

Ambiguity Avoidance is Overrated[†]

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1. Introduction

Grice (1975, p. 30) wrote, “Avoid ambiguity,” as one of several maxims falling under the general category of “Manner”. Gricean maxims are, of course, violable; but violations are normally taken to trigger implicatures, and to occur in order to trigger those implicatures. This particular maxim, however, is routinely violated, for no apparent communicative purpose¹.

In other words, natural language is highly ambiguous. A search of any good dictionary will reveal that most words have multiple definitions, and (as first noted by Zipf, 1949) more frequent words tend to be more ambiguous. Likewise, as computational linguists discovered a few decades ago, most strings of words that constitute well-formed sentences have multiple possible parses. For example, Martin, et al (1987) reported that their system assigned 455 distinct parses to the relatively simple sentence *List sales of the products produced in 1973 with the products produced in 1972*. In addition, there are other ambiguities that do not seem to be tied either to polysemous words or alternative parses. Among these is perhaps the most widely studied type of ambiguity, scope ambiguity. I will return to a more careful taxonomy of types of ambiguity in the next section.

If linguistic ambiguity is so common, why did Grice admonish us to avoid it? All of his maxims are presented as elaborations of the following general “Cooperative Principle”: “Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged.” (p. 29). Among what he claimed “is required” in conversations is that the participants “Be perspicuous” (p. 30). He evidently believed that ambiguity diminished perspicuity.

Grice’s intuition on this point seems very natural. If an utterance has multiple meanings, the task of the listener in ascertaining the speaker’s intended meaning is made more difficult, for it now includes the extra step of disambiguation. Moreover, the likelihood

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¹ Grice (p. 36) wrote, “We...are concerned only with ambiguity that is deliberate, and that the speaker intends or expects to be recognized by his hearer. The problem the hearer has to solve is why a speaker should...go out of his way to choose an ambiguous utterance.” One might argue, then, that Grice was not concerned with the kind of ambiguity that this paper is about. But the fact that he thought that “choos[ing] an ambiguous utterance” required “go[ing] out of [one’s] way” indicates that Grice was unaware of the pervasiveness of ambiguity in natural language. Had he realized that most utterances are multiply ambiguous, he would presumably have formulated his maxim differently.

of miscommunication is increased, since it is possible that the listener will select an interpretation different from the one the speaker intended. Hence, efficient communication would seem to dictate ambiguity avoidance.

This intuitive argument for ambiguity avoidance gains plausibility from experience. We have all experienced situations in which listeners asked speakers which of two possible interpretations they had in mind -- for example, when someone asks, "Do you mean *funny* 'peculiar' or *funny* 'ha ha'?" This disrupts and delays the conversation, but happens relatively frequently because it avoids an even less desirable consequence: a misunderstanding.

It is puzzling, therefore, that so much ambiguity persists in language. If functional considerations influence the direction of language change (as one might expect), then changes that reduce ambiguity would seem to be strongly favored. Yet there is little, if any, evidence that ambiguity in languages has decreased over time.

Grice's intuition that ambiguity is an undesirable property of language is widely shared. Many people, including a number of linguists, have proposed that various properties of language are explainable as ways of avoiding ambiguity. For example, the following passage from a website on the basics of Latin² implicitly appeals to the need to avoid ambiguity as to which argument in a transitive clause is subject and which is object:

The reason Latin is a more flexible language in terms of word order is that what English speakers encode by position in the sentence, Latin handles with case endings at the ends of nouns, adjectives, and verbs. English word order tells us that what is the subject is the (set of) word(s) that comes first in a declarative sentence, what is the object is the set of words at the sentence end, and what is the verb separates subject from object.

Essentially the same argument is made by Fries (1940) in comparing the word orders of Old English and Modern English: what once was communicated with inflections came to be communicated through more rigid word order. Fries (p. 207) cites Sapir's (1921) distinction between "concepts" whose expression is "essential or unavoidable" and those whose expression is "dispensable or secondary."

If, for example, we are to say anything about a bear and a man in connection with the action of killing, it is 'essential and unavoidable' that we indicate which one did the killing and which one was killed. ... On the other hand, whether the killing took place in the past, the present, or the future, whether it was instantaneous or long drawn out, whether the speaker knows of this fact of his own first-hand knowledge or only from hearsay, whether the bear or the man has been mentioned before-these matters are of the 'dispensable or secondary' type and may or may not be expressed.

In other words, every language must have mechanisms for expressing the basic argument structure of a clause (who did what to whom), and particular sentences should not be

² <http://ancienthistory.about.com/od/basicsoflatin1/qt/LatinEnglishSVO.htm>

ambiguous with respect to argument structure. Something close to this idea is defended in Hankamer's (1973) paper "Unacceptable Ambiguity", which proposes a universal condition to prevent certain kinds of transformational rules from introducing structural ambiguity. He argues, for example, that a German sentence like (1) must be interpreted with the initial noun phrase functioning as the subject, even though both NPs happen to have identical nominative and accusative forms.

- (1) Welche Frau sieht das Kind?
which woman sees the child

If the initial NP were masculine, case morphology could distinguish its grammatical role, so both (2a) and (2b) are possible.

- (2) a. Welcher Mann sieht das Kind?
which (Nom) man sees the child
'Which man sees the child?'
b. Welchen Mann sieht das Kind?
which (Acc) man sees the child
'Which man does the child see?'

But Hankamer claims that (1) only has the interpretation analogous to (2a)³.

Bouma (in press) cites Jakobson (1936) as having similarly argued that case syncretism in subject and object can lead to word-order freezing, and Flack (2007) claims that the same is true of Japanese. Thus, the idea that languages do not permit ambiguity with respect to argument structure is a recurrent one.

Linguists have also cited avoidance of temporary ambiguities that might add to processing complexity as a reason for particular linguistic structures. For example, Langacker (1974; 631) writes the following:

that-deletion is not permitted in non-extrapolated subject clauses:

- (3) That he has never played rugby before is apparent.
(4) *He has never played rugby before is apparent.

Viewed in purely syntactic terms, the non-deletability of *that* in 3 is surprising and must be treated as exceptional in some fashion -- hardly a satisfying state of affairs. On the other hand, a functional perspective enables us to begin to explain why English should observe this restriction. If *that*-deletion were permitted in nonextrapolated subject complement clauses, the resulting surface structures, such as 4, would present the language user with certain processing difficulties; in this instance, the listener would naturally hypothesize (mistakenly) that *He has never ...* initiates the main clause, since nothing would signal its subordinate status until later in the sentence. The retention of *that* in sentence-initial complement clauses enables the listener to avoid this processing error

In short, the ungrammaticality of (4) is explained through appeal to the undesirability of leaving the basic structure of the sentence ambiguous until the copula is encountered.

³ This judgment is Hankamer's. Not all native German speakers agree, and their judgments seem to be influenced by context and prosody.

These are just a few examples of a very common form of explanation about language: languages and their speakers are presupposed to prefer forms that are unambiguous, and facts about grammar or usage are motivated by ambiguity avoidance.

There are a number of reasons, however, to doubt that ambiguity avoidance plays a major role in language use. The primary purpose of this paper is to review those reasons, and to conjecture why people do not avoid ambiguity more than they do. In the next section, I clarify what I mean by ambiguity, and exemplify several types of ambiguity. In section 3, I summarize a variety of studies of how ambiguity influences language processing and use, concluding that ambiguity avoidance plays a relatively minor role. In section 4, I consider possible explanations for the conflict between the *a priori* argument for avoiding ambiguity and the empirical evidence that people do not do so. Finally, section 5 provides some brief pointers for future research questions relating to ambiguity.

2. Types of Ambiguity

Ambiguity must be distinguished from vagueness, although it is not always easy to decide whether a specific case of unclear meaning is one or the other. Ambiguous expressions have more than one distinct meaning; vague expressions have a single meaning that cannot be characterized precisely. (It is of course possible for an expression to be both ambiguous and vague, if it has multiple meanings, at least one of which cannot be made precise). If expressions are thought of as picking out regions in some semantic space, then ambiguous expressions pick out more than one region, whereas vague expressions pick out regions with fuzzy boundaries.

To illustrate this distinction consider the word *trillion*. According to Dictionary.com, *trillion* can denote either 10^{12} or 10^{18} ; thus, it is ambiguous. There is also a vague usage, meaning, simply, ‘a very large quantity’.

A more typical case is the standard example (at least among philosophers of language) of an ambiguous (polysemous) word, namely *bank*. It is usually discussed as though it had exactly two well-defined meanings: ‘financial institution’ (of a particular kind) and ‘edge of a river’. A quick glance at an English dictionary reveals that it has many more definitions; Dictionary.com lists 30. Many of these are very closely related, and could be argued to be subcases of a single meaning (e.g. “an institution for receiving, lending, exchanging, and safeguarding money” and “a special storage place: *a blood bank*; *a sperm bank*”), and some are certainly vague (“a long pile or heap; mass: *a bank of earth*; *a bank of clouds*”).

Distinguishing ambiguity from vagueness is particularly difficult in cases where a word has two meanings that are clearly semantically and historically related. For example, two of the many meanings of *mark* as a noun are “a visible impression or trace on something, as a line, cut, dent, stain, or bruise” and “an affixed or impressed device, symbol, inscription, etc., serving to give information, identify, indicate origin or ownership, attest to character or comparative merit, or the like, as a trademark”. Are these really two meanings, or does *mark* have one meaning general enough to encompass both? I will not

attempt to answer that question in this paper. Instead, I will focus my attention on cases that seem to me to constitute clear cases of ambiguity rather than vagueness.

The simplest cases of ambiguity are lexical. As noted, it is extremely common for words to have multiple meanings. It is similarly possible for morphemes that are not words to be ambiguous. An obvious case is the English *-s* suffix, which is a marker of plurality when affixed to a noun⁴ and marks third-person singular subject agreement when affixed to a verb.

A more subtle case is the prefix *un-*: when attached to an adjective (as in *unhappy*, or *unaware*), its meaning is close to simple negation⁵, but when attached to a verb (as in *unbuckle* or *undo*) it denotes a reversal of the action denoted by the verb. Because there are quite a few adjectives that are morphologically indistinguishable from passive participles of verbs (see Wasow, 1977, for some diagnostics to tell them apart), the two prefixes *un-* give rise to lexical ambiguities. For example, *The belt was unbuckled* can describe either an action (the unbuckling of the belt) or a state (the unbuckled condition of the belt)⁶.

Not all ambiguities can be tied to specific lexical items. Structural ambiguities arise when a given string of words can be parsed in two different ways, with different meanings. Clear examples of this occur with coordinate constructions, where modifiers or complements on either periphery of the construction can be associated with either the whole coordination or just the adjacent conjunct. This is illustrated in (5).

- (5) a. The guards let small men and women exit first.
b. Teachers and students of the speaker received priority seating.

In (5a), *small* may modify just *men* or *men and women*, and in (5b) *of the speaker* may be the complement of just *students* or of *teachers and students*.

Other structural ambiguities arise when modifiers have multiple possible attachment sites, even in the absence of coordination. The standard example of this is *We saw a man with a telescope*, where *with a telescope* may be taken as modifying *a man* or *saw a man*, resulting in two interpretations with very different truth conditions. In sentences with two prepositional phrases at the end (such as *We saw a man in a strange hat with a telescope*), the number of possible parses goes up to 5; and, as the number of PPs

⁴ The phonologically identical but orthographically distinct morpheme 's also attaches to nouns, indicating possession. Thus, in speech the morpheme in question is three-ways ambiguous.

⁵ I hedge this statement because it is not contradictory to say, *I am not happy, but I am not unhappy, either*. Thus, *unhappy* must mean something a bit stronger than simple negation. But this meaning is nevertheless clearly distinct from the reversing meaning of the *un-* that attaches to verbs. It is not possible to unbuckle something that was never buckled, but someone who was never happy can be unhappy.

⁶ One might question whether these are two distinct senses, since the reversal meaning entails that the negation meaning: if something gets unbuckled its resulting state is unbuckled. But where *un-* is attached to a stem that is unambiguously a verb, the reversal meaning is an essential component. Thus, *He unbuckled the belt* is false if the belt was never buckled, and *He unbuckled the belt, which had never been buckled* contains a contradiction.

increases, the number of parses explodes. More precisely, as Church and Patil (1982) argue, the number of parses increases with the Catalan numbers, a function that increases faster than any polynomial function.

Like lexical ambiguities, structural ambiguities are extremely common, though they are rarely noticed in ordinary language use. They are a major contributor to the large number of parses produced by computational parsing systems. I will return below to the issue of why people overlook so much ambiguity.

A third type of ambiguity concerns the scope of various kinds of operators. These may include quantifiers, negation, and various sorts of adverbs. Examples are given in (6).

- (6) a. Everyone in the room speaks two languages.
- b. Many arrows did not hit the target.
- c. Pat frankly criticized our proposal.

(6a) can mean that there are two languages common to everyone in the room or that everyone in the room is bilingual. (6b) can mean either that not many arrows hit the target, or that many failed to hit it. And (6c) can attribute frankness to Pat or to the speaker's description of what Pat did. In none of these cases do I know of any compelling arguments for identifying the different readings with different phrase structures⁷.

Still other ambiguities are hard to fit into any of these categories. These include cases like (7).

- (7) a. The lamb is ready to eat.
- b. Press passes must be displayed.

In (7a), the lamb may be the eater or what is eaten. (7b) would be appropriate in a situation where only people with press passes were permitted to enter a designated area; but it could also be used in a situation where those people with press passes were required to display them (for example, so that the organizers could know how large the press presence was), but no requirement was being imposed on people without such passes. Again, there is no compelling reason to posit a structural ambiguity in either of these cases, but there is also no obvious lexical ambiguity or difference in scope between the readings.

Note, by the way, that (7a) is a counterexample to the claim, cited above, that languages do not permit ambiguity with respect to argument structure. Other counterexamples are given in (8).

- (8) a. Sandy likes Pat better than Chris.
- b. Welches Mädchen liebt Peter? [German, from Bouma (in press)]
 which girl loves Peter
 'Which girl loves Peter?' or 'Which girl does Peter love?'
- c. Akio san mo mikaketa [Japanese, from Tily (2010)]
 Akio too saw

⁷ There are of course analyses of such ambiguities in the literature that posit syntactic differences between the two interpretations, but the posited structural differences are motivated solely by the semantic ambiguities.

‘Akio also saw someone’ or ‘I also saw Akio as well’

Thus, ambiguity with respect to who did what to whom does occur, despite suggestions to the contrary in the literature.

There is nevertheless a correct insight underlying these suggestions. To the best of my knowledge, all languages have grammatical mechanisms (usually word order, case marking, or agreement) to indicate argument structure. Although it is possible to construct sentences that are ambiguous with respect to argument structure, such examples are the exception rather than the rule. In contrast, grammars do not routinely provide mechanisms to avoid other structural ambiguities (such as PP attachment). Hence ambiguities with respect to argument structure are much less common than some other kinds.

All of the non-lexical examples so far have been of ambiguous sentences. There are also cases, much studied by psycholinguists, of regions of sentences that are ambiguous, although the ambiguity is resolved later in the sentence. In these cases, the listener, hearing the sentence one word at a time, either must keep multiple possible (partial) interpretations in mind until the disambiguating material is encountered, or must guess which of the possible interpretations will turn out to be the correct one. Examples are given in (9)-(11), with (a) presenting the ambiguous region, and (b) and (c) giving continuations that pick the two different interpretations of (a).

- (9) a. I believe Sandy...
b. ...because Sandy is honest.
c. ...is lying.
- (10) a. Put the apple in the bowl...
b. ...right now.
c. ...onto the table.
- (11) a. The policeman questioned....
b. ...the suspect for two hours.
c. ...by the defense attorney changed his story.

Such temporary ambiguities are not limited to structural cases. They can even occur within lexical items. For example, Tanenhaus, et al (1995) studied word pairs that shared an initial syllable (such as *candy* and *candle*), and demonstrated that listeners’ eye movements were sensitive to the ambiguity that existed during the utterance of one of the words.

3. Ambiguity and Sentence Processing

Many psycholinguists studying sentence processing have assumed that ambiguity was a hindrance to efficient processing, and have used that assumption in explaining experimental results or observations. An early and celebrated example of this was Bever’s (1970) discovery of the phenomenon of “garden path sentences” like *The horse raced past the barn fell*. Such examples have fascinated psycholinguists ever since, and many accounts of their unacceptability have been proposed. Most of them involve the observation that *raced past the barn* is temporarily ambiguous between a reduced relative

clause (with a passive verb) and the main clause verb phrase (in the past tense). The problem people have understanding such sentences is said to be the result of initially selecting (or strongly favoring) the latter interpretation. In short, the garden path phenomenon is attributed to the difficulty of processing a certain kind of temporary ambiguity.

This type of explanation is called into question by the observation of Tabor, et al (2004) that reduced relative clauses that look like past-tense verb phrases are hard to process, even when earlier context makes the past-tense VP parse impossible, so that there is no temporary ambiguity. Thus, *The woman addressed the man served the beer by the waiter in coattails* elicits a garden path reaction, even though *served the beer by the waiter in coattails* is unambiguously a reduced relative clause throughout.

The question of whether ambiguity avoidance plays a role in sentence processing has been investigated most directly and extensively by Victor Ferreira. In a series of papers (Ferreira 2003, 2006a, 2006b, 2008; Ferreira & Dell 2000; Ferreira, et al 2005; and Roland, et al 2006), he and his collaborators have looked for evidence bearing on the question of whether ambiguity avoidance influences grammatical choices. They have found very little support for the idea that it does.

A phenomenon discussed in several of Ferreira's papers is the optionality of *that* at the onset of certain complement clauses. For verbs (like *believe* or *remember*) that can be followed either by a direct object or by a finite complement clause, the presence of the complementizer *that* signals to listeners or readers that the immediately following NP is the subject of a subordinate clause, not the direct object. That is, (12a) avoids a temporary ambiguity that might cause a listener or reader to think (briefly) that *the announcement* is the object of *believed*.

- (12) a. I believed that the announcement was in error.
b. I believed the announcement was in error.

If speakers seek to avoid ambiguity, they will use the complementizer *that* more often before NPs that could be mistaken for direct objects than before those that could not. Hence, if ambiguity avoidance plays a role in this alternation, then we should see higher rates of *that* in sentences like (13a) than those like (13b).

- (13) a. I believe (that) you are wrong.
b. I believe (that) he is wrong.

Testing this hypothesis both experimentally and in corpora, Ferreira and his collaborators found that the potential for temporary ambiguity had no effect on the rates of complementizer use.

In another set of experiments, Ferreira (2006b) tested the reduced relative clause construction that gives rise to the classic garden path effect discussed above. Participants were instructed to modify sentences to make them easier to understand. The stimuli included sentences that had the temporary ambiguity found in garden path sentences, as well as sentences with the same syntactic structure but without the temporary ambiguity, because of the verb morphology. This is illustrated in (14)

- (14) a. The team defeated in the Superbowl vowed revenge the next season.

b. The team beaten in the Superbowl vowed revenge the next season. *The team defeated* is temporarily ambiguous in a way that *The team beaten* is not. In each case, the subject noun was also modified by an adjective, such as *winning* or *losing*. For cases like (14a), where the initial portion of the sentence is ambiguous, one of the adjectives (*winning*, in this case) makes the main-clause (past tense) interpretation of the following verb more plausible, whereas the other makes it less plausible. Participants turned out to be sensitive to this difference in plausibility, adding *that was* to the beginning of the relative clause more often when the adjective made the garden path interpretation more plausible. But they did this irrespective of whether the verb morphology supported the temporary ambiguity. Put another way, the difference illustrated in (14) did not influence how participants modified the sentences, but the difference between inserting *winning* vs. inserting *losing* did.

Ferreira, et al (2005, 2006a) investigated lexical ambiguity through a series of experiments involving pairs of participants, each of whom viewed an array of pictures of objects. One participant would be required to describe one picture in the array to the other. In the critical cases, there was an ambiguity in the most common term used to describe the picture. For example, the term *bat* can describe either a flying mammal or a type of club used in baseball. When the array contained pictures of both types of bats, speakers increased their use of modifiers (e.g., *flying bat* or *baseball bat*) over control cases where only one type of bat was depicted. However, participants used the disambiguating modifier only about 60% of the time; the other 40% of the time, they used the ambiguous unmodified noun. In contrast, when the array contained what the authors call a “nonlinguistic ambiguity” such as two flying bats of different sizes, speakers disambiguated with modifiers like *big* and *small* 99% of the time. Thus, even in a clearly communicative task where context could not help to disambiguate, speakers often ignored lexical ambiguities (but not nonlinguistic ambiguities).

Studies by other investigators have also found surprisingly little evidence that speakers avoid ambiguity. In a study reported in Wasow (2002), I looked for an effect of ambiguity on the relative ordering of direct objects and prepositional phrases in the Brown Corpus (Kucera and Francis, 1967). Specifically, I examined about 1200 verb phrases consisting of a verb, a noun phrase, and a prepositional phrase; they were divided roughly equally between examples with the canonical ordering V-NP-PP and examples with the far less common ordering V-PP-NP. In most cases with the canonical ordering, there is a structural ambiguity, because the PP could, in principle, be attached to the NP or directly to the VP. This is the sort of structural ambiguity that gives rise to the semantic ambiguity in *We saw the man with the telescope*. Unless the verb obligatorily requires both an NP and a PP complement (e.g. *put*) or the NP is of a kind that does not normally take a PP modifier (e.g. a proper name), V-NP-PP is structurally ambiguous. In many cases, this structural ambiguity does not present the comprehender with any problem because either: (i) the meaning associated with one structure makes no pragmatic sense (e.g. *I saw the man with the bucket*), or (ii) the meanings associated with the two structures are the same or close enough that it doesn't matter in the context of use (e.g. *They built the house on the hillside*). The structural ambiguity does not arise in the V-PP-NP order: both the PP and NP are attached directly to the VP. Hence, writers

could use the non-canonical ordering as a way of avoiding ambiguities. If they did this, we would expect to see the effect primarily in cases of full ambiguity (which could confuse readers), not in cases whose ambiguity is purely structural.

The Brown Corpus examples were coded for full ambiguity, structural ambiguity only, or no ambiguity. In the case of the V-PP-NP examples, the coding was for whether they would have been ambiguous in the V-NP-PP ordering. The analysis of these data also included a factor for the relative lengths of the NP and PP, which is well known to exert a strong influence on the choice between these two word orders. In a model that included relative length, ambiguity, and an interaction factor for the two, both length and the length-ambiguity interaction came out as statistically significant, but ambiguity by itself did not. This suggests that ambiguity played at best a minor role in the word-order choice. Since these data were taken from written and edited text, where one would expect the strongest evidence of ambiguity avoidance, they suggest that other considerations are far more important in this alternation.

Arnold, et al (2004) conducted an experiment to see whether word-order choices were affected by temporary ambiguities. In particular, they compared speakers' choice between the (a) and (b) versions of sentences like (15) and (16).

- (15) a. The foundation gave a museum Grant's letters to Lincoln.
b. The foundation gave Grant's letters to Lincoln to a museum.
- (16) a. The foundation gave a museum Grant's letters about Lincoln.
b. The foundation gave Grant's letters about Lincoln to a museum.

(15b) contains a temporary ambiguity absent from the other three examples: until the second occurrence of *to* is encountered, *to Lincoln* can (and very likely will) be interpreted as the goal argument of *give*. If ambiguity avoidance influences speakers' word-order choices, (15a) should be selected over (15b) more frequently than (16a) is selected over (16b).

Arnold, et al tested participants in pairs, each of whom had instructions the other could not see. The first participant would read a sentence providing the information to be conveyed to the second participant (say, *A museum received Grant's letters to Lincoln from the foundation*), and the second participant would then ask a question formulated so as to require the first participant to reword the sentence s/he just read (e.g. *What did the foundation do?*). In responding, the first participant would then need to choose whether to use the double object construction (as in the a-sentences of (15) and (16)) or the prepositional construction (as in the b-sentences). If speakers want to avoid ambiguity, they should pick the double object construction more often when the prepositional alternative would be temporarily ambiguous (as in (15)) than when it would not (as in (16)).

Surprisingly, Arnold, et al found that the double object construction was chosen significantly more frequently in cases like (16), where neither version has an ambiguity. That is, the result was exactly the opposite of what ambiguity avoidance would predict!

Other authors have used corpus studies and experiments to argue for a more substantial role of ambiguity avoidance in language use. For example, Temperly (2003) considers the distribution of relativizers (*that* or a *wh*-word) in non-subject relative clauses in English, and argues that relativizers occur more frequently when the head noun plus the subject of the relative could be misparsed as a compound. He presents a corpus study showing that relativizers appear less frequently when the first word of the relative clause subject is a pronoun or a determiner than when it is a noun. Temperly's study, while suggestive, is also open to many other interpretations. Jaeger (2006), Jaeger & Wasow (2008), and especially Roland, et al (2007) present far larger more detailed corpus studies of relativizer optionality, and offer different explanations for Temperly's observation.

Haywood, et al (2005) conducted an experiment in which participants interacted with confederates in a task of moving pictures of objects around on a grid. In the critical cases, the objects to be moved could naturally be described in a way that would give rise to a temporary ambiguity, illustrated in (17a). This temporary ambiguity could be eliminated by the insertion of disambiguating material, as in (17b).

- (17) a. Put the penguin in the cup on the star.
b. Put the penguin that's in the cup on the star.

In some cases, the visual array supported only the low attachment of the first PP. For example, if there was only one penguin in the array and it was in the only cup in the array, then participants could see that *in the cup* in (17a) had to be a modifier of *penguin* even before they encountered the final PP. In other cases – e.g. when the array included another penguin (not in a cup) and another cup (not containing a penguin) – the visual array temporarily supported both interpretations of (17a). Haywood, et al found that participants inserted disambiguating material (as in (17b)) significantly more often when the visual array supported both interpretations. They also found a significant effect of priming. That is, when the confederate used an unambiguous form like (17b), participants were more likely to insert disambiguating material in their next turn. The effect of priming was stronger than that of the visual context. In particular, Haywood, et al report (p.365), “28% more disambiguated utterances following primes containing *that's* than following primes not containing *that's*” but only “10% more disambiguated utterances in two-referent contexts than in one-referent contexts”. Thus, although the study is presented as positive evidence for the influence of ambiguity avoidance on the form of utterances, like other studies it found that influence to be considerably smaller than that of other factors.

The work reviewed in this section constitutes only a small sample of the many psycholinguistic studies that bear on the question of the role of ambiguity avoidance in sentence production. But the bottom line conclusion to be drawn from a more comprehensive survey would be much the same: While there is evidence that the possibility of a confusing ambiguity occasionally leads speakers to choose another linguistic form, such cases are rare. Other factors seem to play a much more important role in the choice among roughly equivalent forms of expression.

4. Possible Explanations

If one assumes that the primary function of language is the efficient transmission of information, then the intuitive arguments for avoiding ambiguity seem compelling. Indeed, Chomsky (2002; 107) cites ambiguity as a reason to treat “the use of language for communication” as “a kind of epiphenomenon”. And there are certainly some uses of language in which ambiguity is helpful. As noted by Wasow, et al (2005), there are uses of language in which a speaker wants the addressee to understand an utterance in one way, although the speaker understands it another way. These include cases in which a speaker is being diplomatic (*Nothing would please me more*) and cases of deliberate deception for commercial or political purposes (*lifetime guarantee*, meaning ‘guaranteed for the lifetime of the product’).

While ambiguity may be exploited in these ways, they cannot be the whole explanation for its pervasiveness. And Chomsky’s claim that the primary function of language is not communication seems so counterintuitive that it should be accepted only as a last resort. So the fact that people rarely avoid ambiguity still cries out for explanation.

Zipf (1949) proposed an explanation of lexical ambiguity based on the idea that it is desirable to minimize effort for both speaker and addressee. From the perspective of the speaker, effort is minimized if there is only one word, which would be used to cover all possible meanings. From the perspective of the addressee, effort is minimized if each possible meaning is expressed by a different word. Language, he argued, represents a compromise between these interests, in which the number of meanings per word is larger than one but less than the total number of possible meanings. While there are many obvious flaws to this argument as presented, Piantadosi, et al (to appear) develop a closely related argument for the existence of ambiguity and test some of its predictions.

Piantadosi, et al point out that there are many features that can contribute to the amount of effort involved in using a word. These include length, phonotactic complexity, and number of phonologically and/or semantically similar words. It is easier for language learners, as well as for speakers and hearers, if words that are easy on these dimensions are used frequently. This can include using one form for multiple meanings, so long as the meanings are sufficiently distant from one another to make confusion regarding which is intended relatively rare. This reasoning predicts that properties like word length and phonotactic complexity should correlate negatively with number of meanings. Piantadosi, et al test several such predictions against dictionaries of English, German, and Dutch, getting generally confirmatory results.

Piantadosi, et al provide another simple, but persuasive, explanation of why languages are ambiguous. To achieve maximal efficiency as a medium of communication, a language should not convey unnecessary information. (Recall Grice’s Maxim of Quantity, half of which says: “Do not make your contribution more informative than is required.”) Since the context of use generally contributes a considerable amount of information about what the speaker is likely to be talking about, utterances should omit such information. Consequently, many sentences, taken in isolation, are ambiguous,

although hearers have no difficulty in understanding what meaning was intended on particular occasions when they are used.

Piantadosi, et al formulate this argument in terms of the information-theoretic notion of entropy. A very similar idea was put forward years earlier in a rather different way by Levinson (2000). He claimed that articulation constitutes a “bottleneck” for efficient communication, because it is so slow. The escape from this, he argued, is for speakers to leave out much of what they intend to say, relying on the powerful inferencing capabilities of humans to fill in what is missing. The point of both Piantadosi, et al’s and Levinson’s versions of this argument is that communication is more efficient if linguistic expression conveys only part of the intended meaning, thanks to the human ability to use context to infer what the speaker intends to communicate. As a consequence, sentences or parts of sentences, taken in isolation, are typically ambiguous.

Anecdotal support for this position comes from the fact that language is especially ambiguous when it is both heavily abbreviated and relatively de-contextualized. Two types of uses of language that fit this description are newspaper headlines and signs. And these two sources provide an endless source of mildly humorous ambiguities for popular writers about language. They note, for example, that a sign saying *Wet Floor* could be taken as a warning or as a command, and that *Slow Children* could be interpreted as an admonition plus a reason or as a description. Similarly, headlines like *Tuna Biting Off Washington Coast* or *Doctor Testifies in Horse Suit* show up regularly in newspaper columns and popular books about language. I have found that they provide useful comic relief in lectures to lay audiences or undergraduates. The point here is that they work because the absence of context makes it particularly easy to recognize the silly interpretations.

There is, however, one aspect of meaning in which ambiguity is characteristically avoided, namely, argument structure – who did what to whom. Evidently, this is such a central component of what is communicated that it is normally obligatorily marked – at least in simple declarative clauses without ellipsis. But, as noted above, ambiguities do arise even in this domain. So although grammars contain mechanisms to minimize this one type of ambiguity, ambiguity avoidance is widely overrated as a factor in language structure and use.

5. Questions for Future Research

Levinson and Piantadosi, et al give convincing explanations for why natural languages are ambiguous. While this is real progress, much remains to be done before natural language ambiguity has been fully explained. I conclude this survey with some questions regarding ambiguity that still puzzle me.

- Can the sort of information-theoretic modeling that Piantadosi, et al use to predict patterns of ambiguity in the vocabularies of three languages be extended to non-lexical types of ambiguity?

- Garden path effects have consistently been attributed to comprehenders' difficulty with local ambiguities in the sentences in which they are found. But the same sort of local ambiguities exist in many places without inducing garden path effects. For example, a Japanese sentence with a relative clause modifying the subject normally begins with the relative clause, which is indistinguishable from a main clause until the noun it modifies is encountered; yet Japanese speakers find such sentences perfectly natural. Moreover, as noted above, garden path effects arise in some cases where the preceding context rules out the supposedly misleading parse. So what predicts where garden path effects will occur? And if they are not to be explained in terms of ambiguity, what causes them?
- There are simple changes in languages that would reduce ambiguity without any obvious cost. For example, there are many phonotactically simple monosyllables that are not common English words (e.g. *gub, rit, mim, leck, plig*); why haven't these lexical gaps been used to reduce the amount of polysemy in short words? Likewise, a vast amount of PP attachment ambiguity could be avoided if the basic word order of English verb phrases placed PPs before the direct object (that is, V-PP-NP, instead of V-NP-PP, as the canonical ordering); this would render VPs like *saw the man with the telescope* unambiguous. Since there is a cost (however slight) to ambiguity, why hasn't English made this change in its word order? Can cases like these be explained along the lines advocated by Levinson and Piantadosi, et al?
- In some cases, people seem blind to ambiguities beyond the level that might be expected based on considerations of context and human inferential abilities. In a course I taught, I presented students with the following riddle:
 You're standing on a bridge, and see a boat full of people approaching. It goes under the bridge, and, when it emerges on the other side, there's not a single person on the boat. Nobody climbed onto the bridge or jumped in the water. How is this possible?
 Out of over 100 students who saw this in my classes, only one got the answer (that everyone aboard was married). The use of *single* to mean 'unmarried' is not uncommon, and the context of being presented with a riddle (in a lecture about language) should have encouraged people to see the ambiguity; but they didn't. Why not?

Summing up, Grice notwithstanding, ambiguity is rarely avoided. In fact, people's ability to infer other people's intentions based on incomplete information makes ambiguous language a more efficient medium of communication than unambiguous language would be. But much remains to be learned about what sorts of ambiguities facilitate communications and what sorts create problems.

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