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A Theory of Scalar Implicature

Julia Hirschberg

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CHAPTER I

Introduction

Speakers may convey many sorts of 'meaning' via an utterance, including ENTAILMENTS,[1] PRESUPPOSITIONS,[2] and IMPLICATURES,[3] as well as the ILLOCUTIONARY FORCE[4] and PERLOCUTIONARY EFFECT(S),[5] which may be associated with any utterance. While students of natural-language processing have looked at some of these phenomena in considerable detail,[6] they have left others unexamined. In particular, little attention has been paid to CONVERSATIONAL IMPLICATURES -- those non-truth-functional, context-dependent meanings identified by Grice [Grice 75] as relying for their interpretation upon speaker and hearer recognition of certain maxims of cooperative conversation. In effect, since hearers take into account not only those propositions speakers commit themselves to, but also those they do not, speakers may anticipate this inferential capacity when framing an utterance.[7]

This thesis presents a formal account of one type of conversational implicature termed here SCALAR IMPLICATURE, which relies for its generation and interpretation upon the hypothesis that cooperative speakers will say as much as they truthfully can that is relevant to a conversational exchange. For example, B's utterance of (1a)

(1) A: How was the party last night?
 a. B: Some people left early.
 b. Not all people left early.

---

[1]Those meanings which must be true in every possible world or model in which the sentence uttered is true.

[2]Traditionally, those meanings which are entailed by both the sentence uttered by the speaker and by its negation. More pragmatic views of presupposition define it as those meanings which must be true in order for a speaker felicitously to utter the sentence in question. [Gazdar 79a]

[3]Non-truth-functional meanings.

[4]The type of illocutionary act a speaker performs via some utterance, as, *asserting*, *promising*, *questioning*, etc. Roughly, what the speaker intends the utterance to do. [Searle 69]

[5]The effect a speaker has on some hearer by uttering some sentence; so, *convincing*, *inspiring*, and *getting hearer to realize* are termed perlocutionary acts. [Searle 69]

[6]Such as illocutionary force in indirect speech acts [Cohen 79, Perrault 80] and presupposition [Kaplan 79, Mercer 84].

[7]Note throughout that I will consider only declarative utterances.

B knows, (1b) also holds -- even though the truth of (1b) clearly does not follow from the truth of (1a). A may reasonably conclude that, if B in fact believes that everyone left early, s/he would have said so -- and, in planning his/her response, B may anticipate this conclusion. In Grice's terms, B has conversationally implicated (1b). This meaning is representative of the class of scalar implicatures.

Scalar implicatures may be distinguished from other conversational implicatures in that their generation and interpretation is dependent upon the identification of some salient relation that orders a concept referred to in an utterance with other concepts. In 1, for example, the salience of an inclusion relation between 'some people' and 'all people' in the discourse is prerequisite to B's implicating that (1b) -- and to A's understanding that (1b) has in fact been implicated. Given that 'all people' can be said to include 'some people', we can account for the scalar implicature of (1b) intuitively as follows: B has said (1a). S/he might just as easily have said (1b). (1b) may be viewed as a 'more informative' response than (1a), since it conveys all the information that (1a) does -- and more. If B had said (1b), we would not only know that B believed that some people left early -- but that s/he believed it not the case that everyone left early. This ordering of an utterance spoken with other possible utterances via the ordering of concepts mentioned and not mentioned is at the heart of scalar implicature.

The description of scalar implicature I will present is based upon the examination of 'non-logical' inferences apparently licensed in a large corpus of naturally occurring data collected by me and by others from 1982 through 1985. The bulk of data examined were transcripts of a radio call-in program, 'The Harry Gross Show: Speaking of Your Money', recorded from February 1-5, 1982, in which an expert provides callers with financial advice [Pollack 82]. Other protocols examined include Kathy McKeown's student advising transcripts [McKeown 85], Philip Werner's medical protocols [Werner], and Ethel Schuster's cooking instruction transcripts [Schuster 82], as well as a number of individual tokens. Although, for the sake of brevity, many of the tokens presented in the thesis consist of question/ answer pairs, the other protocols permit the study of scalar implicature in a larger discourse context.

While the claim that speakers are in fact implicating some meaning must often be based upon post hoc intuitions, subsequent discourse often provides convincing evidence that one or both conversational participants has indeed considered the implicitly conveyed meaning to be part of what the speaker has conveyed. For example, in the following conversation between a caller (A) and a hospital clerk (B),

(2) A: Do you have information on a patient?
B: What's the name?
A: K___ M___ for maternity.
B: I don't think she's delivered yet.
A: Then she HAS been admitted.
B: Yes.

the caller requests confirmation of the implicated 'K___ M___ has been admitted'. Similarly, in 3, A makes B's implicature explicit

(3) B: Do you know who's taking your place down here?
A: You told me -- x is.
B: Yeah.
A: Are you upset about that.
B: I'm not upset.
A: Do you mean to imply that other people are?

by her question. Gazdar [Gazdar 79a] notes a similar phenomenon in his example (presented here in 4

(4) A: Is your mother well and back?
B: Well she's back, yes.
A: She's not well then.

These and other examples presented below provide an empirical base for the account I will present of the sorts of meanings speakers can convey via scalar implicature and the linguistic and non-linguistic contexts in which they can convey them. This description in turn forms the basis of a computational account of the phenomenon. While it is difficult to avoid at least implicit claims to cognitive reality in such an enterprise, I have tried to limit such claims to the following: People are able to generate and interpret meanings of the sort I term scalar implicatures. While other characterizations of these meanings and accounts of how they might be communicated are indeed possible, that presented below does allow us to simulate this generation and interpretation computationally.

A computational account of one type of conversational implicature of neccessity involves some re-examination of the broader phenomenon. In particular, no sufficient conditions have been proposed for conversational implicature -- even in non-computational work -- and those necessary conditions suggested in the literature are the subject of considerable debate. In fact, only one serious attempt at a formal account of conversational implicature has so far been made [Gazdar 79a] -- for a small subset of the class. So, in defining scalar implicature, I must first develop a formal account of conversational implicature. In Chapter 2 of this thesis, I examine some of the major controversies in the linguistic literature on conversational implicature and some of the obstacles to a satisfactory definition of the phenomenon. I propose that a conversational implicature p_j is licensed by a speaker's utterance of some u_i when a

speaker intends to convey p_j by saying u_i; when speaker and hearer mutually believe that speaker is being cooperative and that belief in p_j is 'required' given u_i and speaker cooperativity; and when p_j is CANCELABLE, NONDETACHABLE, and REINFORCEABLE.

In Chapter 3, I examine previous attempts to identify sub-classes of conversational implicature, and, in particular, the work of Horn [Horn 72], Harnish [Harnish 79], and Gazdar [Gazdar 79a], which I draw upon in defining scalar implicature. Scalar implicature in effect subsumes the phenomenon identified by Horn and Gazdar, while including a wider variety of inferences which I argue should be seen as members of a single class. I then introduce scalar implicature and relate it to these previous descriptions. In particular, I present a new strategy for utterance ranking and propose a redefinition of the epistemic force of licensed implicatures; both of these contributions respond to problems long recognized but unresolved in the literature. From an intuitive description of scalar implicature, I propose a set of scalar implicature conventions which, for a given utterance and given salient ordering(s), permit the identification of licenseable scalar implicatures.

In Chapters 4-6, I show how these conventions may be used to calculate scalar implicatures. Chapter 4 defines a representation for utterances and implicatures and justifies the epistemic force I assign to scalar implicatures. In Chapter 5, I describe the types of ordering relation that can support scalar implicature and provide a definition of utterance ranking in terms of partial ordering relations.[8] In Chapter 6, I relate the conventional aspects of scalar implicature to the interpretation of particular inferences in context. I discuss how current notions of discourse FOCUS/ TOPIC/ CENTERING can be adapted to the task of identifying salient expressions and salient partial orderings in a discourse. Finally, I extend the scalar implicature formalism developed in earlier chapters to accommodate more complex implicatures arising from utterances in which more than one expressions is salient.

While various existing systems -- COOP [Kaplan 79] and HAM-ANS [Hoeppner 84a], for example -- have implicitly recognized the need to accommodate some aspects of the behavior examined in this thesis, efforts to interpret or generate such meanings have had limited success. In Chapter 7, I argue that such failures have occurred in large part because of the lack of an independently motivated account of the phenomenon. I describe one application of the theory of scalar implicature developed in previous chapters to computer-human interaction -- a system that proposes alternate responses to yes-no questions based upon the potential scalar

[8] In previous work on scalar implicature I have termed such posets 'scales' after Horn and Gazdar [Hirschberg 84a, Hirschberg 84b, Hirschberg 84c, Hirschberg 84d] . However, confusion over intuitive definitions of scales as linear orderings has convinced me to abandon this terminology. Mea culpa.

implicatures which direct responses might license. I present sample sessions in which this system, QUASI, proposes responses to questions about switches in a computer mail domain. In the conclusion to the thesis, I suggest further ways in which the calculation of scalar implicature should be useful in natural-language processing. For natural-language processing, knowledge of meanings such as those conveyed via conversational implicature is essential to provide a theoretical basis for more sophisticated models of human behavior and to permit machine inference of all that natural-language input may convey -- and machine anticipation of all that generated text may communicate.

CHAPTER II

Conversational Implicature in the Gricean Framework

One day in class, a student asked the rabbi what he would rather have, five daughters or $5000. 'Five daughters,' answered the rabbi. 'Oh, come now, Rabbi, that's not possible,' protested the student. 'Well,' explained the rabbi, 'in the first place, if I had $5000, I would no doubt want more, and greed is a terrible sin. Secondly, should I desire $5000, I still wouldn't get it--wishing doesn't make things so--and I would look like a fool. And, thirdly, young man, I would rather have five daughters because I actually have eight.'

In this chapter I will first motivate the study of conversational implicature for mputational linguistics. Next, I will examine previous attempts to define the phenomenon d identify certain necessary conditions on the phenomenon. I will then claim that these nditions represent sufficient conditions for conversational implicature. Based upon this finition, I will propose a formal account of conversational implicature that will form the basis subsequent chapters for the calculation of SCALAR IMPLICATURES.

1. A Problem for Semantics

Linguists and philosophers of language have long noted the inadequacy of a truth-nctional semantics to capture certain aspects of utterance meaning. For example, each of the llowing utterances may, in some contexts, convey more than a speaker actually *says*:

(5)
a. George went to jail and became a criminal.
b. Ellen is twenty-one.

uth-functional semantic theories cannot differentiate between the utterances in 5 and the rresponding utterances in 6, even though the members of each pair may license quite different ditional 'meanings'.

(6)
a. George became a criminal and went to jail.
b. Ellen is at least twenty-one.

So, (5a) and (6a) will have the same truth conditions: Each is true just in case both conjuncts are true. But the asymmetric interpretation of conjunction in natural language (See Section 3.1.1.1.) permits the utterer of (5a) to convey a very different meaning than s/he can convey by uttering (6a): By (5a), a speaker may convey that George's going to jail resulted in his corruption, which cannot be conveyed via (6a); but (6a), and not (5a), can convey that George's criminality led to his imprisonment. The utterer of (5b) may convey that, as far as s/he knows, Ellen is no older than twenty-one, while the utterer of (6b) cannot. However, if I say (5a) and you later find out that George became a criminal before he went to jail, you will probably not say that I have lied, although you may feel I have mislead you; similarly for (5b) and (6b).

Note also that these non-truth-functional meanings will not always be licensed by the utterance of the sentences in 5. For example, the utterances in (7a) and (7b) are not likely to license the meanings licenseable by

(7)
a. *George went to jail and became a criminal*, though not in that order.
b. Who in this crowd can buy us some beer? *Ellen is twenty-one.*

by the utterances presented in 5. So, these meanings are both non-truth-functional and context-dependent.

Context-dependent meanings pose obvious problems for computational linguistics. The simple lexical solution -- redefining lexical entries for items such as *and* to include an additional temporal/causal meaning -- is impossible just because of the context dependency of this meaning. A more reasonable alternative -- adding new senses for each context-dependent meaning which the use of a lexical item may license -- is also unsatisfactory: First, since the number of items which can be used to license such meanings is large, this solution is undesirable from a practical point of view. Second, it entails that all the utterances in 5, 6, and 7 will always be treated as ambiguous, which seems both counter-intuitive and computationally expensive. While designating a 'default' meaning might override these objections, it is not clear how such a default might be chosen. (See Section 3.1.1.1.) And including non-truth-functional meanings in the lexicon is in general somewhat risky. Third, it leaves unanswered the central problem of how this proliferating ambiguity might be disambiguated.

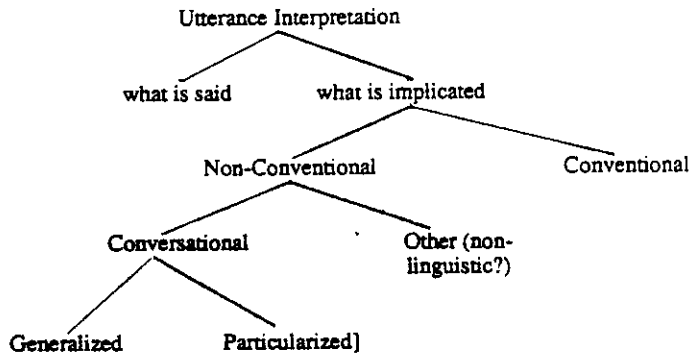
.2. The Gricean Framework

As an alternative to such lexico-semantic approaches, Grice [Grice 75, Grice 78] proposes solution within the framework of linguistic PRAGMATICS.[9] Grice retains a simple lexicon, as ell as a truth-functional semantics for the natural-language counterparts of the operators, uantifiers, and connectives of the first-order predicate calculus such as *and*. He accounts for screpancies between natural language and its formal representation -- i.e., for non-truth-nctional, context-dependent aspects of utterance interpretation -- as CONVERSATIONAL IPLICATURES.[10]

.2.1. Classifying Meanings

In his broad view of utterance interpretation, Grice distinguishes *what is said* from *what is nplicated*, as illustrated in Figure 2-1.

Figure 2-1: The Gricean Framework



hat is said is, for Grice, the CONVENTIONAL FORCE of an utterance -- those context-ıdependent meanings that follow from the conventional meaning of an utterance and which

[9]Earlier work on contextual or pragmatic inference is summarized in [Hungerland 60].

[10]Grice introduces the verb *implicate* to denote the licensing of these particular understandings as well as the ıuns IMPLICATURE (the act of implicating) and IMPLICATUM (that which is implicated). These terms are intended imarily to distinguish these non-truth-functional inferences from those that may logically follow from an utterance a standard rules of deduction operating on its semantic representation. [Grice 75:41-42]

determine its truth conditions. *What is implicated* represents those additional aspects of utterance interpretation that do not affect its truth conditions. CONVENTIONAL IMPLICATURES are non-deductive inferences derived from the conventional meaning of utterances; thus, while conventional implicatures are non-truth-functional, they are context-independent. For example, for Grice, lexical items such as *but* and *therefore* license conventional implicatures, as in (8a) and (8b).[11]

(8)
a. He is an Englishman; he is, therefore, brave.
b. He's a New Yorker but I like him.

Conventional implicatures form part of what is implicated rather than what is said chiefly because their meaning is not captured in a truth-functional semantic representation.[12] For example, in Grice's view, while the proposition in (8a) will be false if the male referent is, say, French, it will not, strictly speaking, be false if the consequential connection between being an Englishman and being brave fails to hold.

In this framework, meanings such as those discussed in Section 2.1 form part of the class of CONVERSATIONAL IMPLICATURES. Like conventional implicatures, conversational implicatures are non-truth-functional; however, unlike conventional implicatures, they are context-dependent.

2.2.2. Formalizing Conversational Implicature

In defining conversational implicature, I will employ a representation which assumes a modal logic which includes operators expressing intention, belief, and mutual belief. Here I will present a partial syntax for this representation, which will be augmented in this and subsequent chapters. In the following discussion, assume that p_i, p_j, ... are variables ranging over well-formed formulas (wffs); u_i, u_j ... range over utterances; S denotes some speaker and H, some hearer. C_k, C_l, ... range over contexts, which, for the moment, may be seen simply as temporally ordered sequences of utterances in the current discourse.[13] So, for present purposes,

[11]Note that, while it is now generally accepted that such items convey their meaning via conventional implicature, for most such items what that meaning *is* has not been established. So, while it might seem reasonable to paraphrase *but*'s contribution as *X and, surprisingly enough, Y*, no such paraphrase has been generally agreed upon in the literature. The standard interpretation of 'but' is that it conveys a sense that something is 'contrary to expectation'.

[12]Unsuccessful proposals have been made to incorporate conventional implicature in the realm of semantics, as, for example, [Karttunen 79].

[13]A complete representation of *context* will not be attempted in this thesis; presumably, the computation of other types of conversational implicature may require additional contextual information.

be represented as [...,u_i,u_j], where u_j is the utterance immediately prior to the current ce, u_k -- the utterance whose meanings are currently in question. u_i is the utterance iately prior to u_j, and so on. Note that the index of the current context C_j is identical to lex of the immediately prior utterance u_j. Given this simplification, contexts will be d simply by the concatenation of u_k to C_j to form C_k.

The following are wffs in this representation:

$\neg p_i$

$p_i \vee p_j$

SAY(S, H, u_i, C_h): S says u_i to H in C_h.

REALIZE(u_i, p_i): u_i realizes p_i.

CAUSE(p_i, p_j): p_i causes p_j.[14]

INTEND(S, p_i): S intends to do p_i or intends that p_i hold.[15]

KNOW(S, p_i): S knows that p_i.

BEL(S, p_i): p_i follows from S's beliefs.

BMB(S, H, p_i): the proposition represented by p_i follows from S's beliefs about what is mutually believed by S and H.

Below I will assume that $p_i \wedge p_j$ abbreviates $\neg(\neg p_i \vee \neg p_j)$, that $p_i \Rightarrow p_j$ corresponds to $\neg p_i$ nd that $(p_i \leftrightarrow p_j)$ abbreviates $(p_i \Rightarrow p_j) \wedge (p_j \Rightarrow p_i)$.

Note that REALIZE identifies an utterance with the semantic representation of the sition it realizes. For computational purposes, then, REALIZE can be seen as taking an nce and returning its representation in some semantic theory (or vice versa, for ation). I have not distinguished here among propositions, events, and actions, although y a satisfactory definition of CAUSE and INTEND requires such a distinction. CAUSE d probably relate one action to another, while INTEND should probably relate an agent to an action s/he intends to perform or to a proposition she intends to make hold.[16] W and BEL are epistemic operators axiomatized as for [Hintikka 62]'s K and B operators. ticular,

Knowledge as True Belief

$$\text{KNOW}(S, p_i) \leftrightarrow \text{BEL}(S, p_i) \wedge p_i.$$

---

e use of propositions as objects of causality is discussed below.

e use of propositions as objects of intention is discussed below.

espite this current simplification, there is a simple mapping between the use of CAUSE and INTEND below more satisfying definition of each: In every case presented below, INTEND will be associated with an agent proposition which might better be construed as an event, while CAUSE will relate two propositions which also be represented as actions.

BMB is the one-sided mutual belief of [Clark 81, Perrault 81]: A speaker (S) believes that P is mutually believed between S and hearer (H) when

$$\text{MB(S,H,P)} = \text{SB(P)} \wedge \text{SBHB(P)} \wedge \text{SBHBSB(P)} \wedge \ldots$$

Similarly

$$\text{MB(H,S,P)} = \text{HB(P)} \wedge \text{HBSB(P)} \wedge \text{HBSBHB(P)} \wedge \ldots$$

A proposition P is mutually believed by both H and S (two-sided mutual belief) if both MB(S,H,P) and MB(H,S,P) hold. One-sided mutual belief (MB(S,H,P), or, here, BMB(S, H, p_i) is equivalent to SB(P) $\wedge$ SB(MB(H,S,P)); hence, BMB is defined equivalently as:

Mutual Belief:

$$\text{BMB}(S, H, p_i) \leftrightarrow \text{BEL}(S, p_i) \wedge \text{BEL}(S, \text{BMB}(H, S, p_i))$$

I will employ this syntax throughout the thesis, translating from that of other authors where possible to avoid proliferation of notational systems. Also note that, for the sake of simplicity, all variables will be assumed to be universally quantified unless otherwise specified.

2.3. Maxims of Cooperative Conversation

In Gricean theory, participants in conversation assume that their partners share knowledge of certain underlying domain- and exchange-independent conversational goals, which Grice subsumes under his COOPERATIVE PRINCIPLE (CP):

> 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. [Grice 75:45]

Because the CP is shared knowledge, speakers can license and hearers can interpret inferences beyond the conventional force of an utterance, in large part by comparing 'what is said' to 'what might be said' in the exchange.

Grice distinguishes four maxims of cooperative conversation, which further specify what it means to observe the CP, the MAXIMS OF QUANTITY, QUALITY, RELATION, and MANNER.[17] These maxims are "standardly (though not invariably) observed by participants in a talk exchange." [Grice 78:113] While Grice does not claim that these four exhaust the notion of communicative cooperativity, so far the pragmatic literature has, by and large, accepted these as (collectively) sufficient conditions on the CP.[18]

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[17]Grice [Grice 75:47] notes that there are other maxims of an aesthetic, social, or moral nature, such as 'Be polite'; he does not include these with his conversational maxims, since they are not so specifically connected with the particular goals of a talk exchange. These provide the basis for those nonconventional but nonconversational implicatures noted in the figure above.

[18]Attempts have been made to order these maxims, to identify one (Relation or Quality) as primary, subsuming the rest, and to define sub-maxims. See, for example, [Sperber 83, Kempson 75].

To permit formalization of speaker obedience of these maxims, I will introduce variables n_i, ... which range over individual (labels for) maxims and M_i, M_j, ... which range over sets i. I will also define for each of the standard maxims what it means to observe that maxim he predicate OBEY, where OBEY(S, m_i, C_k) indicates that S is observing the maxim m_i in ontext C_k. This predicate will later permit a general definition of 'speaker cooperativity' in Gricean framework.

Grice's original MAXIM OF QUALITY,

> Try to make your contribution one that is true.
> 1. Do not say what you believe to be false.
> 2. Do not say that for which you lack adequate evidence. [Grice 75:46]

ins speakers from providing information for which they have insufficient evidence and ucts them to consider the effect of their contribution in assessing its truthfulness. That is, S rs the Maxim of Quality iff propositions not believed true are not stated. Or, equivalently, S eying this maxim iff everything S says s/he also believes to be true:

Obeying Grice's Maxim of Quality

$$((\text{SAY}(S, H, u_i, C_k) \wedge \text{REALIZE}(u_i, p_i)) \Rightarrow \text{BEL}(S, p_i)) \leftrightarrow \text{OBEY}(S, \text{Quality}, C_k)$$

However, Joshi's [Joshi 82:190] revision of this maxim presents a more difficult task. i defines Quality in terms of S and H's MUTUAL BELIEFS[19] as follows:

- if S says p_i, then it must be that S believes p_i;
- based on S's assessment of S and H's mutual beliefs, it should not be possible for H, from what has been said (p_i), to infer some other fact (say p_j) which S knows to be false;
- if there is such a possibility, then, after saying p_i, S should add further information (e.g., $\neg p_j$) to "square away" the mutual beliefs;
- otherwise, S is likely to mislead H by possibly making him continue to believe in p_j, which is false in the knowledge base.

In other words, to obey Joshi's Maxim of Quality, S should not only speak the truth and d the false, but should avoid truths which might lead H to draw false conclusions. This ion might be defined as:

Obeying Joshi's Revised Maxim of Quality

$$((\text{SAY}(S, H, u_i, C_k) \wedge \text{REALIZE}(u_i, p_i)) \Rightarrow \text{BEL}(S, p_i)) \wedge$$
$$(\text{BEL}(S, \text{CAUSE}(\text{SAY}(S, H, u_i, C_k), \text{BEL}(H, p_j))) \wedge \text{SAY}(S, H, u_i, C_i) \wedge$$

[19]Here I have changed only the notation for S and H.

$$\text{BEL}(S, \neg p_j)) \Rightarrow (\text{SAY}(S, u_j) \wedge \text{REALIZE}(u_j, \neg p_j)))^{20} \leftrightarrow \text{OBEY}(S, \text{Quality}_{\text{Joshi}}, C_k)$$

If S is obeying $\text{Quality}_{\text{Joshi}}$, then not only will S believe what s/he says, but, also, if S believes that the saying of u_i will license belief in p_j -- and if S does indeed say u_i while believing p_j to be false -- then S will also say some u_j which realizes $\neg p_j$. For the remainder of this work, reference to the Maxim of Quality should be understood as reference to $\text{Quality}_{\text{Joshi}}$.

While the Maxim of Quality applies only to assertions,[21] suggestions for extending it to queries, imperatives, and other speech acts have been made [Kempson 75]. For example, if a speaker observing this maxim asks a question, that speaker may be presumed not to know the answer to that question.

Grice's remaining maxims are less easily formalized. The MAXIM OF QUANTITY,

> a) Make your contribution as informative as is required (for the current purposes of the exchange).
> b) Do not make your contribution more informative than is required. [Grice 75:45]

requires that S select a level of informativeness appropriate to the exchange. [Fogelin 67] paraphrases the first part of this maxim (implicitly in terms of the Maxim of Quality as well) as "Make the strongest possible claim that you can legitimately defend." However, it is not clear how to quantify 'informativeness' or 'strength of claim' to permit comparison of potential utterances. Furthermore, specifying what the 'required' or 'appropriate' level of such informativeness is in some C_k seems impossible to do in any general way. While I will examine these questions in some detail in Chapters 3 and 5 and in Section 6.3.2.1, OBEY(S, Quantity,C_k) must remain, for now, intuitively defined.

The same is true for a notion of obedience to Grice's MAXIM OF RELATION, OBEY(S, Relation, C_k). Relation is summarized as: Be relevant. Whatever information S provides should be relevant to the exchange. Grice himself [Grice 68] has suggested that this maxim might subsume part (b) of the Maxim of Quantity. Others have gone further to propose that this maxim may in fact subsume all Grice's other maxims; if information is *relevant*, they claim, then clearly it will also be truthful and appropriately detailed. [Horn 84, Sperber 83]

Finally, Grice's MAXIM OF MANNER,

[20]REALIZE is actually too strong here, since u_j may simply convey $\neg p_j$ by means other than assertion. In Section 2.4.2, I will introduce the concept of LICENSING belief which will be substituted in this definition.

[21]Cf. [Gazdar 79a:48].

Be perspicuous.
1. Avoid obscurity of expression.
2. Avoid ambiguity.
3. Be brief (avoid unnecessary prolixity).
4. Be orderly.

requires that S provide information in a format appropriate to H and to the circumstances of the exchange. Gazdar [Gazdar 79a] notes that S's observance of this maxim accounts for the implicatures associated with ASYMMETRIC *and*, as in (5a) and (6a) above.[22] More specifically, Harnish [Harnish 79] suggests the following submaxims of Manner:

Super Submaxim: Be representational; in so far as possible, make your sayings "mirror" the world.

SubMaxim of Time: In so far as possible, make the order of saying reflect the order of events.

SubMaxim of Space: In so far as possible, if objects a, b, c,... ϕ together, put their names together when reporting this ϕ-ing.

Some attempts toward formal accounts of this maxim -- particularly, of its submaxims -- have been noted in [Gazdar 79a:43-44]. However, since these formulations lack precision and account only for parts of the behavior encompassed by this maxim, I will assume that OBEY(S, Manner, C_h) too is intuitively defined.

Given these notions of what it means for speakers to obey the Gricean maxims, we can now define Grice's more general concept of speaker cooperativity in terms of obedience to them. Because it will be useful to talk about speaker observance of particular maxims or sets of such maxims, I will define cooperativity as follows:

Speaker Cooperativity:
$$\forall m_i \in M_j \{\text{OBEY}(S, m_i, C_h) \leftrightarrow \text{IS\_COOP}(S, C_h, M_j)\}$$

That is, S is being cooperative with respect to maxims M_j iff S is obeying each $m_i \in M_j$. Given this definition, we can specify Grice's notion of speaker cooperativity as just speaker obedience to the Maxims of Quality, Quantity, Relation, and Manner: IS_COOP(S, C_h, {QUALITY, QUANTITY, RELATION, MANNER}).

Speakers may sometimes FLOUT, or ostensibly violate, one or more maxims, intending thereby to communicate some additional meaning to H. So, in Grice's classic example, a philosophy professor flouts the Maxim of Quantity to implicate a poor opinion of a pupil applying for a position in Philosophy:

[22] I.e., the surface order of conjuncts reflects the temporal order of events mentioned.

(9) Dear Sir,
Mr. X's command of English is excellent, and his attendance at tutorials has been regular.
Yours, etc.

It might seem that the Maxim of Quantity is being violated here, since letters of recommendation for philosophers might be expected to contain some (favorable) reference to a pupil's skills in that field. Yet Grice explains that H interprets S's behavior as cooperative: If S *is* in fact observing the CP, then, in particular, S has said as much as he truthfully can (that is favorable) about his/her pupil's skills. If S says nothing favorable in this regard, then H may conclude that S is not able truthfully to comment favorably on his/her pupil *qua* philosopher. Since S can anticipate this conclusion on H's part, S can in fact convey to H 'I can say nothing favorable about Mr. X as a philosopher' via 9. So, an apparent violation or flouting of the CP in fact represents the fulfilment of S's obligation to observe it.[23] And S relies upon H's belief that S is being cooperative in order to convey such implicit meanings.

Clearly, however, speakers do not always obey these maxims either implicitly or ostensively. S may *violate* the maxims, thus misleading H; for example, S may lie (violating the Maxim of Quality) or understate (violating the Maxim of Quantity). However, it is significant that the very notions of lying or understatement rely for their definition upon the notion that these maxims represent the 'norm'. S may also *opt out* of the maxims, making it plain that s/he is **not** being cooperative: Watergate-style 'stonewalling' exemplifies this option. S may also be faced with a *clash* between two or more maxims and be unable to fulfill all of them. Consider 10, where

(10) A: Where does C live? (= [Grice 75]'s (3))
B: Somewhere in the south of France.

A is planning with B an itinerary for a holiday in France. Both know A wants to visit his friend C. By his response, B implicates he does not know C's precise whereabouts. He is faced with a clash between the maxims of Quantity and Quality: to obey Quantity, he should supply a more

[23] Although some have claimed [Harnish 79] that meanings licensed via the flouting of a maxim must be licensed differently from those licensed by its observance, this claim seems to miss Grice's notion that one may follow the CP less directly in these cases. [Harnish 79] terms conversational implicatures licensed via obedience to the maxims IMPLICATURE SIMPLICITER.

:cific location, but to obey Quality, he should say only what he has adequate evidence for.[24]

For Grice, the CP and its maxims are to be viewed as part of a speaker's communicative npetence: Although our observance of them may be implicit, "...our linguistic practice is *as* ve accepted these rules and consciously followed them." [Grice 68] For Morgan, the CP and maxims are among his CONVENTIONS OF LANGUAGE USE; they represent "rules for inferring . intentions behind speech acts, or, from the speaker's viewpoint, for selecting one's erances so as to convey one's intentions, by exploiting the maxims." [Morgan 78:262] The eanings' speakers exploit these maxims to license are, then, Grice's conversational plicatures.

4. Conversational Implicature

While the notion of conversational implicature is not hard to grasp intuitively, it has ›ven difficult to define precisely. The generality of the CP and the conversational maxims ıkes it difficult to specify just what is being observed or flouted in a particular instance, and alyses of which maxims are involved in particular implicatures vary widely from observer to server. While Grice proposed several characterizations of conversational implicature, each s been shown to have serious limitations. Subsequent efforts [Thomason 73, Walker 75, Katz] to formulate alternative definitions appear even less useful. So, it is not surprising that only e serious attempt at a computational approach to conversational implicature has been ıde [Gazdar 79a], and that this attempt eschews a definition of the general phenomenon.

For Griceans, conversational implicatures are those non-truth-functional, context pendent aspects of utterance interpretation which depend critically upon *S* and *H*'s (implicit) ›gnition of the CP and the conversational maxims for their conveyance. So, for example, if says (11a) and assumes that A believes B is obeying the CP,

(11)
a. I have five dollars.
b. I have more than five dollars.

[24]To explain *S*'s behavior when faced with such clashes, [Harnish 79] proposes a PRINCIPLE OF CHARITY: "Other ngs being equal, construe the speaker's remark so as to violate as few maxims as possible". He and other authors 'e suggested that the maxims in fact should be ordered by the degree to which they are important to successful mmunication; if such an ordering is correctly identified, then speakers' behavior when faced with clashes should be ringement of the lower-ranked maxims before the higher-ranked maxims. However, there is little agreement on w the maxims should be ordered. Some [Sperber 83, Horn 84] see Relation as primary: whatever *S* says must first all be relevant to the conversation. Alternatively, Grice's [Grice 75] argument that Quality (or, truthfulness) is ›bably *S*'s first consideration is also persuasive, particularly in cases like 10.

B may license the inference 'for all B knows ¬(11b)'.[25] This inference is licensed via the shared assumption that a cooperative speaker says as much (Maxim of Quantity) as s/he truthfully (Maxim of Quality) can that is relevant (Maxim of Relation) for the particular exchange. So, if B believes his/her total readily available cash is relevant, then by choosing to affirm *five* when s/he might, with equal brevity, affirm some higher value x entailing *five* (in the sense that, if one has six dollars then one also has five dollars), B licenses the conclusion that s/he is unable truthfully to affirm x. Either s/he believes s/he does not have x dollars or s/he does not know whether s/he has x dollars. Hence, in this instance, B implicates ¬(11b) by asserting (11a).

A single utterance may license multiple implicatures. For example, B's response in 12 may convey

(12) A: I don't have enough money for lunch.
B: I have five dollars.

that B is willing to lend A lunch money, as well as ¬(11b).

2.4.1. Implicature and Speaker Intention

Although Grice's general work on utterance meaning makes it clear that he intends conversational implicature, as all aspects of utterance meaning, to be defined in terms of speaker intention, confusion about this point is evident throughout the literature on implicature. That is, conversational implicatures are often spoken of as meanings which *H* infers in a certain way, rather than as meanings *S* seeks to communicate in a certain way. Of course, even if we define conversational implicature in terms of *S*'s intentions, we can also talk about *H*'s beliefs about those intentions as a condition on *H*'s inference that *S* has implicated that p_j (See the definition of inferred conversational implicature in Section 2.4.4.); but this does not change the need to choose the point of view from which one will define the phenomenon itself.

Grice identifies conversational implicature as part of the $meaning_{nn}$ ('nonnatural meaning') of an utterance [Grice 69]. $Meaning_{nn}$ is distinct from 'natural meaning' in that it is not conveyed directly to H,[26] who must consequently do a certain amount of inferencing to

[25]See Section 5.1.4.1 for a fuller discussion of conversational implicatures licensed via mention of cardinals.

[26]In response to criticism that his account of $meaning_{nn}$ failed for audienceless utterances, Grice substituted 'addressee' for 'hearer'. Although it is theoretically possible that *S* might implicate p_j to him/herself, this possibility will be ignored here, so I will continue to use 'hearer' instead of addressee.

nterpret S's utterance.[27] More usefully, $meaning_{nn}$ differs from natural meaning in that it is a unction of S's intention and of S's beliefs about H's recognition of this intention, while ntentions do not play this determining role in cases of natural meaning. For his utterance to convey some $meaning_{nn}$, S must intend to produce a certain effect in H, which will often be the ecognition of some belief; Grice labels this intending M-INTENDING. S must also intend this effect to result (at least in part) because of H's recognition of S's intention. However, Grice notes that neither S nor H need be "aware of" these intentions *qua* intentions [Grice 69].

While the concept of $meaning_{nn}$ has been the subject of considerable debate,[28] Grice's liscussion does make clear his position that aspects of $meaning_{nn}$, in particular, conversational mplicature, should be defined in terms of S's intentions rather than H's beliefs about those ntentions. S's implicating p_j is independent of H's understanding that S has implicated p_j in he same way that S's asserting p_i is independent of H's understanding that S has asserted p_i -- or that S's implying p_j by asserting p_i is independent of H's recognizing that p_i logically implies p_j. In neither of these latter cases would we want to say that a meaning has been asserted or mplied simply because H has understood it or because H believes that S has asserted or implied t. Similarly, then, if H infers some p_j that S has not intended, even if H believes that S has mplicated p_j, we would not want to say that S has implicated p_j. So, S has not implicated p_j unless s/he has intended to implicate p_j.[29] Conversely, S implicates p_j just in case s/he intends o implicate p_j – regardless of whether H understands it.

Curiously, even Grice does not always maintain this distinction between implicating and understanding what has been implicated, as is evident from his identification of conversational mplicature with the lexical items involved its licensing (See Section 3.1.1) and from his

[27] [Wright 75] notes that this distinction is not dichotomous but should be seen on a continuum.

[28] Grice originally claimed that speaker intention was prior to utterance and even sentence meaning. However, as many [Searle 69, Kempson 75, Wright 75, Yu 79] have noted, his account is circular: Some independent aspect of sentence meaning must surely constrain the set of communicative intentions speakers may have when uttering that sentence, or we could not explain how speakers choose among possible utterances. That is, if I want to tell you the time, I am constrained in the ways I may communicate the time to you by more than merely my intention to tell you the time. I will not usually say 'It is raining' to tell you that it is five o'clock, for example, although, if speaker intention were prior to sentence meaning, there should be no way for me to choose between 'It is raining' and 'It is five o'clock'. So, most Griceans, including, apparently, Grice himself, have abandoned this claim, while holding to some weaker claim for the centrality of speaker intention in utterance meaning. [Kempson 75:138-141, Grice 78:120, Wright 75, Yu 79]

[29] This position appears to accord with [Walker 75:157]'s definition of conversational implicature:

> S conversationally implicates ϕ by u_i iff in uttering u_i S M-intends to convey ϕ to his audience, and intends this intention to be recognised partly because of the audience's recognition of the sense of u_i (together with its expectation that S also knows the sense of u_i); but partly also because the audience expects S to be conforming to the Cooperative Principle, and expects S to anticipate this expectation and to act accordingly.

discussion of implicature CANCELATION (See Section 2.4.2.1). However, while it is true that S will take (his/her beliefs about) H's inferential capacity into account in planning to implicate p_j, and while it is certainly possible to define what it means for H to infer that S has implicated p_j, Grice's belief in the primacy of speaker intention to utterance meaning suggests that what it means for S to implicate p_j is best defined from S's point of view. So, as a beginning to a definition of conversational implicature, I will specify that S IMPLICATES p_j to H by saying u_i only when

Condition 1. S intends to convey p_j to H by saying u_i.

That is, S can be said to implicate p_j via u_i only if

Intention to Implicate:
INTEND(S, CAUSE(SAY(S, H, u_i, C_k), BEL(H,p_j)))

Note that it is not sufficient to say that S intends to convey p_j -- but that s/he must intend to convey p_j *by saying* u_i if we are to count p_j a conversational implicature. That is, conversational implicatures are confined to those meanings licensed via linguistic behavior. Note also that, while Condition 1 is a necessary condition on conversational implicature it is obviously not sufficient; for Grice, all utterance meaning must hinge upon S intention.[30]

2.4.2. Other Necessary Conditions on Conversational Implicature

While Condition 1 is derived from Grice's more general work on utterance meaning, Grice himself proposes other necessary conditions on conversational implicature. However, these suggestions are flawed -- chiefly by Grice's failure to be specific about the point of view from which each is defined. [Grice 75:49-50] presents the following characterization:[31]

> A man who, by (in, when) saying (or making as if to say) that p_i has implicated that p_j, may be said to have conversationally implicated that p_j PROVIDED THAT
>
> **G1.** he is to be presumed to be observing the conversational maxims, or at least the cooperative principle;
>
> **G2.** the supposition that he is aware that, or thinks that, p_j is required in order to make his saying or making as if to say p_i (or doing so in THOSE terms) consistent with this presumption; and
>
> **G3.** S thinks (and would expect H to think that S thinks) that it is within the competence of H to work out, or grasp intuitively, that the supposition mentioned in G2 is required.

[30] In fact, if we could assume this view to be universal, we could define it for all utterance meaning, not simply conversational implicature.

[31] I will distinguish Grice's proposed necessary conditions on conversational implicature from my own by prefacing his with 'G'.

So, Grice would say S implicates p_j by saying p_i to H when H presumes that S is observing the CP; when this presumption plus S's saying that p_i require one to conclude that S believes that p_j; and when S thinks (and would expect H to think S thinks) that H can figure all this out.

Note however that the belief spaces postulated for each of Grice's conditions -- or the lack of such specification -- make it difficult to determine the point of view from which conversational implicature is to be defined. Grice does not specify who must presume or suppose conditions G1 and G2, although it seems that he means G1 to be a condition on H's beliefs. However, given that condition G3 is a condition on S's beliefs, condition G1 as stated allows conversational implicature to be defined in terms of H's beliefs, when S's may be at variance. That is, suppose you believe I am obeying the CP but I believe that you do not believe this. If, say, I believe you believe I am not observing the Maxim of Quality, then, when I assert p_i, I will not believe that I can implicate p_j, even though condition G1 holds. So, under this condition, implicatures will be defined which S does not believe have been licensed by an utterance, violating Grice's belief in the primacy of speaker intention to meaning -- my Condition 1 above. So it seems that this condition should be revised to require that S believe that H believe in S's cooperativity.[32]

Suppose then that BEL(S, BEL(H, 'S is obeying the CP')) but that it is not the case that BEL(S, BEL(H, BEL(S, BEL(H, 'S is obeying the CP'))))). Perhaps I believe you believe me cooperative but I also believe you do not realize I believe this -- BEL(S, ¬BEL(H, BEL(S, BEL(H, 'S is obeying the CP')))). Imagine that you and I have just quarreled. In the midst of the quarrel, you call me a liar and are instantly contrite. Since we have been long-time friends, I do not believe that you believe me a liar. But when I see how upset you are at your accusation, I realize that you believe I believe you must believe me a liar. At this point the postulated conditions hold with regard to the Maxim of Quality: I believe you believe me truthful but I also believe you do not believe this. Then I will not believe that I can convey to you some implicature via your belief in my adherence to Quality, since I will not believe that this assumption can play any role in your 'working out' of an implicature.[33] Because G1 is thus sensitive to nested belief contexts, not only must we specify that BEL(S, BEL(H, 'S is obeying the CP')) but we must require that BEL(S, BMB(H, S, 'S is obeying the CP')).

[32]Note that this condition will not require that H actually believe in S's cooperativity.

[33]While it is also possible that S might license certain inferences when s/he believes H believes S is not obeying the maxims, it seems difficult to propose any regularity in this lack and, thus, difficult to propose any inferences derivable from it.

With this revision, Grice's G1 may be restated as:

Condition 2. S believes that it is mutually believed between S and H that S is being cooperative.

Although it may be difficult to tell when S is observing the CP and the conversational maxims, as I have noted above, we can represent this observance via IS_COOP(S, C_k,{QUALITY, QUANTITY, RELATION, MANNER}).[34] Then Condition 2 may be represented as:

Mutual Belief in Speaker Cooperativity:
BEL(S, BMB(H, S, IS_COOP(S, C_k, {QUALITY, QUANTITY, RELATION, MANNER}))).

Next, consider how Condition G2 encapsulates the notion that some (non-deductive) argument *Arg* exists -- independent of S or H apparently -- which, taking S's cooperativity and utterance of p_i as premises, yields p_j as a conclusion. That is, in Grice's terms, conversational implicature is calculable: There exists some *Arg* that represents a way of 'working out' that a cooperative S's saying that p_i must lead H to conclude that p_j. Unfortunately, as well as failing to specify who must believe that *Arg* yields p_j, Grice fails to make clear the sense in which he intends that a non-deductive conclusion such as p_j be 'required', given *Arg*.

>From Grice's examples, it seems that condition G2 is often satisfied via S's belief about H's belief that other choices of utterance S might make would violate the maxims, i.e., be less informative or less truthful or less relevant or less appropriately presented than the utterance S has actually made. That is, procedures by which conversational implicatures are 'worked out' seem often to rely upon a comparison of an utterance with those other utterances S might have produced. In Chapter 3 I will pursue this notion in more detail. I will propose that, at least for general classes of conversational implicature, it is possible to specify ways in which this notion of 'required' can be defined. For the moment, I will introduce a predicate, LICENSE(S, H, p_j, u_i, C_k, M_i), which denotes that some inference represented by p_j is licensed by SAY(S, H, u_i, C_k) given IS_COOP(S, C_k, M_i).[35]

It should be clear that Grice's notion of the inference of p_j being 'required' relies upon at least S, H, and u_i. LICENSE must also depend upon context, even though Grice fails in G2 to

[34]Note that this will allow future change to the set of maxims that define speaker cooperativity if desired. It is also possible that conversational implicature does not require mutual belief that S is obeying all conversational maxims. Theoretically, it seems possible that S might implicate that p_j via mutual belief that S is observing only a subset M_i of the Gricean maxims, providing that the working out of p_j relies only upon mutual belief in S observance of M_i. I will return to this possibility in Chapter 3. In the meantime note only that this representation allows for future revision of our theory in this direction.

[35]For meanings other than conversational implicatures, of course, M_i may be null.

specify how *Arg* can be seen as context dependent.[36] Given that the context-dependence of implicature is the motivating factor in the introduction of the concept itself, this is a serious omission. Note also that, while condition G1 may best be defined in terms of speaker obedience to all of the maxims in the CP, condition G2 need not be. Although it is not always possible to reach agreement on which maxims are involved in some implicature, unless it is possible to specify these maxims, it is clearly impossible to talk about the process by which implicatures are to be 'worked out'. For example, we would not say that *S*'s obedience to the Maxim of Manner plays a role in the implicature of ¬(11b) via the utterance of (11a). So it will be useful to specify for any implicature the maxims that are involved in the 'requirement' that some conclusion be reached; hence, the M_i argument to LICENSE.

Given this notion of LICENSE we can proceed to examine another major weakness in Grice's description of condition G2, namely, his failure to specify the belief space in which LICENSE(S, H, p_j, u_i, C_k, M_i) will hold. Also, while some implicata may be of the form BEL(S,p_j), others, such as ¬(11b) will be of the form ¬BEL(S,p_j). That is, S may license belief in S's belief or belief in S's lack of belief via implicature. Given these considerations, and assuming for the moment that speaker cooperativity is defined as in my Condition 2, we might then redefine Grice's condition G2 as something like:

BEL(S,LICENSE(S, H, p_j, u_i, C_k, M_i))

Note however that, 'BEL(S,LICENSE(S, H, p_j, u_i, C_k, M_i))' may be true while 'BEL(S, BEL(H, LICENSE(S, H, p_j, u_i, C_k, M_i)))' is false. That is, I may believe that my belief in p_j is required if I am cooperative and have uttered p_i, but at the same time fail to believe that you share this belief. In this case, I will not believe that my saying that p_i will convey to you p_j. For example, if I believe you believe I am lying, then my belief in the inferences that my utterance will license given that I am perceived as obeying the CP will not be of much use. So, condition G2 might be met, while S might believe that no implicature had been licensed. Similarly, if 'BEL(S, BEL(H, LICENSE(S, H, p_j, u_i, C_k, M_i)))' is true but 'BEL(S, BEL(H, BEL(S, LICENSE(S, H, p_j, u_i, C_k, M_i))))' is false, then I may believe that you believe my belief in p_j follows from my cooperativity and my utterance, but I may believe that you believe I do *not* believe this. Say, I tell you '*I have five dollars*' when I believe you believe I believe you only need five dollars. Then I will not imagine that you will conclude that I have no more than five dollars. In effect, then, condition G2 must be redefined in terms of S's beliefs about S and H's

[36] Thomason's [Thomason 73] definition of conversational implicature is the first actually to specify contextual dependence:

> A sentence ϕ conversationally implicates ψ relative to a class C of contexts of utterance, if for all $c \in C$, such that ϕ's assertion in c does not violate the maxims of conversation, ψ is presumed in c.

See [Gazdar 79a:41] for a discussion of the limitations of this definition.

mutual beliefs: that is, for S to implicate p_j to H by saying u_i in a context C_k, it is necessary that:

> **Condition 3.** S believes that it is mutually believed between S and H that p_j is 'required' (or licensed) given that S is obeying some particular M_i and S says u_i in C_k.

I will represent this condition as:

Licensing Conversational Implicature:
BMB(S, H, LICENSE(S, H, p_j, u_i, C_k, M_i))

Grice explains his condition G3, or, how S might envision H 'working out' condition G2, in terms of the following S belief about H's reasoning:

> S has said that p_i; there is no reason to suppose that he is not observing the maxims, or at least the CP; he could not be doing this unless he thought that p_j; he knows (and knows that I know that he knows) that I can see the supposition that he thinks that p_j is required; he has done nothing to stop me thinking that p_j; he intends me to think, or is at least willing to allow me to think, that p_j; and so he has implicated that p_j [Grice 75:50].

While S's implicating that p_j is independent of H's understanding that S has implicated that p_j, this condition expresses the notion that part of what it means for S to implicate p_j is this anticipation of H's ability to 'work out' the implicature. While the importance of this condition has led to some confusion over the point of view from which implicature is defined, note that in fact S need only believe that H can 'work out' the implicatum in order to implicate p_j. In the end, G3 does not require that H actually 'work out' p_j for S to have implicated p_j.

Note however that my revised condition G2, (BMB(S,H, LICENSE(S, H, p_j, u_i, C_k, M_i))) subsumes that 'BEL(S, BEL(H, BEL(S, H can 'work out' that p_j is required for IS_COOP(S, C_k, M_i) given SAY(S, H, u_i C_k))))'. By 'work out' it seems then that what Grice really means is 'come to believe'. Thus, 'BEL(S, BEL(H, BEL(S, H can 'work out'....)))' is equivalent modulo tense to 'BEL(S, BEL(H, BEL(S, BEL(H, LICENSE(S, H, p_j, u_i, C_k, M_i)))))'. But the latter is subsumed by the mutual belief context of the revised condition G2. So, conditions G2 and G3 can be collapsed to a single condition on S and H's mutual beliefs, i.e., my Condition 3.

So far, then, I have proposed three necessary conditions on conversational implicature, one derived from Grice's early work on intention and utterance meaning and two representing revisions of (three) necessary conditions Grice himself has proposed. That is, S may implicate p_j to H by saying u_i in a context C_k when:

1. INTEND(S, CAUSE(SAY(S, H, u_i, C_k), BEL(H,p_j)));
2. BEL(S, BMB(H, S, IS_COOP(S, C_k, {QUALITY,QUANTITY, RELATION,MANNER})));
3. BMB(S, H, LICENSE(S, H, p_j, u_i, C_k, M_i))

That is, S may implicate some p_j by saying p_i to H in some discourse context C_h when: S intends to convey p_j to H by saying that u_i; S believes it is mutually believed between S and H that S is being cooperative; and S believes it is mutually believed between S and H that p_j is somehow 'required' in the circumstance in which the S has said u_i in C_h and that S is obeying the maxims specified in M_t.

However, while Conditions 1-3 do represent necessary conditions for implicature in general, they do not distinguish conversational implicature from other types of implicature. In particular, CONVENTIONAL IMPLICATURE (See Section 2.2.1.) also exhibits the same features. These conditions are also insufficient to exclude entailment from conversational implicature. So, they do not yet provide the definition desired. However, Grice [Grice 75] has also proposed certain additional features of conversational implicature, some of which can be incorporated into a more precise definition of the phenomenon:

G4. a conversational implicatum is CANCELABLE, explicitly or contextually;

G5. a conversational implicatum is NONDETACHABLE;

G6. a conversational implicatum is not part of the conventional force of the expression that gives rise to it;

G7. a conversational implicatum is not carried by what is said but by the saying of it;

G8. a conversational implicatum is often a disjunction of several possible interpretations of an utterance and is often indeterminate.

Grice's conditions G6 and G7, both intended to exclude entailments and conventional implicatures, do so only by fiat and thus exhibit some circularity. As Sadock [Sadock 78:284-285] notes, if it were possible to decide intuitively between the conventional and nonconventional aspects of an utterance, or between what is said and what is licensed by the saying of it, no additional criteria would be necessary. Condition G8 is clearly not a necessary condition even in Grice's original formulation; just as clearly it is not a sufficient condition. Thus the value these last three conditions in a definition of conversational implicature is small. However, conditions G4 and G5 have been adopted as standard diagnostics for conversational implicature. Despite considerable controversy over their status, I will maintain that they do differentiate conversational implicature from other types of utterance meaning.

2.4.2.1. Cancelation

According to Grice, a "putative conversational implicature" p_j can be explicitly CANCELED by the addition of expressions such as *but not* p_j or *I do not mean to imply that* p_j [Grice 78]. That is, the denial of that which is implicated without the denial of that which has been asserted constitutes a successful cancelation, as in 13:

(13) The Adelphi apartment hotel that they were going to tear down and evict me from, *although not in that order*, had been built back in the early twenties about the time that the claw-footed bathtub was beginning to disappear from the American scene.
Oliver Bleeck, *No Questions Asked*, p.16. (My italics)

In this example, the implicit temporal ordering licensed by the use of asymmetric *and* is denied. Note that, in 13, there is no sense that the denial of the implicatum is contradictory or inconsistent with the entailments of the utterance. Since conversational implicatures do not follow logically from the utterances by which they are licensed, the truth of what is said and the truth of what is conversationally implicated by S are independent. So, the latter may be denied without denying the former -- and without licensing a sense of inconsistency or contradiction. That is, if p_i is the semantic representation of an utterance u_i, and u_i licenses the meaning p_j, then p_j is cancelable just in case the conjunction 'p_i and $\neg p_j$', is not contradictory or inconsistent.

Following Gazdar [Gazdar 79a:107], I will define semantic entailment and semantic consistency as follows:

> A sentence p_i is **semantically entailed by** a set of sentences T just in case p_i is true in every possible world in which all members of T are true.

> A sentence p_i is **semantically consistent with** a (consistent) set of sentences T just in case p_i is true in some possible world in which all the members of T are true.

So, ENTAILED(p_i, C_h) will denote that p_i is entailed by the sentences realized by the utterances in (a consistent) C_h. And CONSISTENT(p_i, C_h) will be true iff p_i is consistent with the sentences realized by the utterances comprising C_h. That is, a representation p_i of an utterance is consistent with a context (or set of utterances) C_h just in case the sentence realized by p_i is consistent with the set of sentences realized by the members of C_h. Then the following will be true:

$$\text{ENTAILED}(p_i, C_h) \Rightarrow \text{CONSISTENT}(p_i, C_h)$$

That is, if p_i is true in every World in which the sentences realized by the utterances of C_h are true, it is true in some world. Also:

$$\text{ENTAILED}(p_i, C_h) \Rightarrow \neg\text{CONSISTENT}(\neg p_i, C_h)$$

If p_i is true in every world in which the sentences realized by the utterances of C_h are true, then there is no world in which these sentences and the negation of p_i are true.

Then, as a first attempt at defining cancelability, we might say that (the representation of) a meaning p_j licensed by an utterance u_i is cancelable iff both p_j and its negation are consistent with u_i.

$$\text{CANCELABLE}(u_i, p_j) \leftrightarrow (\text{CAUSE}(\text{SAY}(S, H, u_i, C_h), \text{BEL}(H, p_j)) \wedge \text{CONSISTENT}(p_j, C_i) \wedge \text{CONSISTENT}(\neg p_j, C_i))$$

where C_i is the concatenation of C_h and u_i.

Clearly, if p_i is an entailment of some utterance, it is not cancelable by this definition. Say some utterance u_i realizing p_i entails p_j. Then ENTAILED(p_i, C_i). So, CONSISTENT(p_i, C_i) -- but ¬CONSISTENT($\neg p_j$, C_i) -- by the axioms noted above. So, for any p_i entailed by u_i, ¬CANCELABLE(u_i, p_i). For example, one cannot cancel the self-entailment of (14a), as evidenced by the infelicity of (14b).

(14)
a. George likes apples.
b. #George likes apples, although George does not like apples.[37]

It is less clear whether (15b) should be counted as an entailment of (15a), since the proper semantic representation of this utterance has been the subject of some controversy [Russell 04, Strawson 50]. If not, then by a semantic definition of presupposition,[38] (15a) may be said to presuppose (15b).

(15)
a. The King of France is bald.
b. There is a King of France.
c. #The King of France is bald but there is no King of France.

In either case, the attempted cancelation in (15c) is infelicitous.

If presupposition is defined semantically, then our current definition of cancelation will account for the infelicity of (15c). However, other sorts of meaning clearly cannot be defined in terms of entailment, such as pragmatic presupposition[39] and conventional implicature. For example, (16a), the conventional implicature of (8a) -- which is not entailed by (8a) -- cannot be felicitously canceled, as is attempted in (16b).

(16)
a. His being brave follows from his being an Englishman.
b. #He is an Englishman; he is, therefore, brave, but I don't mean to suggest any connection between the two.

[37] '#' is used throughout to denote pragmatic infelicity.

[38] p_i semantically presupposes p_j iff whenever p_i is true, p_j is true, and whenever $\neg p_i$ is true, p_j is true.

[39] 'My neighbor has hurt herself' is said to pragmatically presuppose that the neighbor is female.

Of course, (14b), (15c), and (16b) are all possible as (self) REPAIRS,[40] where this contradiction is precisely what is intended.

So, while entailments and at least some presuppositions will not be cancelable by the above definition of CANCELABLE, conventional implicatures will be. Not surprisingly, if we define cancelability only in terms of semantic representations -- since we are defining consistency in terms of truth conditions -- meanings not captured semantically will not affect assessments of cancelability. I will return to this problem below.

Unlike other diagnostics discussed below, cancelability is not sensitive to surface order. A canceling clause may follow a putative conversational implicature, as in 13, or precede it, as in 17.

(17) As it turned out there was no connection, but George ate chicken soup and got sick.

Grice also notes that cancelation may be explicit, as in 13 and 17, or contextual. Suppose you have asked me for a five dollar loan, and I hold up a ten dollar bill while uttering '*I have five dollars*'; I will be unlikely to intend to convey '*I do not have more than five dollars*'. In Grice's terms, the putative implicatum '*I do not have five dollars*' will be contextually canceled, even without an explicit canceling utterance.

Note, however, that Grice's account of cancelation suggests that conversational implicature is to be defined more in terms of the form of S's utterance than of his/her intentions. That is, Grice seems to be saying that we can say that S has canceled a conversational implicature p_j if S has (felicitously) asserted $p_i \wedge \neg p_j$ where the assertion of p_i alone *might have* implicated p_j. However, my Condition 1 demands that S intend to convey p_j by saying p_i as a condition on conversational implicature. So, if Grice's identification of cancelation with conversational implicature holds, we are forced to say that, in cases like 17, S has asserted p_i intending to implicate p_j but also intending to cancel that implicature by the utterance of $\neg p_j$. And if S asserts p_i implicating some p_j which is contextually canceled, one must say that S intends to implicate p_j while believing that it will be canceled by the context of utterance. Neither of these explanations seems convincing.

Given these considerations, it seems useful to separate the cancelability test for conversational implicature from the use of cancelation in discourse. The identification of cancelations of conversational implicature in discourse must depend upon speaker intention. Simply because S realizes the conjunction $p_i \wedge \neg p_j$ in an utterance, such that, if S had chosen

[40] Repairs include word recovery, self-editings, error-replacement, and so on.

instead to realize p_i alone in the same context, s/he might have licensed the conversational implicature p_j, one would not say that S has both implicated and canceled p_j. Unless S intends for p_j to be conveyed then p_j has not been implicated. It may be that 17, for example, represents a cancelation of conversational implicature, but only if S intends (for some particular effect) to license an implicature and cancel it in the same utterance.

In fact, the assertion of $\neg p_j$ in cases like 17 seems more naturally interpreted as the BLOCKING of inferences S anticipates H might draw from the assertion of p_i, if perhaps H were to 'work out' some implicature which S has not intended. Since phenomena such as ASYMMETRIC *and* for example, are familiar to conversational participants, S may sometimes anticipate that H will infer a meaning from S's use of constructions or lexical items that can be used to license implicatures. So, S may utter $\neg p_i$ to block this undesired inference. In 18, for example, S blocks the possible inference that he performed no more than two experiments.

(18) I performed two experiments. Well, I <u>performed</u> FOUR, but I'm <u>presenting</u> TWO.

In a sense 18 has the flavor of a repair rather than a cancelation, although there is no sense that S has said something contradictory or inconsistent by the second utterance. Instances of 'cancelation' noted in the literature, then, may more properly be explained as the blocking of inferences H might otherwise be tempted to 'work out' as conversational implicatures.

However, cancelability can still serve as a test for conversational implicature as follows: If we believe that the utterance of some p_i can license p_j and wish to test whether that p_j is licensed via conversational implicature, then the question "Can p_i be felicitously uttered in a context in which p_j is denied or clearly false?" will sufficiently represent what we need from the cancelability test. One can still ask whether the assertion of p_i conversationally implicates p_j by asking (among other things) whether the assertion of $p_i \wedge \neg p_j$ would be felicitous – without specifying that such an artificial construction itself represents an implicature and its cancelation.

Although cancelation has proven the most useful of Grice's tests, Grice and others have noted its weaknesses: First, it is easy to confuse with SUSPENSION, the 'calling into question' of an asserted proposition [Horn 72]. Suspension does not distinguish between conventional and conversational implicature or between conversational implicature and presupposition; even entailment may be suspended by some suitable hedge. Compare the felicitous suspension of that which is presupposed by *only* in (19a) with the infelicitous attempted cancelation in (19b). [41]

[41]*Only* x P(x)' is generally analyzed as presupposing that P(x) and conventionally implicating that there are other y such that it might have been supposed that P(y) while, in fact, ¬P(y).

(19)
a. Only Muriel voted for Humphrey, if even she did.
b. #Only Muriel voted for Humphrey and even she didn't.

While ease of confusion with suspension is no reason to throw out the cancelation test, it does make it less attractive. Especially since the definition of cancelation given above -- and commonly accepted -- is lamentably imprecise, this potential for confusion represents a significant, though perhaps tractable, problem.[42] Much less clear, however, is what can constitute a CONTEXTUAL CANCELATION. Grice appears to mean that conversational implicatures that would be licensed in some contexts will not be in others; that is, the context will 'cancel' the implicature. But since conversational implicature is by definition context-dependent, it seems odd to propose an additional mechanism to explain this definitional criterion.

Second, Grice himself notes [Grice 78] that cancelability does not constitute a sufficient test for conversational implicature. When people speak "loosely", the SENSE of an utterance (what is asserted) may be contextually canceled. For example, he claims that, when looking at a tie in different lights, S may say (20a) without intending that H believe the tie really is changing colors.

(20)
a. It is a light green now.
b. It is a light green now, although of course it hasn't really changed color.

So, part of the conventional force of the utterance is contextually canceled. [Walker 75:159] provides further arguments in this vein. Although one might salvage the cancelability condition by using only explicit cancelability to distinguish conventional from non-conventional, it seems that (20b) is also possible. A more telling counter is to note the ambiguity of the copula here; if interpreted as 'appears' then there is no need to postulate contextual cancelation of its other senses.

[42]It does seem that explicit cancelations exhibit some interesting regularities. For example, Gregory Ward (personal communication) has noted that cancelations seem to require some conventional signaling. For example, (ia) is fine but (ib) is odd.

(i)
(a) Some people left early and *in fact* everyone did.
(b) #Some people left early and everyone did.

However, phrases such as *in fact, actually* and *indeed* are also associated with the suspension of presupposition, so these signals are not unambiguous indications of implicature cancelation [Allwood 72].

The argument that contextual disambiguation may be seen as cancelation -- and thus that cancelability does not provide a useful test for conversational implicature – is made explicit by Sadock [Sadock 78]. He notes that cancelability does not distinguish cases of ambiguity from cases of univocality plus possible conversational implicature. One sense of an ambiguous utterance such as (21a) (which conveys either (21c) or (21d)), can always be denied, 'giving the impression of' a cancelation of one interpretation. So, the denial in (21b) of one interpretation of (21a) -- namely, (21c) -- appears similar to cancelation.

(21)
a. Everyone speaks one language.
b. Everyone speaks one language although no one language is spoken by everyone.
c. One and the same language is spoken by everyone.
d. Everyone speaks at least one language.

Again, though, this objection is much like the contention that cancelation is difficult to distinguish from suspension; if disambiguation is only difficult to distinguish from cancelation, this fact may make cancelability harder to determine, but it does not invalidate cancelation as a diagnostic for conversational implicature. If disambiguation is instead seen as a form of cancelation, then the constraint that conversational implicature be a part of S's intentions (Condition 1) should serve to exclude unintended senses from the realm of conversational implicature. That is, if S does not intend to convey that (21c), then that cannot be deemed a conversational implicature. If S does intend to convey (21c) by uttering (21a) – i.e., if S believes that (21c) -- then (21b) should be seen as contradictory.

Third, a more serious attack on the usefulness of the cancelation test for conversational implicature is Sadock's [Sadock 78:293] claim that cancelability is not even a necessary condition for conversational implicature. He contends that at least one type of conversational implicature, that licensed by the utterance of *almost* p_i, as in 22,

(22) Gertrude almost swam the English Channel.

is "just about uncancelable" -- but nonetheless constitutes a conversational implicature. Contra [Karttunen 75], Sadock proposes that the utterance of *almost* p_i can conversationally implicate 'not p_i' on the following bases[Sadock78,Sadock81]: First he claims that the additional meaning here is easily 'worked out': if S asserts *almost* p_i, s/he may anticipate that H can 'work out' that 'for all a (cooperative) S knows, not p_i', since, if S knows that p_i, it is *misleading* to say *almost* p_i. Sadock must of course maintain that this would be at most *misleading*, not *false*; for, if saying *almost* p_i when p_i is believed true is seen as falsehood, then the understanding 'not p_i' would be part of the conventional force of 'almost p_i'. Second, Sadock cites the high degree

of nondetachability of *almost* p_i.[43] That is, the construction passes the other classic test for conversational implicature. But, Sadock finds that it is almost impossible to cancel the 'not p_i' implicature, as in 23

(23) ??Gertrude not only almost swam the English Channel, in fact she swam it.[44]

So, if utterances like 23 are indeed bizarre, but if *almost* p_i does pass the other test for conversational implicature, then Sadock would maintain that cancelability is not a necessary condition for conversational implicature.

Several responses can be made to Sadock's contention: One might claim that *almost* does license conversational implicatures but that these in fact are cancelable. This contention is supported by the fact that many speakers do find 23 and similar cancelations of *almost* acceptable.[45] For those who do not think 23 felicitous, the next question must be: is the additional meaning licensed by *almost* p_i part of the conventional force of the utterance? If so, then *almost* will not present a counter-example to Grice's cancelability diagnostic for conversational implicature.

The claim that 'almost' licenses conventional implicatures might be supported in several ways: First, if *almost* fails what has been the most reliable diagnostic for conversational implicature, it is difficult to say why the meaning it conveys should be termed conversational implicature. The nondetachability test, itself even harder to apply than cancelability, does not appear to produce such clear results as Sadock believes. For example, if *all but* p_i is included among the various 'ways of saying' *almost* p_i, as seems intuitively justifiable, then, while its utterance does clearly license *not* p_i, this understanding seems to be a conventional implicature of the utterance, apparently licensed in some way by the presence of *but* in the utterance.[46] That is, *all but* p_i *and in fact* p_i appears even more clearly infelicitous than *almost* p_i *and in fact* p_i. Consider (24a) and (24b).
So, at least one of the 'other ways of saying' *almost* p_i, appears to license conventional

[43] See below, Section 2.4.2.2. Briefly, any other way of saying 'almost p_i', such as *just about* p_i or *come close to* p_i*'ing*, may license the same understanding.

[44] Sadock uses '??' to indicate oddness but not complete infelicity.

[45] However, it is not clear that 23 would actually represent a simple cancelation of 22 even if it is felicitous. Placing the potential implicator 22 within the scope of either 'not' or 'only' may well have inhibiting effects on the licensing of implicature. However, speakers do find that a fairer test, ii, is even less acceptable.

(ii) Gertrude almost swam the English Channel, and, in fact, she swam it.

[46] The compositionality of 'all but' is an interesting question for further analysis.

(24)
a. #Mark is all but engaged and in fact he is.
b. (?)Mark is almost engaged and in fact he is.

meanings, not conversational implicature; hence, 'almost' might better be seen as licensing conventional implicatures itself. Finally, Sadock himself notes that utterances such as 22 do not depend for their interpretation on context. Since conversational implicature are just those meanings that arise from the interpretation of an utterance in context, this observation suggests that *almost* does not license conversational implicature.

In summary, Sadock's argument against cancelability as a necessary condition for conversational implicature rests on shaky ground indeed. Better cases can be made both for *almost* licensing conversational implicatures which indeed are cancelable and for *almost* licensing conventional implicatures than for *almost* licensing noncancelable conversational implicatures. In neither case will *almost* represent a counter-example to cancelability as a necessary condition for conversational implicature. Thus, despite Sadock's claim, cancelability does appear to remain a necessary condition for conversational implicature. So, we can augment our Conditions 1 through 3 above with:

Condition 4. p_j is cancelable.

That is, if S saying u_i (which realizes p_i) conversationally implicates p_j, then p_j can be felicitously denied without denying p_i.

Initially, I noted certain problems involved in a formal representation of cancelability. Since, at the moment, we have no way to represent conventional implicatures or pragmatic presuppositions -- or any meaning beyond truth-functional meaning -- it is impossible to exclude such meanings from the set of cancelable meanings without appealing to less 'objective' concepts. For now, we must simply stipulate that FELICITOUS(p_i, C_h) holds whenever the semantic representation p_i of an utterance is felicitous in a context C_h. So, FELICITOUS will represent a weaker condition on p_i and C_h than CONSISTENT. Then we can define cancelability as follows:

Cancelability:
$$\text{CANCELABLE}(u_i, p_j) \leftrightarrow (\text{CAUSE}(\text{SAY}(S, H, u_i, C_h), \text{BEL}(H, p_j)) \wedge \text{REALIZE}(u_i, \neg p_j) \wedge \text{FELICITOUS}(u_j, \{C_h \cup u_i\}))$$

That is, a meaning p_j which is licensed via the utterance of u_i is cancelable iff S may felicitously realize $\neg p_j$ in an utterance u_j in a context in which s/he has uttered u_i.

2.4.2.2. Nondetachability

According to [Grice 75], conversational implicatures other than those arising via the Maxim of Manner cannot be DETACHED from what is asserted (Grice's condition G5): if one assertion of p_i implicates p_j, then 'any other way' of asserting p_i will also implicate p_j. So, when speaker intentions and contexts are held constant, the substitution of utterances with the same conventional force preserves conversational implicature. For example, if S wishes to implicate (25c) in some context C_h, then s/he may choose among at least (25a) and (25b) to accomplish this goal.

(25)
a. Jack bought half a dozen bagels.
b. Jack bought six bagels.
c. $\neg$BEL(S,*Jack bought more than six bagels*)

The same does not hold for conventional implicatures, which are not nondetachable.[47] For example, the utterance of (26a) cannot license the additional meaning communicated by the utterance

(26)
a. He's a New Yorker and I like him.
b. He's a New York but I like him.

of (26b), even though these utterances have the same conventional force. Although nondetachability thus distinguishes between conventional and conversational implicature, it does not distinguish conversational implicature from other aspects of utterance interpretation, such as presupposition and entailment [Grice 78, Sadock 78]. So any way of asserting (27a) -- such as, (27b) -- will presuppose (27c).

(27)
a. He has stopped beating his wife.
b. He no longer beats his wife.
c. He used to beat his wife.

And no way of asserting (28a) -- say, (28b) -- fails to license (28c).

(28)
a. Bill and Harry left.
b. Harry and Bill left.
c. Harry left.

So, nondetachability, like cancelability, may at best represent a necessary condition on conversational implicature. And, of course, for conversational implicatures arising via the

[47] Although it seems simpler to say then that they are DETACHABLE, this simplification has not generally been made in the literature.

Maxim of Manner it is not even this.[48]

Still other limitations of this diagnostic arise from the difficulty of applying it. As [Walker 75, Sadock 78] point out, what it means for some u_i, u_j to represent 'different ways' of asserting p_j is not at all clear. For example, (29a) and (29b) might well be seen as 'saying the same thing'.

(29)
a. I have one leg.
b. I have a single leg.
c. ¬BEL(*S*,I have more than one leg)

However, if, in a given context, the utterance of either (29a) or (29b) licenses (29c), it seems intuitively clearer that (29a) licenses (29c) via conversational implicature than that (29b) licenses (29c) via conversational implicature. Furthermore, (29b) is not cancelable. So, (29a) and (29b) must differ in their conventional force. But at this point, the nondetachability test becomes somewhat circular, unless an independent notion of conventional force can be established.

It seems that what Grice intends by conventional force is that part of utterance meaning which can be captured in a (truth-functional) semantic theory, whatever that theory might be. Then nondetachability can at least be defined with respect to a particular semantic theory for the purpose of applying the diagnostic to particular utterances. So, u_i and u_j might qualify as 'different ways of saying they same thing' just in case their surface forms differ but their 'semantic representations' in this theory are identical (modulo reference resolution). That is, u_i and u_j both realize (the proposition represented by) p_i. So we might define nondetachability as follows:

Nondetachability:

$$\text{NONDETACHABLE}(u_i, p_j) \leftrightarrow$$
$$(\text{REALIZE}(u_i, p_i) \wedge \text{CAUSE}(\text{SAY}(S, H, u_i, C_k), \text{BEL}(H, p_j)) \wedge \forall u_j$$
$$(\text{REALIZE}(u_j, p_i) \Rightarrow \text{CAUSE}(\text{SAY}(S, H, u_j, C_k), \text{BEL}(H, p_j))))$$

Although this solution seems to make the diagnostic feasible, it does not really provide the independent definition of conventional force required. The burden of determining what is conventional and what is not is simply pushed back upon semantic theory. If *single* and *one* have been considered semantically equivalent, then the nondetachability test will predict that (29b) licenses (29c) via conversational implicature; if not, then that meaning will be assigned the status of conventional implicature.

[48] As, for example, the conversational implicatures arising via the Maxim of Manner from the utterances of (5a) and (6a) are not nondetachable.

In addition to this fundamental problem of defining equivalence in conventional force, as Grice himself noted, nondetachability is not necessary for all conversational implicature, since conversational implicatures arising via the Maxim of Manner are detachable. In implicatures such as that which can be licensed via asymmetric *and*, for example, it is a particular way of saying something that licenses the implicature. So, (30a) and (30b) will have the same

(30)
a. Mable got sick and had chicken soup.
b. Mable had chicken soup and got sick.

semantic representation but their utterance may license different implicatures. Of course, since the Maxim of Manner is, like the rest, a very general one, it may be tempting to say of any candidate implicature which fails the nondetachability test that it is somehow derived from this maxim.

[Walker 75, Sadock 78] have also claimed that nondetachability is not a necessary condition even for implicatures arising other than from the Maxim of Manner. They contend 1) that there may be no way other than a 'longer-winded' way to say what is said, which would itself violate the Maxim of Manner; or, 2) that there may be no other way at all to say what is said, so the nondetachability test cannot be applied. Although these contentions do support claims that nondetachability may be of limited utility as a diagnostic, they do not support the claim that it is not a necessary condition: If there is no other way to say what is said, then, trivially, 'any other way ....' will license the same implicature. So, although nondetachability may be of less practical use in identifying conversational implicature than cancelability, it is nonetheless a necessary condition on conversational implicature.

For NONDETACHABLE(u_i, p_j) will be vacuously true if we compute conversational implicatures from the semantic representations of utterances. That is, we have assumed that, if u_i and u_j have the same semantic representation p_i, they will be deemed to have equivalent conventional force. But if we then calculate implicatures p_j from p_i, u_i and u_j must license the same p_j. However, since we not only want to be able to identify conversational implicatures but also to describe properties of these implicatures, then condition 5 should be added to our definition of conversational implicature.

Condition 5. p_j is nondetachable except when it arises via the Maxim of Manner.

That is, if *S* saying u_i (which realizes p_i) licenses p_j, then every u_j that also realize p_i will also license p_j – unless u_i licenses p_j via the Maxim of Manner. Either p_j is nondetachable -- or those maxims involved in LICENSE do not include the Maxim of Manner.

2.4.2.3. Redundancy of Conjunction/Reinforceability

Horn [Horn 72:63] suggests another test for conversational implicature, which is intended o distinguish conversational implicature from presupposition and entailment. He notes that, in ases in which p_i presupposes or entails p_j, it is possible to conjoin p_j to the left of p_i but not to he right. So, (31a), where (31c) is presupposed by (31d), is fine, while (31b) appears odd.

(31)
a. John is a man and he is a bachelor.
b. #John is a bachelor and he is a man.
c. John is a man.
d. John is a bachelor.

Iowever, explicit assertions of conversational implicatures can be felicitously conjoined either o the right or left of the assertion which might otherwise license them, as in (32a) and (32b).

(32)
a. Some people left early but not everybody did.
b. Not everybody left early but some people did.

[Sadock 78]'s notion that conversational implicatures are REINFORCEABLE builds upon Horn's diagnostic. Sadock notes that REINFORCEABILITY also distinguishes conventional from conversational implicature.[49] He proposes that, since conversational implicatures are not part of the conventional force of an utterance, one can make them explicit (by subsequent conjunction as above) without being guilty of REDUNDANCY, as in his example reproduced as 33a). But understandings that are part of that force are

(33)
a. Maggie ate some, but not all, of the cheddar.
b. #It's odd that dogs eat cheese and they do.
c. Dogs eat cheese and it's odd that they do.

not reinforceable without redundacy, as in (33b) where a conventional implicature is reinforced. Of course, (33c) is acceptable. Unlike cancelation, reinforcement occurs frequently in natural liscourse, as in 34.

[49]He finds that cases such as *almost* can be distinguished better by reinforceability than by cancelation. That is, where (he believes) the cancelation test fails for *almost* above (23), reinforcement succeeds, since iii is fine.

(iii) Gertrude almost, but didn't quite, swim the English Channel.

Iowever, if *almost* is not seen as licensing conversational implicatures – but rather conventional ones, this test ecomes suspect. In such a case, it might be that iii carries little sense of 'redundancy' simply because it helps to lisambiguate between two possible interpretations of 22: Gertrude swam part way across the channel and Gertrude bought about swimming the channel but didn't get near the water; iii seems to favor the former reading. But note hat iv seems as acceptable as iii.

(iv) Gertrude almost, but didn't quite, jump off the Golden Gate Bridge.

Thanks to Gregory Ward for this final example.)

(34) "Some *(but not all)* of the points made in sections 1-3 of this paper are implicit or explicit in Montague [1974], especially in PTQ, the paper 'The Proper Treatment of Quantification in Ordinary English'. (Some of the suggestions in 1-3 are also similar to suggestions other papers: Fenstad [1978], Peacocke [1979], e.g.)."
(J. Barwise and R. Cooper, "Generalized quantifiers and natural language", Spring 1980, mss, p.1a. My italics.)

Note that, like cancelation, reinforcement also fails to distinguish conversational implicature from ambiguity, as in the following:

(35) Everyone speaks one language and it is the same language.

However, the same arguments apply then as above (Section 2.4.2.1).

Redundancy of conjunction/reinforceability (which I will term REINFORCEABILITY for convenience) thus appears to be an additional necessary condition on conversational implicature. Although a notion of 'redundancy' for this diagnostic may be even harder to tease out than one of 'contradiction' for cancelability, since our goal is not only to identify conversational implicatures but to describe properties of these implicatures, the fullest possible description of their features is desirable. So, we can add 6 to our conditions on conversational implicature:

Condition 6. p_j is reinforceable.

That is, if S saying u_i (which realizes p_i) licenses p_j, then an utterance of the u_i immediately follow by an utterance of u_j (where u_j realizes p_j) is not redundant.

A definition of reinforceability is made difficult for just the same reasons that cancelation and nondetachability are difficult to formalize: we are working with an inadequate representation of the conventional force of an utterance. So, again we are forced to define a less than objective notion -- this time REDUNDANT(u_i, C_k), denoting that u_i is redundant in the context C_k[50] -- to permit the following definition:

Reinforceability:
$$\text{REINFORCEABLE}(u_i, p_j) \leftrightarrow (\text{CAUSE}(\text{SAY}(S, H, u_i, C_k), \text{BEL}(H, p_j)) \wedge \text{REALIZE}(u_j, p_j) \wedge \neg\text{REDUNDANT}(u_j, \{...u_i\}))$$

[50]Although a satisfactory axiomatization of REDUNDANT must at least await an account of conventional implicature, it seems likely that we might propose a number of conditions under which u_j might be termed redundant, e.g.:

$\text{REDUNDANT}(u_j, \{...,u_i\})$

That is, u_i is redundant in a context in which it has already been uttered – modulo some temporal processing restrictions perhaps. Also, we might say that u_j will be redundant in a context in which a sentence p_i entailing a p_j which u_j realizes has already been realized:

$(\text{ENTAILED}(p_i, \{...,u_i\}) \wedge \text{REALIZE}(u_j, p_j)) \Rightarrow \text{REDUNDANT}(u_j, \{...u_i\})$

2.4.3. Defining Conversational Implicature

I have proposed a revised set of necessary conditions for conversational implicature which not only help to identify particular conversational implicatures but more general classes of conversational implicature. In this section I will claim that these conditions are, collectively, sufficient to define conversational implicature as follows:

Conversational Implicature:
CONVERSATIONAL_IMPLIC(S,H,p_j,u_i,C_k) ↔
1. INTEND(S,CAUSE(SAY(S,H,u_i, C_k),BEL(H,p_j))) ∧
2. BEL(S, BMB(H, S, IS_COOP(S,C_k,{QUALITY,QUANTITY, RELATION,MANNER}))) ∧
3. BMB(S,H,LICENSE(S,H,p_j, u_i,C_k,MAXIMS)) ∧
4. CANCELABLE(u_i,p_j) ∧
5. (NONDETACHABLE(u_i,p_j) ∨ (MANNER ∈ MAXIMS)) ∧
6. REINFORCEABLE(u_i,C_k)

That is, we can define what it means for S conversationally to implicate some p_j to H by saying u_i in a context C_k as follows: S intends to convey p_j to H via u_i; S believes that it is mutually believed between S and H that S is being cooperative -- i.e., obeying the maxims of cooperative conversation; S believes that it is mutually believed between S and H that, given S's u_i in a context C_k, and given S's cooperativity (i.e., obedience to the maxims represented in MAXIMS), p_j 'follows'; p_j is cancelable, nondetachable except when MAXIMS includes the Maxim of Manner; and p_j is reinforceable.

The principal arguments against the proposal that conditions 1 through 6 represent necessary and sufficient conditions for conversational implicature would be Sadock's claims that not all conversational implicature is cancelable; and that even conversational implicatures not derived via the Maxim of Manner may not be nondetachable. Above I have argued against both of these claims, maintaining that Sadock's analysis of *almost* is not convincing enough to warrant abandoning cancelability as a diagnostic for conversational implicature and that Sadock's objections to nondetachability, while well-founded, dispute its practicality rather than its necessity. However, one might also wonder whether, since it has been claimed that diagnostics 4 and 6 fail to distinguish conversational implicature from ambiguous meanings which may be canceled or reinforced, conditions 1 through 6 collectively make this distinction. In fact, as I have argued above, condition 1 at least excludes ambiguous senses from conversational implicature, and a case might also be made that conditions 3 and 5 do so as well. More generally, of those aspects of utterance interpretation that we want to distinguish from conversational implicature via this definition, entailment is ruled out by conditions 4 and 6; presupposition by 4; conventional implicature by 4 through 6; and ambiguous meanings by 1 and (possibly) 3 and 5. While other aspects of utterance interpretation might possibly be defined,[51] while other taxonomies of utterance interpretation might restructure the problem, and while it might be possible to discover other necessary conditions for conversational implicature, for the moment, the conditions stated above represent both the established necessary conditions for conversational implicature and, collectively, sufficient conditions to distinguish conversational implicature from all other aspects of utterance interpretation identified within the Gricean framework.

2.4.4. Inferring Conversational Implicature

Note that, although I have defined conversational implicature from S's point of view in this definition, this definition also makes it possible to identify conditions under which H may infer that some conversational implicature has been implicated. Simply by placing conditions 1 through 3 within H's belief space, we can say what it means for H to be entitled to infer that S has implicated that p_j.

Inferred Conversational Implicature:
BEL(H, CONVERSATIONAL_IMPLIC(S, H, p_j, u_i, C_k)) ↔
1. BEL(H, INTEND(S, CAUSE(SAY(S, H, u_i, C_k), BEL(H,p_j)))) ∧
2. BEL(H, BMB(S, H, IS_COOP(S, C_k, {QUALITY, QUANTITY,RELATION,MANNER}))) ∧
3. BMB(H, S, LICENSE(S, H, p_j, u_i, C_k, MAXIMS)) ∧
4. CANCELABLE(u_i, p_j) ∧
5. (NONDETACHABLE(u_i, p_j) ∨ (MANNER ∈ MAXIMS)) ∧
6. REINFORCEABLE(u_i, p_j)

The notion of what it means for H to believe that S has conversationally implicated p_j is important in that it allows us to specify the circumstances under which S may believe that H has inferred an implicature -- whether or not S intended one; hence, defining conversational implicature in terms of S will not prevent us from reasoning about H's inference of conversational implicature.

Given a definition of conversational implicature and a specification of conditions under which H will believe that S has licensed such implicatures, we would like to use it both to

[51] In particular, one might attempt to define those non-conventional, non-conversational and perhaps 'non-linguistic' implicatures noted in Figure 2-0.

identify and to guide the generation of conversational implicature in computer-human interaction. We would also like to be able to define properties of this class of utterance meanings, so that, ultimately, we will be able to integrate them into a broader notion of utterance meaning.

The usefulness of the formalism provided here is limited by its inclusion of notions such as FELICITOUS, which must for now be stipulated. However, better ways of defining cancelability and reinforceability appear possible if some semantics can be given for conventional implicature. Nonetheless, this definition of conversational implicature does provide a basis on which certain classes of conversational implicature termed GENERALIZED CONVERSATIONAL IMPLICATURES may be defined. In the next chapter I will discuss previous attempts to define classes of generalized implicature based primarily on the assumption of speaker observance of the Maxim of Quantity. These attempts form the basis for the definition of a class of generalized quantity implicature which I will term SCALAR IMPLICATURE.

CHAPTER III
Scalar Implicature

A: What month has 28 days in it?
B: February?
A: Every month has 28 days in it.
Katie Finin

The difficulty of formulating a satisfactory definition of conversational implicature in the abstract has led some to attempt an alternative approach: the definition of classes of conversational implicature which, as classes, can be argued to meet the hard-to-formalize criteria for conversational implicature in general. Such GENERALIZED CONVERSATIONAL IMPLICATURES have been characterized in terms of some specific lexical item or some linguistic construction, like the asymmetric use of conjunction discussed in Chapter 2.

Among such classes, conversational implicatures which involve the Maxim of Quantity have often served as a case in point. Very similar classes of generalized quantity implicature have been described in [Harnish 79], [Horn 72], and [Gazdar 79b, Gazdar 79a, Gazdar 80]. While Harnish and Horn describe the phenomenon from a more intuitive point of view, Gazdar attempts to formalize these intuitions for computational purposes. In this chapter, I will first explore the basis for the current definition of generalized conversational implicature. I will then describe theories of quantity implicature presented by Harnish, Horn, and Gazdar and discuss the strengths and weakness of each; together, these works form the intuitive basis for the class of SCALAR IMPLICATURES which I will subsequently introduce.

3.1. Generalized Conversational Implicature

Within the class of conversational implicatures, Grice differentiates between what is GENERALLY conversationally implicated and what is PARTICULARLY conversationally implicated. Particularized implicatures are exemplified by Grice's classic:

(36) A: I am out of petrol.(= [Grice 75]'s 1)
B: There is a garage round the corner.

In this example, Grice claims B is implicating that, as far as s/he knows, (37a)

(37)
a. The garage is able to provide fuel.
b. There is a garage round the corner but unfortunately it's closed.

holds. For B could not be observing the Maxim of Relation unless his/her mention of the garage were relevant to A's statement. If the garage were closed or out of fuel -- and if B knew this -- then a cooperative B would not mention its location unless s/he blocked the inference (37a), as by asserting (37b). So, either B knows (37a) or s/he does not know whether (37a). Given that B and A can both work this out, B can implicate (37a) by his/her response in 36.

Implicatures such as these Grice terms PARTICULARIZED because the process by which they seem to be worked out appears wholly dependent upon the particulars of a given situation. There seem to him to be no principles which one can abstract from the form of 36 or from the context in which it is uttered that might link (37a) to implicatures licensed by other utterances. GENERALIZED conversational implicatures however, can be analyzed in broader terms. One might, however, counter that a frame or script-based approach might indeed propose similarities between this exchange and one like 38.

(38) A: I'm hungry.
B: There's a restaurant next door.

Indeed, I will propose that the traditional distinction between generalized and particularized implicature is a false one, an artifact of the inventiveness of analysts -- or lack thereof.

3.1.1. Classes of Generalized Implicatures

To date, a number of classes of generalized implicature have been identified -- primarily on the basis of a speaker's use of certain lexical items or certain syntactic constructions. These classes include implicatures characterized by mention of 'ranked verbs' such as *like* and *love*, by use of productive causatives (*cause to X*), and by mention of the natural-language equivalents of the logical quantifiers and connectives. However, it has been difficult to determine how best to define generalized implicature as a class.

3.1.1.1. Asymmetric '*And*'

It has been claimed [Lakoff 71, Schmerling 75] that the concept of ASYMMETRIC *and* described in Chapter 2 identifies a class of generalized conversational implicature. Recall that implicatures such as those licensed via (39a) and (39b) are closely tied to

(39)
a. Maude went to Las Vegas and got rich.
b. Maude got rich and went to Las Vegas.

S's use of conjunction. Note the similarity of these implicatures to each other and to the implicature which might be licensed by the utterance of 40. In each case, *S* may license a temporal/causal inference via the Maxim of Manner.[52]

(40) Harold got bored and went to church.

Like all conversational implicature, these are contextually determined: The utterance of (41a), for example, might convey a temporal ordering between conjuncts, although clearly it need not always license this meaning.

(41)
a. No, Officer, I was sure Ralph hadn't done anything unusual the night of the crime. I checked with his friends and, sure enough, that night *Ralph did his homework and called Nancy*.
b. Ralph never lets his social life interfere with school, and he always sticks to his schedule. For instance, he was really afraid once that Murray was going to ask Ralph's girl Nancy to the Prom. Ralph never asked her out more than a week before, so of course he hadn't got her sewn up for that. Now, you or I would've probably called her the minute we got out of basketball practice. But not our Ralph. Sure enough, that night *Ralph did his homework and called Nancy*.

But it seems more likely that such a temporal implicature is intended by the utterer of (41b). So, these generalized implicatures, while more context-independent than particularized implicatures like that licensed in 36, are still context-dependent.

The relative context-independence of generalized conversational implicatures has led to serious confusion over the distinction between this phenomenon and the conventional force of an utterance. Even Grice [Grice 75:56] describes generalized conversational implicatures as cases in which "the use of a certain form of words in an utterance would normally (in the

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[52]Schmerling [Schmerling 75] suggests that the additional meaning conveyed in such cases is better captured by the notion that the first conjunct has some sort of priority over the second. This priority may be temporal or causal; or, the first conjunct may be a necessary condition for the second, as in v.

(v) I left the door open and the cat got in.(= [Schmerling 75]'s 72)

ABSENCE of special circumstances) carry such-and-such an implicature or type of implicature." From this description Harnish [Harnish 79:353] is led to claim that, when certain lexical items which can license generalized implicatures are uttered, the implicature will hold unless it is explicitly or contextually canceled; others effectively adhere to this view.[53]

Perhaps the claim might be made that the 'default' implicature carried by *and* (or by conjunction) is canceled by the context in (41a). However, under this characterization one would be forced to say that the 'normal' use of *and* is the asymmetric understanding conveyed in (39a), 40, and (41b). In (41a), some unspecified 'special circumstances' contextually cancel this 'normal' temporal/causal understanding. But why asymmetric *and* should be more 'normal' than symmetric *and* is unclear. And how these canceling circumstances may be identified is never discussed by those who assume their existence. Finally, the central role of speaker intention which Grice himself champions elsewhere (See Section 2.4.1.) is impossible to maintain under this account of generalized conversational implicature.

These observations should indicate why I have rejected a representation of conversational implicature in general and scalar implicature in particular in terms of some DEFAULT LOGIC such as Reiter's [Reiter 80]. While such a strategy might be feasible in an engineering sense, there is no principled basis upon which to assign defaults, as the case of asymmetric *and* indicates. In particular, note the difficulty of assigning a 'default interpretation' to mention of the cardinals, as noted in Sections 3.2.1 and 5.1.4.1.

A similar case against current definitions of generalized conversational implicature may be made for those generalized conversational implicatures defined by *S*'s use of conditionals and productive causatives, as well as phenomena such as disjunction, indefinites, quantifiers, verbs of incompletion, and certain related noun or verb pairs which will be discussed in Chapter 5. While 'association with particular lexical items' or 'association with particular constructions' is sufficient to accommodate some of these classes, it will not suffice for all.

3.1.1.2. Conditionals

Gazdar [Gazdar 79a] identifies a class of CLAUSAL QUANTITY IMPLICATURES with implicatures licensed via the utterance of compound or complex sentences which have some constituent s_1 whose affirmation or negation is not entailed or presupposed by the matrix s. For example, in (42a), neither s_1's affirmation nor its negation is entailed or presupposed by s. According to Gazdar, if *S* utters a sentence like (42a) while knowing s_1 to be either true or false,

[53]This tendency is also apparent in the work of Horn [Horn 72] , and Gazdar [Gazdar 79a], discussed below.

(42)

a. $_s[_{s_1}$ [If John is convicted]$_{s_1}$ he will hang]$_s$

b. $_s[_{s_1}$ [Since John has been convicted]$_{s_1}$ he will hang]$_s$

s/he violates the Maxim of Quantity. A more informative but equally brief sentence might be produced which presupposes either s_1 or its negation, perhaps, (42b). So, *H* is entitled to infer that 'for all *S* knows s_1' and 'for all *S* knows $\neg s_1$' are clausal quantity implicatures of (42a). Given that *S* is believed cooperative, then, s/he may implicate 'for all *S* knows {John has been convicted, John has not been convicted}' via (42a).

Following Geis and Zwicky [Geis 71], Horn [Horn 72] claims that conditionals can convey other sorts of generalized implicatures as well. To offer a condition for some p_i to apply is to implicate that only this condition will do; i.e., if *S* says that p_i is a sufficient condition for p_j, then *S* may implicate that p_i is a necessary condition too. So, by saying '*if* p_i *then* p_j', *S* can license the implicature that '*if* $\neg p_i$ *then* $\neg p_j$'.[54] Thus, for Horn, the speaker of (42a) may implicate 43

(43) If John hangs, he will have been convicted.

as well as Gazdar's clausal quantity implicatures.[55]

To characterize clausal quantity implicatures as 'associated with' the lexical items *if...then* is clearly unsatisfactory. Recall that all conversational implicature must be nondetachable (See Section 2.4.2.2.), i.e., any other waying of lexicalizing conditionality must convey the same implicature. Obviously, conditionality may be lexicalized by items other than *if...then* -- as, '*say* p_i *occurs, then* p_j'. Such constructions may also license the belief that *S* can neither affirm nor deny p_i. So, again, it seems wiser to define classes of generalized conversational implicature in terms of phenomena broader than the mention of particular lexical items -- perhaps some semantic regularity.

[54]In effect, this explains the well-known fallacy of denying the antecedent in terms of conversational implicature. See also Prince's suggestion, discussed in Section 5.1.3.

[55]This serves as a nice illustration of the fact that a single utterance -- and, even, a single aspect of that utterance -- may convey multiple implicatures. It should also strengthen the case for the primacy of speaker intention to a definition of conversational implicature, since clearly *S* may say that (42a) without wishing to implicate that 43.

3.1.1.3. Principle of Extra Effort

However, other classes of generalized conversational implicature have been defined in terms of a 'principle of extra effort'; which is difficult to encompass even in the more abstract terms of semantic similarity. As McCawley [McCawley 78] notes, when *S* says (44a) instead of (44b), s/he

(44)
a. The tulip is pale red.
b. The tulip is pink.

expends greater effort than the alternative utterance (here, (44b)) would require. In this case this 'extra effort' manifests itself in an utterance containing more morphemes than the alternative. Here, *S* conveys to *H* that, for some reason, (44b) will not fully convey his/her meaning. In (44a), McCawley believes that *S* conveys that the tulip is some color between pink and red. Similarly, by choosing to utter (45a) instead of (45b), *S*

(45)
a. He caused the sheriff to die.
b. He killed the sheriff.

chooses a syntactically more complex utterance with more lexical/phonological material. The choice of productive causatives (*cause to* p_i) over lexicalized causatives (such as *kill*) may convey that there is something unusual in the causal relationship under discussion; in (45a), it seems unlikely that *he* actually shot the sheriff -- but more likely that *he* brought about the death in some indirect manner.[56]

It seems likely that further study of particularized implicatures may identify new classes of generalized conversational implicature. In fact, the distinction heretofore made between generalized and particularized conversational implicature may turn out merely to have been an artifact of the limited nature of studies of conversational implicature to date. However, whether this distinction survives, it is clear that currently identified generalized conversational implicatures represent more likely candidates for computation than do those now termed particularized. Of these, the classes that rely primarily upon speaker observance of the Maxim of Quantity appear to be the most promising.

[56]See [McCawley 78] for additional arguments in favor of seeing productive causatives as involving more "effort" than lexical causatives.

3.2. Generalized Quantity Implicature

Generalized quantity implicatures rely for their generation and interpretation upon comparisons of the relative 'strength' or 'informativeness' of utterances made with other utterances a cooperative speaker might have made in a given context. Horn's [Horn 72] SCALAR PREDICATION implicatures, Harnish's [Harnish 79] QUANTITY-QUALITY implicatures, and Gazdar's [Gazdar 79a] SCALAR QUANTITY IMPLICATURES all represent attempts to characterize those conversational implicatures which rely for their generation and interpretation on the notion that a cooperative speaker will say as much as s/he truthfully can (and, in Harnish's cases, that is relevant to an exchange). These classes form the basis for my definition of SCALAR IMPLICATURE. In this section I will describe Horn's and Harnish's intuitive identification of their classes of quantity implicature and then introduce the class of scalar implicatures.

3.2.1. Scalar Predication

In a study of the relationship between logical operators -- in particular, negation -- and their natural-language counterparts, Horn [Horn 72] examines those generalized quantity implicatures that can be licensed by *S*'s mention of what Horn terms SCALAR PREDICATES; these predicates include the natural-language counterparts of the logical operators, quantifiers, modals, and connectives, as well as cardinals, ordinals, and numerous miscellaneous modifiers.[57]

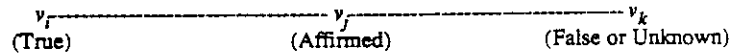
Following Grice's [Grice 65:451] statement that "One should not make a weaker statement rather than a stronger one unless there is a good reason for so doing", Horn defines SCALAR PREDICATION as follows: When a cooperative speaker refers to a value v_j on some SCALE *Sc*, where *Sc* is defined by SEMANTIC ENTAILMENT,[58] that v_j will represent the highest value on *Sc* that *S* can affirm while observing the Maxims of Quantity and Quality. If v_j entails v_i, then v_j can be seen as a HIGHER value on *Sc* than v_i. Then, any v_k that is higher on *Sc* than v_j

[57]Horn's focus is the lexical incorporation of negation. Contending that languages contain only the lexical items they need, Horn proposes that, if the use of some lexical item licenses the implicature p_i, it is unlikely that p_j will itself be lexicalized. [Horn 72:205] For example, if the use of *some* conversationally implicates the negation of stronger predicates on a quantifier scale, such as *all*, then the negation of these stronger predicates, e.g., *not all* need not be lexicalized.

[58]Horn's definition of semantic entailment is identical to Gazdar's one-sided entailment: v_j semantically entails v_i when v_i is true under every assignment of truth values (i.e., in every possible world) under which v_j is true. False values semantically entail nothing for both Horn and Gazdar, lest they be forced to define the invalidities as semantically entailing all sentences.

is implicitly marked (by S's assertion of v_j) as either false or unknown, depending upon the 'distance' between v_k and v_j on Sc.[59] That is, *as far as S knows*, $\neg v_k$. And any v_i on Sc that is lower than (entailed by) v_j will be implicitly marked as true. In sum, for the scale depicted in Figure 3-1, if v_k entails v_j entails v_i, then v_k is a higher value

Figure 3-1: Affirming a Scalar Value



than v_j, and v_i is a lower value than v_j. S's affirmation of v_j will implicate that higher values v_k are either false or unknown and will imply that lower values v_i are true. Implicatures arising via scalar predication, then, are always associated with corresponding implications.

For example, Horn would say that, by uttering (46a), S implicates $\neg$(46b), based upon a

(46)
a. Some of the people left early.
b. All of the people left early.

quantifier scale *some/ all*. That is, in saying (46a), S is saying as much (Maxim of Quantity) as s/he truthfully (Maxim of Quality) can. The 'working out' process may be understood by S and H as follows: When S affirms (46a), H may infer that, with equal brevity, S might have affirmed (46b). Surely, if a cooperative S could have truthfully affirmed (46b) s/he would have, since, by affirming (46b), S would have implicitly affirmed (46a), since (46b) semantically entails (46a). If S is indeed obeying Quantity and Quality, it must be the case that S is unable to affirm higher values in general and *all* in particular -- i.e., that, for S, higher values are either false or unknown. While values between *all* and the mentioned *some* may be marked as unknown, Horn claims that S's failure to affirm *all* forces the inference that that value is known by S to be false, since *all* represents the positive poll of the quantifier scale (See Section 4.2.1.). Hence, by asserting (46a), S implicates KNOW(S, $\neg$(46b)).

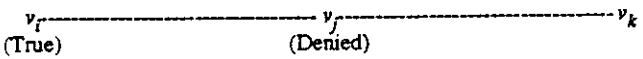
Denying scalar values will also license conversational implicatures. However, for Horn, where S may affirm a scalar value to establish an upper bound on some scale, s/he may deny a scalar value to establish a lower bound. For example, Horn claims that (47a) uttered with 'unmarked' intonation will license (47b).

[59]See Section 4.2.1 for a discussion of Horn's notion of 'distance'.

(47)
a. I don't have three friends.
b. I have fewer than three friends.
c. I have more than three friends.

That is, for the scale illustrated in Figure 3-2, the denial of v_j will implicate that lower values v_i are true.[60]

Figure 3-2: Denying Scalar Values



However, Horn claims that, when (47a) is uttered with stress on *three*, it will license (47c). [Horn 72:70] He is apparently referring to the utterance of (47a) with FALL-RISE intonation.[61] Clearly, simple 'contrastive' stress on *three* does not necessarily produce a lower-bound interpretation (See (48a).), although, such an interpretation is

(48) A: So, you say you don't have two friends to cosign this loan?
a. B: No, I don't have THREE friends.
b. B: Well, I don't have \three/ friends.

clearly possible, as in 49; in this example, B does convey that Gopalan smokes more than three cigarettes a day by stressing *three*.

(49) A: I thought Gopalan said he smokes about three cigarettes a day.
B: It's not THREE cigarettes a day.

However, even with FALL-RISE on *three* ((48b)) one can get an upper or a lower-bound reading. So, contra Horn, intonation does not appear to disambiguate negation of cardinals. Thus, denial of scalar values poses a problem for Horn's theory.

[60]Horn does not predict that speakers may license their ignorance of such lower values by denial, which would complement his discussion of implicatures arising via affirmation. Also note that, since Horn's definition of semantic entailment is one-sided, he cannot predict that the denial of v_j will semantically entail the falsity of v_k -- i.e., that S does not have *four* friends, or *five*. However, this sense certainly seems to be licensed in some way by the utterance.

[61]FALL-RISE is a type of FALLING-RISING intonational contour, describable in Pierrehumbert's [Pierrehumbert 80] system as L*+H' L- H%. It is distinguished from other falling-rising contours in that it is a SCOOPED contour (Cf. Ladd 1980), that is, one in which pitch peak is reached late in the accented syllable (SYL). (In examples below, SYL will be marked as '\SYL/'.) There may be more than one such SYL within the FALL-RISE contour. For each SYL, a relatively abrupt drop in pitch must occur within the following two syllables. In addition, FALL-RISE is characterized by a sentence-final rise in pitch. See [Ward 85a] for a detailed study of this contour and its meaning.

Further problems are presented by the inadequacy of Horn's entailment definition of scale to encompass all the quantity implicatures he finds intuitively similar. Although most of the 'canonical' scales Horn identifies (which include the quantifiers and cardinals, as well as the natural-language counterparts of the logical modals (epistemic and deontic) and connectives, and the ordinals)[62] can be defined in terms of his semantic entailment, he notes that implicatures licensed via adjectival scales such as *cold/ cool/ tepid/ warm/ hot* or *ugly /plain /pretty /beautiful* are difficult to account for. A hot soup may also be a warm soup, but is it also a tepid one? Surely it is not cold. Yet such scales do appear to support some sort of quantity implicature, as when B licenses the inference that he believes in some value less than warm in 50:

(50) A: It's not cool outside.
B: Well, it's not warm.

And Horn notes that other rankings clearly cannot be defined in terms of his semantic entailment, but can also support quantity implicatures. He claims that a scale *tort/ misdemeanor/ felony/ capital crime* which cannot be defined by entailment (if a crime is a felony it is neither a misdemeanor nor a tort) does permit quantity implicature, as in 51, in which utterance of (51a) can implicate 'for all *S* knows ¬(51b)'.[63]

(51)
a. Smoking marijuana is (at least) a misdemeanor in most states.
b. Smoking marijuana is (at least) a felony in most states.
c. #?Smoking marijuana is a misdemeanor and in fact it's a felony in most states.

However, while (51a) indeed appears to this meaning, it is not clear that this meaning is conveyed by conversational implicature. For ¬(51b) (assuming 'at least' is not part of the utterance under consideration) does not appear to be cancelable (See (51c).). So, (51a) may license ¬(51b) by means other than conversational implicature; logical implication from exclusive disjunction of crime types is a plausible way to model this. However, other orderings impossible to define via entailment more clearly convey conversational implicatures, such as the ordering inferrable as salient in 52.

(52) A: Did you get Paul Newman's autograph?
B: I got Joanne Woodward's.

[62]These will be described in Chapter 5.

[63]I believe that '(at least)' in these examples is intended only to identify the sense of the utterance -- not to represent part of it.

3.2.2. Quantity-Quality Implicature

An apparently independent proposal of Harnish's [Harnish 79] considers additional metrics that support implicatures quite similar to those described by Horn. Harnish proposes a submaxim of the maxims of Quantity and Quality as the basis for these implicatures:[64]

Maxim of Quantity-Quality: Make the strongest relevant claim justifiable by your evidence.

He claims that *S* may license quantity-quality implicatures if s/he is assumed by *H* to be observing this maxim and if *S* and *H* can compare the 'strength' of an utterance with the 'strength' of possible alternatives. By committing him/herself to some u_i, *S* can implicate that s/he is not able to commit him/herself to any stronger u_j.

So, in Chomsky's [Chomsky 72] example (illustrated in 53),[65] where Horn might explain the implicature (¬(53b)) licensed by the utterance of (53a) as *S*'s assertion of the highest

(53)
a. One of my five children is in elementary school.
b. Two of my five children are in elementary school.
c. #Two of my five children but not one are in elementary school.

value on a cardinal scale that s/he can truthfully assert, Harnish compares 'strength of claim': If *S* asserts (53a), and if the number of children *S* has in elementary school is RELEVANT in the discourse, the strength of *S*'s claim can be measured by the number of children about which s/he predicates *be-in-elementary-school*. (53b) is a stronger assertion than (53a) because, "in simple quantitative terms", Harnish claims, *two* is 'stronger' than *one*. If *S* were to assert (53a) while believing (53b) to be true, s/he would not be obeying the Maxim of Quantity-Quality. So, if *S* assumes *H* believes him/her to be cooperative, *S* may implicate ¬(53b) by saying (53a). In Horn's terminology, Harnish would presumably say that, not only must scalar values be mentioned, but the scale on which they appear must be relevant.

While, like Horn, Harnish finds that one way to measure strength of claim is via utterance entailment,[66] he proposes numerous other metrics as well. So, the implicature licensed via (53a) may be explained in terms of entailment: Having two children in elementary school

[64]Although it would seem that Harnish's maxim is dependent upon Relation as well, he does not include it.

[65]I have changed the order of the sentences.

[66]His treatment of entailment is less satisfactory than Horn's and Gazdar's one-sided entailment -- and is not, in fact, an actual definition: For Harnish, "if an utterance u_j entails another u_i, then u_j *and* $\neg u_i$ is a contradiction. If u_j entails u_i and u_i does not entail u_j, then u_j may be seen as stronger or more informative than u_i." Invalidities are excluded separately from any semantic entailment relationship.

entails having one child in elementary school -- but having one child in elementary school does not entail having two; so (53b) is a stronger assertion than (53a). However, other quantity-quality implicatures, rely upon different measurements of 'strength of claim'. For example, Harnish notes that the denial of some p_i for a specified time period may license the belief that p_i held for some prior time period. So, the utterance of (54a) can implicate (54b).

(54) a. I haven't played tennis for ten years.
b. I played tennis before (ten years ago).

However, Harnish does not go beyond suggesting numerous additional metrics which appear to license related conversational implicatures. Furthermore, all the metrics he suggests appear to represent linear orderings.

Like Horn, Harnish notes in passing that quantity implicatures may be licensed via denial. For example, he claims that the denial of (55a) (i.e., "Not all of the tables are round.")) can implicate that (55b):

(55) a. All the tables are round.
b. Most of the tables are round.
c. Some of the tables are round.

By Harnish's definition of the relative 'strength' of utterances, the denial of (55b) is stronger than the denial of (55a), since ¬(55b) entails ¬(55a).[67] So, uttering ¬(55a) can implicate ¬(55b), or, (55b). So, Harnish provides a more principled and somewhat neater explanation for implicatures resulting from denial than does Horn. However, Harnish does not explain why ¬(55a) does not convey (55c) instead of (55b). Nor does he consider problems of intonational variation and scope ambiguity.

3.2.3. Defining Classes of Quantity Implicature

As I suggested in Chapter 2, it appears simpler from a computational point of view to identify classes of generalized conversational implicature which, as classes, can be shown to satisfy the definition of conversational implicature presented in that chapter -- and then to test candidate instances for membership in these classes -- than it is to test each candidate instance by a general definition of conversational implicature. For example, if we can define classes of generalized quantity implicature from Horn's and Harnish's descriptions of scalar predication implicatures and quantity-quality implicatures, and if these classes can be shown to satisfy the

[67] Note that this holds only because Harnish's definition of entailment is two-sided -- i.e., if p_i entails p_j then $\neg p_j$ entails $\neg p_i$.

conditions on conversational implicature proposed in Chapter 2, then any identifiable instance of these classes will also represent a conversational implicature and exhibit the features of the more general category.

It is possible to make some headway with such a definition from Horn's and Harnish's characterizations: Although Condition 1 on speaker intention is stronger than anything Horn and Harnish propose, it will apply to scalar predication implicature and quantity-quality implicature as to any conversational implicature. Condition 2 (mutual belief that S is observing the maxims) is also stronger than Horn's and Harnish's specification that S must be presumed cooperative; however, since the latter is itself equivalent to the Gricean condition which 2 subsumes (See Section 2.4.2.), this presents no difficulty. More interestingly, however, is the way that Horn's and Harnish's intuitions provide a basis for specifying circumstances under which Condition 3 (mutual belief that some inference is licensed -- given speaker obedience to certain maxims M_i and utterance of some u_i in a context C_k) may be satisfied.

Condition 3 can be satisfied in Horn's terms for some inference p_j as follows: H's belief in p_j will be licensed when S and H mutually believe that S is obeying the Maxims of Quantity and Quality in affirming some scalar predicate v_i (via an utterance that realizes p_i) when p_j includes a higher value v_j than v_i (but is otherwise identical to p_i). To formalize this, we might, for the moment, make the following simplifying assumptions: Identify v_i and v_j with the semantic representations p_i and p_j of propositions which affirm these values, ranking p_i and p_j indirectly via the ranking of v_i and v_j. So, when v_j is higher on some scale Sc than v_i (i.e., when v_j entails v_i) we will say that p_j is higher than (entails) p_i, or, HIGHER(p_i, p_j, Sc). Then, for Horn's class of scalar predication implicatures, Condition 3 may be satisfied if scalar predication occurs: That is,

Conversational Implicature via Scalar Predication:
(IS_COOP(S, C_k, {QUANTITY,QUALITY}) ∧ SCALAR_PRED(S, H, u_t, p_j))
⇒ LICENSE(S, H, u_t, p_j, C_k, {QUANTITY,QUALITY}).

Then we can define SCALAR_PRED as follows (again, assume universal quantification with widest scope over unquantified variables):

Scalar Predication:
$\exists Sc\ \forall p_j\ \{(\text{REALIZE}(u_t, p_t) \wedge \text{HIGHER}(p_j, p_t, Sc)) \Rightarrow \text{SCALAR\_PRED}(S, H, u_t, \text{KNOW}(S, \neg p_j) \vee \neg\text{KNOW}(S, p_j))\}$

That is, for all speakers, hearers, and utterances, if, for some u_t realizing p_t, there is some Sc ranking p_j higher than p_t, then, for all such p_j, S may license that s/he knows p_j to be false or that s/he does not know p_j to be true -- by saying u_t. Since Horn does not really take context into account at this level, this lack is reflected in the definition of SCALAR_PRED. Note that implicatures licensed via the denial of scalar predicates will require a separate axiom.

Quantity-quality implicatures might be represented similarly: Let σ_i, σ_j, ... range over measurements of strength of utterance which include but need not be limited to those mentioned by Harnish. Let STRONGER(u_j, u_i, σ_i) denote that u_j is stronger than u_i when measured by some metric σ_i; STRONGER might be at least partially defined in terms of Harnish's entailment. Then specify the relevance of σ_i in a context C_i by RELEVANT(σ_i, C_i).[68] Then we can describe sufficient conditions for Condition 3 via Harnish's theory similarly to those defined for Horn's:

Conversational Implicature via Quantity-Quality Implicature:
(IS_COOP(S, C_h, {QUANTITY-QUALITY}) ∧
QUANTITY_QUALITY_IMPLIC(S, H, u_i, p_j, C_h)) ⇒ LICENSE(S, H, u_i, p_j, C_h, {QUANTITY,QUALITY}).

And, like SCALAR_PRED, QUANTITY_QUALITY_IMPLIC can be defined as:

Quantity-Quality Implicature:
$\exists\sigma_i\ \forall u_j$ {(RELEVANT(σ_i, C_h) ∧ REALIZE(u_j, p_j) ∧ STRONGER(u_j, u_i, σ_i)) ⇒
QUANTITY_QUALITY_IMPLIC(S, H, u_i, $\neg p_j$, C_h)}

That is, if u_j is stronger than u_i with respect to some σ_i which is relevant in C_h, and if u_j realizes p_j, then S may license $\neg p_j$ by saying u_i to H in C_h.

Note that the weaknesses of Horn's and Harnish's theories pointed out above are reflected in these axiomatizations of Condition 3, including Horn's lack of incorporation of context or relevance into his specification of how quantity implicature is licensed and Harnish's vagueness about measures of strength and relevance. These issues must be resolved before a successful definition of quantity implicature is possible.

It is difficult to test Horn's and Harnish's classes of implicatures for the remaining conditions identified in Chapter 2 – cancelability, nondetachability, and reinforceability – unless we assume entailment definitions of scale/measure of strength. If so, it seems that these classes, *qua* classes, can be shown either to be cancelable or to represent conventional implicatures as follows: Recall that cancelability rests upon the felicity of the conjunction of some (utterance that realizes) p_i to the denial of a p_j which it might otherwise license; if the implicature $\neg p_j$ is cancelable, then '$p_i \wedge \neg p_j$' – or, '$p_i \wedge p_j$' – is felicitous. So, for some quantity-quality implicature $\neg p_j$ licensed by an utterance u_i, CANCELABLE(u_i, $\neg p_j$) ↔ CAUSE(SAY(S, H, u_i, C_h), BEL(H, $\neg p_j$)) ∧ FELICITOUS(p_j, {C_h ∪ u_i}) (See Section 2.4.2.1.).

[68] Since Harnish nowhere attempts to define his notion of 'relevance', I will employ this simple predicate.

For Harnish's quantity-quality implicatures that are defined by an entailment metric, CAUSE(SAY(S, H, u_i, C_h), BEL(H, $\neg p_j$))) will generally be true.[69] So we must argue the felicity of asserting p_j when (in effect) '$p_j \wedge p_i$' may be felicitously affirmed.

First we will argue that 'p_j and p_i' does not represent a contradiction: For implicatures licensed via an entailment metric, Harnish states that, if u_j entails u_i, then 'u_j and $\neg u_i$' (or, its representation '$p_j \wedge \neg p_i$') represents a contradiction. Furthermore, for these implicatures, he demands that u_j itself not realize a logical invalidity. But, if '$p_j \wedge \neg p_i$' is contradictory, then '$p_j \wedge p_i$' is not.

Of course, even if the utterance of '$p_i \wedge p_j$' is not contradictory, it may nonetheless be infelicitous if '$\neg p_j$' is conveyed via conventional implicature. Recall that, if '$p_i \wedge p_j$' is infelicitous but not contradictory and, if '$\neg p_j$' does not represent a conversational implicature, then '$\neg p_j$' will represent a conventional implicature. So, meanings licensed via entailment are cancelable -- or they represent conventional implicatures. Similarly, Horn's implicatures can be shown to be either cancelable or conventional when scales are defined by entailment.

We could eliminate the second conjunct – conventionality – by showing that these meanings must be nondetachable (Condition 5) – since conventional implicature is not nondetachable. While Harnish does not provide enough information to permit testing this condition, Horn does. So, we can rule out the possibility that implicatures arising via scalar predication are conventional by arguing that they will all be nondetachable: Horn specifies that his scalar predicates are not lexical items but rather semantic concepts. Since, as noted in Section 2.4.2.2, nondetachability may be seen as just semantic identity, it would seem that implicatures conveyed via scalar predication must be nondetachable. So, Conditions 4 (cancelability) and 5 (nondetachability) appear to be satisfied for those implicatures licensed via entailment scales.

Finally, entailment-defined scalar predication implicatures and quantity-quality implicatures can be shown to satisfy Condition 6 (reinforceability) in much the same way they can be shown to satisfy Condition 4: Since, critically, p_j entails that p_i but p_i does not entail that p_j, the affirmation of p_j when p_i has just been affirmed should not be redundant – unless p_j represents a conventional implicature which – at least for Horn's class of implicatures – it cannot. Thus, $p_i \wedge KNOW(S, \neg p_j)$ or $p_i \wedge \neg KNOW(S, p_j)$ should not be (internally) redundant, and implicature arising via entailment-defined scalar predication will be reinforceable.

[69] See Section 5.1 for criticisms of some of the particular implicatures Harnish claims.

In sum, it is possible to define a class of generalized quantity implicature in the terms described in Chapter 2 from Horn's and Harnish's descriptions -- if we assume an entailment definition of scale/measure of strength and if we accept the notion of 'relevant' as primitive. The problems associated with these assumptions, of course, are just those weaknesses of Horn's and Harnish's theories identified above: the need to incorporate a notion of relevance in context and of context itself into the identification of quantity implicatures and the need to identify an adequate way to compare the relative informativeness of utterances.

3.2.4. Summary

Horn's and Harnish's accounts represent independent attempts to define comparative informativeness in the Gricean framework at an intuitive level. While Horn's scalar predication is a simpler and better defined phenomenon -- and also better known -- Harnish's quantity-quality implicature encompasses a broader notion of what appears to be the same class of quantity implicatures. But, although Harnish suggests that a much broader range of relations may license these implicatures than Horn's semantic entailment, neither Harnish nor Horn is able to identify a metric or set of metrics which account for all the implicatures in the class they are defining. Furthermore, all the metrics suggested define linear orderings, when, in fact, implicatures intuitively similar to those they discuss may be supported by other sorts of orderings. Both Horn and Harnish recognize that context will play a role in the licensing of quantity implicatures, but only Harnish suggests how that role might be specified for the class in question: His quantity-quality implicatures will be licensed only when the metric used to compare strength of claim is relevant in the context. However, he does not discuss how such relevance might be determined. Although both scalar predication implicature and quantity-quality implicature suggest ways in which quantity implicature might be defined in terms of the definition of conversational implicature presented in Chapter 2, neither is sufficiently precise or inclusive to permit a comprehensive definition.

3.3. Scalar Implicature

While scalar predication and quantity-quality implicature capture some important generalizations about an intuitively coherent class of quantity implicatures, a study of naturally occurring discourse suggests that Horn's and Harnish's intuitions may be extended to account for a still broader class of implicatures, which I term SCALAR IMPLICATURE. Scalar implicature subsumes those quantity implicatures described by Horn and Harnish, and also includes subclasses which differ from those described by Horn and Harnish in three important ways. First, they rely upon orderings that are not linear, as well as upon metrics other than entailment.

Second, they involve inferences about utterances that reference -- in Horn's terminology -- not only the higher and lower values Horn and Harnish allow, but what I will term ALTERNATE values as well. Roughly speaking, these are values which are neither higher nor lower than one another but which share a common higher or lower value. Third, they arise not only from affirmation or negation of values (as allowed by Horn and Harnish) -- but also from a speaker's commitment to ignorance of some value. In the remainder of this section I will describe the extensions to scalar predication implicature and quantity-quality implicature that define the larger class of scalar implicatures.

To avoid present and future terminological confusion, I will denote the relationships which support scalar implicature (which Horn terms 'scales' and Harnish 'measures of strength of claim') ORDERINGS (represented by O), and will call the measuring principles which define such orderings ORDERING METRICS.[70] Since Horn, Harnish, and Gazdar require these notions only to rank utterances via values contained in them as 'higher' or 'lower' -- or 'stronger' or 'weaker' -- than other utterances, I will specify for now only that O be such that it will support these intuitive distinctions. I will adopt Horn's nomenclature for items ranked by these metrics in such orderings, which I too will call VALUES. Variables σ_i, σ_j ranging over metrics have already been defined, as have variables denoting values. However, I will also introduce new variables O_i, O_j ranging over orderings, which I will define more precisely in Chapter 5.

3.3.1. Additional Measures of Informativeness

Many utterances that appear to license implicatures similar to those identified by Horn and Harnish refer to entities, attributes, events, or states that cannot easily be viewed as values in linear orderings defined by entailment. Such items may be viewed as ordered hierarchically, as by some whole/part, type/subtype, entity/attribute, or set/subset relationship.

For example, in 56, B

(56) A: Did you manage to read that section I gave you?
B: I read the first couple of pages.

mentions a part (*first couple of pages*) of a whole (*section*) to implicate that he has not read the whole. In Horn's terms, he affirms the highest value he can -- but, here, it is a 'value' in a part/whole hierarchy.

57 and 58 illustrate implicatures that may be licensed via recognition of some

[70] In previous work on scalar implicature I have termed such posets 'scales' after Horn and Gazdar. However, confusion over intuitive definitions of scales as linear orderings has convinced me to abandon this terminology.

type/subtype ordering among referenced items: In 57, B's denial of having made a particular type of

(57) A: Have you made fondue in this pot yet?
B: Not chocolate fondue.

fondue conveys that she has made other types of fondue in the pot in question; in fact, as B later explained, A had given her the pot as a wedding gift and she was embarrassed to admit to not having used it before. So, she implicated having previously used the pot.[71] In 58, B licenses the implicature that Leo does not like the other flavor[72]

(58) A: So, Leo likes Bonkers?
B: She likes liver flavor.

of the queried cat treat -- chicken. Note that, even if A does not know that there are several flavors of Bonkers, B's response will convey that other flavors exist. Type/subtype relations such as these may be seen as ordered by entailment from type to subtype, so that subtypes represent higher values in that they entail lower supertypes.

Set/subset relationships and set/member relationships will also license quantity implicatures. In 59

(59) A: Have you gotten the letters yet?
B: I've gotten the letter from X.

B conveys that he has not received all the letters to which A refers – by 'saying as much as he truthfully can' in affirming receipt of the *letter from X*. Set/subset orderings are seen as sets that entail all their subsets.

Finally, exchanges like 60 may rely upon several different metrics

(60) A: Do you have Lana Moro or Bernat yarns?
B: We have Cassino.
A: Do you have Cassino in sweet violet?
B: We have Cassino.

to convey implicit information: In a telephone call to a yarn shop, A asks whether the shop sells two brands of yarn, *Lana Moro* and *Bernat*. The clerk replies with a type of Bernat yarn, *Cassino* – implicating that she does not carry Lana Moro at all and that the only type of Bernat that she carries is Cassino. When A further inquires about a particular color of Cassino, B

[71] In the end, a compulsively honest B finally admitted her misleading implicature to A.

[72] Cats have little choice.

conveys that she does *not* have the desired color.[73] So, in this exchange, A and B have utilized a set/subset ordering (*Lana Moro* and *Bernat* form a set of brands of yarn), another set/member ordering (*Cassino* is a member of the set of Bernat yarns), and a type/subtype or entity/attribute ordering (*sweet violet* is a type of Cassino yarn or it is the value of an attribute of this yarn, namely, its color.) Such entity/attribute orderings may be ordered from attributes to entity, such that an entity entails its (definitional) attributes.

It should be noted that the responses in 56 through 60 are appropriate not simply by virtue of their closeness of match to the topic of the preceding query. It is the asymmetry of the relationship between mentioned values -- or between mentioned values and some salient third value – that is essential to explain scalar implicatures. So, to the linear metrics identified by Harnish and Horn as supporting their quantity implicatures, I will add these hierarchical relationships.

3.3.2. Higher, Lower, or Alternate Values

While Harnish and Horn concentrate on quantity implicatures generated regarding 'higher' value or 'stronger claims', scalar implicatures include inferences licensed about lower values/'weaker claims', and alternate values/claims. In 56, 59, and 60, for example, speakers convey information about higher values by affirming a lower value – i.e., they convey the implicit information that they are unable to affirm a higher value. In 57 and in 61, speakers convey that they are unable

(61) A: Was he cute?
B: He wasn't stunning.

to falsify lower values. In the latter, for example, B licenses the inference that, while he cannot deny *cute*, he cannot affirm *stunning*.

Note that conveying that higher values are false by denying a lower value, as in 62 and 63, does not follow from conversational implicature, but from logical implication. In 62, A and B are discussing who will pay for a trip A will be taking:

(62) A: Maybe she thinks that X should be paying for all of it.
B: She shouldn't be paying for you to go to COLING.

In this exchange, B implies that, since X shouldn't be paying for part of the trip, she shouldn't

[73] Some readers have found this interpretation hard to credit. With FALL-RISE over *Cassino*, A might have interpreted this response as a declaration of ignorance about available colors. But with *Cassino* deaccented, the interpretation presented here was clear. B indeed knew that she had no 'sweet violet'. It seemed that she imagined A might purchase some other color.

be paying for all of it. In 63, similarly, where A inquires about the whereabouts of several cakes, B conveys that she did not eat all of them, since she did not eat the

(63) A: So, did you snarf all the cake down?
B: I didn't eat the chocolate one.

chocolate cake. However, in both cases B also licenses *H*'s belief that she cannot deny unmentioned values, i.e., the rest of the trip and the rest of the cakes. So, as far as B knows *she* should be paying for the rest of the trip (62) and she did eat the rest of the cake (63). Similarly, when speakers convey that lower values are true by affirming a higher value, as in 64 or 65, they convey this meaning too by logical

(64) A: Dan thinks I'm stupid.
B: No, he knows you're stupid.

implication. In 64, B conveys that Dan not only thinks A is stupid -- he knows it. And, in 65, B implies that he'll be

(65) A: So you'll be here all semester?
B: I'll be here all year.

here all semester, since, in fact, he'll be here all year.

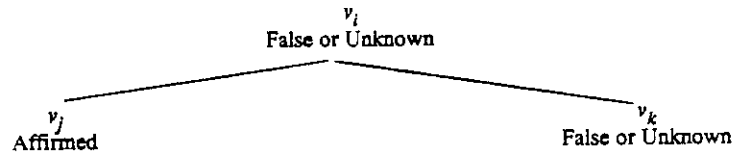
It should be noted that, although scalar implicature does not play a role in the licensing of implications via such utterances, the anticipation of possible scalar implicature does provide an account of a speaker's decision about which utterance to make in such cases: In all the above exchanges, a simple *yes* or *no* would be truthful. Recall the specification in Section 2.4.3 of conditions under which *H* will be entitled to infer that *S* has implicated that p_j. If B says only *yes* in 65, for example, he would (in Horn's terms) be affirming *all semester*; if a temporal ordering is salient in the exchange, as seems reasonable given the query, then A may reasonably be expected to infer that B has implicated that it is not the case that he will be here longer than one semester. That is, A may infer that B has indeed affirmed the highest value he is able to affirm. So, in contemplating making a simple, direct response, B may anticipate that A will infer that B cannot affirm *all year*. So, B may block this inference by providing the indirect response of 65.

Speakers may license implicatures about values that are neither higher nor lower than a queried value, but that share a common subordinate or superordinate. I term these ALTERNATE VALUES; together with the notions of ***higher*** and ***lower*** values, they will be defined more precisely in Chapter 5. In 66, for example, B affirms an

(66) A: So you speak Sephardic?
B: Huh?
A: Do you speak Ladino?
B: I speak Spanish.

alternate to two queried values *Sephardic* and *Ladino*, all from the set of Iberian languages. B implicates that these values are false or unknown by affirming the alternate value, *Spanish*. Figure 3-3 shows implicatures that may be licensed via the affirmation of v_j for higher and alternate values, v_i and v_k:

Figure 3-3: Affirming Alternate Values



In 67, B's denial of *Fundamental Algorithms* licenses the implicature that B is unable to deny the similarly queried *Data Structures*.

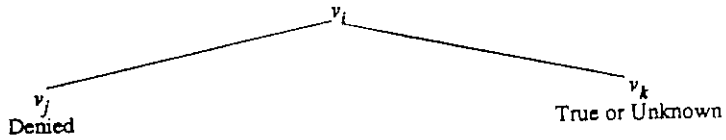
(67) A: Let me just check whether you have all the prerequisites. You have Calc 1 and 2?
B: Uh-hmm.
A: You have Introduction to Programming?
B: Oh, yeah.
A: You have Data Structures, Fundamental Algorithms.
B: No, I don't have Fundamentals.
A: O.K.

So, as far as B knows B has taken Data Structures. Figure 3-4 illustrates the implicatures licensed with regard to alternate values v_k by denying v_j:[74]

In sum, scalar implicatures may be licensed about items intuitively related to a mentioned item as higher/stronger than, lower/weaker than, or alternate to the mentioned item. Additionally, mentioned items may be affirmed or denied to license scalar implicature -- or speakers may license scalar implicature by declaring themselves ignorant of some item.

[74]Note that no scalar implicatures will be licensed with regard to higher values v_i here.

Figure 3-4: Denying Alternate Values



3.3.3. Affirming, Denying, and Declaring Ignorance of Scalar Values

Recall that Horn mentions that quantity implicatures can be licensed by the denial as well as by the affirmation of scalar values; Harnish ranks similar negations in terms of strength of claim. In this section I will propose that scalar implicature may be licensed when speakers declare their ignorance of scalar values -- as well as when they affirm or deny them. First, however, I will propose a hybrid explanation of scalar implicature licensed via denial.

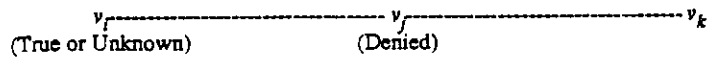
Where Horn explains inferences licensed via denial by postulating that negation of scalar values can set a lower bound, Harnish uses his two-sided definition of entailment to define $\neg p_i$ as stronger than $\neg p_j$ where p_j is stronger than p_i. While this definition is inadequate for non-entailment relations, Harnish's explanation can justify -- by analogy -- the definition of the dual to Horn's notion that cooperative speakers affirm the highest value they truthfully can: Cooperative speakers will deny the lowest value in some salient ordering that they can truthfully deny. By such denials, they affirm or convey their ignorance of lower values. If an ordering v_i/ v_j/ v_k is defined by entailment, then, by denying v_j, S may convey s/he is unable to deny lower values v_i. If a cooperative speaker could deny v_i, then s/he should do so since, by denying an entailed v_i s/he could also deny the entailing v_j. For example, in 68, B denies *getting a mortgage*, a stage in the process of *purchasing a home*, to

(68) A: Did you buy a house?
B: We haven't gotten the mortgage yet.

indicate that earlier stages in this process, such as *making a bid*, are true or unknown. If the latter were false, then, since one cannot attempt to get a mortgage without having made a bid on a house, B might convey this information by denying the lower value *making a bid*. Since B does not deny this lower value, A can 'work out' that, as far as B knows, *making a bid* is true -- or at least not false. So, denying v_j can implicate that S cannot deny a lower value v_i. Figure 3-5 illustrates the implicatures licensed by the denial of a lowest deniable value -- given the

above account.[75]

Figure 3-5: Implicatures Arising Via Denial



Note that, while this account is similar to Horn's (illustrated in Figure 3-2), the two are not identical. Denial of a scalar value will license the scalar implicature that lower values are true or unknown -- not simply true as in Horn's account.

Consider also the following exchange (69) between caller and hospital information clerk:

(69) A: Do you have information on a patient?
B: What's the name?
A: Kathy M. for maternity.
B: I don't think she's delivered yet.
A: Then she HAS been admitted.
B: Yes.

If the *process of having a baby* includes as ordered stages *... / being admitted/ ... / delivering a baby/ ...*, then A's inference that Kathy M. has been admitted can be explained in terms of scalar implicature: B has denied the lowest value (earliest stage) she truthfully can. Therefore, as far as B knows, prior stages are true, and, so, Kathy M. has been admitted.

Speakers may also license scalar implicatures by declaring their ignorance of scalar values, although regularities here are more difficult to determine. It is unclear what the Gricean maxims might predict to be a speaker's obligations regarding assertion of ignorance about scalar values -- beyond the obligation not to feign ignorance. On the one hand, it seems plausible that S assert ignorance about the lowest value in some ordering that s/he is unable to affirm or deny in order to localize the extent of his/her ignorance precisely. For example, in 70 and 71,

(70) A: Is it warm in Antarctica in the summer?
B: I don't know if it gets above freezing.

if the orderings *freezing/ cold/ ... / warm/ ...* and *set of shots cats require* are salient, then, in

[75]Note that no scalar implicatures will be licensed about higher values v_k.

(71) A: So, does Leo need shots this spring?
B: I don't know about rabies.

each case, B may be seen as declaring ignorance of the lowest value s/he truthfully can. In 70, B implicates that, not only is he unaware of whether it is warm in Antarctica in the summer -- but he doesn't even know if it gets above freezing. In 71, B implicates that he is ignorant of only one member of the set of required shots -- rabies -- and intends to convey that he 'knows about' all the other *set of shots she requires*.[76] On the other hand, it seems equally plausible that a cooperative speaker assert ignorance about the most inclusive value s/he is ignorant of. In 72, for example, B chooses to

(72) A: Did they have a boy or a girl?
B: I didn't know they'd had it yet.

mention her more general ignorance of the birth of any baby in response to A's query. In either case, the assertion of ignorance about some value v_j appears to license S's belief that higher values v_k in some salient ordering are false or unknown and that lower values v_i are either true or unknown, as illustrated below:

Figure 3-6: Declaring Ignorance of Higher and Lower Values

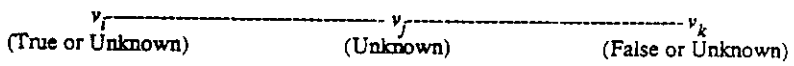
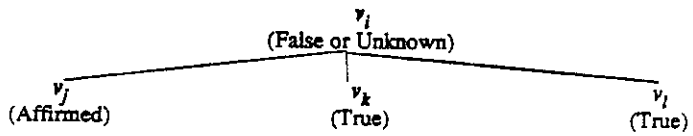


Figure 3-7: Declaring Ignorance of Alternate Values



[76] In fact, B intended to convey his belief that Leo did not need the other shots.

3.3.4. Conventions of Scalar Implicature

The intuitive characterization of scalar implicature presented above can be summarized in a set of conventions, $\text{Imp}_{1\text{-}3}$, which capture the different subclasses of scalar implicatures licensed via affirmation, denial, and declaration of ignorance -- for higher, lower, and alternate values. Given an ordering O that is salient in a context C_i, a value v_j in O, and an utterance u_j affirming, denying, or asserting ignorance of v_j:

- Imp_1: If u_j affirms v_j, then for all v_k such that v_k is higher in O than v_j, S may license the scalar implicature that v_k is false or unknown; and, for all v_l such that v_l and v_j are alternate values in O, S may license the scalar implicature that v_l is false or unknown.
- Imp_2: If u_j is a denial of v_j, then for all v_i such that v_i is lower in O than v_j, S may license the scalar implicature that v_i is true or unknown; and, for all v_l such that v_l and v_j are alternate values in O, S may license the scalar implicature that v_l is true or unknown.
- Imp_3: If u_j is an assertion of ignorance of v_j, then for all v_i on O, such that v_i is lower than v_j, S may license the scalar implicature that v_i is true or unknown; for all v_k on O such that v_k is higher than v_j, S may license the scalar implicature that v_k is false or unknown; and, for all v_l such that v_l and v_j are alternate values in O, S may license the scalar implicature that v_l is true.

Note that, instead of Harnish's notion of 'relevance', I have employed an equally vague notion of 'salience', to denote that which is being attended to. Salience will be defined here as 'that which is most likely to be attended to'. If a scale is salient it is not only *relevant* in a particular context but it is that scale whose relevance a speaker/hearer is most likely to recognize. To license a scalar implicature, I will maintain that S must believe that some ordering is mutually believed salient by S and H, or, $\text{BMB}(S, H, \text{SALIENT}(O, C_h))$. I will discuss the incorporation of 'salience' into the calculation of scalar implicature in detail in Chapter 6.

Following the strategy introduced above in Section 3.2.3, this intuitive characterization of scalar implicature may be used to define a class of quantity implicature in the formalism proposed in Chapter 2 much as Horn's and Harnish's characterizations may. In particular, we can say that

$$(\text{IS\_COOP}(S, C_h, \{\text{QUANTITY,QUALITY}\}) \wedge \text{SCALAR\_IMP}(S, H, u_i, p_j, C_h)) \Rightarrow \text{LICENSE}(S, H, u_i, p_j, C_h, \{\text{QUANTITY, QUALITY}\})$$

Then $\text{Imp}_{1\text{-}3}$ can be axiomatized as follows, where p_i and p_k are identified with the values v_i and v_k they make reference to, and variables are universally quantified as before:[77]

[77] The epistemic force assigned implicatures in the following conventions will be justified in Section 4.2.2.

Imp_1: $\exists O$ {(BMB(S, H, SALIENT(O, C_h)) $\wedge$ REALIZE(u_i, AFFIRM(S, e_i, p_i)) $\wedge$
(HIGHER_SENT(p_i, p_j, O) $\vee$ ALT_SENT(p_i, p_j, O)))
$\Rightarrow$ SCALAR_IMP(S, H, u_i, $\neg$BEL(S, p_j), C_h)}

Imp_2: $\exists O$ (BMB(S, H, SALIENT(O, C_h)) $\wedge$ REALIZE(u_i, DENIAL(S, e_i, p_i)) $\wedge$
(LOWER_SENT(p_i, p_j, O) $\vee$ ALT_SENT(p_i, p_j, O)))
$\Rightarrow$ SCALAR_IMP(S, H, u_i, $\neg$BEL(S, $\neg p_j$), C_h)

Imp_3: $\exists O$ (BMB(S, H, SALIENT(O, C_h)) $\wedge$ REALIZE(u_i, IGN(S, e_i, p_i)))) $\Rightarrow$
((LOWER_SENT(p_j, p_i, O) $\Rightarrow$ SCALAR_IMP(S, H, u_i, $\neg$BEL(S, $\neg p_j$), C_i))
$\vee$
(HIGHER_SENT(p_j, p_i, O) $\Rightarrow$ SCALAR_IMP(S, H, u_i, $\neg$BEL(S, p_j), u_i,
C_i)) $\vee$
(ALT_SENT(p_i, p_j, O) $\Rightarrow$ SCALAR_IMP(S, H, u_i, BEL(S, p_j), C_i))))

For scalar implicature, however, as for scalar predication and quantity-quality implicature, until we can specify the relationship between utterances and scalar values formally, until a satisfactory definition of 'ordering' provides a semantics for HIGHER, LOWER, and ALTERNATE predicates; until SALIENT can be specified in some way; until the meaning of 'affirming', 'denying', and 'declaring ignorance of' values is specified; and until the role of context can be incorporated in these axioms, such a definition will be of limited use.

3.4. Summary

In this chapter I have described the major characterizations of quantity implicature in the literature and have discussed some of their deficiencies. I have also sketched out a new form of quantity implicature which I term SCALAR IMPLICATURE and have described some of the problems that will be involved in its definition.

It should be clear from this discussion that the chief obstacles to a computational treatment of generalized quantity implicature are: the lack of an acceptable measurement of 'strength of claim' or 'quantification of informativeness'; the problem of determing whether a particular ordering is salient in a particular exchange; and the incorporation of context into the calculation of implicatures. In addition to these, certain representational problems must also be considered: In particular, Horn is less than clear and Harnish silent on the question of a speaker's degree of commitment to their quantity implicatures. And neither specifies a formal representation for these implicatures. Both of these problems must be resolved to permit a computational approach to scalar implicature.

In Chapter 4, I will discuss problems of representation and will justify the epistemic force I have associated with scalar implicatures in the presentation of scalar implicature conventions

above; in Chapter 5, I will propose a new way of 'measuring informativeness'; and in Chapter 6, I will discuss how the salience of such a measurement in a discourse context might be assessed.