended program be capable of doing?

The program assumes that the word 'few' sets up a goal to be applied to the set and the predicate following it. Experiments have suggested that 'few' places emphasis on the negation of the predicate and on the comp ss. However, the program assumes that this emphasis is noted on processing 'few', thus affecting the interpretation of the predicate before it is encountered. One prediction based on the program is then, that the emphasis on the comp ss and the negation of the predicate will not occur until after the interpretation of the predicate, if 'few' appears after the predicate. On the other hand, if one assumes that, regardless of the position of 'few', emphasis is not affected by 'few' until after the predicate is processed, then there should be no difference in emphasis between sentences of the form 'few set predicate' and sentences of the form 'predicate few set'. Consider the following sentences:

(6) Most of the fans attended the cup final.

a. They waited patiently for the game to begin.

??b. They preferred to watch the game on T.V.

(7) The cup final was attended by most of the fans.

a. They waited patiently for the game to begin.

??b. They preferred to watch the game on T.V.

(8) Few of the fans attended the cup final.

?a. They waited patiently for the game to begin.

b. They preferred to watch the game on T.V.

(9) The cup final was attended by few of the fans.

a. They waited patiently for the game to begin.

b. They preferred to watch the game on T.V.

It seems to me that there is little difference between (6) and (7) in terms of the suitability of 'a' and 'b' as continuations.

However, 'a' would seem a more reasonable continuation of (9) than of (8). That is, in (9) the 'they' in 'a' refers more easily to fans at the cup final than does 'they' in (8)a. This outcome would be predicted by a model based on the MULISP program. That is, if (8) and (9) were processed in the program, 'few' would influence emphasis on the predicate <u>before</u> the predicate is interpreted in (8), but <u>after</u> the predicate is interpreted in (9). Clearly intuitions are not sufficient to test this prediction. However, such a prediction could easily be tested using the continuation method described for experiments reported in this thesis, or perhaps by a reading time study. Indeed many similar predictions about other q-exps, other contexts, and other word-orders could be tested using these methods. Results from studies testing these predictions would then contribute to our model of how and when it is that words can alter the processing of subsequent input.

Perhaps the most useful extension to the program would allow it not only to interpret quantified statements, but also to <u>produce</u> descriptions of states of affairs involving proportions. The program would then accept states of affairs as input and return a description in response. If the program was an adequate model taking all of the empirical evidence into account, many factors would contribute to the description produced by the computer. That is, the q-exp produced will depend not only on the proportion to be described, but also on the program's prior expectations and on the effects which the q-exp might have on the listener or reader's beliefs about the program's prior expectations. The choice of q-exp must also depend on such things as the desired contents of focus after the listener or reader has processed the program's description.

Such an extension to the program would obviously require more work. However, a great deal may be gained from such an exercise. The empirical work which has been carried out in this thesis reveals many differences between q-exps. But a program designed to use q-exps as descriptions of different states of affairs may reveal many more distinctions between the meanings of these words. The program would produce expressions according to the rules which it is given. Yet the expressions produced may not always fit intuitively with optimal descriptions produced by subjects. One would then have to ask why, and to develop additional rules about the use of various q-exps in order to deal with the discrepancy. Thus, using such a model capable of producing quantified descriptions, it would be possible to discover more factors which influence the choice of q-exp in descriptions of various states of affairs. These factors may concern the relationship between q-exps and the proportional information to be described, and/or more general aspects of discourse processing (eg. the manipulation of the contents of focus) and the effect of q-exps on these.

Before ending this discussion, it must be noted that the q-exps considered in this thesis are only a very small subset of the expressions used in natural language which one might describe as explicitly vague. Many interesting questions about ranges of proportions, expectation and denotation, uncertainty, focus, etc., have been raised with respect to these expressions. However, it seems to me that these questions would be equally interesting with respect to other vague expressions such as temporal frequency adverbs, degrees of belief and certainty hedges, etc. What is more, the experimental methods which have been employed in the present investigations are applicable to the study of these other expressions. For example, consider sentences (10) and (11):

(10) MPs usually attend these meetings.

(11) MPs rarely attend these meetings.

It would be a simple matter to present subjects with proportional information about the meetings attended by MPs and to ask them for natural language descriptions. This would provide a data base on the relationship between frequency adverbs and amounts similar to the data base obtained from experiment 1 on q-exps. Likewise, the other methods used in this thesis are applicable. The continuation task, for example, might reveal that 'rarely' is continued with reasons why MPs don't attend, while 'usually' is followed by reasons why they do attend. Thus, in my view, the present methods may be used for the study of natural language expressions other than q-exps.

In Conclusion

It is clear that there are many questions which have yet to be answered about the use and function of quantity expressions in natural language, and many questions which have yet to be discovered. This thesis has only gone a little way towards explaining some of the things which such expressions can do in a limited set of circumstances. It may be argued that the approach taken here and the assumptions which have been made are not necessary for an adequate account of the role of q-exps. It seems to me, however, that something along the lines of the view presented here is necessary in order to account for experimental findings. The degree to which q-exps are vague indicators of proportion, the way in which they influence our beliefs about the speakers prior expectations, and the way in which they influence what is seen as requiring explanation, are all important aspects of the role of q-exps. These findings also provide clues as to how we use language as a means of communication. Certainly, an account which takes no account of changes in focus during processing, and which relies only upon syntax or semantics to account for the findings reported here, will fail.

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Appendix A

Subjects in experiment 1 were asked to describe six sketches, each of which contained different ratios of male and female pin-figures. The descriptions were then recorded in segments as reported in chapter 3, and these segments are listed here. Note that those segments which were excluded from the statistical analyses are also excluded from the list.

The phrases are presented in alphapbetical order, the first word of each phrase being in **bold** print and appearing to the left of the phrases which it heads. At the end of each phrase (on the right) a number is given, indicating the frequency of that phrase in the data base.

First Word

A(N)

awful	lot	of	SET	1
comfortable	majority	-	-	2
considerable	amount	of	SET	2
	number	of	SET	1
definitely	higher	proportion of	SET	1
enormous	number	of	SET	1
extremely	small	number of	SET	1
	large	proportion of	SET	2
	high	proportion of	SET	2
fair	amount	of	SET	2
	number	of	SET	2
	proportion	of	SET	1

<u>A(N)</u> continued...

fairly	large	proptn	of	SET	1
far	greater	number	of	SET	2
few	SET	-	-		28
	of	SET	-		2
great	majority	of	SET		3
	many	SET	-		3
	number	of	SET		1
greater	amount	of	SET		2
	majority	of	SET		1
	number	of	SET		5
handful	of	SET	-		4
high	number	of	SET		1
	proportion	of	SET		3
large	amount	of	SET		2
	majority	of	SET		6
	number	of	SET		13
larger	amount	of	SET		1
	number	of	SET		4
lot	of	SET	-		37
low	proportion	of	-		2
majority	of	SET	-		12
	grouping	of	SET		1
marginally	greater	number	of	SET	1
minimal	majority	of	SET		1
minimum	amount	of	SET		1
moderate	number	of	SET		1
modest	number	of	SET		1
much	greater	number	of	SET	1
	larger	number	of	SET	1
		proportion	of	SET	3
	smaller	proportion	of	SET	1
number	of	SET	-		1

A(N) continued...

	significant	majority	of	SET		1
		minority	of	SET		1
		proportion	of	SET		2
	significantly	greater	number	of	SET	1
	slight	majority	of	SET		6
	slightly	greater	amount	of	SET	1
			number	of	SET	2
	small	minority	of	SET		1
		number	of	SET		2
		proportion	of	SET		2
	smallish	number	of	SET		2
	substantial	amount	of	SET		1
		number	of	SET		1
	tiny	amount	of	SET		1
		proportion	of	SET		1
	vast	majority	of	SET		4
		number	of	SET		2
	very	few	SET	-		4
		high	proportion of SET			4
		large	number	of	SET	3
		low	number	of	SET	1
			percentage of SET			1
ALL						
	SET	-	-	-	-	1
ALMOST						
	all	SET	-	-		3
		of	the	SET		2
			these	SET		1
		the	SET	-		5
		these	SET	-		1
ARE						
	actually	quite	a	higher number		1
	in	the	minority	-		1

BIGGER					
	majority	of	SET	-	1
EXCEPTION					
	of	a	few	-	1
FAR					
	greater	number	of	SET	1
FEW					
	SET	-	-	-	25
	in	number	-	-	1
GENERALLY					
	all	SET	-	-	1
HAS					
	by	far	a much greater amount		1
HARDLY					
	any	SET	-	-	17
			at	all	2
HUGE					
	amount	of	SET	-	1
IN					
	the	minority	-	-	3
IS					
	an	greater	number	of SET	1
		less	substantial	number	1
		reasonable	high	number	1
		slightly	larger	number	1
LARGE					
	majority	of	SET	-	2
	number	of	SET	-	1

<u>LARGER</u>					
	amount	of	SET	-	1
	number	of	SET	-	2
<u>LARGEST</u>					
	proportion	of	SET	-	1
<u>LOTS</u>					
	and	lots	of	SET	1
	of	SET	-	-	7
<u>MAINLY</u>					
	SET	-	-	-	18
	all	SET	-	-	3
<u>MAJORITY</u>					
	SET	-	-	-	4
	of	SET	-	-	8
<u>MANY</u>					
	SET	-	-	-	28
	of	the	SET	-	1
<u>MINORITY</u>					
	of	SET	-	-	1
<u>MOST</u>					
	SET	-	-	-	14
	of	the	SET	-	21
<u>MOSTLY</u>					
	SET	-	-	-	35
<u>MUCH</u>					
	greater	number	of	SET	2
		numbers	of	SET	1

NEARLY

all	SET	-	-		6
	of	the	SET		1
	the	SET	-		6

NOT

a	huge	majority	-		1
many	SET	-	-		4
so	many	SET	-		1
very	many	SET	-		3

NOTICEABLE

amount	of	SET	-		1

NUMBER

of	SET	-	-		12

ONLY

a	extreme	minority	-		1
	few	SET	-		28
		of	the	SET	1
		scattered	SET		1
	handful	of	SET		4
	little	number	of	SET	1
	slight	majority	of	SET	1
	small	amount	of	SET	1
		number	of	SET	3
	very	few	SET		5
		slight	majority		1
		small	handful of SET		2
			number of SET		1
		very	few	SET	2
			small number of SET		1

OUTNUMBER

by	a	reasonable amount			1
only	by	a	small amount		1

OVERWHELMING

proportion	of	SET	-		1

PRACTICALLY

all	SET	-	-		7
	of	the	SET		2
	the	SET	-		1

QUITE

a	few	SET	-		16
	large	majority	of	SET	2
		number	of	SET	1
	lot	of	SET		11
	number	of	SET		1

SLIGHT

majority	of	SET	-	1

SLIGHTLY

greater	number	of	SET	1

SMALL

amount	of	SET	-	1
number	of	SET	-	1

SOME

SET	-	-	-	18

SPARSE

number	of	SET	-	1

SUBSTANTIAL

minority	of	SET	-	1

THE

amount	of	SET	-		6
great	majority	of	SET		3
greatest	in	numbers	-		1
large	majority	-	-		2
largest	amount	of	SET		1
	number	of	SET		2
	ratio	of	SET	toSET	1

THE continued...

	least	number	of	SET	2
	majority	of	SET	-	33
			the	SET	3
			this	SET	1
	minority	of	SET	-	2
	most	SET	-	-	1
		number	of	SET	2
	number	of	SET	-	34
	numbers	of	SETS	-	6
	overwhelming	majority	of	SET	2
	proportion	of	SET	-	7
	small	number	of	SET	1
	smallest	number	of	SET	3
	vast	majority	of	SET	12
				the SET	2
	very	large	number	of males	1
VAST					
	majority	SET	-	-	1
		of	SET	-	5
VERY					
	few	SET	-	-	80
	many	SET	-	-	3
	much	in	the	minority	1
	small	number	of	SET	1
	very	few	SET	-	3
VIRTUALLY					
	all	SET	-	-	4
		the	SET	-	2

Appendix B

The following experiment was carried out as a pilot study for experiment 6. The task of subjects in this study was similar to that presented to subjects in experiment 6. They were each presented with a sentence of the form 'q-exp set predicate' followed by the words 'Last week they' or by the word 'They' alone. The q-exp in the initial sentence was varied between subjects (the q-exps used were 'only a few', 'a few', and 'few'), as was the set + predicate ('MPs were at the meeting' or 'football fans were at the match'). The subject's task was to complete the second sentence.

Sentence completions from 120 independent subjects were read and placed in one of the following categories:

REF - where 'they' referred to the ref ss ie. those MPs/football fans at the meeting/match.

COMP - where 'they' referred to the comp ss ie. those MPs/football fans who were not at the meeting/match.

WHOLE - where 'they' referred to all MPs/football fans, or MPs/football fans generally.

LW - where 'they' referred to those MPs/football fans who were at last weeks meeting/match. NB. There were no references to those who were not at last weeks meeting/match.

OTHER - where 'they' referred to something other than MPs or football fans - in all three cases, this constituted a reference to members of the football team!

UNCLEAR - where it was unclear which (sub)set of MPs/football fans 'they' had been taken to refer to.

Differences between MP and FF conditions (sentences containing MPs versus football fans), were not great and were in the large part due to the "unclear" and "LW" categories. One problem with this study is that 20 out of 120 sentences were placed in the unclear category, because the experimenter felt that 'they', in some sentences, could be seen as referring to more than one of the categories. One in six of the sentences had to be excluded from the major categories for this reason.

When the MP and FF conditions are collapsed, the following results emerge:

	REF	COMP	WHOLE	LW	OTHER	UNCLEAR	TOTAL
F/T	8	10	2	0	0	0	20
F/L	0	4	2	8	1	5	20
A/T	19	0	0	0	0	1	20
A/L	0	0	0	14	1	5	20
O/T	15	1	0	1	0	3	20
O/L	3	0	1	9	1	6	20
	45	15	5	32	3	20	120

In all but one of the sentences completed in the A few/they condition, 'they' was taken to refer to the ref ss; in the few/they condition, 'they' was taken to refer to the comp ss 50% of the time, and to the ref ss slightly less than 50% of the time; in the only a few/they condition 'they' was taken to refer 75% of the time to the ref ss and only once to the comp ss. These results do not support H1, which would predict no difference between 'Few' and 'a few' in terms of the referent of 'they'. Clearly, the fact that a q-exp denotes a small proportion is not a sufficient condition to allow focus on the comp ss. The results show that 'only a few' can lead subjects to focus on the comp ss (since one subject did use "they" to refer to the comp ss), but obviously the tendency to use 'they' in this way was much stronger with 'few' than with 'only a few'.

It is clear from the table that there are differences dependent on the temporal manipulation. That is, 'they' was used to refer to different things depending on whether or not it was preceded by "Last week...". However on looking at the content of the "Last week" completions, there appears to have been a great deal of confusion in subject's interpretations of how many meetings/matches there were, and when they were held etc., and in many cases the subjects seem to have thought that the meeting/match mentioned in the first sentence, had occurred the previous week. The following two completions provide an example of different interpretations of "Last week..":

(1) Few MPs were at the meeting. Last week they... had dealt with the most important issues, so today's meeting was merely a formality.

(2) Few football fans were at the match. Last week they.. went instead to the cinema because of bad weather.

In (1), "Last week" is interpreted as the week before the meeting mentioned in the first sentence; in (2), it is more likely that "Last week" is the same week as the meeting mentioned in the first sentence. Given the confusion, it is reasonable to assume that the temporal manipulation did not actually function as a temporal manipulation. The 'last week' conditions therefore, cannot be compared with the ". They" conditions.

Since the second hypothesis concerns the need for explanation, it was decided that an analysis of the causal content of sentences would be useful. Such an analysis might throw some light on the difference between 'a few' and 'only a few' which, according to the 'referent of 'they'' analysis above, was minimal. This analysis should provide a better investigation of the second hypothesis, and may also reveal other effects or consequences of using one q-exp as opposed to another.

The analysis of the content of sentences was carried out by the experimenter only. However, the content categories used in this study were useful in constructing categories for experiment 6. The content categories were as follows:

(1) CONSEQUENCE - where the subject stated some consequence of the fact that a small number of people attended the meeting/match.

(2) REASON A - where the subject gave a reason for the number attending/not attending the meeting/match.

(3) REASON B - where the subject stated that people who were or were not at the match, did so in spite of something eg. the weather.

(4) EXPECTATION - where the subject stated what was expected or had been expected before the meeting/match.

(5) OTHER - where the subjects completion could not be placed in any of the above categories.

Having categorised the sentences according to their content, the following results emerged:

	CONSEQUENCE	REASONA	B	EXPECTATION	OTHER	TOTAL
F/T	1	10	0	3	6	20
F/L	1	14	0	0	5	20
A/T	1	0	1	0	18	20
A/L	0	6	1	0	13	20
O/T	4	3	3	0	10	20
O/L	1	7	0	0	12	20
	8	40	5	3	64	120

The table shows that 'Few' often led subjects to give some explanation which implies that on reading 'few' they are likely to expect a reason. This is also true to a lesser extent, of 'only a few', but it is not true of 'a few'. Perhaps one might argue that 'few' cues a reason in terms of the rest of the set (the comp ss), and hence the change in focus found with 'few' sentences. 'Only a few' on the other hand, cues a reason in terms of the part of the set denoted (the ref ss), and hence a change of focus is less likely.

Having carried out this pilot study, experiment 6 was carried out without the temporal manipulation. Also, the categories which were found to be useful in this small study were adapted and given to independent judges who categorised the sentences completed in experiment 6 according to their content.

Appendix C

This appendix contains all of the functions used by the MULISP program described in chapter 10. The information presented here is organised in such a way as to make the relationship between the functions clear. All functions have been assigned numbers for easy reference. They have also been placed in groups according to their relationship with the top level function, INPUT. Thus, functions which are called directly by INPUT are in group A, functions which are called by Group A functions are in group B, etc. Above each function presented, there is a simple description of the tasks which the function carries out.

After presenting INPUT, the program will be presented in two parts. Part I deals with the word-functions which INPUT calls, and subfunctions of these; Part II deals with the ANSWER function which is also called directly by INPUT when all the words have been processed.

Top Level Function

Function (1)

INPUT places the words of the input sentence in a list, and sets categ (a list of the categories of words which have been processed) and next-word (the word which is expected next) to nil. If there are no words left to process, it calls ANSWER (see part II). Otherwise it places the next word in func, and evaluates this as a function (see the word functions in Part I).

```
(defun input (lst words categ next-word func)
            (setq words lst)
            (setq categ nil)
            (setq next-word nil)
            (loop ((null words) (answer))
                     (setq func (car words))
                     (setq words (cdr words))
                     (eval (list func))))
```

Part I

Group A - Words

All word functions call the function CHECKWORD (function 14) either directly or indirectly through another function.

Modifiers

Function (2)

VERY places 'q-mod' in categ, calls CHECKWORD, and sets next-word to 'q-exp'. The function VERY-CHANGES (function 15) is then called.

```
(defun very ()
           (setq categ (cons 'q-mod categ))
           (check-word)
           (setq next-word '(q-exp))
           (very-changes))
```

Function (3)

QUITE places 'q-mod' in categ, calls CHECKWORD, sets next-word to 'q-mod2', and calls the function QUITE-CHANGES (function 16).

```
(defun quite ()
           (setq categ (cons 'q-mod categ))
           (check-word)
           (setq next-word '(q-mod2))
           (quite-changes))
```

Function (4)

A places 'q-mod2' in categ, calls CHECKWORD, sets next-word to 'q-exp', and notes a focus specification in current-knowledge.

```
(defun a ()
            (setq categ (cons 'q-mod2 categ))
            (check-word)
            (setq next-word '(q-exp))
            (put 'current-knowledge 'specification '((e ref/pred)
                                                     (reason to)
                                                     (ss ref))))
```

Quantity Expressions

Function (5)

```
(defun few ()
            (q-info)
            (few-range)
            ((null (get 'current-knowledge 'specification))
             (put 'current-knowledge 'specification
                            '((e comp/not-pred)
                              (reason not)
                              (ss comp)))
              (%modify))
            (%modify))
```

Function (6)

```
(defun many ()
             (q-info)
             ((get '% 'mmod)
               (put 'current-knowledge 'note
                        '(the wrong modifier for many))
               (put '% 'mmod nil))
             (many-range)
             (put 'current-knowledge 'specification '((e ref/pred)
                                                      (reason to)
                                                      (ss ref)))
             (%modify))
```

Function (7)

```
(defun lot ()
            (q-info)
            ((get '% 'emod)
              (put 'current-knowledge 'note
                       '(the wrong modifer for lot))
              (put '% 'emod nil))
            (lot-range)
            (put 'current-knowledge 'specification '((e ref/pred)
                                                    (reason to)
                                                    (ss ref)))
            (%modify))
```

Sets

Function (8)

```
(defun mps ()
        (set-info 'mps))
```

Function (9)

```
(defun fans ()
         (set-info 'fans))
```

Function (10)

```
(defun meetings ()
         (set-info 'meetings))
```

Function (11)

```
(defun matches ()
         (set-info 'matches))
```

Relations

Function (12)

```
(defun go-to ()
         (rel-info 'go-to))
```

Function (13)

```
(defun are ()
        (rel-info 'are))
```

Group B

Function 14

CHECK-WORD checks to see if next-word has something in it (ie. if a particular category is expected), and if the category of the present word matches the word in next-word. If this is not the case, a note is placed in current-knowledge stating what category was expected.

```
(defun check-word ()
      ((and (not (null next-word))
            (not (member (car categ) next-word)))
       (put 'current-knowledge 'note
              (list '(I was expecting a) next-word))))
```

Function 15

VERY-CHANGES places in 'emod' values representing the effect of 'very' on the proportions denoted and expected by q-exps.

```
(defun very-changes ()
     (put '% 'emod '((there 5 5)
                     (yexp 5))))
```

Function 16

QUITE-CHANGES places in 'mmod' values which represent the effect of 'quite' on the proportional information given by a q-exp.

```
(defun quite-changes ()
     (put '% 'mmod '((there 5 5))))
```

Function 17

Q-INFO is used by all basic q-exps. It places 'q-exp' in categ, calls CHECKWORD (function 14), and sets next-word to 'set'.

```
(defun q-info ()
     (setq categ (cons 'q-exp categ))
     (check-word)
     (setq next-word '(set)))
```

Function 18

%MODIFY is called by all q-exp functions. It checks to see if there is anything in 'emod' (information from modifiers which make proportional information more extreme). If there is anything, then it modifies the proportional information using the function EMMODIFY (function 24). It then checks to see if there is anything in 'mmod' (information from modifiers which make proportional information more moderate), and if there is the function MMODIFY (function 25 is called).

```
(defun %modify ()
     ((get '% 'emod)
      (put 'current-knowledge '% (list
         (list*  'there (emodify (cdr (assoc 'there
                                   (get  'current-knowledge '%)))
                            (cdr (assoc 'there (get '% 'emod)))))
         (list*  'yexp  (emodify (cdr (assoc 'yexp
                                   (get  'current-knowledge '%)))
                           (cdr (assoc 'yexp (get '% 'emod))))))
      (put '% 'emod nil))
     ((get '% 'mmod)
      (put 'current-knowledge '% (list
         (list*  'there (mmodify (cdr (assoc 'there
                                   (get  'current-knowledge '%)))
                            (cdr (assoc 'there (get '% 'mmod)))))
         (assoc 'yexp (get 'current-knowledge '%))))
      (put '% 'mmod nil)))
```

Function 19

FEW-RANGE checks to see if there is any proportional information in current-knowledge. If there is it places proportional information from 'few' in '%2', otherwise it places this information in '%'. The proportional information given is that 10 to 25% is denoted, and prior expectations will be altered by 10%.

```
(defun few-range ()
     ((get 'current-knowledge '%)
      (put 'current-knowledge '%2 '((there 10 25)
                                    (yexp 10))))
     (put 'current-knowledge '% '((there 10 25)
                                  (yexp 10))))
```

Function 20

MANY-RANGE carries out the same check as FEW-RANGE, before noting that 40 to 70% are denoted, and that prior expectations will not be affected by 'many'.

```
(defun many-range ()
      ((get 'current-knowledge '%)
       (put 'current-knowledge '%2 '((there 40 70)
                                     (yexp 0))))
      (put 'current-knowledge '% '((there 40 70)
                                   (yexp 0))))
```

Function 21

LOT-CHANGES also checks to see if there is any proportional information in current-knowledge, before noting that 40 to 60% is denoted and that prior expectations are not affected.

```
(defun lot-range ()
      ((get 'current-knowledge '%)
       (put 'current-knowledge '%2 '((there 40 60)
                                     (yexp 0))))
      (put 'current-knowledge '% '((there 40 60)
                                   (yexp 0))))
```

Function 22

SET-INFO is called by all set function. It places 'set' in categ, calls CHECK-WORD (function 14), and sets next-word to 'relation' or 'nil'. If there is no current-knowledge, it places information about the set from the world (function 30) in current-knowledge. If there is no subset of current-knowledge relating to the present word, information associated with the word is added to current'knowledge. Otherwise, current-knowledge is reduced to that subset of itself which is associated with the present word. If prior expectations about proportions are available in current-knowledge, these are then stored with the other proportional information in current-knowledge.

```
(defun set-info (word)
      (setq categ (cons 'set categ))
      (check-word)
      (setq next-word '(relation nil))
      ((null (get 'current-knowledge 'information))
       (put 'current-knowledge 'information (get 'model word)))
      ((null (assoc word (get 'current-knowledge 'information)))
       (put 'current-knowledge 'information
                 (append (get 'model word)
                         (get 'current-knowledge 'information))))
      (put 'current-knowledge 'information (assoc word
                 (get 'current-knowledge 'information)))
      (put 'current-knowledge '% (append
                 (get 'current-knowledge '%)
                   (list (list* 'pexp
                     (cdr (assoc 'attend
                       (get 'current-knowledge 'information)))))))
```

Function 23

REL-INFO is called by all relation word functions. It places 'relation' in categ, calls CHECK-WORD, and sets next-word to 'set' and 'q-exp' meaning that the next word is expected to be in one of these categories. Current-knowledge is then reduced to that subset of itself which relates to the present word.

```
(defun rel-info (word)
      (setq categ (cons 'relation categ))
      (check-word)
      (setq next-word '(set q-exp))
      (put 'current-knowledge 'information (assoc word
                  (get 'current-knowledge 'information))))
```

Group C

Function 24

EMODIFY takes two lists of values as arguments. If the first value in the first list is small, it then reduces each member of the second list by the corresponding value in the first list. Otherwise the values of the first list are added to those of the second.

```
(defun emodify (lst1 lst2)
      ((< (car lst1) 35)
       (mapcar '- lst1 lst2))
      (mapcar '+ lst1 lst2))
```

Function 25

MMODIFY takes two lists of values as arguments. If the first value in the first list is large (over 35), then it adds to members of the second list the value of the corresponding member of the first list. Otherwise the values of the first list are subtracted from the second.

```
(defun mmodify (lst1 lst2)
      ((< (car lst1) 35)
       (mapcar '+ lst1 lst2))
      (mapcar '- lst1 lst2))
```

Part II

Group A

Function 26

ANSWER list all of the information in current-knowledge, calls the function ANSWER2 and repeats the contents of current-knowledge minus the note.

```
(defun answer ()
      (print (list categ
            (get 'current-knowledge 'note)
            (get 'current-knowledge '%)
            (get 'current-knowledge '%2)
            (get 'current-knowledge 'specification)
            (get 'current-knowledge 'information)))
      (answer2)
      (terpri)
      (list (get 'current-knowledge '%)
            (get 'current-knowledge '%2)
            (get 'current-knowledge 'specification)
            (get 'current-knowledge 'information)))
```

Group B

Function 27

ANSWER2 calls the functions %CHANGE and INFOCHANGE (functions 28 and 29).

```
(defun answer2 ()
      (%change)
      (infochange))
```

Group C

Function 28

%CHANGE checks to see if their are prior expectations and q-exp effects on expectations in current-knowledge. If there are MMODIFY is called to adjust the expectation values and the proportion expected by the speaker is noted in current-knowledge.

```
(defun %change ()
      ((and (assoc 'yexp (get 'current-knowledge '%))
            (assoc 'pexp (get 'current-knowledge '%)))
       (list (put 'current-knowledge '%
                  (append (get 'current-knowledge '%)
                          (list* '(you expected)
                              (mmodify (cdr (assoc 'pexp
                                   (get 'current-knowledge '%)))
                                   (cdr (assoc 'yexp
                                   (get 'current-Knowledge '%)))))))))
      (list (get 'current-knowledge '%)))
```

Function 29

INFOCHANGES reduces current-knowledge to that subset of itself relating to 'reasons' if 'reason' is found in the focus specification, and the value of 'reason' in the specification determines the kind of reason which is left in current-knowledge. If the specification has '(reason not)', for example, informatino associated with 'reason' and 'not' will be left in current-knowledge.

```
(defun infochange ()
     (put 'current-knowledge 'information
       (assoc (cadr (assoc 'reason
                       (get 'current-knowledge 'specification)))
            (assoc 'reason (get 'current-knowledge 'information))))
     (list (get 'current-knowledge 'specification)
           (get 'current-knowledge 'information)))
```

Function 30

WORLD places information in a model which is used by the program. This function is run before INPUT to ensure that 'previous current-knowledge' is no longer used.

```
(defun world ()
     (put 'current-knowledge '% nil)
     (put 'current-knowledge 'specification nil)
     (put 'current-knowledge 'information nil)
     (put 'current-knowledge 'note nil)
     (put 'model 'mps '((are boring)
                        (work hard)
                        (tell lies)
                        (go-to
                         (meetings
                            (attend 50)
                            (discuss cuts)
                            (vote on bills)
                            (get bored)
                            (reason (to (are interested in topic)
                                        (like speaker)
                                        (have duty)
                                        (want to argue))
                                    (not (are on holiday)
                                         (dont like speaker)
                                         (are lazy)))))))
     (put 'model 'fans '((are noisy)
                         (cheer the teams)
                         (drink too much)
                         (go-to
                           (matches
                             (attend 66)
                             (shout loudly)
                             (attack each other)
                             (enjoy themselves)
                             (reason (to (like the team)
                                         (want to win)
                                         (have a day out))
                                     (not (bad weather)
                                          (prefer television)
                                          (bad team)))))))
      (put 'model 'matches '((type1 sticks)
                             (are dangerous)
                             (can light fires)
                             (type2
                               (games
                                  (example football)
                                  (example rugby)
                                  (watched by fans)))))
      (put 'model 'meetings '((are boring)
                              (held in conference rooms)
                              (used for policy decisions)
                              (attended (by mps)
                                        (by businessmen)))))
```