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Communicating Quantities: A Review of Psycholinguistic Evidence of How Expressions Determine Perspectives

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SUMMARY

The way in which information about proportions, amounts, frequencies, probabilities, degrees of confidence, and risk is portrayed in natural language is not neutral, but reflects presuppositions and assumed norms. In this paper we present a review of evidence in support of this position. We show that the choice of expressions for communication depends in a systematic way on the kinds of inferences communicators draw. We go on to discuss the consequences of this for attribution phenomena, aspects of reasoning, the portrayal of uncertainty, and responses to questionnaires. We also suggest that communicator preferences for using language rather than numbers may have to do with human reasoning being argument-based, rather than with a preference for vagueness, as has been commonly claimed.

INTRODUCTION

Quantifiers, frequency adverbs, and expressions of probability alike play a major role in communication both in casual encounters and in the communication of information about likelihood, risk, the weather, the amount of fat in food, and the expectation of bargains in store sales. The use of quantifying expressions also permeates questionnaire work (e.g. Gaskell *et al.*, 1993). Thus a questionnaire might ask how often a person feels unhappy by allowing the options *never*, *seldom*, *sometimes*, *often*, *always*, rather than asking what percentage of the time the subject feels unhappy. There are many ways of expressing quantities, and they are far from equivalent, even when the amounts they depict are the same. For instance, the following possibilities exist for portraying the amount of fat in a can of soup, among a host of others:

- Contains 2% fat
- Contains only 2% fat
- 98% fat free

The amount being depicted is the same, and so the three utterances have equivalent truth, but the rhetorical impact of the formulations is undoubtedly different. In this paper we review a body of research into such phenomena, and indicate some of the practical and methodological consequences.

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As an applied issue, the number of areas where questions of the use of verbal information to depict quantities is very large, a testament to the generality of the issue. It includes the description of physical effort (Angel *et al.*, 1994), defining standards of proof to juries (Kagehiro, 1990), how the description of attributes influences house-purchases (Lindberg and Görling, 1991), the labelling of additives in food (Wogalter *et al.*, 1996), and expressions used in Market Research Reports (Scipione, 1995). There has been considerable work on the use of verbal labels on questionnaire design using scales (e.g. Haddock, 1988; Newstead *et al.*, 1987; and examples mentioned later in this paper). In addition, there has been a serious effort to investigate the comparative effectiveness of portraying probabilities and uncertainties by verbal and numerical means (e.g. Budescu *et al.*, 1988; Wallsten, 1990; and examples discussed below).

In this paper we take the stand that whether numbers or verbal expressions are used to communicate, rhetorical and perspectival aspects of the message have to be taken into account in any choice of expression made. Furthermore, we shall show how verbal expressions provide subtle information which powerfully influences the kinds of inference a reader draws.

Let us begin with a discussion of how information about uncertainty, frequency and probability is imparted. Here there has been a split between those who believe that there is no substitute for the precision of numbers (e.g. Behn and Vaupel, 1982; Moore, 1977; Von Winterfeldt and Edwards, 1986) and those who believe that natural language is more comprehensible (e.g. Zimmer, 1983, 1984). The claim that the use of numbers is best is based on the idea that if a person makes a statement about uncertainty or probability, any preference for using natural language is misguided because the statement will be founded on a mental probability distribution with a mean value and variance. To use natural language simply compounds any difficulties of interpretation (Von Winterfeldt and Edwards, 1986). Yet, under many circumstances there is a preference for using language. Thus Wallsten *et al.* (1993b) surveyed 442 undergraduate and graduate students, asking whether they thought that other people would prefer to express (give) degrees of uncertainty verbally or numerically, and what their own preference would be. Seventy-seven% thought that other people would prefer to give the information in verbal format, and 68% said they would prefer that format for giving information themselves. Reasons given included the idea that uncertainties may not be very reliably known, so numbers would not be warranted. When asked about receiving information 70% of participants said they preferred to receive it numerically. Others have demonstrated a general preference for communicating with natural language expressions, using participants from various populations (Brun and Teigen, 1988; Erev and Cohen, 1990).

There has been a little work on the possible basis of any difference between number and language as a way of communicating. Thus Zimmer (1984) asked bank clerks to provide verbal predictions of future monetary exchanges. Those asked to provide numeric predictions tended to report only in terms of quantitative variables, while those given free reign mentioned important qualitative variables. Zimmer claimed that using different presentation modes puts attention on different aspects of the problem-space. Windschitl and Wells (1995) showed that participants who were instructed to indicate uncertainties in numerical terms tended to be relatively unaffected if the same problem was presented in different formats, while those using verbal terms were affected by context. They suggested that using numbers leads to a

more analytic, rule-based approach to representation and reasoning than does the use of words. They also showed that participants' verbal descriptions better predicted individual preferences among options with unknown outcomes than numbers, and to be better predictors of behavioural intentions. For some purposes, such as those where numerical values are meaningful, and where reasoning should be restricted to simple framework, using numbers might be best. If the idea is to elicit aspects of a representation of uncertainty which reflects a person's likely behaviour (as with an attitude questionnaire), then verbal descriptors might be more useful.

Although there have been such analyses of the qualitative differences between numerical and verbal means of communicating risk and uncertainty, most researchers who have made comparisons appear to have done so in the belief that verbal expressions serve to denote (numerical) amounts, or ranges of amounts. The question has been how accurate are verbal expressions, rather than what different patterns of thought and reasoning might be set up by numbers and verbal expressions which might denote the same amount (e.g. Mosteller and Youtz, 1990; Reagan *et al.*, 1989; Wallsten and Budescu, 1995).

The potential impact of such rhetorical differences has been overlooked completely in some areas. For instance, the Psychology of Attribution is concerned with the attribution of causes for events. Experiments in this area rely heavily on imparting information about the frequencies of events to experimental participants by verbal description (Kelley, 1967; Hilton and Slugoski, 1986). While frequency information is presented in verbal form, the influence of rhetorical effects has hardly ever been controlled for. This is discussed more fully below. Similarly, in much questionnaire research seeking information about the frequencies of events or experiences, natural language is used as though it elicits frequency information independently of rhetorical effects. Much the same can be said of the very extensive literature on reasoning under uncertainty, where information is typically delivered unquestioningly in numerical form, even though this form of delivery itself is not free of rhetorical overtones. Finally, during the elicitation of knowledge from experts, verbal indicators of likelihood and frequency are generally preferred and often given, yet these are viewed as rough approximations to numerical values rather than statements with a necessary rhetorical component.

In the body of this paper, we review the psychological evidence regarding the rhetorical impact of quantifiers in particular, and of related expressions such as frequency expressions and probability terms in general, and we describe some consequences of these findings for a variety of issues. The paper is organized as follows. First, we give a short review of the relationship between verbal items and the quantities they may denote. We then go on to describe our research on quantifiers, which demonstrates substantial attention and inference-controlling properties. We show how these properties appear to hold for terms of frequency, likelihood, risk, and so on, in a general way. Finally, we discuss the consequences of these observations.

THE LANGUAGE-NUMBER EQUIVALENCE THESIS

Given a statement like *Q of the children enjoyed the school outing*, participants can easily provide a percentage translation when expressions like *many*, *few*, etc. are substituted for *Q*. It almost seems like a truism that quantifiers will lie on some sort of scale, and that a mapping will hold between a distribution of numbers and a natural

language quantifier. But it is a much greater step to suppose that the internal (mental) representation of quantifier meanings is in terms of an internal scale, and of course an even greater step still to suppose that any kind of scaling can accommodate the major features of quantifier meaning.

There is a very large number of quantifiers, frequency expressions and expressions relating to risk and chance levels which people use in their everyday lives. For instance, in a simple communication task where participants were allowed to use any non-numerical quantifiers they liked to effectively communicate information about a limited range of proportions, no less than 182 different expressions were used (Moxey, 1986; cf. Moxey and Sanford, 1997; see also Budescu *et al.*, 1988, for similar observations in the probability domain). There is thus some need to explain the variety of expressions people use, and to explain why so many expressions denote what must plainly be similar amounts.

The overlap between expressions in scaling studies is typically very great, so great, in fact, that the practical consequence is that researchers seek out optimally small sets of expressions which might form an optimally discriminating (interval) scale (e.g. Goodwin *et al.*, 1977; Hammerton, 1976; Hartley *et al.*, 1984; Pohl, 1981; Schriesheim and Gardiner, 1992; Schriesheim and Schriesheim 1974, 1978). For the very practical issue of communicating risk and probability, two strategies have been taken. One is the attempt to develop a set of standardized phrases for the official communication of all risk (e.g. Mosteller and Youtz, 1990; Reagan *et al.*, 1989); the other is to calibrate the way a particular expert uses her own phrases through scaling, using, for instance, membership functions (Wallsten *et al.*, 1986). With these, the acceptability of an item over a range of potential values is graded between 0 (no fit) to 1 (perfect fit). So, for the probability terms studied by Wallsten *et al.* (1986), *likely* might be given a value of 0 for $p = 0.2$, one of 0.1 for $p = 0.3$, and 1.0 for $p = 0.8$, for instance. Membership functions thus convey information about the form of the mapping from an expression to amounts (e.g. variance, skew, kurtosis) as well as central tendency information.

Membership functions are claimed to be quite stable for a given individual, and by establishing the membership functions for the terms a particular person uses, it has been possible to show that some types of gambles are made in the same way as those based on numerical information (Wallsten *et al.*, 1993a). Clearly such a method takes into account individual variation in the way that a common vocabulary does not, and may be one way to overcome the problem of developing an interpretable and discriminating scale.

However, there are problems. In normal communication, users do not have access to each other's membership functions. Second, the differences between items on scales may be greatly exaggerated by the use of within-subjects designs. Participants are typically given a variety of expressions in the same task, which means that different values for different expressions could arise through contrast effects (e.g. Daamen and de Bie, 1991; Poulton, 1968, 1973, 1989). Other context effects include the finding of Newstead *et al.* (1987) that the numerical values assigned to quantifiers depended on the set size from which the values could be chosen. Thus low-magnitude quantifiers (few, several) signified a greater proportion when they described small set sizes than large ones.

In order to circumvent contrast effects between items, Moxey and Sanford (1993b) carried out a study of 10 quantifiers by Moxey and Sanford (1993a) in which they required 450 participants to assign just one number to one quantifier on one occasion

only. Thus there was no opportunity to develop a strategy of comparison between either quantifiers or situations. The results showed that several quantifiers were simply not distinguishable from one another (*a few*, *only a few*, *not many*, *few*, and *very few*). While a between-subjects design generally leads to larger variance, in a communication setting, interlocutors only get one statement, not a whole set for comparison purposes.

One aspect of this result might be considered surprising. In a direct comparison everyone would judge *very few* if anything to be less than *few*, for instance. However, there is now other evidence showing that intensifiers like *very* and *really* only show reliable intensifying effects when participants are able to contrast them directly with each other (e.g. Cliff, 1988; Smith *et al*., 1988), the effect disappearing in single judgment designs (O'Muircheartaigh *et al*., 1993; Wright *et al*., 1995). So, the effects of intensifiers on assigned scale values, when they appear, may be largely explained in terms of stimulus contrast effects. More recently, Tsao and Wallsten (1994) showed that the form of membership functions depended on the number of other phrases in the experiment.

The other universal problem for word-to-scale mapping accounts of quantifier meaning is that the values assigned by participants depend upon context. In particular, if an event has a high base-rate expectation, such as people enjoying parties, then the values assigned to (say) *many* in *many people enjoyed the party* is higher than it is for a low baserate expectation (as in *many of the doctors in the hospital were female*). Such effects are found for quantifiers even in independent groups designs (Moxey and Sanford, 1993b); and they occur with frequency adverbs and probability terms (Pepper, 1981; Pepper and Prytulak, 1974; Wallsten *et al*., 1993b; Wright *et al*., 1994), and with common expressions of risk such as significant/insignificant risk (Smith, 1998, unpublished manuscript). Apart from baserate expectation, Weber and Hilton (1990) demonstrated an effect of the severity of outcome on the numerical interpretation of probabilities. Also, Mullet and Rivett (1991) showed that when descriptions were given of the chances of a child passing a test, or of failing it, the same phrase led to higher values being assigned in the case of the positive outcome. All these data indicate that the assignment of numbers to quantifiers and probability statements is heavily dependent upon context. These effects are more thoroughly documented in Budescu and Wallsten (1994), Clark (1990), Moxey and Sanford (1993a), and Wallsten and Budescu (1995).

To summarize, not only is there great overlap in the numerical values which subjects will assign to even a small set of terms, or great overlap of membership functions, but there are persistent effects of context on interpretations, including baserate and the severity and affective polarity of the outcome. Natural language expressions are imprecise in many respects, yet there is an enormous variety of expressions which people choose to use.

INFERENTIAL ACTIVITY

It is our belief that the preference for presenting information in verbal form, rather than in numerical form, is not because speakers do not want to be subjected to the precision implicit in number usage, but because they typically have an orientation or perspective on the information being conveyed. For instance, in describing some low risk, such as the risk of getting pregnant while using a given form of contraception,

the speaker might think that if this happens on 0.01% of occasions, this is virtually zero, or alternatively, they might wish to draw attention to the fact that it can happen. The power of these perspectives is hopefully made clear in the rest of this paper.

Negativity, reference, and focus patterns

Even the most cursory glance at quantifiers in normal usage shows a split between those which have some sort of negative component (e.g. *not many*, *few*, *not quite all*) and those which do not (*many*, *a few*, *nearly all*). (Negativity is a complex concept, and is discussed briefly in the Appendix.) One pillar of our argument is that negative quantifiers lead to different patterns of inference about quantified statements than do positive ones. We have demonstrated several differences between positive and negative quantifiers (Moxey and Sanford, 1987, 1993a, Sanford *et al*., 1996). One basic observation is that the preferred patterns of reference resulting from negative quantifiers are different from those resulting from positives. This is a major piece of evidence that perspective effects are a function of quantifier type.

A simple quantified statement like *Some of the children like football* requires someone to take into account several sets in order for them to reason about what has been said:

(a) The set of children who like football (logically necessary).
(b) The set of children who do not like football. (The presence of this set is implicated but not logically necessary.)
(c) The set of people who like football and are not children. (Possible set.)
(d) In addition, it is necessary that there is a set of children as a whole (a+ b), over which quantification is taking place.

One important question is which of these sets may be referred to, and how. The most prominent, focused elements of a discourse may be referred to by means of pronouns (e.g. Sanford and Garrod, 1981). Thus the use of a pronoun can be taken as diagnostic of a particular element being highly available. So (1a) is acceptable while (1b) is not.

(1) Some of the children played in the park.
(1a) They got very hot after about ten minutes.
(1b) They played at home instead.

In this case focus is on the subset who played at the park, and not on those who played at home. To refer to those who played at home, a different referential device is needed, rather than a pronoun, such as *Those who did not played at home instead.*

To examine how focus worked over a range of quantifiers (Moxey and Sanford 1987, 1993a; Sanford *et al*., 1996) used a continuation task, in which subjects wrote continuations to quantified statements. The continuations were constrained in that they had to start with *They*, as in:

(2) Few of the children ate the ice cream. They ...

Continuation patterns for positive quantifiers, like *A few* and *Nearly all* showed a preference for reference to set (a), which we called the Standard Reference Set pattern (Reference Set for short):

(3) Nearly all the fans went to the football match. They cheered all the way through.

In complete contrast, for negative quantifiers like *few* and *not quite all*, it was found that the greater proportion of pronominal references was to set (b), the set for which the predicate does not hold. This was termed Complement Set Reference pattern (Complement Set for short):

(4) Not quite all the fans went to the football match. They were on a bus that broke down and didn't make it.

Note that complement set reference is not appropriate for positive quantifiers, as in (5):

(5) Nearly all the fans went to the football match. They were on a bus that broke down and didn't make it.

Table 1 provides a summary of the main quantifiers investigated, along with a classification of polarity and whether or not complement set reference was induced. The patterns obtained are not an artefact of forcing the use of a pronominal reference. Moxey *et al.* (submitted) have found the pronominal reference pattern to hold even when participants are allowed to continue with any sentence they wish. Furthermore, the preferred patterns influence the ease of integrating subsequent sentences during reading, as indexed by self-paced reading time (Sanford *et al.*, 1996), and eye-tracking measures (Paterson *et al.*, 1998). When a negatively quantified sentence is followed by a sentence consisting of a reference-set pattern continuation, it is processed more slowly than a complement set pattern continuation. For a positively quantified sentence, the same type of result holds, *mutatis mutandis* (see also Jarvella and Lundquist, 1994).

These reference patterns demonstrate that the focus of quantifiers of negative and positive polarity differs. Negative quantifiers seem to cause the reader to concentrate on the set of items which does not fit the predicate, while positive quantifiers cause a concentration on the set that does fit the predicate.

Table 1. Quantifiers inducing complement set focus, or blocking complement set reference

Negatives: complement set inducers	Positives: complement set blockers
Hardly any (2)	
Few; very few (1,3)	A few (1,3)
Not many (1,3)	Many (1,3)
Less than half (2)	More than half (2)
Less than 20%, 80% (2)	More than 20%, 80% (2)
Not all; Not quite all (2,3)	Nearly all; almost all (3)
Not quite 20%, 40%, 60%, 80% (3)	Nearly 20%, 40%, 60%, 80% (3)
No more than 20; 20% (4)	At least 20; 20% (4)
Weak inducers:	
At most 20; 20% (4)	
Only a few (1)	
Only *X*% (2)	

Data sources: (1) Moxey and Sanford (1987); (2) Moxey and Sanford (1993a); (3) Sanford *et al.* (1996); (4) Moxey *et al.* (submitted).
Note: Complement set focus typically explains between 60% and 90% of reference patterns in the 'induced' cases. In the weak cases, the rate is somewhat lower.

Inferences stemming from negativity

Additional analyses of the continuations produced in these experiments showed that the *content* of the continuations differed for negative and positive quantifiers (Moxey and Sanford, 1987, 1993a). The predominant form of continuation to negatives was some reason why the predicate did not hold (Reasons Why Not). So, in (4), the explanation is one of why a subset of the fans did not make it. For positives, this was seldom the case. With positives, the predominant form was of a simple continuation (What Happened Next), as in (3), and sometimes a reason why the predicate holds (Reasons Why), as in (6):

(6) A few of the fans went to the match. They wanted to see the new striker in action.

These continuations show how what readers think about is under the control of the type of quantifier, and this opens up the possibility that the kind of inference pattern which results from encountering a negative statement is a major force in determining the pattern of reference described earlier.

This link comes about because negative statements have the property of introducing a presupposition, which is then denied (Clark, 1976; Wason, 1965). The statement *John didn't go to the cinema last night* introduces the possibility that someone might expect that he did go, and then denies it. Similarly, the statement *Not many people go to the cinema* implies that someone might have expected that many did, and then denies that this was the case. There are two kinds of evidence that might be considered in relation to this: the acceptability of an inference and direct measures of what is supposed.

For (7) and (8), what is a good and bad thing differs (* denotes an unacceptable discourse pattern):

(7) In the aircrash, not many people were killed, which is a good/bad* thing.
(8) In the aircrash, a few people were killed, which is a bad/good* thing.

We can explain this difference in terms of the negative *not many* inducing the supposition that if not many people were killed, then there was reason to suppose that many *might* have been killed. So, in the *not many* case, it is a *good thing* that fewer were killed than was expected. Such a presupposition induction does not hold for positive expressions, such as *a few*, and so to say *a good thing* in that context is to assert that the fact that there were people who were killed is a good thing. That would clearly be unacceptable in the present context.

Moxey and Sanford (1993b) carried out a direct test of presupposition and denial. They presented participants with statements like (9):

(9) Few of the local doctors were female.

Participants then stated what proportion they thought the writer of the statement might have *expected before he knew the facts*. In a related test, another group of participants stated what they thought the writer would have assumed the reader to have expected before the facts were stated. Using such a methodology, it was found that what was expected for the writer was a higher proportion for the negative quantifiers *not many*, *few*, and *very few*, along with *only a few*, than was the case for the positive *a few*. This supports the view that the first set of expressions introduces a supposition that more were expected. A similar test was carried out of the expectations the writer might have of the reader. For the quantifiers *not many* and *only a few* higher estimates than for *a few* were produced, as with the first test.

However, for *few* and *very few*, the estimates of prior expectations of the reader were no different from those for *a few*. Different quantifiers thus convey information about expectations at different levels.

The direct results provide evidence supporting the idea that presuppositions are introduced by the negative expressions, and *only a few*. The picture is complicated by the fact that *few* and *very few* differ from the others in that participants did not indicate that a speaker using these expressions would assume that the listener expected that more would be the case, any more than they would assume that for expressions using *a few*. So, it appears that *not many* makes participants think that the speaker herself expected more, and that the speaker believed the listener expected more. In contrast, only the first of these holds for *few* and *very few*.

There are two points to be made here. One is that in traditional semantic treatments of presupposition, there is no question asked about who holds the belief making up the presupposition. However, such a distinction is apparently needed. Second, although the *few*/*not many* distinction may appear to be a mere detail, it forms the basis of preferences for *not many* over *few*, and vice versa, in controlled communication tasks, described later.

The relation of inferences to focus patterns

Negative quantifiers have thus been shown to do three things: they put (referential) focus on the complement set, they inculcate inferences about reasons why the predicate might not hold for all individuals, and they trigger a pattern of presupposition that more were expected than turned out to be the case. Elsewhere (summarized in Moxey and Sanford, 1998; Moxey *et al*., submitted) we have suggested that all these details could be explained by a single process. The essence of the idea is that a negative quantifier triggers a presupposition introduction/denial sequence in the mind of the listener. This in turn generates what might be termed a Cognitive Question: why was the presupposition denied? In a continuation task, participants typically attempt to answer the implicit question in their responses, concentrating on reasons why the predicate might not be true. In creating continuations, if a plural reference is employed, it will be to the complement set.

BEYOND QUANTIFIERS

What is true of quantifiers we claim holds for terms depicting the frequency of events, and degrees of probability, risk and confidence. In this way, the arguments apply to all terms likely to be used in the portrayal of amount, frequency, uncertainty and strength of evidence. Recent research supports this claim. For example, a wide range of negative expressions put a different perspective on the representation of events, just as was the case with quantifiers. Thus the simple test, introduced earlier, of the value (good or bad) of an outcome is easily shown to be parallel to the results for quantifiers:

(10) There is a small probability of death, which is a good*/bad thing.
(10′) It is improbable that anyone will die, which is a good/bad*thing.
(11) There is a small risk of death, which is a good*/bad thing.
(11′) There is an insignificant risk of death, which is a good/bad* thing.

(The asterisks denote unacceptable propositions.)

The pattern observed suggests that the negative expressions introduce a presupposition that things should have been more probable or risky than turned out to be the case.

There has been no direct test of the pattern of prior expectations, which might be inferred as a result of using these expressions, but there has been work on the pattern of focus that they set up. Thus Smith (1998, unpublished manuscript) showed that the adjectives *insignificant* and *negligible* lead to a strong degree of complement set focus. Both are used very frequently to qualify *risk* in risk statements in the press, as in (11). In contrast, *small*, *significant*, and *large* do not induce complement set focus. The expressions showing complement focus have a negative component. Furthermore, the content of continuations in Smith's study showed that where the complement pattern occurred, it was accompanied by content of the Reason Why Not type. So, an *insignificant risk* can be taken as putting focus on reasons why things are safe.

For frequency adverbs, Moxey *et al.* (1990) showed that the types of continuations induced by the negative adverbs *seldom* and *rarely* were of the Reasons Why Not type, in contrast to those produced by the positives *occasionally* and *frequently*. Finally, Teigen and Brun (1995) showed much the same thing for probability terms. Using the Moxey/Sanford continuation task, they showed that negative expressions such as *not quite certain*, *uncertain*, *improbable*, *doubtful* etc. produced continuations which emphasized reasons for why a fact was doubtful, while positive expressions such as *probable*, *a small chance*, *a good chance*, and a *small probability* produced continuations which explained why a fact was not doubtful. As with the quantifier results, this was true regardless of the magnitude of confidence being expressed. For instance, *not quite certain* is a high probability, while a *small probability* is not, yet the emphasis they created was on Reasons Why Not and Reasons Why respectively.

So, perspective effects occur not only with quantifiers of differing polarities, but also with probability, risk and frequency expressions. Together, these represent the major ways of describing likelihoods of one sort or another, using natural language.

CONSEQUENCES OF PERSPECTIVE EFFECTS

These perspectival effects are important, and have consequences for how statements are interpreted. We shall begin with a description of simple studies concerning how appropriate quantifiers are chosen, using carefully controlled contexts. We then consider several different areas in which there appears to be a major impact of perspective effects.

Optimizing choice of expression

Moxey and Sanford (1998) have demonstrated that the choice of quantifier is governed by constraints on the situation of the communication. These experiments consisted of having participants read one of several possible vignettes. The assertion in each case was that some event only occurred in a small proportion of possible cases. For instance, there is only a small probability that a new car will suffer a breakdown in the fist two years after purchase. Participants then chose from a range of expressions, which would best meet the needs of an act of communication. For low probabilities,

the quantifiers of interest were *a few*, *only a few*, *few*, and *not many*. All these denote roughly the same proportions in a given scenario (Moxey and Sanford, 1993b), but they differentiate on the inference and focus effects described earlier. Consider a scenario where a car salesman was telling a customer about the number of cars of a certain kind, which had broken down within two years of purchase. The customer was obviously keen on the car. A statement of the kind: – – *of these cars break down in the first two years after purchase* was presented to the participants: they simply had to fill in the blank with one of four quantifiers: *few*, *not many*, *only a few*, *a few*, being truthful but appropriate in what they chose. The order of preference was *Few* > *not many* > *only a few* > *a few*. The difference between *few* and *not many* was reliable, and the differences between *few* and *not many* and *only a few* and *a few* were also significant. This is consistent with the idea that three objectives were being met:

- (a) A small number was being depicted (i.e. denotation).
- (b) Attention was to be directed to the large number of vehicles, which did not need attention (i.e. focus).
- (c) The salesman did not want to use an expression, which meant that he accepted that the customer would expect that it was possible that a larger number would have broken down. (i.e. the possible supposition of a breakdown is held only by the salesman, not by the customer, as in the levels effect).

Point (c) explains the preference of *few* over *not many*, while, point (b) explains the preference of *few* and *not many* over *only a few* and *a few*. *A few* is the worst case, in that it does not redirect attention at all; *only a few* directs attention to consequences of a small proportion.

Moxey and Sanford (1998) were also able to show that when it is important to take into account the implied prior expectations of the listener, *not many* was preferred over *few*. Finally, when focus should be on the small number of cases for which a predicate does hold (as in telling someone that they need an operation, with only a small chance of survival), it is better to say *A few people survive* than it is to use any of the other quantifiers in the choice set.

Attribution experiments: a potential confound in the literature

One area where the choice of quantifier is important is in attribution. Work in the psychology of attribution is concerned with discovering how people arrive at an assessment of the cause of some event, such as *John failing his exams*, or *A boy kicking a dog* (e.g. Kelley, 1967; Hilton, 1988). It is typical to present situations and background information to people in vignettes, and then to ask them to make attributions of cause. Background information alters the perception of cause by helping define what is normal in a situation. Consider the following:

(12) John gets angry with Mary.

Few other people get angry with Mary.

The fact that the norm is for other people not to get angry with Mary suggests (in the absence of more data) that the cause is something to do with John (he might be unusually aggressive, for instance). In the next case, a different conclusion is suggested:

(13) John gets angry with Mary.

A few other people get angry with Mary.

In this case, there is nothing to view John's action as abnormal, because a few other people get angry with her. This intuitive example shows how the shift from *Few* to *A few* can influence the pattern of attributions. Barton and Sanford (1990) showed that quantifier effects on attribution patterns are very large. The terms *a few* and *occasionally* serve simply to assert that something is true, but does not reflect the smallness of the proportion of cases, or the number of occasions on which it is true. In contrast, the terms *only a few*, *only occasionally*, *few* and *rarely* do serve to draw attention to the smallness of the proportion of cases or occasions on which something holds.

There are two points. First, the effect of quantifier choice on the pattern of attribution is dramatic, and illustrates how two expressions denoting small proportions that cannot be discriminated (*few* versus *a few*; *occasionally* versus *rarely*) are simply not interchangeable. Second, there are vast numbers of experiments which have been carried out using the attribution paradigm, and, typically, normative information is delivered through quantifiers which confound the amount or proportion of times something happens with whether or not the descriptor is a negative or positive expression. For instance, for a small proportion, the expression *rarely* is typical, rather than *occasionally*. As far as we are aware, there is no use of percentages (such as 5% of people) in the descriptive vignettes used in the Attribution Theory literature, but to the extent that straightforward percentage statements, and positive expressions like *a few* and *occasionally* behave in the same way with respect to focus and inference patterns (Moxey and Sanford, 1993a), there may be reason to suppose that the effects normally reported might not occur.

We believe that this is an important confound in the attribution literature, especially so since the traditional interpretation of how baserate information is used by subjects is an index of covariation (i.e. as frequency information). It is quite possible that the contrasts between high and low levels of covariation are due to contrasts between perspectives, and that purely numerical information would not have the same impact on attributional patterns.

The presentation of quantified and uncertain information

The fact of expressions controlling inference patterns means that where natural language is used instead of numerical descriptions, the information being presented is not neutral, but is being presented from a perspective. This puts a great deal of control into the hands of the communicator. In simple advertising, this may be considered fair game. Consider a sale in which some of the items have been reduced, and a handful have 50% knocked off the original price. The truth of the situation may be represented by any of the following:

(a) Sale! No more than 50% off any item!
(b) Sale! 50% or less off!
(c) Sale! Up to 50% off!

By the arguments we made earlier, (a) introduces the presupposition that one might have expected more than 50% off some items, and then denies that. This is hardly the message the shopkeeper would want the customers to focus on; (b) does much the same thing, but by not using an explicit negation marker, it more weakly focuses on the presupposition; (c) simply asserts an upper limit. By leaving off the fact that this applies to only some items, unless one thinks about it, there is an impression that a

reduction applies to all items. But of course, up to 50% off can include cases where there is no reduction at all on some items.

These arguments follow from the general principles described earlier in the paper, and constitute rather obvious examples of rhetorical properties. But the problem is more general, in that the word sets used to present probabilities and proportions verbally rather than numerically typically confound negativity with the proportion denoted, sometimes using all negative items for likelihoods below 50/50. This may not matter in some instances, such as in prolonged experiments where verbal expressions are being used as a scale in a very obvious manner. However, it may well matter in simple, one-off communications.

Superficially, numbers and proportions themselves appear impervious to this kind of thing, and so our examples might give a boost to the view that for serious matters, numbers should be used. But there are problems with numbers too. It is well established that the range and distribution of numbers influence the choices subjects make by indirectly conveying information about what is 'normal'. For instance, if there is a higher proportion of numbers denoting a low frequency of some action than a higher frequency, this may lead to the assumption that the norm is a relatively low frequency. Certainly, the average response under those circumstances is lower than it would be if high frequency numbers predominated (Schwarz *et al.*, 1985; Wright *et al.*, 1997). Even more relevant to our own argument is the way in which it is difficult if not impossible to escape perspective effects when using numbers. Consider these ways of specifying contraceptive reliability:

98% reliability.
2% risk of failure.

These numbers are logical counterparts of one another, and yet one focuses on the fact of unreliability, and the other on the fact of reliability. The situation is much the same as it is for the earlier soup examples:

- 95% fat free.
- Contains 5% fat.

Emphasis can be put on one or other aspect of the situation. Certainly, respondents in the soup case believe that the upper statement would lead to more sales than the lower statement (Sanford and Moxey, unpublished data). Of course, it is possible to translate from one of these expressions to the other, but an important empirical question is whether or not people do that; we propose that unless people are thinking analytically about the information with which they are being presented, they are likely not to make such a translation. The question is open for investigation.

A major advantage of using numbers is that arithmetic can be used, and it has been suggested that presenting information as numbers leads subjects to focus thoughts on quantitative aspects, while using words leads them to think about more qualitative aspects of the situation (Zimmer, 1983). However, It is our view that the powerful rhetorical effects of natural language expressions, and the perspective effects inherent even in how a proposition with proportions is phrased suggests that people normally think *qualitatively*. That is, although people can often state some degree of belief in how something is likely to be the case (especially at extremes), they clearly confabulate this with the value or cost of the outcome (e.g. Weber and Hilton, 1990), and are typically more concerned with the evidence for and against a position. This view has

been formalized as Argumentation Theory (see Toulmin, 1958 for an early statement of a model of argument; Mitroff *et al*., 1982 for applications to business policy; Smith *et al*., 1991 for an overview of this perspective; Fox *et al*., 1993 for applications to reasoning under uncertainty in Artificial Intelligence). Earlier linguistic work on argumentation is described in Anscombre (1985), and Ducroit (1988). If such qualitative reasoning truly reflects how people represent uncertainties, then it is scarcely surprising that those rhetorical functions, which control perspectives, focus, and patterns of inference, are widespread through the language of uncertainty. Rather than communicate that a risk is very small, people typically communicate that it is small but (they think) it should be ignored, as with *insignificant risk* or that it may be small, but it is there, and should not be ignored as with *very small risk*. Often the view of probability, uncertainty, or quantification, which is portrayed by a speaker, depends on the appraisal of arguments underlying the summary view, and these may not be known, or even specifiable, numerically. A final area where this might be important is in answering multiple choice questionnaire items about the frequency of behaviour. Checking an item like *rarely* or *seldom* may be a declaration of the unimportance of the low frequency, rather than just being a declaration of frequency (in which case *very occasionally* would do as well). There are potential effects here that have not been explored.

Perspectives and other work on thinking

If expressions manipulate perspectives and inferences, then they certainly should influence reasoning in a widespread way. However, to date there have been few studies examining this proposition directly. Nevertheless, Teigen *et al*. (1996a,b) showed that whether people focus on the likelihood of positive or negative outcomes in voter behaviour and football fixtures influences the conjunction fallacy. In the conjunction fallacy (Tversky and Kahneman, 1982), on hearing some facts about a person, participants may be more likely to believe that they are, say, *a bank teller who is active in the feminist movement*, than just *a bank teller*. This cannot be the case, since being a bank teller holds for both cases. The effect is reduced when focus is on how *unlikely* something will be. Teigen *et al*. (1996b) report having carried out a pilot study on this using verbal expressions of doubt and (*unlikely*, *highly likely*, etc.), claiming to find this focus effect under these conditions.

CONCLUSIONS

The purpose of our review is to show that the communication of uncertainty, quantification, and frequency by natural language necessarily brings in the rhetorical properties of the words used. As we indicated in the Introduction, there are many areas where quantification is a central issue, and the arguments are applicable in each of these. Awareness of the importance of rhetorical properties is starting to grow, as we have illustrated (see, for instance, Wolgater and Silver, 1990, for a discussion of how different warning terms convey more than just a unidimensional hazardousness).

In addition to arguing strongly for the importance of rhetorical factors in conveying quantity information, we illustrated some of the mechanisms through which this comes about. Thus quantity expressions trigger the patterns of inferences which people make, the subsets of a proposition on which they focus, and can convey subtle

information about prior expectations. There are several consequences. Choice of quantifiers reflects both focus and the way expressions trigger prior expectation. Attribution patterns depend upon polarity. The conjunction fallacy depends upon the polarity of the information presented. Our review also included evidence that even if numbers are used to express risks and uncertainties, the propositions which they are part of naturally introduce perspectives too, so the arguments about natural language and polarity apply in part to the use of numbers.

We also propose that the preferences which people express for conveying information in natural language rather than numbers is not because they do not want to be committed to exact numbers (though that may be part of the issue). Rather, it is because people's summary use of simple natural language expressions results from them having a view about the evidence base on which their judgments are made. One example is the significance of choosing to check a negative polarity quantifier in a questionnaire, which we propose reflects an evaluation of importance as much as it does frequency. The use of polarity and words like *only* reflects just this. We suggest that a better understanding of the choice of scale-like expressions can be achieved by the study of how these rhetorical phenomena influence decision making under various circumstances, rather than simply by pursuing the quantities, which they may denote.

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APPENDIX: NEGATIVITY

Negativity in language is detected by a variety of tests, which often rely on intuitions. Although logical negation is well understood, its application to language is often problematic, and a discussion is beyond the scope of this review. However, one

observation is that there is a class of expressions which typically appears only in negative linguistic environments, so-called Negative Polarity Items (e.g. Van der Wouden, 1994; Zwarts, 1994). Standard examples include *any*, and *anymore*, and also *give an X*, as in *give a damn*, etc. So, it is acceptable to say *I don't give a damn*, but not *I give a damn*. Although someone might say *I DO give a damn* when someone has just asserted that they don't, it is with emphasis, and is treated differently in linguistics. Similarly, it is acceptable to say *I don't know any students*, but not to say *I know any students*. So, the acceptability of a negative polarity item can be used as a diagnostic for 'hidden' negativity. Thus, (a) is acceptable, while (b) is not, so *Few* and *Not many* are negative, while *a few* and *almost all* are positive:

(a) Few/Not many people know any Greek anymore.
(b) A few/Almost all people know any Greek anymore.

The same applies to frequency adverbs:

(c) People seldom/rarely do that anymore.
(d) People occasionally/very occasionally do that anymore.

So (c) is acceptable, and *seldom* and *rarely* are negative, while *occasionally* is not.

There is no good linguistic theory which explains negative polarity items properly, but such simple tests have been used throughout our work to 'define' items as negative and positive (see Moxey and Sanford, 1993a, 1998, for more details).

