CHAPTER IV

Representing Scalar Implicature

From a discussion of the local pubs and eccentric things overheard therein on Islay, an island in the Inner Hebrides off the coast of Scotland: "Just two things overheard recently: 'How many tractors have you got now, Angus?' 'I have two -- and another one.'"
New York Times Sunday Travel Section, 10 March 1985

The only serious formal account of conversational implicature in general and of quantity implicature in particular is found in [Gazdar 79a]. In his computational solution to the PROJECTION PROBLEM,[78] Gazdar formalizes Horn's scalar predication as SCALAR QUANTITY IMPLICATURE. Aspects of this formalism can be adapted for the representation of scalar implicature.

In this chapter I will propose a representation for scalar implicature within the more general representation of conversational implicature laid out in Chapter 2 -- based in part upon Gazdar's formalization of Horn. In particular, I will adopt Gazdar's approach to utterance representation and his syntactic approach to the derivation of quantity implicatures. However, contra Horn and Gazdar, I will propose a representation of the epistemic force of scalar implicature which differs critically from representations of scalar predication and scalar quantity implicature. Since I will propose a new definition of the orderings that support scalar implicature in Chapter 5, I will continue to use 'ordering' where Gazdar employs 'scale' and to substitute *O* for Gazdar's variables denoting scales except where discussing Gazdar's work on scales in particular.

[78]The problem of how the various meanings licensed by the conjuncts of conjoined sentences are inherited by the conjunction.

4.1. Representing Quantity Implicature

Gazdar describes a method of calculating utterance meanings by defining functions which, for any utterance, will produce sets of entailments, potential presuppositions, and potential implicatures which the speaker of that utterance might license.[79] The actual meanings an utterance licenses are then calculated by incrementing the current context first with the current utterance's entailments and then with its potential meanings (in a particular but not explicitly motivated order). Meanings that cannot be added without making the context inconsistent are deemed to have been canceled by the context.

To demonstrate his general scheme, Gazdar chooses Horn's notion of scalar predication as one example of the conversational implicatures he will calculate; he terms Horn's phenomenon SCALAR QUANTITY IMPLICATURE. However, in adapting scalar predication for computational purposes, he is forced to make certain simplifying assumptions about the phenomenon. In particular, he implicitly adopts Horn's initial entailment definition of scale (which, as we have seen in Chapter 3, Horn himself recognizes to be inadequate), although he claims to have abandoned any 'semantic' definition of scale in favor of assuming that scales are 'given' [Gazdar 79a:58].

4.1.1. Representing Scale

To support the computation of scalar quantity implicature, Gazdar must formulate a more precise account of scales and values on them. His first task in this enterprise is to formalize Horn's notion of scale. After unsuccessful attempts to define a more satisfactory means of ranking utterances,[80] Gazdar in effect adopts Horn's entailment definition of scale -- augmented only by the constraint that scales be formed from values drawn from a single domain. So, for $n>1$, an n-tuple of EXPRESSIONS[81] $<e_1, e_2, \ldots, e_n> = Sc$ is a quantitative scale for Gazdar iff each member of *Sc* has the same DOMAIN OF SORTAL APPLICABILITY[82] as every other member, and e_i, e_j are ranked by entailment.[83] Gazdar does not suggest how these scales may be derived or

[79]Gazdar initially termed potential presuppositions *pre-suppositions* and potential implicatures *im-plicatures* to distinguish them from actual presuppositions and implicatures.

[80]See Chapter 5 for a fuller discussion of Gazdar's attempts at rankion.

[81]See Section 4.1.2.2.

[82]Two expressions have the same domain of sortal applicability if they are subject to the same set of selection restrictions [Thomason 72].

[83]Gazdar curiously defines scales from stronger to weaker, e.g., all/ some.

how they may be identified from utterances. In effect, he is forced to assume that they are just 'given to us'. Below, I will substitute $<e_i,e_j,\ldots,e_n> = O$ for Gazdar's scales.

4.1.2. Representing Utterances

Gazdar argues convincingly that conversational implicatures should be calculated from an utterance's semantic representation. Reading implicatures from lexical items in surface structure is inappropriate from both a theoretical and a practical point of view, since to do so equates conversational implicature with conventional meaning -- as I discussed in Chapter 2. Particularly when we extend quantity implicature beyond Horn's canonical orderings, this approach is inappropriate for the derivation of quantity implicatures, since values in such orderings are conceptual rather than lexical. In addition, even if it were possible to anticipate all the lexical items that might be employed to license scalar implicature, such anticipation would require redundat listing of synonyms for lexical items referencing a common value. So, the scalar implicature licensed in (73a), that

(73) A: I think you would have to get it from the instructor for the course...
B: For which course?
a. A: Possibly from both courses.
b. A: Maybe from both courses.

'for all A knows not *certainly from both courses*' might also be licensed via the response in (73b). Reading implicatures from lexical items would involve a distinct analysis for (73a) and (73b), failing to capture the obvious generalization.

Also, Gazdar demonstrates that implicatures cannot just be read directly from the concept or proposition realized by an utterance -- i.e., from the utterance's semantic interpretation. Different utterances may realize the same proposition (have the same truth-conditions) but convey quite different implicatures, as we saw examples of asymmetric *and* in Section 3.1.1.1. Given that conversational implicatures are nondetachable (Condition 5 from Chapter 2), it may not be immediately clear how conversational implicatures that do not rely for their interpretation upon *S*'s observance of the Maxim of Manner will present this possibility. Since 'any other way' of saying u_i must also license p_j -- if p_j is a conversational implicature licensed by the saying of u_i -- how can it be, as Gazdar claims, that "many different sentences can express a given proposition and many of these will not contain the scalar item and thus not carry the im-plicature" [Gazdar 79a:56]? However, it is clear that a general representation of conversational implicature must accommodate conversational implicatures that rely upon the Maxim of Manner for their interpretation. So, Gazdar's general point seems well-taken even if his specific claim about scalar quantity implicature is unclear.

4.1.2.1. Sentences

Gazdar defines a level of representation intermediate between surface form and semantic interpretation, which he terms a SENTENCE, or, "any member of the set of proposition-denoting wffs defined by the formation rules of the language employed for semantic representation." At this level, expressions such as {*perhaps, maybe, possibly*} all referring to a single value in an ordering of epistemic modals (See Section 5.1.2.) will each be represented by the same item. Although Gazdar does not specify a particular semantic representation -- in fact, for illustrative purposes he simply employs English sentences -- he does note that it should be 'surfacey' enough to capture the surface order of conjunction, for example. So, while 'logically equivalent' statements will have the same semantic interpretation, they need not not have the same semantic representation.

For the semantic representations of utterances licensing scalar implicatures, I will employ wffs of the representation introduced in Chapter 2. Since the calculation of scalar implicatures does not seem to require access to surface form, these wffs will simply be taken as Gazdar's sentences. If this work were to be extended to other types of generalized conversational implicature, of course, this equivalence would not be appropriate.

4.1.2.2. Expressions

These sentences may be ranked with regard to one another via values associated with 'subparts', or EXPRESSIONS, of sentences, which Gazdar does not further define. Sample expressions are '*possible*' in the sentence '*possible(exists(x)(person(x) and left(x,early)))*', as well as '*exists*', '*exists(x)*', '*person(x)*', and '*early*'. The variables e_i, e_j range over such expressions.

Since Gazdar does not constrain expressions except that they be subparts of sentences, presumably, any substring of a sentence may form an expression -- e.g., '*exists(x)(person*' or even ')'. Clearly, not every substring will correspond to a value -- although every value must be representable by some expression. Gazdar is not concerned with the problem of constraining the set of legal expressions, since, for him, orderings are simply given, apparently as lists of expressions, which, in turn, may simply be identified in semantic representations. However, once we extend scalar quantity implicature to scalar implicature, and allow for rankings among utterances that are not simply given, the problem of identifying the class of expressions which may denote values in an ordering becomes important. Given the representation described in Chapter 2, I will define a subexpression of a sentence p_i as any constant, predicate, logical operator (including the epistemic operators), connective, or quantifier symbol of p_i, or any wff that is a subformula of p_i.

In summary, the approach Gazdar takes to the derivation of implicatures in general and quantity implicatures in particular -- and the approach I will adopt for scalar implicature -- is a syntactic one. By manipulating the semantic representation of (a proposition realized by) an utterance, we can derive the semantic representations of propositions which may be licensed by that utterance -- i.e., the semantic representations of conversational implicatures. The semantic representations p_j of possible scalar implicatures licensed by some utterance u_i with semantic representation p_i, can be calculated by substituting for some expression e_i in p_i values e_j which appear in a common ordering O. p_i and p_j can then be ranked indirectly, via the ranking of their subexpressions in O.

4.1.3. Ranking Utterances

With a representation of scale (ordering) and the concepts of sentence and expression, Gazdar proceeds to describe how utterances may be ranked via the expressions in their semantic representations. To do this, he defines the notion of EXPRESSION ALTERNATIVE as follows:

> Sentences p_i and p_j are **expression alternatives** with respect to e_i and e_j iff p_i is identical to p_j except that in ONE place where p_i has e_i, p_j has e_j.

This definition formalizes Horn's and Harnish's notion of utterance comparison. I will adopt the predicate EXP_ALT(p_i, p_j, e_i, e_j) to denote that p_i and p_j are expression alternatives with respect to e_i and e_j.

Next, Gazdar defines a notion of sentence SIMPLICITY:

> A sentence p_i is **simple** with respect to an occurrence of a component expression e_i iff p_i contains no logical functors having wider scope than e_i.

This definition is intended to allow Gazdar to avoid what he claims is a serious flaw in Horn's theory: failure to allow for the effect of logical functors (among which Gazdar includes negation, quantifiers, connectives, and modal operators) with scope over scalar values on predicted implicatures.

Gazdar notes that, by Horn's definition of scalar predication[84], the utterance of (74a) could implicate that (74b).

(74)
a. It is not the case that Paul ate some of the eggs.
b. Paul ate all of the eggs.
c. Paul ate a few of the eggs.

[84]Actually, one of several. This particular definition is reproduced on page 75.

Gazdar claims Horn fails to recognize that, when such logical functors as 'not' have scope over mentioned values like 'some', quantity implicatures will not be licensed. That is, utterances such as (74a) (which are not 'simple' with respect to some scalar under consideration) should be excluded from among those which may license scalar quantity implicatures. However, while it is clear that (74a) will not license (74b), it is not clear that Horn's intuitive description of scalar predication would predict that it should. That is, Horn's claim that the denial of values will set a lower bound for implicatures appears to cover just this point. With this interpretation, the utterance of (74a) should convey (for Horn) that lower values are true, as, (74c).

And Gazdar's contention that other 'logical functors' such as modals, quantifiers, and connectives will block quantity implicatures does not appear well-founded. For example, it does seem that the utterance of (75a) licenses ¬(75b), that (75c) licenses ¬(75d), and

(75)
a. It is possible that Paul ate some of the eggs.
b. It is possible that Paul ate all of the eggs.
c. Paul ate some of the eggs or Paul is a liar.
d. Paul ate all of the eggs or Paul is a liar.
e. Some people think Paul ate some of the eggs.
f. Some people think Paul ate all of the eggs.

that (75e) can license ¬(75f).

So, Gazdar's 'set of logical functors' should be confined to negation alone -- and he should account for scalar quantity implicatures that will be licensed for sentences that are not 'simple' as defined above. I will redefine sentence simplicity then as:

> A sentence p_i is **simple with respect to an occurrence of a component expression** e_i iff p_i contains no instances of negation with wider scope than e_i.

Note that p_i may still include the negation operator and be simple with respect to some e_i so long as e_i is not within the scope of this negation.

Assuming the predicate SIMPLE(p_i, e_i) to stand for 'p_i is simple with respect to e_i', then SIMPLE EXPRESSION ALTERNATIVES can be defined as follows:

$$\text{SIMPLE\_EXP\_ALT}(p_i, p_j, e_i, e_j) \leftrightarrow \text{SIMPLE}(p_i, e_i) \wedge \text{SIMPLE}(p_j, e_j) \wedge \text{EXP\_ALT}(p_i, p_j, e_i, e_j)$$

With these definitions, we can specify how expressions may be ranked via values and how they in turn may be used to rank sentences.

- For O a quantitative ordering such that $O = \langle e_1, e_2, \ldots, e_n \rangle$ where $n>1$ (i.e., a linear ordering as for Horn, Harnish, and Gazdar) ∧ SIMPLE_EXP_ALT(p_i, p_j, e_i, e_j):
  - p_i is lower (or weaker) than p_j with respect to O;
  - p_j is higher (or stronger) than p_i with respect to O;

- For O a quantitative ordering such that e_i and e_j are alternate values in O (as described in Section 3.3.2) $\wedge$ SIMPLE_EXP_ALT(p_i, p_j, e_i, e_j):
  p_i and p_j are alternate sentences with respect to O.

Notions of higher/stronger, lower/weaker, and alternate will for now be understood as described in Section 3.3.2. So, for any quantitative ordering, if some expression precedes another in that ordering, then a sentence containing the first expression will be ranked lower (less informative) than a sentence containing the second, so long as there is no negation in the sentences external to the expressions in question. Similarly, the notion of a sentence being ranked higher, or more informative than another can be explained via the corresponding ranking of component expressions. Lastly, the notion of a value being alternate to another value can define a similar notion of sentence alternates. These definitions are captured in the following predicates:

Higher Sentences:
$\exists O$HIGHER_SENT(p_i, p_j, O) $\leftrightarrow \exists e_i \exists e_j$ (HIGHER(e_i, e_j, O) $\wedge$
SIMPLE_EXP_ALT(p_i, p_j, e_i, e_j))

Lower Sentences:
$\exists O$LOWER_SENT(p_i, p_j, O) $\leftrightarrow \exists e_i \exists e_j$ (LOWER(e_i, e_j, O) $\wedge$
SIMPLE_EXP_ALT(p_i, p_j, e_i, e_j))

Alternate Sentences:
$\exists O$ALT_SENT(p_i, p_j, O) $\leftrightarrow \exists e_i \exists e_j$ (ALTERNATE(e_i, e_j, O) $\wedge$
SIMPLE_EXP_ALT(p_i, p_j, e_i, e_j))

4.1.4. Speaker Commitment

Finally, in view of the characterization of the different types of utterances licensing scalar implicatures which I have made in Section 3.3.3, I will now propose yet another distinction among (declarative) sentences. First, assume that every utterance can be represented as S's commitment to belief in some proposition or to lack of such belief; this restriction is necessary to represent declaration of ignorance and will be justified on theoretical grounds below in Section 4.2.3. Then

- a sentence p_i represents a DENIAL of a subexpression e_i iff p_i is of the form BEL(S,$\neg p_j$) where p_j is simple with respect to e_i;
- p_i represents an ASSERTION OF IGNORANCE of a subexpression e_i iff p_i is of the form $\neg$BEL(S, p_j), and p_j is simple with respect to e_i; and,
- p_i represents an AFFIRMATION of a subexpression e_i iff p_i is of the form BEL(S, p_j) and p_j is simple with respect to e_i.

These definitions can be represented as follows:

Denying a Value:
DENIAL(S,e_i, p_i) $\leftrightarrow$ (p_i = BEL(S, $\neg p_j$) $\wedge$ SIMPLE(p_j, e_i))

Declaring Ignorance of a Value:
IGN(S, e_i, p_i) $\leftrightarrow$ (p_i = $\neg$BEL(S, p_j) $\wedge$ $\neg$BEL(S, $\neg p_j$) $\wedge$ SIMPLE(p_j, e_i))

Affirming a Value:
AFFIRM(S, e_i, p_i) $\leftrightarrow$ (p_i = BEL(S, p_j) $\wedge$ SIMPLE(p_j, e_i))

4.1.5. Summary

Gazdar's formal treatment of scalar quantity implicature thus provides the basis for a formal account of scalar implicature. An utterance u_i can be identified by its semantic representation p_i. A component expression e_i of p_i can be associated with a value v_i in some ordering O to permit the ranking of p_i vis a vis other p_j which are expression alternatives to p_i via some e_j associated with a higher, lower, or alternate value in O. A revised definition of Gazdar's sentence simplicity can be used to specify whether p_i constitutes an affirmation, denial, or assertion of ignorance with respect to e_i.

With these definitions, we are close to a satisfactory representation of scalar implicature. However, the epistemic force of these implicatures must first be determined.

4.2. Epistemic Force

There is no agreement in the literature as to the epistemic force – the appropriate characterization of speaker knowledge or belief – which should characterize conversational implicature in general or quantity implicature in particular. For quantity implicature, Harnish in effect ignores the question, while Horn is inconsistent and unconvincing. Neither Gazdar nor his critics, in their simplifying proposals, come up with an intuitively satisfying solution.

4.2.1. Horn's 'Distance from Pole'

Initially, Horn glosses S's implicit commitment to an implicature p_i licensed via scalar predication as 'for all S knows p_i' or 'it is consistent with what S knows that p_i', following Hintikka's explanation of his possibility operator, P [Hintikka 62]. Part way through the thesis, however, Horn declares that a quantity implicature's epistemic force can be determined by measuring the 'distance' of the value involved from the positive pole on its scale. Horn's formalism runs as follows, where S^b_a denotes the substitution of b for all occurrences of a in S:

> ... given a quantitative ordering of n elements $p_1, p_2, \ldots, p_n$ and a speaker uttering a statement S which contains an element p_i on this scale, then
> (i) the listener can infer $\neg S^{p_j}_{p_i}$ for all p_j, p_i ($j \leq n$)
> (ii) the listener must infer $\neg S^{p}_{p_i}$

(iii) if $p_k > p_j > p_i$, then $\neg S^{p_j}_{p_i} \Rightarrow \neg S^{p_k}_{p_i} \ldots$ [Horn 72:90]

That is, when S affirms p_i, H must infer that S's highest value p_n is false; s/he may infer that intermediate values between p_i and p_n are false.[85] So, for Horn, (presumably in the absence of cancelation or blocking), the assertion of p_i forces the implicature that p_n is false but only invites the inference that values higher than p_i but lower than p_n are false. In these terms, then, Horn would claim that the assertion of (76a) would force the inference ¬(76d) but would only invite the inferences ¬(76b) and ¬(76c).

(76)
a. Some of the people left early.
b. Many of the people left early.
c. Most of the people left early.
d. All of the people left early.

Thus, for Horn, it is the structure of the ordering itself that determines the epistemic force of implicature.

Horn provides little by way of motivation for this claim. Its obvious flaw is essentially the issue discussed in Section 3.1: While generalized implicatures may be associated with particular lexical items or linguistic constructions, these phenomena are not sufficient conditions for conversational implicature. Context and speaker intention play critical roles. If we interpret Horn's account simply as characterizing the meanings speakers may license via conversational implicature, rather than as defining conversational implicature in terms of hearer interpretation, the role of speaker intention in conversational implicature which I view as primary emerges unscathed. However, Horn's account cannot be squared with the equally important contextual dependence of conversational implicature.

In (77a) and (77b), for example,

(77)
a. A: Are all mushrooms poisonous?
b. A: Are many mushrooms poisonous?
B: Some are.

it seems odd to say that B necessarily implicates KNOW(B, ¬all mushrooms are poisonous) – in all contexts – and may at the same time convey ¬KNOW(B, many mushrooms are poisonous). If B knows little about mushrooms, s/he will be equally uncertain about whether *many* or *all* mushrooms are poisonous, so the asymmetry of implicature appears odd here. Alternatively, if B knows a great deal about mushrooms, s/he may implicate KNOW(B, ¬*many mushrooms are poisonous*) in response to (76b) and KNOW(B, ¬*all mushrooms are poisonous*)

[85] In fact, as Gazdar notes, Horn fails to specify an additional condition, $i<j$, but this is clearly intended.

in response to (77a) as well. It seems more reasonable to say that the epistemic force of the implicature B licenses is a function of B's domain knowledge, rather than of the structure of the ordering evoked.

In addition, since it is difficult to identify endpoints of orderings in general, assigning epistemic force via distance from positive pole will be impossible in many cases. For example, does (78a) force the inference ¬(78b), or does it instead force the inference ¬(78c) and only invite the inference ¬(78b)?

(78)
a. The soup is warm.
b. The soup is hot.
c. The soup is very hot.

Finally, Horn does not explain why, throughout his thesis, he defines implicatures in terms of speaker knowledge rather than speaker belief.

4.2.2. The Epistemic Force of Scalar Quantity Implicatures

Gazdar's view of Grice's Maxim of Quality simplifies that injunction to "Say only that which you know." [Gazdar 79a:45-47] So, for Gazdar, the utterance of p_i by S implicates KNOW(S, p_i). Rejecting the complexities of a logic of belief, Gazdar argues that, whether or not S has knowledge of p_i – i.e., whether or not p_i represents S's true belief – by asserting p_i, S commits him/herself to knowledge of p_i. The important point for Gazdar is not whether S actually knows that p_i (i.e., that S believes that p_i and that in fact p_i holds) – but that, by realizing p_i in an utterance, S has committed him/herself to knowing that p_i. In support, he cites Sacks' [Sacks68] argument that the following exchange is odd:

(79) A: She KNOWS you're crazy.
B: No, she THINKS I'm crazy. She happens to be right.

That is, speakers will be credited with knowledge whenever propositions they espouse are correct, whether or not they are aware of the truth of their beliefs. However, since I have argued that conversational implicature is defined from a speaker's point of view – not from the inferences his/her hearer may draw – this argument is only applicable in the sense that speakers might anticipate such inferences in making their implicatures. Furthermore, the possibility of cancelation indicates that propositions conveyed via conversational implicature should not in fact be accorded the same epistemic status in the discourse as those conveyed via assertion, so argument by analogy from assertion is not compelling. Furthermore, as we will see below, even those (like Gazdar and Soames) who represent implicatures as commitments to knowledge often describe implicatures as commitments to belief. For these reasons, it seems preferable to claim a weaker sort of speaker commitment for conversational implicature in general and scalar implicature in particular, a commitment to belief in and not knowledge of propositions.

Employing Hintikka's [Hintikka 62] epistemic logic, Gazdar identifies scalar quantity implicatures licensed by an utterance with the semantic representation p_i as $K_S(\neg p_i)$, or KNOW(S, $\neg p_j$) in my notation.[86] Thus, Gazdar simplifies Horn's two-tiered notion the epistemic force of quantity implicature.[87] All scalar quantity implicatures will exhibit the same epistemic force -- speaker commitment to knowledge of the falsity of some proposition. So, for Gazdar, affirming v_i marks higher values v_j as known to be false.

While Horn's distinction between invited and forced implicatures is untenable, Gazdar's simplification seems unwarranted. Contra Gazdar, Soames [Soames 82] argues that it is much too strong to claim that a speaker who affirms a lower value knows higher values to be false. He suggests that higher values are marked as false only when S can be expected to know their truth-value -- otherwise they are marked as unknown. Using Hintikka's P operator,[88] Soames proposes that sentences p_j referring to higher values v_j may be implicitly marked either as $K_S\neg(p_j)$ or as $P_S(p_j)$ by the utterance of p_i -- depending on H's belief about S's knowledge. Note here that it seems likely that Soames is implicitly employing belief rather than knowledge to identify implicatures -- although, for Soames, it is hearer belief that defines the epistemic force of implicatures.

Soames' criticism seems well taken. Given Gazdar's account, in fact, a speaker asserting v_i but ignorant of v_j would have to make that ignorance explicit (e.g., (80a)) lest s/he risk falsely implicating a knowledge s/he lacks (e.g., ¬(80b)).

---

86 Hintikka's knowledge operator is glossed as *S knows that* p_i.

87 More precisely, Gazdar defines a function f_s which, given a sentence ψ, returns a set of POTENTIAL scalar quantity implicatures as its value:

$$f_s(\psi) = \{\chi : \chi = K\neg\phi_{\alpha_i}\} \text{ for all } \phi_{\alpha_i} \text{ such that for some quantitative scale } Q,\ \alpha_i, \alpha_{i+1} \in Q$$

(i) $\psi = X\ \phi_{\alpha_{i+1}}\ Y$ where X and Y are any expressions, possibly null

(ii) $[\psi] \subseteq [\phi_{\alpha_{i+1}}]$ where ϕ_{α_i} and $\phi_{\alpha_{i+1}}$ are simple expression alternatives with respect to α_i and α_{i+1}

That is, the utterance of some u_i with the semantic representation ψ scalar quantity implicates that S knows it is not the case that ϕ iff there is some sentence ϕ' which

- is just like ϕ except that it contains a weaker scalar expression
- is entailed by ψ
- is either identical to ψ or forms part of it (e.g., it is a conjunct of ϕ)

so long as the scalar expressions in question are not within the scope of any logical functors in ϕ or ϕ'. (I have corrected some typographical errors in Gazdar's account here.)

88 Glossed as *for all the speaker knows* or *it is compatible with all the speaker knows that*. So, $P_S(p_i)$ would represent *for all S knows* p_i. Note that, if P_S(it is raining) is consistent with S's knowledge, P_S(¬(it is raining)) is also consistent. Or, where $P_S(x)$, $P_S(\neg x)$ must also be true.

(80)
a. Some of the people left early but I don't know if they all did.
b. All of the people left early.

However, Soames' solution presents its own difficulties: Soames claims that any given implicature will be taken either as indicative of S's belief in the falsity of some proposition -- or, as S's lack of knowledge about that proposition's truth or falsity. That is, S may implicate $K_S\neg(p_j)$ or $P_S(p_j)$. However, it is not clear that implicatures are this precisely delineated. First, in question-answer exchanges it is reasonable to assume that, in the general case, if a questioner asks a question, s/he has some reason to believe the speaker capable of answering it. But, in such cases, Soames' account would predict that all implicatures licensed by responses will license S knowledge of falsity, i.e., KNOW(S, $\neg p_j$). But the same objections raised above against Gazdar must then apply. Second, if each scalar quantity implicature must be represented as either $K_S(\neg p_j)$ or $P_S(p_j)$, then the 'working out' of any implicature (both by H and by S in anticipation of this) must involve a decision about whether S might be expected to know the truth or falsity of p_j or not. While H's belief about what S may be expected to know may indeed play an important role in the inferences s/he draws, to require that s/he always make this distinction -- as Soames does -- seems too strong. It often seems enough for a hearer simply to know that a speaker will not affirm some value; the source of this failure may be only of marginal interest. Elsewhere, Gazdar [Gazdar 80:7] himself appears (implicitly) to recognize such weaker implicatures as he describes the 'working out' of the implicature licensed via (81b):

(81)
a. John is patriotic and quixotic. (= [Gazdar 80]'s 40)
b. John is either patriotic or quixotic. (= [Gazdar 80]'s 41)

"So if my addressee hears me reply with (81b), and if he assumes that I am conforming to the maxims which govern conversations, then he can infer *at least that I do not know (81a) to be true, or even, more strongly, that I believe (81a) to be false.*" (my italics) Note here also that Gazdar himself seems to recognize that, whatever the computational difficulties presented by a logic of belief, it is belief and not knowledge that best characterizes these implicatures.

4.2.3. The Epistemic Force of Scalar Implicatures

Although none of the solutions discussed above appears satisfactory, parts of Horn's and Soames' discussions point to the solution I propose for scalar implicature: the use of disjunction to represent quantity implicature. Horn's informal glosses for his examples are presented as implicit epistemic disjunctions, i.e., 'for all S knows...' and Soames' claim that S may implicate either knowledge of the falsity of some p_j or lack of knowledge of p_j suggests that scalar implicatures might be seen as epistemic disjunctions. However, for Horn and Soames, speakers may license either disjunct of such disjunctions. For scalar implicature, I propose that speakers license the disjunction itself.

Justification for the representation of scalar implicature as disjunction comes from Grice himself. Recall from Section 2.4.2 that Grice [Grice 75] characterizes conversational implicature as "often a disjunction of several possible interpretations" and "often indeterminate." As noted in that section, part of the 'working out' of any conversational implicature involves S's belief that H can calculate some p_j which H must suppose S to believe in order to interpret S's utterance of p_i as cooperative. According to Grice, such calculation often results in multiple possible beliefs q_i, which will be reflected in a disjuntive implicature, $q_1 \vee q_2 \vee \ldots \vee q_n$. Consider Grice's:

(82) You are the cream in my coffee.

Here he proposes that, when used ironically, S intends H to reach first the metaphoric interpretation and then the ironic.

However, in other cases, while it seems reasonable to suppose that H identifies a disjunctive interpretation, one is less comfortable imputing the intentional conveyance of this disjunction to S. For example, in Grice's interpretation of 36, reproduced in 83, B implicates that either

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

B knows the garage in question can supply fuel or B does not know whether it can do so. While it seems reasonable that A may infer this disjunction, it seems counter-intuitive to say that B has implicated it. For, if so, then, given Condition 3 on conversational implicature (S belief that S and H mutually believe that some p_j is 'required' given S cooperativity and an utterance u_i), A must believe that s/he and B mutually believe that 'KNOW(B, (garage can supply petrol) ∨ ¬KNOW(B, ¬(garage can supply petrol)))' is required to make B's saying '*There is a garage round the corner*' consistent with B's observing CP and the maxims. But clearly the disjunction is not 'required' here in any intuitive sense,[89] since the supposition of either disjunct alone would suffice to permit the interpretation of B's utterance as cooperative. And since B obviously knows which of the disjuncts holds -- i.e., the state of his/her own knowledge -- it seems odd to suppose that B will implicate a weaker (i.e., a disjunctive) proposition than s/he knows to be the case. In fact, such behavior might well constitute a violation of the Maxim of Quantity.

[89]Recall that this is about the only sense in which we are allowed to understand 'required' -- since it cannot mean logically 'necessary' (See Section 2.4.2.)

But perhaps this oddness/uncooperativity is only apparent. Perhaps S does in fact choose to convey '$p_i \vee p_j$' that is weaker than, although consistent with, his/her actual belief that p_i. S may anticipate that H will be able to disambiguate the implicature by figuring out the appropriate disjunct; at least, s/he can anticipate that H will be able to infer '$p_i \vee p_j$'. That is, in 83 A might reason: "If I say 'There is a garage round the corner' now, B will believe either that I know the garage is open or that I don't know that the garage is closed. I know that the garage is open. However, whichever disjunct is true should make little difference to B; in either case, s/he should seek petrol at the garage in question, although with more or less confidence in finding it. So, the disjunction will suffice. To disambiguate explicitly would involve unnecessary effort." (Of course, as Grice notes, neither S nor H may recognize S's communicative intention as such; that is, neither need 'work out' the implicature so literally.) There may be many such cases where there is no need for H to disambiguate disjunctive implicatures: when simply the belief that S cannot falsify some proposition -- or that S cannot affirm some proposition -- is enough. For these reasons, scalar implicatures will be represented as disjunctions -- which may be disambiguated by hearers if necessary according to their world knowledge or beliefs about a speaker.

Further, as noted above, I propose that these disjunctions will be disjunctions with regard to speaker belief about propositions rather than speaker knowledge of them.

So, scalar implicatures licensed by S's affirmation of some value may be characterized as 'S believes higher p_j are false or S does not know whether higher p_j are true or false'. Such disjunctions may be represented simply by '¬BEL(S, p_j)', which will be true except when S believes p_j true. In effect, the denial (¬T) of one of three logical possibilities (T,F,#) in a three-valued logic is equivalent to the disjunction of the other two (F ∨ #).

The three-valued logic assumed here does pose problems for the actual computation of scalar implicatures, since no theorem provers exist for such a logic. While I will maintain a three-way distinction among speaker beliefs throughout the remainder of the thesis, note that '¬BEL(S, p_j)' will be true in a two-valued logic just in case 'BEL(S, ¬p_j)' and, similarly, '¬BEL(S, ¬p_j)' will be true just in case 'BEL(S, p_j)'. So, where logical systems do not permit representation of ignorance -- e.g., where a 'closed world' assumption is made -- scalar implicatures may still be represented as simplified by the assumptions of these systems in the same way that ignorance is simplified by them.

4.3. Representing Scalar Implicature Conventions

With solutions to problems of representing and ranking utterances, with a means of specifying the affirmation, denial, and declaration of ignorance of values, and with the epistemic force of scalar implicature identified, we can now improve upon the description of scalar implicature provided in Section 3.3. In Section 3.3.4, I proposed certain conventions of scalar implicature $Imp_{1\text{-}3}$ to satisfy Condition 3 of my definition of conversational implicature. These conventions can now be modified to incorporate the specifications of speaker commitment to utterances and to licensed implicatures discussed above:

Imp_1: $\exists O\,(BMB(S, H, SALIENT(O, C_h)) \wedge REALIZE(u_i, AFFIRM(S, e_i,$
$BEL(S, p_i))) \wedge (HIGHER\_SENT(p_i, p_j, O) \vee ALT\_SENT(p_i, p_j, O)))$
$\Rightarrow SCALAR\_IMP(S, H, u_i, \neg BEL(S, p_j), C_h)$

Imp_2: $\exists O\,(BMB(S, H, SALIENT(O, C_h)) \wedge REALIZE(u_i, DENIAL(S, e_i, BEL(S,$
$\neg p_i))) \wedge (LOWER\_SENT(p_i, p_j, O) \vee ALT\_SENT(p_i, p_j, O)))$
$\Rightarrow SCALAR\_IMP(S, H, u_i, \neg BEL(S, \neg p_j), C_h)$

Imp_3: $\exists O\,(BMB(S, H, SALIENT(O, C_h)) \wedge REALIZE(u_i, IGN(S, e_i, \neg BEL(S,$
$p_j))) \Rightarrow$
$((LOWER\_SENT(p_i, p_j, O) \Rightarrow SCALAR\_IMP(S, H, u_i, \neg BEL(S, \neg p_j), C_j))$
$\vee$
$(HIGHER\_SENT(p_i, p_j, O) \Rightarrow SCALAR\_IMP(S, H, u_i, \neg BEL(S, p_j), u_i,$
$C_j)) \vee$
$(ALT\_SENT(p_i, p_j, O) \Rightarrow SCALAR\_IMP(S, H, u_i, BEL(S, p_j), C_j))))$

So, for example, we can now represent that S may license the scalar implicature '$\neg BEL(S, p_j)$' by affirming his/her belief in p_j when p_i is ranked higher than or alternate to p_j and when the ordering O used to rank these sentences is salient. It remains still to provide a semantics for the notions of 'higher', 'lower', and 'alternate' which I have used to define these rankings, and to provide some understanding of how 'salience' will be represented in these definitions.

4.4. Summary

In this chapter I have continued the description of the class of scalar implicatures introduced in Section 3.3, providing a way to specify utterance ranking and various aspects of speaker commitment to an utterance and to licensed implicatures. In the next chapter I will propose a new means of ranking expressions, which, in turn, will provide definitions for 'higher', 'lower', and 'alternate' sentences.

CHAPTER V

Quantifying Informativeness

Herman: What do you think, Grandpa. Will it be a boy or a girl?
Grandpa: Probably.
The Munsters

In previous chapters, I have shown that scalar implicature, like quantity implicature in general, relies upon S and H's perception of the ranking of S's utterance with other utterances s/he might have selected instead. Horn, Harnish, and Gazdar have based this ranking upon a notion of scale or 'strength of claim', which they have basically defined by some form of entailment. However, all three accept that entailment cannot in fact account for all and only those meanings they have identified as quantity implicatures.

In this chapter, I will first identify the orderings that support scalar implicature -- some derived from previous work on quantity implicature, some representing modifications of this work, and some new. Then, I will examine relations that do not support scalar implicature. From a comparison of these two classes, I will propose a new characterization of these orderings, as PARTIALLY ORDERED SETS and claim that any poset can support scalar implicature. I will demonstrate how utterances can be ranked via these partial orderings, and how this means of 'quantifying informativeness' accommodates just the class of scalar implicatures. I will then propose a more precise semantics for the notions of HIGHER, LOWER, and ALTERNATE sentences and expressions introduced in Chapters 3.3 and 4 -- based upon a poset condition on scalar implicature.[90]

[90] I note again that, in previous work on scalar implicature, I have termed such posets 'scales', following Horn's and Gazdar's usage. Confusion over intuitive definitions of 'scale' as 'linear ordering' have persuaded me to abandon this usage.

5.1. Orderings Supporting Scalar Implicature

In Section 3.2, I introduced some of the ways in which Horn and Harnish compare utterance informativeness; in Section 3.3 I proposed that hierarchical rankings too support scalar implicature. In this section I discuss these and other orderings, which, I claim, will all permit the licensing of scalar implicature.

A number of the orderings supporting scalar implicature are derived from Horn's 'canonical' entailment-defined orderings, which include the natural language counterparts of the logical quantifiers, modals (epistemic and deontic) and connectives, as well as numerical orderings. Harnish, Kempson, and Prince, have noted that the logical connectives support other implicatures as well. Still other rankings have been identified from definites and indefinites, spatial and temporal orderings, epistemic verbs, verbs of incompletion,[91] and a host of noun pairs and miscellaneous modifiers. To these, I will add that metrics such as set/subset, whole/part, type/ subtype, and entity/ attribute relations, as well as generalization/ specialization hierarchies and instance-of relations also define orderings that support scalar implicature. These orderings include domain-dependent as well as domain-independent, and linear as well as hierarchical rankings. While many might be defined by some notion of entailment, a number cannot.

5.1.1. Quantifier Orderings

Since Aristotle, linguists and philosophers have debated the 'two *somes*' problem [Horn 73] – whether *some* means *some and not all* or *some and perhaps all*. So, in 84, B interprets A's '*some*' as conveying '*not all*'.

(84) A: Well, some of it you can charge to your grant.
B: Some?
A: Oh, all.

But clearly *some* will not always convey *not all*, as in the suspension in 85.

(85) I just received a letter from X describing their new project at Y, now that Z is finishing up. They plan to build a NL consultation system dealing with private investments. He asked if we could send him a copy of the Harry Gross transcripts. I believe *some (if not all) of them* were in a file at one time. What's the state? Can I get him a copy?

[91]Such as 'try to', 'intend to'.

As noted in Section 3.2.1, quantity implicatures based upon Horn's quantifier ordering *some/ all* provide a Gricean solution to this problem. Horn derives this ordering from the natural-language equivalents of the logical quantifiers, '$\exists$' and '$\forall$', which he orders by entailment. While this scale cannot be justified in model-theoretic terms – $\forall x\ P(x)$ does not entail $\exists x\ P(x)$ – the entailment of *some x* by *all of the x* may be maintained via Russell's contention [Russell 04] that universally quantified statements such as (86a) entail (86b): That is, such statements should be modeled as '$\exists x\ P(x) \wedge \forall x\ P(x)$', which, of course, entails '$\exists x\ P(x)$'.

(86)
a. All of the unicorns like grapes.
b. Some of the unicorns like grapes.

Note that this argument will not hold for statements '*All X are Y*', which are standardly represented with simple universal quantification. However, Horn's argument that, in general, the use of *some* can implicate *not all* – presumably, from his examples, even without the definite reference – does seem intuitively plausible. That is, statements of the form '*Some X Y*' seem intuitively 'weaker' than statements of the form '*All X Y*', and statements such as (87a) do seem able to convey ¬BEL(*S*, (87b)).

(87)
a. Some unicorns like grapes.
b. All unicorns like grapes.

The point here is, however, that while quantifiers do form an intuitive scale, and while some such ordering can be justified in model-theoretic terms, that justification does not extend to all uses of quantification which seem to support quantity implicature.

Other intuitive notions of quantification permit the composition of finer grained orderings by analogy from *some/ all*, orderings such as *few/ some/ many/ most/ all*. So, in 88, A conveys that lower values in such a ranking are true or unknown, e.g., ¬BEL(A, ¬(I have some comments)).

(88) A: Well, I don't have very many comments, Ethel.

These values may be lexicalized in a variety of ways, as in 89 and 90:

(89) A: And you took some courses...
B: I've taken a lot of computer courses in high school.

(90) A: The heaviest rain for us is over.
B: Not all the rain though?

Additional quantifier orderings can be derived from the base quantifier ordering by quantifying over places, times, persons, or other entities:

somewhere/ everywhere
sometimes/ often/ usually/ always
someone{body}/ everyone{body}

Each of these permits scalar implicatures similar to those discussed above: *S* may assert *sometimes* to implicate ¬*often*, ¬*usually*, and ¬*always* -- or *practically everybody* to implicate ¬*everybody*, as in 91.

(91) Schuyler and Betty Chapin know practically everybody in the performing arts. Isaac and Vera Stern know *everybody* in the performing arts.
The New Yorker, 20 December 1982

And, *S* may deny higher values, such as *everywhere*, to implicate that lower values, such as *somewhere*, are true or unknown, as in 92.

(92) Yet gains in agricultural productivity are not welcomed everywhere.
NYT, 23 February 1983

Here, ¬BEL(NYT, ¬(*gains in agricultural productivity are welcomed somewhere*)) appears to be licensed; the reader assumes the Times cannot truthfully deny that productivity gains are welcomed somewhere – i.e., that either gains are welcomed somewhere or the Times doesn't know whether they are or not.

Harnish's observation that the utterance of (93a) may convey that ¬(93b) relies upon a similar notion of quantifier ordering. He notes that, since (93b)

(93)
a. He walked halfway to New York.
b. He walked all the way to New York.

entails (93a) but not vice versa, (93b) represents a stronger claim than (93a). *S* may therefore assert (93a) to implicate ¬BEL(*S*, (93b)) if s/he believes that s/he and *H* mutually believe s/he is observing the Maxim of Quantity-Quality. Although 'canonical' orderings like the quantifiers might seem difficult to mention without licensing the implicatures described above, in fact these meanings need not be conveyed. For example, the meaning Harnish finds licensed by (93a) need not be licensed by 94.

(94) A: I hear George bet Tom he couldn't walk at least half the distance from Minneapolis to New York.
B: Yeah, he bet him $500.
A: So, what did Tom do?
B: He walked halfway to New York.

The felicity of such dialogues, in addition to the cancelability of implicatures licensed via mention of quantifiers, confirm that these meanings do represent conversational implicatures.

5.1.2. Modals

Mention of EPISTEMIC and DEONTIC modals may also license scalar implicatures. Lexicalizations of values in an epistemic ordering *possible/ certain* support scalar predication in exchanges like 95. Here B licenses the belief that ¬BEL(B, *I was (certainly) in the neighbourhood*).

(95) A: You were in the neighbourhood of the pantry at one time, were you not?
B: I may have been.
Cyril Hare, An English Murder

The DEONTIC modals (*permissible/ obligatory*) permit the implicature B conveys in 96,

(96) A: See my comment was, if we should throw even the $2000 into an IRA or something for her....
B: You could do that too.

¬BEL(B, *we should throw even the $2000 into an IRA...*). Similarly, in 97, B licenses the implicature that ¬BEL(B, *we think Gemayal will survive*).

(97) A: Do you still think that President Gemayal will survive?
B: Well, we think that he should.
This Week with David Brinkley, 19 February 84

And the denial of a higher value in this ordering, *should have to*, in 98, conveys that the lesser deontic *can* is true or unknown. That is, ¬BEL(B, ¬(*A can take off the back plate*)).

(98) A: I would like to know if I can take off the back plate.(= [Hobbs 79a]'s 4)
B: You shouldn't have to.

Unlike the quantifier orderings, the modal orderings can be justified in model-theoretic terms: In all modal systems, if NECESSARY(p_i) in some model, then POSSIBLE(p_i) in that model; similarly, if OBLIGATORY(p_i), then PERMISSIBLE(p_i). So, in each case, a modal ordering can be defined for the natural-language counterparts of these operators via the logical entailment of their logical counterparts.

5.1.3. Logical Connectives

The natural-language counterparts of the LOGICAL CONNECTIVES, *or* and *and* have figured in several discussions of quantity implicature. Horn bases his *or/ and* ordering on the fact that natural-language *or* is often interpreted by hearers as exclusive: So, 'p_i *or* p_j' may be

5.1.3.2. Conjunctive Assertions

Just as disjunction figures in several types of scalar implicature, so does conjunction. Since the truth of $p_i \wedge p_j$ entails the truth of p_i and of p_j, one might define an ordering p_j/ p_i *and* p_j by analogy from p_j/ $p_i \wedge p_j$. Such an ordering accounts for the implicature in 106 that the dog is not vicious.

(106) A: Uh, a very large and vicious dog is about to attack me.
B: He's large.

Similarly, in Gazdar's example (reproduced in 107), B conveys

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

that her mother is not well, as A recognizes explicitly.

5.1.3.2.1. All-Implication

Implicatures licensed via one of Harnish's measures of 'strength of claim' – ALL-IMPLICATION appear also to rely upon a p_j/ $p_i \wedge p_j$ ordering. Implicitly, Harnish relies upon this relationship in claiming that the Maxim of Quantity-Quality solves the classic problem of how the assertion of (108b) conveys (108c). [Harnish 79:126-9,320ff]

(108) What color is the flag?(= [Harnish 79]'s (22))
a. (The flag is) red and white.(= [Harnish 79]'s (23))
b. (The flag) is red.(= [Harnish 79]'s (24))
c. The flag is all (only?) red.(= [Harnish 79]'s (25))

He explains that, if *H* believes *S* is being cooperative, then, in particular *H* will believe *S* is obeying Quantity-Quality. (108a) is a stronger claim than (108b), since *red and white* entails *red*, but not conversely. Recall that, for Harnish, the entailment of u_j by u_i is characterized by the fact that 'u_j and $\neg u_i$' represents a contradiction. So, in this case 'the flag is red and white and the flag is not red' would, in his view, represent a contradiction. Of course, one might easily argue that 'the flag is red and white and the flag is not all red' does not. Furthermore, Harnish states that u_j will be stronger than u_i if u_j entails u_i and u_i does not entail u_j. Clearly, 'the flag is red' does not entail that 'the flag is red and white' -- by any definition of entailment. By saying the 'weaker' (108b), then, *S* implicates that ¬(108a) -- and, therefore, that (108c).

In fact, some more general notion of informativeness here – e.g., why would *S* mention only one color in the flag if s/he was able to mention others – appears preferable to entailment. However, Harnish also notes that adjectives such as *spotted*, *dirty*, *stained*, *torn*, *patched*, *dented*, *wet*, *on fire*, for which we might make a similar relative informativeness argument, do

not support similar implicatures.[95] And others, such as *twisted*, *curved*, and *steep*, in Harnish's terms "convey only weak ALL-IMPLICATION". Harnish seems to suggest that the possibility of implicature appears dependent upon the degree to which the fact that the property mentioned holds for some part **x** of a whole **y** entails that it holds for all of **y**. So, while part of the phenomenon Harnish describes may be subsumed by identifying a relationship between conjunctions and their conjuncts, other aspects remain to be explained.

5.1.3.2.2. Specificity of Assertion

Harnish's notion of SPECIFICITY OF ASSERTION also relies implicitly upon an ordering derived from natural-language conjunction: When *S* asserts p_i *and* p_j, Harnish claims, s/he implicates *not (only)* p_i *and not (only)* p_j. The former will be seen as more specific than the assertion of p_i or p_j alone -- and, thus, as a weaker utterance. For example, by asserting (109a) *S* may implicate ¬(only)(109b).

(109)
a. Jones wants ham and eggs for breakfast.
b. Jones wants ham for breakfast.

But by Harnish's own entailment measure, (109a) represents a stronger statement than (109b) since $p_i \wedge p_j$ entails both p_i and p_j. The truth of a conjunction $p_i \wedge p_j$ entails the truth of its conjuncts, and conversational implicatures do not contradict entailments. In fact, *S* may implicate ¬(109a) by asserting (109b). It is not clear why 109 should differ from 108, for instance; so, two of Harnish's own metrics would predict different implicatures for the same utterance. So, I will prefer the 'p_j/ $p_i \wedge p_j$' ordering over Harnish's 'specificity of assertion' notion.

A number of orderings formed from the logical connectives support scalar implicature, including:

p_i *or* p_j/ p_i *and* p_j;
p_i *or* p_j/ p_i; and
p_j/ p_i *and* p_j.

Since Harnish's all-implication appears consistent with the latter, this notion too will be included in my understanding of scalar implicature. However, his 'specificity of assertion', which seems to contradict this p_j/ p_i *and* p_j ordering, will not be included.

[95] Although, 'the flag is wet' does seem to convey that 'the flag is (all) wet' even if it is difficult to imagine what 'the flag is (all) patched' might mean.

5.1.4. Numerical Orderings

5.1.4.1. Cardinal Predicates

It is generally accepted that mention of a cardinal *n* may be ambiguous between *exactly n*, *at most n*, and *at least n*. Kempson [Kempson 75:154-155] proposes that the *at least n* reading for cardinals can license quantity implicatures. She notes that, when *at least* explicitly modifies a cardinal *n* in an utterance, *S* may implicate ***more than n***. Consider 110, in which Kempson

(110) I have at least five dollars.

would predict that *S* implicates that s/he has more than five dollars. However, native speakers informally polled do not seem to share Kempson's intuition. Furthermore, it seems that whatever sense of ***more than n*** that may be conveyed by such utterances comes instead from *at least*'s conventional force -- i.e., '*exactly or more than n*' -- rather than from conversational implicature. The problem of distinguishing this meaning from conversational implicature by tests such as cancelability results from the disjunctive nature of the meaning; so, (111a) and (111b)

(111)
a. I have at least five dollars and no more.
b. I have at least five dollars and in fact more than five.

both are felicitous, since they cancel only part of the conventional force of what *at least* conveys.

Horn, on the other hand, finds that only the '*no more than n*' reading will license conversational implicatures. I claimed in Section 3.2.1 that intonation will not disambiguate among the various readings. However, context can: In response to A's query in (112a), it seems likely that B intends to convey *at least five dollars* by (112e).[96]

(112)
a. A: Can you afford the movies?
b. A: Do you have ten dollars?
c. A: You know, you must declare your foreign currency upon entering Czechoslovakia.
d. A: Do you have a dollar?
e. B: I have five dollars.

However, in response to (112b), (112e) appears to license *at most five dollars*. After (112c), (112e) seems more like to be interpreted as *exactly five dollars*. In the simple cases, (112b) and (112d), prior mention of a larger or smaller cardinal appears to favor the *at most n* or *at least n*

[96] It has been pointed out to me that this interpretation may already be out-dated; assume that it costs less than five dollars to see a movie.

reading;[97] but, in (112c), it seems likely that world knowledge tells us B is more likely to have exactly as much money as s/he declares. Note also that, (112e) might be viewed as either a positive or a negative response to (112d) -- i.e., *Yes, I have (at least) five dollars* or *No, I don't have (at most, or, exactly) one dollar.*

5.1.4.1.1. Approximating Contexts

Horn examines other clues that appear to disambiguate speakers' use of cardinals. When a cardinal is 'rounded' (as in approximating contexts), it is less likely to be taken as indicative of an upper bound (i.e., as ***at most n***). So, without a disambiguating context, (112e) is more likely to be interpreted as ***at least five dollars*** or even as ***approximately five dollars*** (asserting no bound) than, say, (113a)

(113)
a. I have $5.50.
b. I have $5.57.

would be. Arguably, (113b) would be even more likely to be taken as an exact specification: Since rounded amounts can be substituted for a number of more specific amounts, the assertion of an ostensively rounded amount like *$5.00* may stand for many amounts, including *$5.57*. However, the assertion of an apparently non-rounded amount like *$5.57* cannot be used when, say, *$5.00* is known to be true. So, the assertion of a more specific amount like *$5.57* can be seen as providing more information than the assertion of a rounded amount like *$5.00*. Note the correspondence between these observations and Harnish's notion of 'specificity of assertion' above (Section 5.1.3.2.2). However, the latter would predict that, if *S* makes a more general assertion when a more specific assertion would be relevant, s/he may implicate s/he cannot assert a more specific value. So, the assertion of (112e) may convey *S* cannot be more precise about the state of his/her finances -- cannot say (113b). Horn is more concerned with what the assertion of (113b) will convey. Since cardinals taken as asserting an upper bound are those which can license quantity implicatures, it will be easier for *S* to convey and *H* to interpret implicatures arising via the assertion of these clearly 'non-rounded' cardinals.

5.1.4.1.2. Lexicalized Cardinals

Additionally, Horn claims that lexicalized cardinals (such as ***annual***, ***bicycle***, ***double***, and ***monologue*** which incorporate a cardinal) 'force' an upper-bound interpretation -- and, thus, must license ***not more than n*** (See Section 4.2.1). So, he predicts that the utterance of (114a) may implicate ¬(114b), while the utterance of (114c) must implicate ¬(114b).

[97] (112e) might also be interpreted as the proffering of an alternate denomination of bill in response to (112d); 'I have four dollars' however avoids this possibility. And see below (Section 5.1.4.1.1) on approximating contexts.

(114)
a. This figure has three sides.
b. This figure has four sides.
c. This figure is a triangle.
d. #This figure is a triangle, and, in fact, it is a square.

However, for (114c), this meaning does not seem to be cancelable; i.e., (114d) is infelicitous. So, it seems more likely that (114c) conveys ¬(114b) conventionally (i.e., that ¬(114b) is part of its conventional force) rather than via conversational implicature. That is, *triangle* is defined as a geometric figure with three and only three sides. Thus, contra Horn, lexicalized cardinals do not appear to license the conversational implicatures that the mention of cardinals license.

5.1.4.1.3. 'Reversed' orderings

Horn acknowledges that his entailment-defined cardinal ordering will not accommodate all quantity implicatures that may be licensed by the mention of cardinals. For example, he finds that the implicature licensed by the utterance of 115 relies upon a 'reversed' cardinal ordering.

(115) Arnie is capable of breaking 70 on this {golf} course.

S's assertion of *70* may implicate ¬BEL(*S*, *Arnie is capable of breaking* ***n*** *on this course*) for n < 70. So, in such a case, Horn believes the cardinals should be represented as:

80————————70————————60————————50

While such cases might seem to pose yet another problem for Horn's entailment condition, there is a simple solution. In golf, *breaking 70* does entail *breaking* ***n*** for all n > 70; so semantic entailment may in fact suffice to define the ordering evoked by *S*. However, this ordering is not defined over the cardinals, but rather over events which involve cardinals. 115 shows how a cardinal may figure in orderings other than a simple ordering of cardinals by entailment; again, in such cases, knowledge of the relative salience of metrics will be required to disambiguate possible scalar implicatures.

In sum, the assertion of a cardinal *n* may license the scalar implicature ¬BEL(*S*, n+j) for *j > 0* when context indicates that a cardinal ordering is salient. In this regard, cardinals that appear to be 'rounded' are more difficult to use to convey scalar implicatures. However, Kempson's notion '(*at least*) ***n***' may be used to implicate '***more than n***', and Horn's contentions that mention of lexicalized cardinals license quantity implicatures and that cardinal ordering may be reversed in some cases will not be adopted in this theory.

5.1.4.2. Ordinal Predicates

Horn claims that the canonical ordering of the ordinal scalar predicates resembles his reversed cardinal ordering -- i.e.,

nth———— ...————*fourth*———— *third*————*second*———— *first*

So long as an ordinal refers to a ranking other than ***number of instances***, he claims, its mention asserts upper-boundedness, and thus conveys that smaller, or, higher, ordinals are known to be false. So, the assertion of ***third*** conveys ¬*second* and ¬*first* in (116a).

(116)
a. Little Herbie came in third out of 200 entries.
b. #Little Herbie came in third and in fact second out of 200 entries.

However, it seems doubtful that (116a) conveys either of these meanings via conversational implicature, since ¬*second*, for example, is not cancelable ((116b)). Too, (116a) conveys ¬*fourth* as well, but this meaning would not be predicted by Horn's analysis.

Horn further contends that *only* reverses an ordinal ordering, as in (117a).

(117)
a. The Socialist Worker candidate is expected to finish only sixth.
b. #The Socialist Worker candidate is expected to finish only sixth and in fact seventh.

But, again, the meaning in question is not cancelable ((117b)) -- and thus cannot be termed a conversational implicature. It appears rather to represent a conventional implicature from *only*.

Horn's exclusion of ordinals referring to 'number of instances' from consideration is ironic: Although such ordinal references do not rely upon a 'reversed ordering', they do appear to support quantity implicatures -- although these implicatures are quite different from those Horn proposes. These ordinal-based implicatures appear to rely critically upon the type of entity modified by the ordinal. When ordinals modify stages of some (linear) process, for example, a corresponding ordering of the ordinals

first————*second*———— *third*———— ...————*nth*

appears appropriate, as in (118a).

(118) A: Have you finished the third grade?
a. B: I've finished the second.
b. B: I've finished the fourth.

In (118a), B implicates that s/he has not finished the third grade; while, in (118b), B conveys that she has completed it. However, when ordinals modify entities that are not linearly ordered, as in (119a) and (119b),
it seems likely that both responses implicate that B has not read the third chapter. Here, a set/

(119) A: Have you read the third chapter?
a. B: I read the second.
b. B: I read the fourth.

member ordering appears salient. Nothing in Horn's theory can explain either of these cases of quantity implicature.

So, I will claim that, although mention of ordinal values may indeed support scalar implicature, Horn's account of implicatures so licensed is incorrect. Implicatures licensed via an ordinal will also depend upon the entity modified by that ordinal: if a linear ordering of entities modified is salient, *S* may license one sort of meaning by choice of ordinal; if a non-linear ordering is salient, then s/he may only license another sort of meaning.

5.1.5. Indefiniteness and Definiteness

Grice [Grice 75] and Prince [Prince 81a] note that the use of an indefinite NP often conveys that *S* cannot or sees no need to be more specific, as in (120a). If *H* owns the

(120)
a. A bulldozer just flattened a car in the parking lot.
b. I've been sitting in a car all morning.

flattened car, that fact will be relevant. By failing to identify the vehicle more specifically, *S* implicates that, so far as s/he knows, further identification is irrelevant; thus, the car is not *H*'s (and possibly does not belong to any known acquaintance of *H*'s). But obviously this implicature will not be carried by every use of the indefinite. Consider Grice's example (reproduced in (120b)), in which it seems less likely that *S* is conveying this inability to identify *a car* more specifically.

Gazdar has proposed that such implicatures are best seen as scalar quantity implicatures: that is, indefinites and definites can be ordered *a*/ *the*. Again, Russell's argument that use of a definite description *the X* entails (for *S*) the existence of some such *X* provides a logical justification for this ordering. Since indefinites other than the indefinite article can be uttered to license similar implicatures, as in 121 (where A and B discuss what kind of connections a potential date must have had to be chosen for a television dating program), a more general version of this ordering might be *indefinite*/ *definite*.[98]

(121) A: Works on the show.
B: Some show.

[98]Such responses are most felicitous with stress or with FALL-RISE intonation over the indefinite, i.e., *\Some\ show. B successfully conveyed that the unappealing candidate must at least* . See Note 61.

Obviously, indefinites need not always license scalar implicatures: Generic indefinites for example, like *A whale has lungs*, will not license the implicature ¬BEL(*S*, *the whale has lungs*).

The uniqueness (within some inferable set or context) that definite descriptions convey can also be explained in terms of scalar implicature: When *S* refers to *one of his books* in 122, he

(122) Well, fortunately, his book is doing so well -- that, well, one of his books is doing so well -- another one is not doing badly either -- and he will be in a position where he can do that. That's really great.

blocks the possible implicature ¬BEL(*S*, X has written more than one book) that *H* might have inferred from the initial definite reference -- *his book*.

While it is interesting to consider this account of the additional meanings which indefinites and definites may convey, it is unclear how such an analysis fits into more sophisticated accounts of this much-studied phenomenon. So, while a theory of scalar implicature must accommodate the observations discussed above, I will not pursue this particular line of inquiry specifically.

5.1.6. Ranked Entities, States, Actions, and Attributes

A number of authors have noted that quantity implicature can also be supported by phenomena which cannot be described more generally than by the observation that certain nouns, verbs, and modifiers -- or, denotations of certain entities, states, actions, and attributes, as I will term them -- appear to be intuitively rankable. The lexical items which figure in this phenomenon have given support to the notion that generalized conversational implicature are defined by the presence of certain lexical items. Many of these rankable items may be used to evoke orderings that support scalar implicature.

5.1.6.1. Rankable Entities

Walker [Walker 75] has noted that the relationship between nouns such as *friend* and *lover* permits generalized conversational implicatures, as when the utterer of (123a) implicates ¬(123b).

(123)
a. This is my friend John.
b. This is my lover John.
c. This is my friend John, who is also my lover.

Again, not every use of *friend* ((123c), for example) will convey that ¬*lover*.

Horn also notes that military ranks (*private/ corporal/ sergeant* ...), life stages (*child/ toddler/ infant/ newborn*), and, of course, his *tort/ misdemean... felony/ capital crime* c... ring permit the licensing of similar implicatures. Note that, while *lovers* may also be *frien* ...ney need not be -- and *sergeants* cannot be *privates*; so, although some of these rankings ...hich do appear to support scalar implicature -- may be described by an intuitive notion of ent...ment, even a very intuitive definition cannot distinguish all and only those orderings sup...rting quantity implicature. These observations provide further evidence that an entailment definition of utterance ranking is inadequate.

Too, many of these orderings may be quite domain-dependent. For example, 124 is impossible to interpret unless we know whether Dr. X is more or less powerful or respected than the chief surgeon -- or is, in fact, s/he.

(124) A: Does the chief surgeon concur in your diagnosis?
B: Dr. X thinks I'm right.

Except in the final case, concurrence of the chief surgeon will in no way entail the concurrence of Dr. X. If Dr. X is, say, less powerful/ responsible than the chief surgeon, then B may implicate ¬BEL(B, *the chief surgeon concurs in the diagnosis*) in the above exchange. If Dr. X instead ranks higher the chief surgeon, it does not appear that any inference about the chief surgeon can be drawn here.

5.1.6.2. Rankable Activities, States, or Attitudes

Certain verbs may denote activities, states, or attitudes which are themselves rankable. For example, it is clear from 125, 126, and 128 that verbs indicating 'degree of emotional attachment' may also be ordered. In 125, B implicates her lack of commitment to *like* by affirming *don't mind*.[99]

(125) A: She likes it.
B: I don't mind it.

While no scalar implicatures are licensed during the exchanges presented in 126-128,[100] they

(126) A: That cat doesn't like anything.
B: She loves being brushed.

(127) A: Well, are you in love with this guy?
B: Well, I love him.

[99]We might of course analyze B's response as a denial of *mind*, but it seems clear in this exchange from that the more idiomatic notion of *don't mind* as a lesser degree of attachment than *like* is intended.

[100]In which higher values are affirmed.

(128) A: You don't like snow?
B: I LOATHE it.

motivate the claim that speakers consider *loathe, like, in love, love* to be intuitively rankable. Again, if B merely acquiesces in *don't like*, or *in love* s/he might risk A concluding that B cannot affirm yet higher values. I shall return to this notion in Section 7.1.3. Such dialogues provide the best criteria for the identification of these miscellaneous rankings, in particular, those which are domain dependent.

Orderings of other verbs, such as *want* and *need* will also support scalar implicature. From 129, for example, we see that 130 will be felicitous.

(129) A: O.K. Oh, you want this.
B: I need this.

(130) A: Do you need this?
B: I want it.

Mention of epistemic verbs, *think, believe*, and *know*, can also support scalar implicature, [O'Hair 69, Gazdar 80, Pinkal 83] as shown above in 64 (repeated here), in which B rejects A's implicature ¬BEL(B, *X knows I'm stupid*).

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

Similarly, in 131 and 132, the ordering *think/ believe/ know* supports the scalar implicature ¬BEL(B, *believe* ...) and ¬BEL(B, *know* ...).

(131) A: O.K. Do you have my records of like what I took?
B: Yes, I think so.

(132) A: And you have Data Structures?
B: No, I think I'm going to take that next term.

Alternate lexicalizations of items in this ordering are illustrated in the exchanges in 133 and 134. In 133, B implicates

(133) A: Do you know how many we have?
B: We can check.

¬BEL(B, *I know how many we have*) by affirming *can check*, while in 134 B conveys the same implicature by affirming *find out*.

(134) A: Do you know what time it is?
B: I can find out.

Such use of the epistemics has been discussed in the literature as HEDGING behavior. [Lakoff, G 72, Prince 82b] Hedges other than the epistemics may also license scalar implicatures: In 135 and 136, from a fictional interrogation of witnesses by police, speakers attribute propositions to others to implicate their own inability to commit themselves to those propositions.

(135) A: Nobody saw anything or anyone. Mrs Praed discovered the body at about six o'clock in the morning--
B: She says.

(136) A: Mr Porle, I believe you were employed by a Miss Marietta Rainer. Is that correct?
B: I used to clean her windows–yes.
A: You know she was recently found dead?
B: So someone told me–yes.

[Prince 82b] terms these uses of performatives and epistemics *shields*, and explains that they introduce fuzziness in the relationship between propositional content and speaker.

[Prince 82b]'s *approximators* also represent hedges whose use may support scalar implicature: Items so identified will introduce "fuzziness within the propositional context" as in [Prince 82b]'s 137:

(137) A: Are his feet blue?
B: They're kind of blue.

B implicates here that ¬BEL(B, *his feet are blue*) by use of what [Prince 82b] terms an ADAPTOR – a term which adapts an old term to a new instance -- here, *kind of*. Other approximators called *rounders* provide a more general term when the precise term is not available or is unnecessary. So, in [Prince 82b]'s 138,

(138) Her temperature was about 100.

S implicates that ¬BEL(*S*, *her temperature was 100*).

It has not been noticed in the literature that similar orderings may be evoked by the mention of certain verb/preposition pairs. In 139, for example,

(139) A: Should we have the ham for Christmas?
B: We could have it during Christmas.

B implicates ¬BEL(B, *we should have the ham for Christmas*) by affirming the lesser value *have it during*; that is, the ham should not be the main course for Christmas dinner, but it could be eaten during the Christmas season. Note that this distinction relies also upon the recognition that the referent of *Christmas* in A's question, *Christmas dinner* is distinct from the *Christmas season* to which B refers.

And in the exchange presented in 140, in which a (somewhat unusual) caller describes her

(140) B: I as a result of my extensive investigations and especially on an international basis -- I was involved in industrial and governmental espionage so I had to be very careful about –

A: CIA stuff?
B: Pardon me?
A: CIA stuff?
B: We HAVE worked WITH them.
A: I see.
B: I don't work FOR them.
A: I see.
B: Uh I work FOR my corporation.
A: Uh huh.
B: I have also worked with security organizations, the FBI –
A: Uh huh.
B: And the intelligence groups. But what happened was I had to remain silent about my inheritance because uh we were threatened.

past work to a financial advisor, the caller (B) first implicates ¬BEL(B, *we worked for the CIA*) and then reinforces this implicature explicitly. In this exchange, the scalar implicature is licensed by a ranking of *work with* as a lesser item than *work for*; this ordering is plausible if one considers that *working for* someone involves *working with* them, but not vice versa.

5.1.6.3. Rankable Attributes

Horn in particular has noted a number of modifiers which support quantity implicature; some are presented below:

pretty/ beautiful	*happy/ ecstatic*
warm/ hot	*cool/ cold*
intelligent/ brilliant	*fair/ good/ excellent*
middle-aged/ old	*adolescent/ adult*
critically/ mortally/ fatally (wounded)	

These and numerous other modifier orderings also support scalar implicature.

For example, Horn finds that the affirmation of *pretty* implicates the inappropriateness of every stronger term, which, for him, is every term that entails *pretty* in an ordering defined by *degrees of attractiveness*.[101] Thus, the utterance of (141a) conveys that ¬BEL(*S*, (141b)).

(141)
a. That picture is pretty.
b. That picture is beautiful.

Scalar implicatures are also licensed in 142, in which a speaker points to a standard deviation that looks rather large and explains:
The audience understood that *S* was conceding ¬BEL(*S*, ¬*that's an X amount*), for X < *tiny* in

---

[101] Horn does not claim that all these attributes can be ordered by entailment, and even *pretty* is suspect in this regard.

(142) That's not a tiny amount, but...

some .... *large, medium, small, tiny* ordering. Note here, as in other modifier orderings such as the temperature scale or *degrees of attractiveness*, that the orientation of such rankings varies with context (See Section 6.3.2.3).

Orderings formed from intuitively rankable entities, states and activities, and attributes – licensed via mention of the NP's, VP's, adjectivals and adverbials that refer to them -- thus support scalar implicature. Of all the orderings discussed previously in the literature, this class has been the most difficult to accommodate in a single measurement of informativeness. Such rankings are also inherently difficult to identify, since they may be quite domain-dependent.

5.1.7. Temporal Implicatures

Harnish and Horn have both identified numerous temporal indicators that may license quantity implicatures, including tense and temporal adverbials such as Horn's *sometimes/ always* ordering. Harnish notes that use of the past tense in (143a) seems to convey that "the activity or state indicated by the verb no longer is present". [Harnish 79:388] So (143a) can convey ¬(143b).

(143)
a. I x'd (to) p_i.
b. I now p_i.

In particular, he points out that verbs such as *used to, wanted to*, and *believed* may license such implicatures. For example, in 144, *S* implicates that ¬BEL(*S, chocolate cigarettes now come in a box ...*).

(144) Chocolate cigarettes remind me of my childhood. They used to come in a box that looked like a fake cigarette box for kids. I like the idea of using them, but I would feel silly using this kind of chocolate cigarette.

Harnish also notes that use of the simple past tense for any verb will license the quantity implicature that the queried state does not now hold; so, *I p_i'd* may convey ¬BEL(*S, I now p_i*). For example, in 145 B

(145) A: Are you on your honeymoon?
B: Well, I was.

conveyed an indirect negation to the question asked by this means – implicating ¬BEL(B, *I am now on my honeymoon*).

Similarly, Horn proposes that what he terms 'quasi modals' (and what others have called

'verbs of incompletion') also license quantity implicatures, via orderings such as *want to/ try to/ succeed in*. For example, in 146

(146) A: Is she going to get that card renewed?
B: She's trying.

B implicates that her friend has not yet -- and is not sure of eventually succeeding in -- getting a free membership card to a night club renewed. Similarly, in 147, A implicates ¬BEL(A, *I am having V-8 juice*).

(147) A: Do you want V-8 juice?
B: Are you having V-8 juice?
A: I'm considering it.

And in 148, B implicates that he has *not* actually bought the television set.

(148) A: Did you buy the TV?
B: I'm going to.

Horn omits verbs such as *able, persuade, forget*, and *intend* from his scalar predicates, since he claims that these predicates entail either their complements or the negation of their complements and thus cannot be used to implicate that negation. However, *able* and *intend* do indeed appear to support quantity implicatures similar to those supported by his 'quasi-modals'. *Be able to p_i* is not synonymous with *manage to p_i* as Horn claims; possessing the ability to achieve p_i need not entail *achieving p_i*. So, the utterance of 149 need not convey that B has indeed made dinner; in fact, B conveys just the opposite in this exchange.

(149) A: Have you made dinner yet?
B: I can.

Neither does *intending to do p_i* entail either *doing p_i* or ¬*doing p_i*. In 150, B conveys that the investment in question had been meant as deferred income, even though he questions whether it will count as such.

(150) A: I would suspect that this was part of a pension plan, was it?
B: Not as a pension plan per se. It was intended to be deferred income.

That is, the assertion of *intended to p_i* may convey ¬BEL(*S, p_i*), and this meaning does represent a conversational implicature in the terms presented in Chapter 2.[102] Both *able* and *intend* do in fact support scalar implicature.

Temporal implicatures may also be licensed about present states by the affirmation of

[102]Note in particular that the meaning *intend to p_i* may license is cancelable, as in vi:

(vi) I intended to p_i and in fact I did.

some future state. For example, B's response in 151 licenses the implicature $\neg$BEL(B, *I have a master's*).

(151) A: You have a master's don't you?
B: I will.

In 152, B licenses $\neg$BEL(B, *that is the best way to go (in the future)*).

(152) A: Now is that the best way to go for me?
B: Presently yes.

As I noted in Section 3.2.2, Harnish claims that denying p_i for t_j may license the belief that p_i held for some period t_i, $i < j$. But similar denials may also license implicatures about future time periods: In 153, for example, B's denial of *today* conveys that B will leave at another – presumably future – time.

(153) A: Are you leaving today?
B: I'm not leaving today.

In short, affirming or denying a temporal may license implicatures about past or future states.

If, like Horn, one sees temporal orderings as both linear and defined by entailment, then one cannot explain such two-sided implicatures: Both affirmations and denials of some temporal value v_j may license scalar implicatures involving both higher v_i and lower v_k: The affirmation of v_j may license $\neg$BEL(S, $\neg v_i$) as well as $\neg$BEL(S, $\neg v_k$); the denial of v_j may license $\neg$BEL(S, v_i) as well as $\neg$BEL(S, v_k). So, these orderings are clearly not definable by entailment. The truth of future p_i entails nothing about the truth of present or past p_i.

However, from the implicatures licensed in naturally occurring discourse, it appears that temporal orderings may best be seen as sets of temporal alternatives, any number of which may, in general, hold. In 154, for example, B in fact responded with (154a). However, she might felicitously have given any of the other responses:

(154) A: Do you have a badminton team?
a. B: I had.
b. B: I do now.
c. B: I will have.
d. B: I don't have one now.
e. B: I won't have.
f. B: I didn't have one.

Where (154a) indicated to A $\neg$BEL(B, *S does (now) have a badminton team*) and $\neg$BEL(B, *S will have a badminton team*), (154b) might convey *S*'s inability to commit herself to past and future, and (154c) a similar lack of commitment to present and past. Alternatively, the utterance of (154d) could license $\neg$BEL(B, $\neg$*I had one*) and $\neg$BEL(B, $\neg$*I will have one*); of (154e), lack

of commitment to the falsity of past and present; and (154f), lack of commitment to the falsity of present and future – e.g., *I didn't have one but I do now* or *I didn't have one but I will* might each be implicated by (154f).

Implicatures licensed by mention of such alternatives are identical to those observable when a set/ member relationship is evoked. That is, the affirmation of any member may convey *S*'s lack of commitment to other unmentioned members, while the denial of a member may convey that *S* believes other members true or does not know whether they are true or false (See 5.1.10 below.). While our intuitive notion of time may be linear, then, the implicatures that may be licensed by temporal references suggest a different representation here.

5.1.8. Spatial Orderings

Spatial orderings may also support scalar implicature. The directionality of spatial orderings appears to follow the egocentricity observable in most deictic behavior, in which the unmarked point is the deictic center: Just as the central person is the speaker and the central time the time of utterance, so the central place is the speaker's location at the time of utterance. [Levinson 83] So, implicatures licensed via spatial orderings will be calculated with respect to *S*'s location unless otherwise indicated. Below I will assume that deictic center and speaker location are identical for simplicity's sake.

In 155, for example, B appears to affirm a nearer location to deny a queried further location.

(155) A: Did you get downtown?
B: I went to Bonwit's.

Similarly, in (156a), a bus-driver affirms one street to deny that

(156) A: Do you go straight up Walnut?
a. B: To Thirty-fourth.
b. B: I don't go to Thirty-fifth.

his bus will go to the end of Walnut, Sixty-Third Street. But B might have conveyed the same information by (156b), denying a further location to implicate the affirmation of a nearer location.[103] Similarly, in 157, B affirms a nearer location to deny the farther *way to* location.

(157) A: Is this the way to the Towne Building?
B: This IS the Towne Building.

[103] It seems less likely that B would choose a denial in this situation, although the denial is perfectly interpretable. However, 'I turn before Thirty-fifth' seems somewhat more natural an alternative.

, S may affirm a nearer location l_i to convey lack of commitment to a farther one l_j (i.e., ¬BEL(S, l_j)) or deny a farther l_j to convey ¬BEL(S, ¬(l_j)).

It also would seem that a speaker may declare ignorance of some location l_j to convey ¬BEL(S, ¬(l_i)) for l_i closer to S than l_j and ¬BEL(S, l_k) for l_k further from S. So, B might ...avey that ¬BEL(B, *it gets to Thirty-sixth*) and ¬BEL(B, ¬(*it gets to Thirty-fourth*)) by the ...ponse in 158.

(158) A: Does this bus go up Walnut?
B: I don't know if it gets to Thirty-fifth Street.

1.9. Process Stages and Prerequisites

Harnish implicitly recognizes the notion that process or prerequisite orderings may permit ...alar implicature in his discussion of how the assertion *x finished y* may be viewed as a ...onger remark than the assertion *x started y*. Since *finishing* 'entails' *starting*,[104] – but not ...e versa – the assertion of *x started y* implicates the falsity of *x finished y*, as when S ...iplicates ¬(159b) by saying (159a).

(159)
a. Minnie started mowing the lawn.
b. Minnie finished mowing the lawn.

...is intuition seems correct, even though Harnish's explanation is unconvincing.[105] And the ...nial of *finish* can be employed to implicate ¬BEL(S, ¬*start*) -- that *finish* is the earliest stage some process S can truthfully deny. As far as S knows, earlier stages like *starting* are true.

---

104 In the sense that *having finished* 'entails' previously *having started*. This is one example of the disparity ...tween Harnish's abstract characterization of entailment and the intuitive – and, here, temporally-dependent – ...tion he is trying to capture.

105 According to Harnish, since *finishing* entails *starting*, *x finishing y* is equivalent to (viia). The denial of (viia) is ...ib).

(vii)
(a) (x started y) ∧ (x finished y)
(b) ¬(x started y) ∨ ¬(x finished y)
(c) ¬(x started y)
(d) ¬(x finished y)

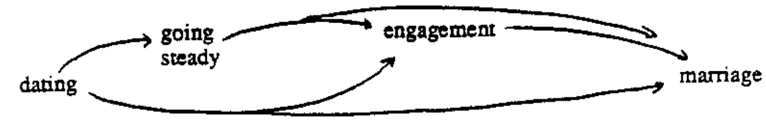
...early the truth of the first disjunct of (viib) ((viic)) is sufficient for the truth of the disjunction. So S might deny ...ia) simply by affirming (viic). By affirming (what is, in effect) the disjunction (viib) instead, S thus makes a ...aker statement than would be relevant and suitable if s/he could truthfully affirm (viic). So it must be that (viic) is ...se, i.e., that *x started y* is true. Of course, the truth of the second disjunct of (viib) ((viid)) is also sufficient for the ...th of (viib). So, by the same reasoning we might conclude that S is unable to affirm (viid) and that *x finished y* is ...e! The problem, of course, is that Harnish defines *finish* in terms of itself (i.e., *x finishing y* is equivalent to (viia)) ...d assumes an implicit ordering of conjuncts which his notation does not support.

Note that, in exchanges such as 160, B provides an indirect response to A's query, which we might

(160) A: Did you finish this?
B: I didn't start it.

interpret as an attempt to block the implicature that could be licensed by a simple denial of *finish* -- i.e., that lower values such as *start* are true or unknown to B.

Orderings such as these may be seen as *stages of a process* or *prerequisite* orderings and support scalar implicature. For example, assume the following ordering:



Then we can explain the following implicatures as affirmations of stages in this process: In 161, B implicates that the woman in question is

(161) A: So, is she married?
B: She's engaged.

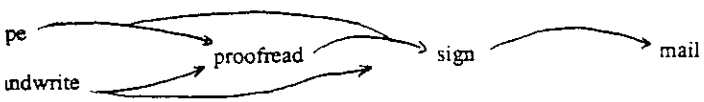
not married by affirming that she is engaged. Note that this response will not commit B to the truth of *going steady*, for example, although this state may sometimes precede engagement. So, process orderings need not be linear.

But note that expressions which may be seen as denoting process stages need not actually serve this function. In some contexts, for example, *taking the GRE's*, *writing a thesis*, *doing a project*, *taking a comprehensive exam taking prerequisites* and *taking electives* might be modeled as stages in a process of completing a Computer Science major. But it seems clear that, in an exchange like 162, these expressions are better seen

(162) A: O.K. And for Barnard students, they had to take either GRE or write a thesis, right? But for Computer Science I don't know what to do. Is there any project or...?
B: No, no, not. Our Department doesn't require any project neither a comprehensive exam, so all you need to do is fulfill the requirements which are a couple of prerequisites and four electives.

as an unordered set of prerequisites, rather than as stages in a temporally ordered process.

When orderings like these do include alternative or optional paths, such branching nodes may be seen, like hierarchical siblings, as alternate values in the ordering. For example, signing a letter may be preceded optionally by proofreading it, and also by the alternate stages of typing the letter or writing it out by hand, as represented below:



ıen, in an exchange like (163a), the affirmation of an alternative stage *typing a letter* licenses e

(163) A: Have you mailed that letter yet?
a. B: I've typed it.
b. B: I haven't proofread it.

ıplicature ¬BEL(B, *I mailed the letter*) about the queried higher stage and ¬BEL(B, ¬(*I* *rote the letter by hand*)) about the unqueried alternate value. Note, however, that B's terance of (163b) can implicate only ¬BEL(B, ¬(*type* ∨ *handwrite*)) -- not one particular sjunct.

So, not only do linear orderings, such as those discussed by Horn and Harnish, support alar implicature, but non-linear orderings do as well. Process stages may be ordered by either pe of metric.

1.10. Sets and Whole/ Part Relationships

Other non-linear orderings that support scalar implicature, which have not been discussed eviously in the literature, include set/ proper subset relationships[106] and part/ whole lationships. I have already noted some naturally occurring data in support of this claim (See amples 59 and 71.). Further examples of scalar implicature licensed via evocation of sets are esented below.

(164) A: Can you sing a Motels song right now?
B: Now?
A: Yeah.
B: My cousin can.

(165) A: Do you have apple juice?
B: I have grape or tomato or bloody mary mix.

(166) A: Have you ever knitted before?
B: I've done a lot of crocheting.

(167) A: I'll have a small lentil soup, and whole wheat bread.
B: We have rye, pumpernickel, and rolls.

s implicature in 164 that she is not able to sing a Motels song is also based upon affirmation a subset of a perceived set of relatives. Similarly, in 165 B evokes the set of juices to

[106] Defined over the non-null subsets of some salient set.

implicate ¬BEL(B, *I have apple juice*); by committing herself to the set *{grape,tomato,bloody mary mix}*, B does not commit herself to the set *{grape,tomato,bloody mary mix,apple}*, and thus, does not commit herself to *apple juice*. The exchanges in 166 and 167 involve similar implicatures. The set/ subset orderings that may permit scalar implicature are limited only by the imagination of conversational partners: For example, in 168, B's reply indicates that she has

(168) A: You should be able to log on to the VAX -- so long as you've had your granola.
B: I had grapefruit.

decided that the set of breakfast foods must be salient -- although this speaker later confessed to having been quite puzzled by A's remark.

The claim that speakers may implicate lack of commitment even to unmentioned members of some salient set is supported by the following exchanges: In 169, A clearly understands that B has implicated that no one other than her son and daughter live with her.

(169) A: Isn't there anybody waiting for you at home?
B: Yes there is...my son, my daughter.
A: No one else?

And, in 170, *S* blocks the potential inference that his

(170) Fine? Alright, get hold of a copy of the July 7 81 WSJ, next to the last page. You can get it down at the Logan Square Library or at any one of the major colleges in the area and, uh, Drexel, Temple, Villanova, Lasalle, St. Joe's, uh, Penn State [sic], Lidener [sic] -- I hope I didn't miss anybody. If I did it was unintentional...

list has exhausted the major colleges in the area. In sum, such exchanges provide evidence that, when *S* affirms a proper subset of some mentioned or inferable set *V*, s/he may implicate that s/he is unable to commit him/herself to unaffirmed members of *V*; in effect, by affirming a proper subset v_i, *S* may license ¬BEL(S, v_j) where $v_i \nvdash v_j$ and v_i and v_j are non-null and are in the power set of *V*.

A more complex example of how speakers may license scalar implicature by evoking set-inclusion relationships is presented in 171:

(171) 1) A: Let me just check whether you have all the prerequisites. You have Calc 1 and 2?
2) B: Uh-hmm.
3) A: You have Introduction to Programming?
4) B: Oh, yeah.
5) A: You have Data Structures, Fundamental Algorithms.
6) B: No, I don't have Fundamentals.
7) A: O.K.
8) B: Or Comput[ability].

9) A: O.K., so you'll need Fundamentals, Comput[ability]. You have...
10) B: I'll have to take Finite Math, too.
11) A: O.K. You have Discrete Math?
12) B: Yeah, I have it and I have Assembly Language.
13) A: O.K., and do you have any electives?
14) B: Yeah, I have one -- Intermediate.
15) A: O.K., so you need three more electives, and you need Comput[ability], Discrete...Finite Math?
16) B: Finite Math and Fundamentals.

In lines (3) and (5) of this example, A, a faculty adviser lists prerequisite courses for a computer science major for B, a student. In (6), by denying a singleton subset of the set {Data Structures,Fundamental Algorithms} listed in (5), B implicates that s/he has taken the undenied member, *Data Structures* – that is ¬BEL(B, ¬*Data Structures*). In (10), B corrects A's implicature from (9) that the set {Fundamentals,Computability} will exhaust the set of required courses B has yet to take; implicitly, A has conveyed ¬BEL(B, *Finite Math*) -- that, as far as A knows, B will not have to take Finite Math – so B corrects that implicature. In (12), B adds that s/he has taken *Assembly Language* when questioned about *Discrete Math*. A simple response of '*yes*' to (11), s/he may believe, could encourage A to conclude that ¬BEL(B, *I have Assembly Language*). So, B blocks that potential inference in (12). Finally, B corrects the apparent implicature licensed by A in (15), that A has mentioned all the courses B has left to take – hence ¬BEL(B, *courses other than those mentioned in (15)*) -- by adding that s/he must also take *Fundamentals*.

The implicatures speakers license by the enumeration of part(s) of a whole are similar to those licensed by the mention of a proper subset – conveniently enough, since particular examples may often be interpreted in either framework. For example, in 172, B implicates he has not read the other half of the book;

(172) A: Did you finish the book?
B: Half of it I read.

in 173, B corrects A's implicature that ¬BEL(A, *there is no air-conditioning in other rooms of the house*).

(173) A: I've been told there's no air-conditioning in my bedroom.
B: There's no air-conditioning anywhere in the house.

In each case, these exchanges might just as easily be analyzed in terms of set/subset relations. However, since the implicatures licensed by asserting a proper subset are identical to those licensed by asserting part(s) of a whole – i.e., both represent lower values in a salient ordering -- the choice is unimportant for this analysis.

5.1.11. Type/ Subtype, Instance-of, and Generalization/ Specialization Relationships

Scalar implicatures may also be licensed by reference to items related by a type/ subtype, instance-of, or generalization/ specialization relationship. So, in 174, B implicates ¬BEL(B, *I have Italian*) by affirming the alternate value *vinaigrette* in an ordering of *types of salad dressings*.

(174) A: What kind of salad dressing do you want?
B: Do you have Italian?
A: Vinaigrette.

In 175, B conveys that she does have a form of *paste* by affirming the subtype, *rubber cement*.

(175) A: You don't have paste, do you?
B: Rubber cement.

Note here that, since the truth of a subtype v_j entails the truth of its type v_i, v_j will represent a higher value than v_i and sibling subtypes v_j and v_k will represent alternate values for the purpose of calculating scalar implicatures. So, *S* may affirm a type to convey lack of commitment to a subtype, may deny a subtype to affirm a type, or may affirm or deny one or more subtypes to convey the opposite commitment to alternate subtypes.

Even MARGINAL or ATYPICAL subtypes[107] may license scalar implicatures. In 176, for example, B's affirmation of *vitamins* conveys that his child is not taking

(176) A: Is she taking any medication?
B: Vitamins.

any other medications, although *vitamins* itself is not clearly a type of medicine. And B's response in 177 conveys that she does not have

(177) A: Do you have a pet?
B: We have a turtle.

other pets. Because the affirmation of a marginal subtype can be employed to implicate ¬BEL(*S*, other subtypes), responses such as those in 176 and 177, as in 178 below, may be interpreted as either *yes* or *no*, depending upon whether *H* believes vitamins constitute medication, turtle constitutes a type of pet, or allergies constitute sickness.

(178) A: Are you sick?
B: I've got allergies.

S's implicature will, however, be independent of *H*'s understanding that *S* has given a positive response or a negative one.

[107]Items whose membership in the type v_i is debatable, as, penguins are generally classified by subjects as marginal or atypical members of the category of birds. See [Rosch 75, Jolicoeur 84].

Scalar implicatures licensed via type/ subtype relationships are similar to those that may be licensed by evocation of instance-of or generalization/ specialization relationships. For example, in 179, B may implicate ¬BEL(B, *that will be Visa*)

(179) A: Will that be Visa?
B: It'll be a charge.

by affirming *charge*. And, in 180, where the relationship between *outside* and *car* clearly cannot

(180) A: Is he outside?
B: He's in the car.

be seen as one of type/ subtype, the fact that B may convey commitment to *outside* by affirming *in the car*, suggests that B may implicate ¬BEL(B, *he's in the car*) by affirming *outside*, as in 181, or convey

(181) A: Is he in the car?
B: He's outside.

¬BEL(B, *¬he's outside*) by denying *in the car* in 182 based upon a generalization/ specialization ordering.

(182) A: Is he outside?
B: He's not in the car.

Like implicatures licensed via evocation of set/ subset and part/ whole relationships, scalar implicatures licensed by mention of members of type/ subtype, instance-of, and generalization/ specialization relationships are difficult -- but, for our purposes, unnecessary -- to tell apart.

5.1.12. Entity/ Attribute Orderings

Finally, scalar implicatures may also be licensed by evocation of an entity/ attribute relationship, as in 183, 184, 185, and 178. In 183, for example, B implicates that he cannot commit himself to the queried proposition *there is an opera on* by affirming

(183) A: Is there an opera on?
B: There's a recorded one.

an attribute of an opera presentation (*recorded*). B is not sure a recorded opera constitutes having an opera on, so says 'as much as he truthfully can' by affirming an attribute. Likewise, in 184, B

(184) A: Are you a doctor?
B: I have a PhD.

affirms an attribute of some *doctors* to implicate her inability to commit herself to *being a doctor*.

Speakers may also license implicatures about their commitment to other attributes by affirming or denying some attribute of an entity. In 185, B implicates ¬BEL(B, *I am Greek*) by affirming an attribute of Greek people (ability to speak the language). By affirming an attribute, in effect,

(185) A: Are you Greek?
B: I speak some Greek.

a speaker may convey that s/he is unable to affirm the entity itself, i.e., in 185, Greek nationality.

If a mentioned attribute is a definitional characteristic of a salient entity, it seems that the affirmation of this attribute should also affirm the entity -- by logical implication. Thus, implicatures based upon entity/ attribute relations seem likely to involve only non-definitional attributes. However, it is difficult to discover attributes for any class which are truly definitional -- e.g., dogs have four legs but a three-legged dog is still a dog. And the affirmation of even truly definitional characteristics when *S* might, with equal effort, have affirmed the entity itself, seems to convey that *S* is unwilling to commit him/herself to the affirmation of the entity, as in 186.

(186) A: Are whales mammals?
B: They have lungs and are warm-blooded.

S may also affirm an attribute to convey his/her inability to commit him/herself to other attributes which may be salient in the discourse, as in 187.

(187) A: Do you speak Greek?
B: I've spent some time there.

Of course, if the salient relationship here is implication (so that *living in Greece* implies *knowing Greek*), a different meaning will be licensed. Similarly, if *S* denies an attribute, as in 188, s/he may confirm other attributes, unless a prerequisite

(188) A: Do you speak Greek?
B: I've never lived there.

relationship rather than an entity/ attribute one is salient.

In sum, where v_i and v_j are attributes of some entity v_k, v_k can be seen as a higher value than v_i and v_j, and v_i and v_j can be seen as alternate values in this ordering of an entity with its attributes.

5.1.13. Summary

The orderings that permit speakers to license scalar implicatures thus range from those relatively domain-independent 'canonical' orderings inspired by the logical quantifiers and connectives to domain-dependent entity rankings -- and from linear orderings to hierarchical orderings. While most orderings which support Horn's scalar predication, Harnish's quantity-quality implicature, and Gazdar's scalar quantity implicature also support scalar implicature, there are a number of exceptions: Scalar implicature is supported by Horn's quantifier, modal, logical connective, cardinal and ordinal orderings, although I have formulated different accounts of implicatures licensed by the numerical orderings and additional orderings that may be derived from the logical connectives. While Harnish's notion of all-implication can be subsumed under the latter, I have argued that his concept of implicatures licensed via 'specification of assertion' contradicts not only intuitive interpretations of his examples but also his own accounts of quantity-quality implicature. Grice's notion that indefinites and definites can be ranked is clearly subsumable by scalar implicature, although just as clearly definiteness and indefiniteness can be given a more sophisticated analysis than scalar implicature provides. Many authors have identified ranked entities, states, actions, and attributes, including epistemic verbs and other hedges; I have identified still more, including orderings of verb/ preposition pairs; all support scalar implicature. From the temporal orderings noted in the literature as supporting quantity implicature, I have formulated a new analysis of the scalar implicatures that temporal references may license. I have also proposed that spatial and process/ prerequisite orderings support scalar implicature; although Harnish implicitly recognizes the latter, his justification is flawed. In addition to the linear orderings to which previous research has confined quantity implicature, scalar implicature may also be licensed by mention of values ranked in orderings such as set/ proper subset, whole/ part, type/ subtype, generalization/ specialization, instance-of, and entity/ attribute relationships.

While it might be possible to extend this listing process to produce an ostensive definition of the orderings that support scalar implicature, a more general definition is clearly to be preferred. Even if an exhaustive list of such orderings were possible, mere listing is theoretically unsatisfying. In practical terms, it would require that each such ordering be predefined, with no principled basis for including or excluding additional, perhaps domain-dependent orderings. In any event, orderings such as 168 indicate that exhaustive listing is impossible: People can and do form scales from items that may bear little intrinsic relationship to one another; these scales are hard to predict outside the context in which they are evoked.

5.2. Defining Scale

Horn, Harnish, and Gazdar have all attempted to characterize the orderings that support quantity implicature by some form of entailment. Although all have recognized flaws in this approach, none has devised a satisfactory substitute. In this section, I will examine previous attempts at characterizing these 'scales', look at proposed definitions of these scales, and point out their deficiencies.

5.2.1. Limits of an Entailment Condition

As noted in Section 3.2.1, Horn notes serious weaknesses in his own entailment definition of scale -- even for his canonical scales. For example, the largely intuitive definition Horn has been forced to propose for his quantifier orderings (See Section 5.1.1.) poses a serious problem for his entailment condition: The idea that *all x* entails *some x* may be satisfying from an intuitive if not a logical point of view. However, as Horn notes, *some/ all* represents only a portion of people's notion of a quantifier ordering; a more complete ordering would include the negative pole as well -- *no(ne)/ some/ all*. But clearly we would not want to say that *all x* entails *no x* – nor that (189b) semantically entails (189a).

(189)
a. None of the people left early.
b. All of the people left early.
c. #No people left early and in fact everybody did.

Although (189a) may indeed convey that ¬(189b), it does not convey this meaning via conversational implicature; the infelicity of (189c) shows that (189a)'s conveyance of ¬(189b) is not cancelable. Horn simply omits these poles from his quantifier orderings.

For modal orderings too Horn omits negative poles, lest *possible* entail *impossible* and *permissible, impermissible*. Again, in exchanges such as 190, the affirmation of the negative pole *impossible*, while conveying that higher values

(190) A: I'm beginning to think finding a lover is impossible. B: It's not impossible....

possible and *necessary* are false, does not convey this meaning via conversational implicature. So, again, negative poles must be omitted from such orderings -- not only to preserve an entailment condition, but also to predict possible conversational implicatures correctly.

Although this truncation strategy seems reasonable – if counter-intuitive – for quantifier and modal orderings, it is less easily applied to orderings like the miscellaneous modifiers discussed in Section 5.1.6.3. Again, a full specification of an intuitive ***degrees of attractiveness*** ordering -- say, *hideous/ ugly/ plain/ pretty/ beautiful* -- cannot be defined by semantic entailment -- lest *beautiful* entail *hideous*, for example. But while it may be sufficient to omit negative poles from quantifier and modal orderings, it is less clear how best to mutilate modifier orderings. It is easy to say that *beautiful* does NOT entail *hideous* or *ugly* -- but does it entail *plain* – or even *pretty* for that matter?

For the temperature scale *cold/ cool/ tepid/ warm/ hot*, Horn tries to resolve a similar dilemma. He claims that while the assertion of *warm* implicates *not hot*, the assertion of *cool* cannot implicate *not warm*; instead, *cool* asserts the negation of *warm*. The difference between the two cases for Horn is the difference in felicity between (191a) and (191b).[108]

(191)
a. #The soup is cool if not warm.
b. The soup is warm if not hot.

On this basis, Horn divides the temperature scale into halves, *cool/ cold* and *warm/ hot*, with *cold* the positive pole of its half. So, *hot* entails *warm* but not *cold*, and *cold* entails *cool*. Middle values like *lukewarm* remain a problem, since they do not seem to be entailed by either *cold* or *hot*. But Horn's solution for this ordering – as for *degree of attractiveness* above -- seems a misguided attempt to save his entailment condition. If we accept that a hot soup is NOT therefore also a cold soup, can we really accept that it IS a warm soup? Whatever *hot* entails about *warm*, e.g., *A hot soup is not only warm, it's hot.*, it should also entail about *cold*. Or are all these values just mutually exclusive states. At any rate, note that, in naturally occurring discourse (192), *cold* and *warm* seem to be perceived as values on a common scale -- and as licensing particular implicatures via their relative positions.

(192) A: It's cold out here.
B: It's not warm.
.....
A: Why didn't you just say 'yes'?
B: Because then you'd think I thought it was colder than it really is.

For B, *not warm* appears to convey ¬BEL(B, *¬it's cool*) as well as ¬BEL(B, *¬it's cold*); that is, B denies *warm* to implicate his lack of commitment to the falsity of all lesser values on a temperature ordering. B can deny only warm and nothing less than that. So, in this case, Horn's splitting strategy would not explain B's implicature.

Implicatures licensed in 193 and 194 provide further evidence that modifier orderings should not be divided: In the former, A implicates ¬BEL(A, *¬they're all right*) and ¬BEL(A, *¬they're bad*) on a modifier ordering *bad/ all right/ good*, while B

[108] Horn distinguishes between the two in terms of SUSPENDIBILITY (See Section 5.2.2.); a cool/ warm relationship is not suspendible, while a warm/ hot relationship is.

(193) A: They're not very good though. The camera's lousy.
B: But they're not bad.

(194) A: Did you do all right?
B: I didn't do that good, you know.

implicates ¬BEL(B, *¬i did all all right*) and ¬BEL(B, *¬i did (good) well*) from the reversed ordering *good/ all right/ bad* -- that is, A and B have evoked differently oriented value orderings.[109] The conclusion from this exchange was that 'the pictures are all right' -- the intersection of the speakers' implicatures ¬BEL(*S*, *¬they are all right*). In 194, B implicated ¬BEL(B, *I did all right*).

While quantifier, modal, and some modifier orderings may be truncated or split, orderings such as the temporals and process/ prerequisites discussed above are more difficult to accommodate within an entailment definition. As noted in Section 5.1.7, truth of v_i in the future clearly does not entail the truth of v_i in the present or past. And while process orderings might be considered entailments in the sense that accomplishing stage v_j in a process 'entails' having accomplished stage v_i, this notion of entailment is far from the one or two-sided logical implication usually employed to define semantic entailment. And, of course, orderings such as *tort/ misdemeanor/ felony/ capital crime* and other ranked entity orderings (See Sections 3.2.1 and 5.1.6.1.) simply cannot be defined in terms of even the most general notion of entailment. In consequence, Horn proposes a more general definition of scale – in terms of SUSPENSION.

5.2.2. Defining Scales by Suspension

Throughout his discussion of miscellaneous scalar predicates, Horn is concerned with identifying linguistic constructions that favor 'upper-boundedness' as a means of identifying additional scalar predicates. For example, he identifies 'scalar clues' in items like *downright* and *absolutely, let alone, even, only*, and *just*. So, when it becomes clear that his entailment definition of scale must be abandoned, Horn proposes an alternate definition via certain of these constructions.

Constructions like those represented in 195 suggest that *unattractive/ hideous*, *colonel/ general*, *good/ great*, and *unpleasant/ obnoxious* may be seen as (parts of) scales.

[109] See Section 6.3.2.3 for a discussion of the hypothesis that mentioned poles can indicate the orientation of evoked orderings.

(195)
a. George is unattractive if not {downright/absolutely} hideous.
b. Frank isn't a colonel let alone a general.
c. This picture is good even if it isn't great.
d. Leo isn't obnoxious, {just/only} unpleasant.

In each case the explicit relation of v_i to v_j appears to assert the upper-boundedness which *S*'s assertion of v_i (alone) might implicate. Similarly, Horn notes that modification of a (possible) scalar predicate by *too*, as in 192, can also provide a test of scale.

(196) It's cold out but it's too warm for skiing.

'*Too* v_j', he explains, conveys that a weaker element on a scale than that which actually holds should hold. So, if it's *too warm*, then some v_i less than *warm* (e.g., *tepid*, *cool*) should hold.

Horn proposes to employ one class of such constructions, SUSPENDERS, which he exemplifies by *X if not Y* -- or, v_i *if not* v_j -- as a substitute for his entailment definition of scale. Suspenders are so termed because they function to suspend implicatures that might be licensed by the utterance of v_i alone. Some examples are shown in Table 5-1:

childish if not infantile	middle-aged if not old
acceptable if not attractive	satisfied, if not pleased
unusual if not unprecedented	excellent if not perfect
glossed over if not entirely overlooked	possible if not probable
lukewarm if not downright unsympathetic	some if not many

Table 5-1: Horn's Suspenders

While the first member of each pair may 'suspend' the second, the converse is not true; so, for example, '*many if not some*' is infelicitous if not contradictory.

From these suspensions, a scale *Sc* can be defined as follows: If 'p_i *if not* p_j' is a felicitous utterance but 'p_j *if not* p_i' is not, then p_j is a higher value than p_i on *Sc*. These scales need not be linear but may be hierarchical; that is, scalar predicates need only be partially ordered.[110] Horn further notes that these scales may be infinite, as for the cardinals. Horn explains that all his entailment-defined scales can also be defined by felicity of SUSPENSION (See Section 2.4.2.1.). For example, a quantifier scale *some/ many/ most/ all* might be defined as in 197. Note particularly that (197d) is infelicitous; so, this suspension definition produces the 'right' results for negative poles.

[110] Horn clearly does not use partial order in the technical sense here, since he goes on to allow cycles, such as *days of the week* or *months of the year* as scales. (In fact, these ostensible cycles must be interpreted as linear to support quantity implicature, as I discuss in Section 5.3.1.)

(197)
a. Some if not many of the people left early.
b. Many if not most of the people left early.
c. Most if not all of the people left early.
d. #None if not some of the people left early.

Moreover, suspension can also define scales for which entailment definitions are suspect if not downright impossible, as in 198 (*condone/ promote*), 199 (*sick/ dying*), and 200 (*misdemeanor/ felony*).

(198) [George Jackson's] jailers condone racial prejudice, if they don't promote it.

(199) Camille is sick if not dying.

(200) Smoking marijuana is a misdemeanor if not a felony in every state of the union.

However, while a suspension definition of scale does indeed accommodate relationships which support scalar predication but which an entailment definition excludes, it is unsatisfactory in other ways: First, definition of scale by felicity of suspension is clearly an unsatisfactory solution from a computational point of view, unless all scales are to be predefined as such or felicity judgments are to be solicited interactively. Second, while values 'close together' on a scale may felicitously be suspended (as in (201a)) to define a suspension scale, attempted suspension of others is less clearly felicitous (as in (201b)).

(201)
a. one if not two
b. one if not forty
c. thirty-nine if not forty

Given only the suspension test and (201b), *one* and *forty* will not appear on single scale. However, if (201a) and (201c) were instead the first and final pairs in a list of cardinal suspensions, the cardinal scale would be definable by suspension. Since suspension appears thus not to be transitive, a definition of scale based on suspension will succeed for Horn's scales only if individual suspension pairs are carefully chosen. And note also that it is not clear that 'forty if not thirty-nine' is infelicitous, as, for example, in 202.

(202) George isn't as old as he looks. I'm not sure how old he really is but I think he's only about forty if not thirty-nine.

So, Horn's suspension definition of scale will not in fact define the cardinals as scales, since it is possible to assert 'thirty-nine if not forty' and 'forty if not thirty-nine'. Third, as noted in Section 2.4.2.1, phenomena other than conversational implicatures are suspendable, including conventional implicature, presupposition, and even entailment. So, Horn's proposed definition will identify scales such as *only vote/ did vote* from (203a) and *bald/ exists* from (203b).[111] So, while

(203)
a. Only Muriel voted for Humphrey if even she did.
b. The king of France is bald if there is a king of France.

a suspension definition of scale will accommodate those scales that entailment does not, it will also identify scales that do not support quantity implicature.

In sum, Horn's entailment definition of scale is too restrictive; yet his alternative suspension definition is both too weak, including as scalars items which clearly do not support the class of quantity implicatures he wants to define, and too constrained, excluding scales Horn would wish to include.

5.2.3. Gazdar's Definition of Scale

In adapting Horn's notion of scalar predication for computational use, Gazdar attempts a more formal definition of scale. For him, the chief difficulty in defining a quantitative scale is enforcing that items ordered on a scale be qualitatively similar as well as quantitatively ordered. For example, how can *believe/ know* be defined as a scale but not *regret/ know*?

Initially, Gazdar proposes that "identity of selectional restrictions" or "identity of item-induced presuppositions" might serve as similarity criteria. In [Gazdar 79a] he suggests that Thomason's [Thomason 72] notion of SORTAL CORRECTNESS (See Section 4.1.1.) might serve to constrain values on a single scale. He finds Thomason's definition too broad, allowing quantitative orderings such as *John/ person*, which do not support scalar implicature.[112]

In the end, however, Gazdar must abandon this attempt at a formal definition of scale, adopting the view that 'semantic informativeness' is a pragmatic notion that cannot be captured by the concept of semantic entailment. As noted in Chapter 4, Gazdar effectively accepts an entailment definition of scale for the purposes of demonstrating his formalism, assuming that such scales will be 'given'.

---

[111]Note that Horn does not limit his 'suspenders' to 'if not', but includes those in this example.

[112]In fact, a *person/ John* ordering does support scalar implicature, as a generalization/ specification ordering:

(viii) A: Did John stop by today?
B: A person did.

5.2.4. Other Definitions of Scale

While analyses of other linguistic phenomena, such as *let alone* [Fillmore 83], *all but, at that*, and *much less* constructions, polarity [Fauconnier 75] -- and other forms of conversational implicature [Fauconnier 79] have centered upon a notion of scale, these analyses too have foundered on the inadequacy of an entailment definition of scale and the difficulty of finding an alternative. Other discussions of polarity [Ladusaw 80],[113] pragmatic phenomena such as TOPICALIZATION [Prince 81b], EPITOMIZATION [Ward 83], and FOCUS/ CENTERING [Joshi 81, Grosz 83], and prosodic phenomena such as CONTRASTIVE STRESS [Culicover 83] and FALL-RISE intonation [Ladd 80] have proposed simple set membership or functional dependency to account for the relationship between an utterance and its context and the additional meanings that their phenomena may license. However, as noted above, simple set membership represents only one of the metrics which support scalar implicature, and, clearly, many scalar implicatures cannot be explained in this framework.[114] And [Joshi 81, Grosz 83] acknowledge that their 'functional dependence' is only an approximation of the relationship they intend.[115] So, from previous studies of quantity implicature -- and from work on other linguistic phenomena based upon 'strength of claim', the general consensus is that, while some metric for ranking utterances must be found, the most acceptable choice, entailment, is simply inadequate.

5.3. Ranking Utterances via Posets

From the discussion in Section 5.1 it should be clear that a satisfactory characterization of the orderings that support scalar implicature must accommodate not only orderings defined by entailment, but also orderings which Harnish, Horn, and Gazdar have identified as supporting quantity implicature that are not defined by entailment, as well as the additional orderings I have identified above which are neither linear or not defined by entailment. In this section, I propose a new definition of this group of relations and argue that only these relations support scalar implicature. I then demonstrate how, given this new characterization, it is possible to specify definitions of higher, lower, and alternate values among ordered items and thus to complete the formalization of the scalar implicature conventions I proposed in Section 3.3.

---

[113]Ladusaw in fact proposes that Fauconnier's entailment scales be defined as sets: So, for example, he claims that *father* entails *man* because the set of fathers is a subset of the set of men; and, if p_i entails p_j then the set of circumstances under which p_i is true must be a subset of the set of circumstances under which p_j is true; so 'be a father' $\subseteq$ 'be a man'.

[114]In fact, as I will propose in Chapter 8, set membership appears to be insufficient to explain some of the phenomena for which it has been employed.

[115][Ward 85b] discusses how the notions of utterance ranking proposed here might provide a reasonable substitute.

Above I have used the terms *relation*, *ordering*, *scale*, and *ranking* loosely to refer to those relationships among expressions or among the things denoted by expressions that serve to support scalar implicature. Before proceeding to a general account of these metrics, I will specify a more precise terminology: Henceforth, I will define orderings to be (mathematical) RELATIONS as follows: Let V be a set. Then a RELATION O on V is a subset of $V \times V$. The ordered pair $<v_i,v_j> \in O$ is commonly denoted by v_iOv_j. The metric by which such a relation is constructed I will term the ORDERING METRIC of the relation, or, simply, its METRIC.

5.3.1. Relations Not Supporting Scalar Implicature

Above I have characterized the relations that support scalar implicature by listing those that do indeed support the phenomenon, much as previous authors have done. However, we can also specify which relations do not support scalar implicature. I have already established that a relation supporting scalar implicature does so by providing a way to determine, for any two items ordered in that relation, whether one item is higher or lower than another, or whether the two are alternates with respect to some common higher or lower value. So, relations that do not support scalar implicature are just those which fail to support such distinctions. These orderings include CYCLIC relations[116], temporal parallelism, and, in general, relations that are not both REFLEXIVE[117] and ANTISYMMETRIC[118] or relations that are not both IRREFLEXIVE[119] and ASYMMETRIC[120] -- as well as relations that are not transitive[121]

First, consider the cyclic relation evoked in the constructed 204. We can reasonably assume that the squares on a monopoly board constitute a cycle from our knowledge of board games.

---

[116]A CYCLE is a finite chain of edges connecting vertices $(v_i,...,v_n)$ for which v_i coincides with v_n. That is, there is a (unique) path from v_i to itself.

[117]A relation O on a set V is reflexive iff for all $v_i \in V$ v_iOv_i. *Is_a_legal_representative_of* is a reflexive relation on the set of independent adults, for example, since each member of this set is his/her own legal representative.

[118]A relation O is antisymmetric iff for all v_i, $v_j \in V$ v_iOv_j and v_jOv_i implies $v_i = v_j$. The relation *is_as_tall_or_taller_than* is an antisymmetric relation.

[119]A relation O is irreflexive iff for all $v_i \in V$ $v_i \not{O} v_i$. So, *brother_of* is irreflexive, since no man is his own brother.

[120]A relation O on V is asymmetric iff for all $v_i,v_j \in V$, if v_iOv_j then $v_j \not{O} v_i$. The relation *is_taller_than* is asymmetric.

[121]A relation O is transitive iff for all v_i, v_j, $v_k \in V$, v_iOv_j and v_jOv_k implies v_iOv_k. So, a non-transitive relation is simply a relation for which this transitivity condition fails to hold. *Sibling_of* represents a transitive relation, while *friend_of* represents a non-transitive relation. If I am Mary Jo's sibling and Mary Jo is Henry's sibling, then I am also Henry's sibling. However, if Neal is Martha's friend and Martha is Derek's, it need not follow that Neal is also Derek's friend.

(204) A: Did you pass Go on that turn?
B: I got to Free Parking.

But, if B's response evokes this relation in the discourse, his/her response will be ambiguous. For, *getting to Free Parking* may or may not have involved *passing Go*. So, *Free Parking* will be both a HIGHER and a LOWER value than Go, since one is spatially located both 'before' and 'after' the other. Since the ranking of these two items with respect to one another is thus ambiguous, A has no basis for interpreting B's response -- nor B for calculating how his/her response will be interpreted, if a cyclic relation is perceived as salient. However, if B perceives the relation of *Free Parking* to *Go* to be linear rather than cyclic, and also believes *Free Parking* is ordered **before** *Go*, then B may implicate ¬BEL(B, *I got to Go*) by the response in 204. Alternatively, if B linearizes this cycle such that *Free Parking* is ordered **after** *Go*, his/her response may be interpreted as "I not only passed Go but I got as far as Free Parking."

Similarly, in 205, if the process of playing cards is seen as

(205) A: Have you shuffled the cards?
B: We've finished the game.

circular, B will be unable to convey any scalar implicature by this response. *Finishing a game* may be seen as both HIGHER and LOWER than *shuffling the cards* in this exchange. So, B might convey either that s/he hasn't shuffled because s/he doesn't intend to play another game, or s/he may be conveying that not only has s/he shuffled the cards -- but in fact s/he's finished a game.

Convention or context may suggest the linearization of these cycles to permit scalar implicature. For example, cycles such as days of the week or month, months of the year, and global spatial orderings appear to have conventional linearizations. With no further specification of context, B's response in (206a) is likely to be

(206) A: Will the report be finished by the 30th?
a. B: The first.
b. B: The fifteenth.

interpreted as *no*. *The first* will be seen as that subsequent to the queried *thirtieth* rather than the *first* preceding it, perhaps because of some convention that conversational participants assume the closest value to the queried value in these linearizations when ambiguity exists. In (206b), with *thirtieth* and *fifteenth* diametrically opposed in the cycle, it is less clear that hearers will prefer one interpretation over another, unless perhaps some principle of ellision might be proposed such that, all other things being equal, reference to a month other than that of the deictic temporal center requires specification of that month.

So, cycles will not permit scalar implicature -- unless, by some such linearization, they become non-cyclic. For, any values v_i, v_j in a cyclic relation O must both precede and succeed itself; that is, both $v_i O v_j$ and $v_j O v_i$. So, (the transitive closure of such) cycles are symmetric.[122]

Other symmetric relationships, like *sibling_of* in 207, also fail to support scalar implicature:

(207) A: Is John Bill's brother?
B: Mark is John's.

If A knows that Mark is also Bill's brother, B's response will allow him to deduce the direct response *no*. However, note that this conclusion would come not from implicature but from deduction. No scalar implicature can be licensed by this response.

A relationship such as temporal parallelism also fails to support scalar implicature. If *watching television* and *sitting down* are seen as related only in that they may be performed at the same time[123] in 208,

(208) A: Are you watching television?
B: I'm sitting down.

then, not only will no scalar implicature be licensed, but B's response will probably not be deemed cooperative -- or even coherent -- by A.

Also, relations that are not transitive fail to support scalar implicature. For example, a response of (209a) cannot be interpreted as conveying a scalar implicature via the linear *isa_friend_of* relation apparently evoked, because such a relation is not transitive.

(209) A: Is Jane Mary's friend?
a. B: She's George's friend and George is Mary's.
b. B: George is.

While A might infer that B does not believe Jane is Mary's friend, simply from B's failure to provide a direct response, this inference will not be conveyed via scalar implicature. But A cannot conclude that the proposition *'Jane is Mary's friend'* is either true or false unless she infers that B believes the *isa_friend_of* relation is transitive. Otherwise, B's additional information provides no basis for either implicature or deduction of a direct response. A response of (209b) can, of course, license the scalar implicature ¬BEL(B, *Jane is Mary's friend*) via a set/ subset relationship.

Consider finally the relation of 'liking', which is neither reflexive and antisymmetric nor

[122] A relation O on a set V is symmetric iff, for all $v_i, v_j \in V$, $v_i O v_j \Rightarrow v_j O v_i$.

[123] They may be seen in other relationships that do support scalar implicature, such as members of the set of possibly activities or in a prerequisite relationship, of course.

irreflexive and asymmetric, and which is not transitive. Then B's response of (210a) will not permit the licensing of scalar implicatures:

(210) A: Does Jane like Mary?
a. B: Mary likes Jane.
b. B: Harry likes Arthur.

In fact, it is difficult to know what conclusions to draw from (210a). It might be that B means to convey that, indeed, Jane must like Mary since Mary likes Jane. But it might also be that B conveys ignorance of whether or not Jane likes Mary. While the latter might seem a more likely interpretation, consider that (210b) will license the same implicature. So, it is not an ordering by 'liking' that supports the inference, but rather the set of liking relationships that B evokes given this interpretation of (210a) and (210b).

In sum, the relations that support scalar implicature -- including those relations identified previously in the literature as well as the orderings I have proposed above -- turn out to be just the class of PARTIALLY ORDERED SETS, or POSETS.[124]

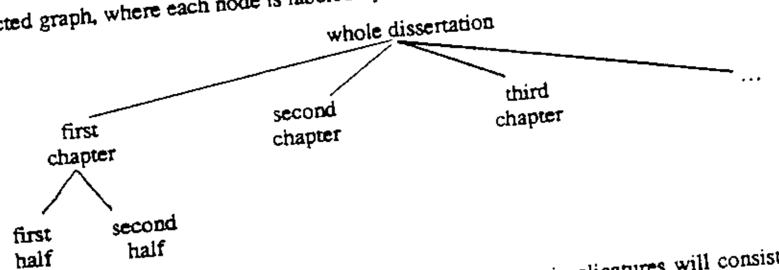
5.3.2. Poset Rankings

A partially ordered set or poset is defined in terms of a set V and a metric σ that partially orders it and denoted by $[V,\sigma]$. Posets supporting scalar implicature may be defined over (expressions that denote) entities, actions, attributes, times, places, or concepts, including those concepts ordered in Horn's canonical quantifier, modal, and number scales -- or any other items. So, a property may be ranked with respect to some entity which exhibits it via an *attribute_of* relation; an event may be ranked with other events according to temporal precedence; types and their subtypes may be ordered in an *isa* hierarchy; actions related by a *prerequisite_of* metric; subsets of a set ranked with respect to one another by an inclusion relation; and so on. Thus, a poset condition on scalar implicature allows us to accommodate not only linear but hierarchical orderings (ordered from root to leaf) in a single concept, and consequently provide uniform definitions of the HIGHER, LOWER, and ALTERNATE predicates introduced in Chapter 3.3.4.

[124] While posets are commonly defined as orderings that are reflexive, antisymmetric, and transitive, Knuth notes that posets may be defined equivalently as irreflexive, asymmetric, and transitive [Knuth 73:258-59]. A relation satisfying the first definition of poset is *is_as_tall_or_taller_than*, and one satisfying the second is *is_taller_than*. Note that one can always start with a relation R_i satisfying the latter definition and produce one satisfying the former R_j simply by adding the ordered pairs $v_i O v_i$ for all v_i in V. In effect, R_j will represent the transitive and reflexive closure of R_p as with *is_taller_than* and *is_as_tall_or_taller_than*. Not only do all the orderings discussed above satisfy one of these definitions of poset, but any poset -- in an appropriate context (See Section 6.3.2.3.) -- can support scalar implicature.

5.3.2.1. Defining Posets over Expressions

Posets are defined not over entities, actions, and so on, but over expressions (as defined in Section 4.1.2.2), or semantic representations, which correspond or refer to them. For example, model we might conceive of an ordering 'parts of a dissertation' defined over the set of *dissertation parts* by the metric *isa_part_of*. For such a conceptual ordering, we can define a corresponding partial ordering on expressions, such as *first chapter*, *first half*, *whole dissertation*, that refer to these parts. Such a poset might be represented by the following directed graph, where each node is labeled by such an expression:



So, the partial orders which we may use to calculate scalar implicatures will consist of sets of expressions, ordered via their correspondence to real-world entities and relationships, much as Gazdar defines his scales in terms of expressions (See Section 4.1.2.2.). (In a database environment, this level of representation is equivalent to the modeling of entities and relationships 'in the world' by database entities and relationships.)

Now we can require that, for S to license a proposition represented by some sentence p_j by an utterance represented by a sentence p_i, p_i and p_j must be related by the presence in p_i and p_j of expressions e_i and e_j, respectively, which can be partially ordered by some salient σ. Alternately, we might say that p_i and p_j must be related by some e_i and e_j which appear in some salient poset O. In either account, S's belief that some partial ordering relation is mutually believed salient by S and H is a necessary condition of scalar implicature.

5.3.2.2. Higher, Lower, and Alternate Values

With poset to substitute for Horn's and Gazdar's 'scale' and Harnish's 'measures of informativeness', it is now possible to provide a semantics for the notions of HIGHER, LOWER, and ALTERNATE values used throughout the previous discussion of scalar implicature. In particular, we can provide definitions of the HIGHER, LOWER, and ALTERNATE predicates which were stipulated in Chapters 3.3 and 4.

For any partial ordering O on a set of expressions E, for all $e_i, e_j \in$ E, $e_i \neq e_j$[125]:

1. e_j is HIGHER than e_i wrt O iff $e_i O e_j$;
2. e_i is LOWER than e_j in O iff $e_i O e_j$;
3. e_i and e_j are ALTERNATE values in O iff e_i and e_j are INCOMPARABLE ELEMENTS[126] of O and there exists some $e_k \in$ E such that e_k is higher than both e_i and e_j or e_k is lower than both e_i and e_j in O.

These possible orderings of e_i and e_j in O are illustrated in the constructed example 211, where O is the ordering depicted above, 'parts of a dissertation'.

(211) A: Did you read the first chapter?
a. B: I read the first half of it.
b. B: I read the whole dissertation.[127]
c. B: I read the third.

Let e_i be the expression queried by A (*first chapter*) and e_j be the expression mentioned in B's responses. Then, in (211a), e_i is LOWER than e_j in O; e_i is higher than e_j in (211b); and e_i and e_j are ALTERNATES in O in (211c).

Now recall the scalar implicature conventions Imp_{1-3} presented in Section 3.3.4 as an axiomatization of Condition 3 on conversational implicature. By mentioning the lower value *first half* in (211a), B may implicate ¬BEL(B, *I read the (whole) first chapter*). This implicature is predicted by the convention Imp_1, since *first chapter* is a lower member of the poset 'parts of a dissertation' than *first half*. That is,

(BMB(B, A, SALIENT('parts_of_a_dissertation', C_i)) ∧ REALIZE(*I read the first half of it*, AFFIRM(B, first_half_of_chapter_one, BEL(B, read(B,first_half_of_chapter_one)))) ∧ IS_COOP(B, C_i, {QUANTITY,QUALITY}) ∧ HIGHER_SENT(read(B,chapter_one), read(B,first_half_of_chapter_one), 'parts_of_a_dissertation'))
⇒ SCALAR_IMP(B, A, *I read the first half of it*, ¬BEL(B, read(B,chapter_one)), C_k)

Similarly, B's implicature in (211c) may also be accounted for by Imp_1:

(BMB(B, A, SALIENT('parts_of_a_dissertation', C_i)) ∧ REALIZE(*I read the third*,

[125] This condition is necessary for posets defined as reflexive, antisymmetric, and transitive lest some e_i be defined as higher or lower than itself.

[126] Elements are incomparable if they are not ordered with respect to one another in O, that is, if neither $e_i O e_j$ nor $e_j O e_i$.

[127] While some have found this response odd, consider it in the following context: B wonders whether to interpret A's query as 'Did you read *only* the first chapter?' or as 'Did you read *at least* the first chapter?'

AFFIRM(B,third_chapter, BEL(B, read(B,third_chapter)))) ∧
ALT_SENT(read(B,chapter_one), read(B,third_chapter),
'parts_of_a_dissertation'))
⇒ SCALAR_IMP(B, A, *I read the third*, ¬BEL(B, read(B,chapter_one)),
C_i)

There are no restrictions on those posets which support scalar implicature. However, (at least) one restriction does exist on which posets may be viewed as salient in a given exchange: Above (Section 5.1.6.3) I noted that, for most metrics that rank utterances, both a given metric and its dual (converse) may be candidates for salience in an exchange. However, no metric σ_i which orders values v_i and v_j such that a) v_i is higher than v_j and b) the truth of v_j entails the truth of v_i can support scalar implicature – for the simple reason that, in such a case, a sentence p_i ranked higher than a sentence p_j by σ_i since then the implicature licensed would be inconsistent with the utterance licensing it. In terms of the formalism presented in Chapter 2, such a meaning would not be reinforceable. Consider, for example, (212a):

(212) A: Are you planning to buy a dog?
a. B: A German Shepherd.
b. B: I'm buying a German Shepherd and I'm not buying a dog.

While one might identify either an ordering defined by 'isa' (i.e., a German Shepherd *isa* dog) or by 'subsumes' (i.e., a dog subsumes the subtype German Shepherd) as salient in this exchange, only the latter permits scalar implicature here. B cannot implicate that she is not buying a dog via this response, since buying a German Shepherd entails buying a dog. The attempted reinforcement of (212b) fails. However, we cannot rule out 'isa' relations as potential supporters of scalar implicature: In 213, for example, B's response might evoke either an 'isa'

(213) A: Would you like a dog?
B: I'd like a German Shepherd.

hierarchy – or its dual. Apparently, any poset can support scalar implicature, although other tests for conversational implicature may rule out some particular posets in particular exchanges.

5.3.2.3. Representing Scalar Implicature Orderings as Posets

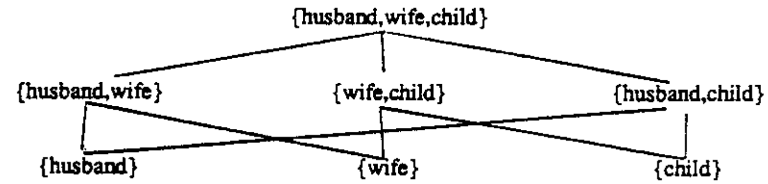
I have demonstrated above how part/ whole relations can be represented. To demonstrate that the other orderings discussed in Section 5.1 are accounted for by a poset condition, I will describe how representative orderings can be accommodated by this condition so that potential scalar implicatures are correctly predicted by Imp_{1-3}.

Relations defined by ordering the non-null members of the power set of some set **x** by set-inclusion allow a poset representation of **x** and its non-null proper subsets as follows: Any non-null proper subset of a set may be ranked as LOWER than the set which includes it, and that

set, in consequence, will represent a HIGHER value in the ordering. Subsets which are neither included in, nor include, one another, will be ALTERNATE values in this poset. Consider how the salient ordering in the following exchange might be represented:

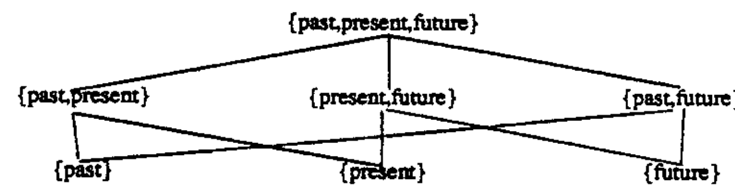
(214) A: Do you speak Portuguese?
B: My husband does.

The inclusion ordering which supports the implicature in 214 might be represented as follows:



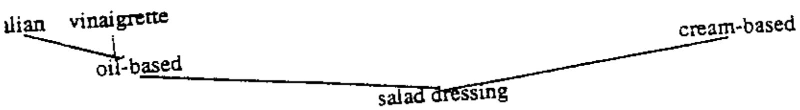
So, *{husband,wife,child}* will be the highest value in this ordering, with the alternate doubletons *{husband,wife}*, *{wife,child}*, *and {husband,child}* lower values and the alternate values, *{husband}*, *{wife}*, *and {child}* lower values still in this poset. By the scalar implicature conventions, then, *S* may affirm, say, *{husband,wife}* to convey ¬BEL(*S*, *{husband,wife,child}*) as well as ¬BEL(*S*, *{husband,child}*) and ¬BEL(*S*, *{wife,child}*). Note, particularly, that there may be some redundance in scalar implicatures predicted from this representation. Also, any subsets so represented may be lexicalized in various ways -- as, the expression *{husband,wife}* might be lexicalized as '*couple*' or as '*husband and wife*'. The theory presented in this thesis will not distinguish between these.[128]

As noted in Sections 5.1.7, temporal orderings may also be represented as sets of temporal for the analysis of licensed scalar implicatures. So, these orderings too will be defined by set inclusion, as:



Posets defined by a type/ subtype metric, such as that which supports 174, may be illustrated by the (partial) classification hierarchy:

[128] But see [Corella 84, Kalita 84] for some approaches to this problem.



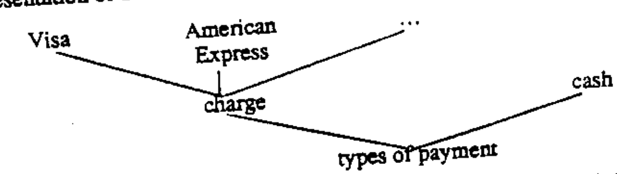
n this poset, *salad dressing* will be a lower value than both *Italian* and *vinaigrette*; thus, the atter types of dressing will be alternate values in the poset. The affirmation of a subtype e_i will hus implicate ¬BEL(*S*, e_j) for alternate subtypes e_j in the poset, by Imp_1. Given the same salient poset, *S* might convey ¬BEL(*S*, *¬I want salad dressing*) by denying *Italian* or *vinaigrette*, as in 215.

(215) A: Do you want salad dressing?
B: I don't want Italian.

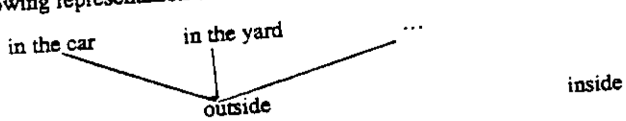
And *S* may convey ¬BEL(*S*, *I'd like vinaigrette*) or ¬BEL(*S*, *I'd like Italian*) by affirming *salad dressing*, as in 216.

(216) A: Would you like vinaigrette?
B: I'd like some salad dressing.

Instance-of and generalization/ specialization relations will be represented similarly, with instances represented higher values than the classes they are instances of, as in the following representation of a relation which might account for the exchange in 179:

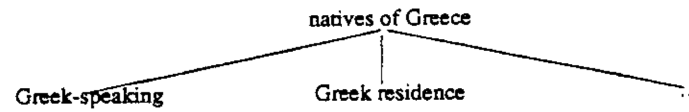


Generalization/ specialization hierarchies may also be represented in this form, as in the following representation of a relation supporting the implicature in 180, 181, and 182:

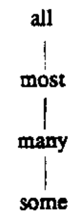


Specializations are higher values in these orderings than their generalizations.

Entity/ attribute orderings may be represented in an 'is_an_attribute_of' relation. So, the following digraph represents an orderings which supports the implicature in 185:



Since linear orderings[129] are themselves partial orderings, orderings such as those defined on the quantifiers, modals, logical connectives, number scales, and on indefinites and definites and locations, as well as those ranked entities, states, actions, and attributes and those process and prerequisite orderings that are linearly ordered may all be represented by posets. For example, quantifiers might be ranked by the informal notion of entailment discussed above (See Section 5.1.1.), and ordered as follows:



Instead of splitting temperature scales as Horn does, we can now define an ordering on temperature values by a metric like *is_cooler_than* to form a poset supporting implicatures like that licensed in 192:

Alternately, the dual to this poset, formed from a metric such as *is_warmer_than* on the same set of temperature values will support the implicature licensed in 217 -- i.e., ¬BEL(B, *the lemonade is cold*).

[129]Orderings for which any two elements are comparable.

(217) A: Is the lemonade cold?
B: It's cool.

'or rankable entities or concepts, such as Horn's bête-noir, *tort/ misdemeanor/ felony/ capital rime*, values now may simply be ordered by a metric such as *is_a_lesser_offense_than* to ccount for the implicatures discussed in Section 3.2.1.

5.4. Summary

All of the relations described in Section 5.1 as supporting scalar implicature share the characteristics of the class of partial ordering relations. Relations that do not support scalar implicature do not exhibit these characteristics. So, a poset condition on scalar implicature appears to capture just those intuitions I have described in previous chapters in a simple and principled way. Furthermore, it seems that any poset may support scalar implicature, in an appropriate context. In addition, this approach allows for the use of novel relations to license scalar implicature. In Chapters 6 and 7, I will describe further advantages of this method of utterance comparison, including ways to compute these relations from an existing knowledge base.

I have mentioned throughout previous chapters some of the problems presented by the role that world or domain knowledge as well as the current discourse context plays in the licensing and interpreting of quantity implicature in general. Definitions of ordering relations may vary from person to person and context to context and thus influence what implicatures may be conveyed. A poset condition permits the specification of the extent to which these definitions may vary without communication breakdown occurring. Even if *S* and *H* define some ordering relation similarly, a *S* can only license a quantity implicature if s/he perceives that that ordering is salient in the discourse and believes that *H* too recognizes this salience. In Chapter 6, I will propose how certain aspects of the discourse context may be accessed to determine which ordering relations may be salient for a given exchange.

CHAPTER VI
Computing Scalar Implicatures

Almost zero is better than less than nothing.
Brian Henry, *The Winds of War*, 2/11/83.

In my discussion of scalar implicature and its predecessors, scalar predication, quantity-quality implicature, and scalar quantity implicature, I have noted the critical role that context plays in the licensing of scalar implicatures. I have proposed that this role may be interpreted as the specification of salient orderings in the discourse which permit inferences about values in such orderings which *S* has not explicitly committed him/ herself to. To represent this specification so far, I have proposed a predicate SALIENT(O, C_h) to denote the salience of O in a discourse context C_h and have claimed that *S* must believe this salience to be a mutual belief of him/ herself and of *H* in order to make some implicature involving recognition of O.

In the present chapter I will examine how context in general and the salience of expressions and posets in particular affects *S*'s licensing of scalar implicatures and *H*'s interpretation of them in greater detail. I will first examine possible disparities in speaker/ hearer definitions of particular posets and how a notion of poset COMPATIBILITY allows us to relax the condition that *S* must believe the salience of some particular poset is a mutual belief of *S* and *H*. I will then discuss strategies for determining the salience of particular orderings in given discourse contexts. Finally, I will present a revised version of the theory of scalar implicature, incorporating salience information and allowing for the presence of multiple salient expressions in an utterance.

It should be noted throughout the following discussion that no claims are made for the cognitive reality of the algorithms or definitions presented below. I will only claim plausibility through computational feasibility. Neither do I claim any contribution to the literature on salience. I will only suggest what salience information is required and why, and how trends in current research, when successful, might accommodate these needs. So, I will be proposing tentative and partial solutions to how our current understanding of salience and apparently related concepts may be used to incorporate contextual information into the calculation of scalar implicature.