Implicature Calculation, Pragmatics or Syntax, or both?

1. Overall Plan

(1) John did some of the homework.
Standard logical rendition:
$\exists x(\text{homework}(x) \wedge \text{John-Did}(x))$

Problematic Inference:
John didn't do all of the homework.

(2) John bought 3 houses.
Standard logical rendition:
$\exists x(|x|=3) \wedge \text{houses}(x) \wedge \text{John-bought}(x))$

Problematic Inference:
John didn't buy 4 houses.

(3) John talked to Mary or Sue.
Standard logical rendition:
(John talked to Mary) $\vee$ (John talked to Sue)

Problematic Inference:
John didn't talk to Mary and Sue.

The neo-Gricean account: the source of these scalar implicatures is a reasoning process (undertaken by the hearer), which culminates in an inference about the belief state of the speaker.

An alternative Syntactic account: implicatures are represented in the grammar by an operator with a meaning akin to that of *only*, *exh*.

- There is a systematic way to state the "scalar implicature" of a sentence explicitly: append the focus particle *only* to the sentence and place focus on scalar items.

(4) John did some of the homework.
Implicature:
John only did SOME of the homework.

For all of the alternatives to 'some', d,
if the proposition that John did d of the homework is true,
then it is entailed by the proposition that John did some of the homework.

(5) John bought three houses.
Implicature:
John only bought THREE houses.

For all of the alternatives to 'three', n,
if the proposition that John bought n houses is true
then it is entailed by the proposition that he bought 3 houses.

(6) John talked to Mary or Sue.
Implicature:
John only talked to Mary OR Sue.

For all of the alternatives to 'or', con,
if the proposition that John talked to Mary con Sue is true
then it is entailed by the proposition that John talked to Mary or Sue.

(7) The *only* implicature generalization (OIG): A sentence, *S*, as a default, licenses the inference/implicature that (the speaker believes) *onlyS'*, where *S'* is *S* with focus on scalar items.

The syntactic account is designed to derive the OIG. In simple cases the Neo-Gricean account derives the same generalization.

The goal: To argue in favor of the syntactic account in the following way:

1. To show that despite initial appearances, the Neo-Gricean account predicts a generalization that is different from the OIG.
2. To present evidence that the OIG is the right generalization.
3. To discuss possible consequences for the meaning of *only* and for the nature of scales.

2. Some of the cases to be discussed

Neo-Grice's Reasoning (very rough outline)

Principles of communication require a speaker to use the most informative (strongest) true proposition from a certain designated set.

Under run-of-the-mill circumstances, (8alt) is a member of the designated set for (8).

(8) John did some of the homework.

(8alt) John did all of the homework.

These principles allow the listener to infer (upon hearing (8)) that unless the speaker believed that (8alt) were false, the speaker would have uttered (8alt).

Since the speaker didn't make this alternative utterance, it fallows that the speaker believes that (8alt) is false.

Derived Implicature: (S believes) it's not the case that John did all of the homework.

2.1. Problems of over-generation

2.1.1. The Puzzle of Disjunction:

(9) John did the reading or some of the homework.

Principles of communication should allow the listener to infer (upon hearing (9)) that unless the speaker believed that (9alt) were false, the speaker would have uttered (9alt):

(9alt) John did the reading or all of the homework.

Since the speaker didn't make this alternative utterance, it should fallow that the speaker believes that (9alt) is false.

Derived Implicature: (S believes) it's not the case that John did the reading or all of the homework.

Problem: $\neg(p \vee q) \equiv \neg p \wedge \neg q$; although we get the correct implicature that John didn't do all of the homework, we also get the incorrect implicature that John didn't do the reading (cf. Chierchia, Schwarz, Sauerland, and Yae-Sheik Lee, among others).

(10) The *only* implicature generalization (OIG): Utterance of a sentence, *S*, as a default, licenses the inference/implicature that (the speaker believes) *onlyS'*, where *S'* is *S* with focus on scalar items.

This problem of over-generation is not that devastating. In fact, Uli Sauerland and Benjamin Spector have shown that the correct results follow quite elegantly once the Neo-Gricean account is spelled out carefully (as long as an extra assumption is introduced). However,

- Exactly the same problem arises in the semantics of *only*:

(11) Speaker A: John did the reading or some of the homework.
Speaker B: Is it possible that he did all of the homework.
Speaker A: No. he only did the reading or SOME of the homework.

(12) Question under discussion: Who is responsible for the fact that various things are missing from the kitchen, among them the ice cream and the candy?
A: I know that John ate the candy or some of the ice cream.
B: Do you think he might have eaten all of the ice cream?
A: No, he only ate the candy or SOME of the ice cream.

- There is a solution in the case of *only*, based on the notion of lumping developed in work by Kratzer (1988). This solution can be carried over to the problem with implicatures if we develop a theory that captures the OIG. However, once the Kratzer amendment is added, the neo-Gricean theories of implicatures can no longer capture the OIG. We will discuss possible responses within the Sauerland/Spector framework.

2.1.2. Comparatives (joint work with Martin Hackl):

(13) a. John read 3 books.
Implicature: It's false that John read 4 books.
b. John read more than 3 books.
*Implicature: It's false that John read more than 4 books.

(14) a. *John only read more than 3_F books.
b. John only read more than 3_F books.

On the face of it, the facts are quite surprising both for the neo-Gricean account and for the syntactic alternative. However, under certain auxiliary assumptions about the nature of degree-scales and modularity (encapsulation), the facts are expected under the syntactic account, but not under the neo-Gricean alternative.

Much of our discussion will center on motivating the auxiliary assumptions. Here we will direct much attention to extraction phenomena, mainly of degree operators.

2.1.3. The "Functionality Problem"[1]

(15) a. I read at least two books.
b. I talked to two or more boys.
c. I talked to Mary or Sue or both.

I will try to argue for a particular account of the fact that (15b,c) do not yield standard scalar implicatures. The account will be based on an observation due to Hurford (1974), which is itself best accounted for under the syntactic approach to implicatures. For (15a), I will provide an account which ought to work under any approach to implicatures. Much of my attention will focus on a comparison with recent alternative proposal (van Rooy and Schultz (2004)).

2.2. Problems of under-generation

Krifka's Puzzle (Krifka 1998):

(16) 3 boys ate 7 apples.
Implicature: it is not true that 4 boys ate 8 apples.

(17) a. I introduced 3 women to 7 men.
Implicature: it is not true that I introduced 4 women to 8 men.
b. I only introduced THREE women to SEVEN men.

[1] The term comes from Bonomi and Casalegno (1993).

Intrusive Implicatures:

(Levinson 2000, Hurford 1974, Cohen 1977, Kempson 1986, Horn 1989, passim).

(18) a. The man whose reading one book is my brother. The man whose reading two books is my brother in law.
b. The man who's only reading ONE book is my brother. The man whose reading two books is my brother in law.

(19) a. The students who did the reading or the homework are in worse shape than the students who did both.
b. The students who only did the reading OR the homework are in worse shape than the students who did both.

3. Background

(20) John did some of the homework.
Standard logical rendition:
$\exists x(\text{homework}(x) \wedge \text{John-Did}(x))$

Problematic Inference:
John didn't do all of the homework.

(21) John bought 3 houses.
Standard logical rendition:
$\exists x(|x|=3) \wedge \text{houses}(x) \wedge \text{John-bought}(x))$

Problematic Inference:
John didn't buy 4 houses.

(22) John talked to Mary or Sue.
Standard logical rendition:
(John talked to Mary) $\vee$ (John talked to Sue)

Problematic Inference:
John didn't talk to Mary and Sue.

3.1. Option 1, strengthen the meaning of the relevant lexical items

(23) John did some of the homework.
Alternative logical rendition:
$\exists x(\text{homework}(x) \wedge \text{John-Did}(x)) \wedge$
$\neg\forall x(\text{homework}(x) \rightarrow \text{John-Did}(x))$

(24) John bought 3 houses.
Alternative logical rendition:
$\exists x(|x|=3) \wedge \text{houses}(x) \wedge \text{John-bought}(x)) \wedge$
$\neg\exists x((|x|>3 \wedge \text{houses}(x) \wedge \text{John-bought}(x))$

(25) John talked to Mary or Sue.
Alternative logical rendition:
[(John talked to Mary) $\vee$ (John talked to Sue)] $\wedge$
$\neg$[(John talked to Mary) $\wedge$ (John talked to Sue)]

(26) Standard Lexical Entries:

a. $[[\text{some}]] = \lambda A.\lambda B.\ A \cap B \neq \emptyset$
b. $[[3]] = \lambda A.\lambda B.\ |A \cap B| \geq 3$
c. $[[\text{or}]] = \lambda p.\lambda q.\ p = 1 \text{ or } q = 1$.

(27) Alternative Lexical Entries:

a. $[[\text{some}]] = \lambda A.\lambda B.\ A \cap B \neq \emptyset \text{ and } \neg(A \subset B)$ (=[[some but not all]])
b. $[[3]] = \lambda A.\lambda B.\ |A \cap B| = 3$ (=[[exactly 3]])
c. $[[\text{or}]] = \lambda p.\lambda q.\ p + q = 1$ (=[[ExOR]])

3.2. Evidence for Standard Lexical Entries

(28)a. John did some of the homework. For all I know he might have done all of it.
b. ≠John did some but not all of the homework. For all I know he might have done all of it.

(29)a. If John bought 3 houses, I will be very angry with him.
b. ≠If John bought exactly 3 houses, I will be very angry with him.

(30)a. John talked to Mary or Bill. I hope he didn't talk to both of them.
b. ≠John talked to Mary or Bill but not to both. I hope he didn't talk to both of them.

3.3. Option 2: Ambiguity

(31) 2 Lexical Entries:

a. $[[\text{some}_{\text{weak}}]] = \lambda A.\lambda B.\ A \cap B \neq \emptyset$
$[[\text{some}_{\text{strong}}]] = \lambda A.\lambda B.\ A \cap B \neq \emptyset \text{ and } \neg(A \subset B)$ (=[[some but not all]])
b. $[[3_{\text{weak}}]] = \lambda A.\lambda B.\ |A \cap B| \geq 3$
$[[3_{\text{strong}}]] = \lambda A.\lambda B.\ |A \cap B| = 3$ (=[[exactly 3]])
c. $[[\text{or}_{\text{weak}}]] = \lambda p.\lambda q.\ p = 1 \text{ or } q = 1$.
$[[\text{or}_{\text{strong}}]] = \lambda p.\lambda q.\ p + q = 1$ (=[[ExOR]])

3.4. The Exhaustivity Generalization

But this is a bad proposal for three reasons:

a. It doesn't capture the full range of scalar implicatures
b. It makes the wrong predictions for ellipsis (Tamina Stephenson)
c. It misses a generalization

3.4.1 Lexical Ambiguities are empirically insufficient

In downward entailing contexts the relevant inferences are reversed:

(32) John didn't do all of the homework.

Implicature:
John did some of the homework.

(33) a. John did much of the homework.
Implicature: John didn't do all of the homework.
b. John didn't do much of the homework.
Implicature: John did some of the homework.

3.4.2. Implicatures don't need to be preserved in parallelism environments
(Tamina Stepenson, p.c.)

(34) John has 2 children. Bill does, too. In fact, Bill has 3 children.

3.4.3. The Generalization:

The phenomenon we are dealing with is pretty general, and multiplying meanings at will misses the generalization:

(35) a. It's warm outside. (Likely inference: It is not hot outside)
b. If it's warm outside, you don't need to take a sweater.
(≠If it's warm but not hot outside, you don't need to take a sweater).

(36) a. Mary is as tall as John is. (Likely inference: Mary is not taller than John is.)
b. Mary is as tall as John is. For all I know, she might be taller
(≠Mary is exactly as tall as John is. For all I know, she might be taller.)

(37) a. It's possible that there is a sneak in the box.
(Likely inference: It's not necessary…)
b. You shouldn't open the box if it's possible that there is a sneak inside.

(38) a. John started working on his experiment.
(Likely inference: he didn't finish)
b. If you start working on your experiment, we will all be happy.

The generalization refers to a class of lexical entries (quantifiers, numeral expressions, truth conditional operators, comparatives, modal operators…), which are members of postulated scales, Horn Scales.[2]

Quantifiers: {Some, Many/Much, Most, Every/All}
Numerals: {one, two, three,…}
Truth conditional operators {or, and}
Comparative operators {as, er}
Various gradable adjectives {warm, hot}, {small, tiny} {big, huge}, etc
Modal operators {possible, necessary}
…

(39) The Exhaustivity Generalization: utterance of a sentence, S, as a default, licenses the inference that (the speaker believes that) all of the scalar alternatives of S that are logically stronger than S are false (Henceforth, the Exhaustivity Inference).

The Scalar Alternatives of a sentence S, Alt(S), are the set of sentences that can be derived from S by replacing scalar items in S by their scale-mates.

(40) Example:
John bought 4 houses is a Scalar Alternative of *John bought 3 houses* . Since *John bought 4 houses* is logically stronger, The Exhaustivity Generalization tells us that utterance of *John bought 3 houses*, as-a-default, licenses the inference that (the speaker believes) that John didn't buy 4 houses.

3.5. The (neo)-Gricean Account (Horn, Gazdar,…)[3]

The Exhaustivity Inferences do not follow from the semantics of sentences but rather from pragmatic reasoning about the belief-state of speakers.

3.5.1. The short version (which doesn't really work):

(41) John bought 3 houses.

(42) Hearer's reasoning:
If John bought 4 houses, that would have been relevant information. S did not provide me with this information. It is therefore reasonable to assume that S thinks that John did not buy 4 houses.

[2] I represent Horn-Scales as unordered sets for reasons discussed in Sauerland (2004). In particular, the generalization needs to make reference to an ordering relation among sentences, which makes it unnecessary to order the lexical items.
[3] The presentation in this subsection is based on class notes of Kai von Fintel and Irene Heim.

3.5.2. The formal nature of the set of alternatives

Why not the following:

(43) *Hearer's reasoning:
If John bought exactly 3 houses, that would have been relevant information. S did not provide me with this information. It is therefore reasonable to assume that S thinks that John did not buy exactly 3 houses.

If the exhaustivity inference is to follow from reasoning about the alternative utterances that the speaker avoided, something needs to be said in order to insure that we have the right set of alternatives.

(44)a. John bought 4 houses $\in$ {S: Hearer considers S as a possible alternatives when hearing (41)}
b. John bought exactly 3 houses $\notin$ {S: Hearer considers S as a pos. alt. when hearing (41)}

Necessary stipulation: {S: Hearer considers S as a possible alternatives when hearing X} = Alt(X)

3.5.3. As it stands the hearer is only justified in making a weaker inference
(Soames 1982:455-456; Groenendijk and Stokhof 1984)

(42) Hearer's reasoning:
If John bought 4 houses, that would have been relevant information. S did not provide me with this information. It is therefore reasonable to assume that S thinks that John did not buy 4 houses.

Wait a second. That was a little hasty. All I can conclude at the moment is that S is not in a position to claim that John bought 4 houses. The reason for this could be that S thinks that John didn't buy 4 houses. But it could just as well be the case that S doesn't know whether or not John bought 4 houses.

Necessary assumption (opinionated speaker): When S is uttered by a speaker, s, the hearer's default assumption is that for every member of Alt(S), s has an opinion as to whether or not S is true.

It is sometimes suggested that we get implicatures only when it is presupposed that the speaker is opinionated. I don't think that's true.

(42) John put 50 leaves in this bag.

3.5.4. The long version (which does work):

Hearer's assumptions:

1. Maxim of Quantity: speakers know that they have to make the most informative relevant contribution to a conversation.

2. Alternative Set: the set of candidates from which the most informative needs to be chosen is constructed with reference to Horn Scales; it is Alt(S).
3. Opinionated Speaker (OS): (as a default) speakers are assumed to have an opinion regarding the truth-value of Alt (S).

(45) Context: A speaker s utters the sentence, *John bought 3 houses*.

1. Given the maxim of quantity, we can infer that it's not the case that s thinks about one of the stronger alternatives in the designated set that it is true.
2. The set of alternatives contains *John bought 4 houses*, which is logically stronger than the speaker's utterance. Hence given 1 it's not the case that speaker thinks that this sentence is true.
3. Given OS the default assumption is that the speaker has an opinion as to whether *John bought 4 houses* is true or false. Given 2 (the conclusion that it's not the case that the speaker thinks that the sentences is true), we can conclude that the speaker thinks that it is false.

So we do not derive the conclusion that S is false, but only the conclusion that the speaker thinks S is false. This might be good enough. If a speaker utters a sentence and by that conveys his belief that a certain proposition, p, holds, it is natural that we will accept p whenever we accept the speakers utterance, and that p will seem to be an inference of the sentence. (However, much of the philosophical literature tries to derive something stronger, something like "mutual knowledge" of the speaker's belief that the stronger alternatives in Alt (S) are false.)

Question to ask: Does this really derive the Exhaustivity Generalization?

Not quite, instead:

(46) The Pragmatic Exhaustivity Generalization: utterance of a sentence, S, as a default, licenses the inference that (the speaker believes that) all of the scalar alternatives of S that are pragmatically/contextually stronger than S are false

The Scalar Alternatives of a sentence S, Alt(S), are the set of sentences that can be derived from S by replacing scalar items in S by their scale-mates.

Our discussion of comparatives will constitute an argument that the Exhaustivity Generalization is a better generalization than the Pragmatic Exhaustivity Generalization.

To understand the type of fact that might distinguish between the two generalizations, consider the following:

(47) John has an even number of kids. He has three kids.

The second sentence of (47), arguably, should not have an *exactly* implicature. Once the first sentence is accepted, the second sentence is not contextually stronger than the alternative which is supposedly responsible for the implicature.

Standard terminology:

a. "Implicatures": inferences from sentences based on reasoning about speakers beliefs.
b. "Scalar Implicatures": Implicatures that rely on the Maxim of Quantity, Horn-Alternatives, and the assumption of an Opinionated-Speaker.

We will use the term "Scalar Implicatures" extensionally to refer to the type of "problematic inferences" we've looked at, even when we will consider the syntactic account under which these inferences are not the result of reasoning about speakers beliefs.

4. An alternative, syntactic, account (cf. G&S 1984; Krifka 1995)

4.1. Background: the semantics of *only* and association with focus

(48) a. Mary only introduced JOHN to Sue.
b. Mary only introduced John to SUE.
b. Mary only introduced JOHN to SUE.

LFa: only [C][$_{VP}$ Mary introduced John$_F$ to Sue]
LFb: only [C][$_{VP}$ Mary introduced John to Sue$_F$]
LFc: only [C][$_{VP}$ Mary introduced John$_F$ to Sue$_F$]

What the sentences in (48) say is that among the propositions in the set C, the only proposition that is true is the proposition that Mary introduced John to Sue. The sentences differ in the value of C something that needs to follow from the theory of focus (For discussion see Rooth (1995), Beaver and Clark (2003)).

(49) a. $C_{(48a)} = \{p_{st}: \exists x \in D_e$ and $p = \lambda w$. Mary introduced x to Sue in w$\}$.
b. $C_{(48a)} = \{p_{st}: \exists x \in D_e$ and $p = \lambda w$. Mary introduced John to x in w$\}$.
c. $C_{(48a)} = \{p_{st}: \exists x,y \in D_e$ and $p = \lambda w$. Mary introduced x to y in w$\}$.

(50) C is (a subset of) the focus value of VP (Foc(VP)).

(51) Informally: Foc(VP) is the set of propositions that can be derived from the interpretations of various modifications of VP; modifications in which focused constituents are replaced by various alternatives.

(52) $[[\text{only}]] = \lambda C_{<st,t>}.\lambda p_{st}.\lambda w: p(w) = 1.\ \forall q \in C.\ (q(w) = 1) \rightarrow (q = p)$

How do we insure that C is (a subset of) the focus value of VP?

(53) Two general approaches:
a. C is directly constrained.
b. C is required to be a contextually relevant set and focus is correlated with the context in the required way.

4.2. A modification in the semantics of *only*[4]

(54) a. John only talked to [Bill and Mary]$_F$.
#That's not true. Look, he talked to BILL.

b. John only read THREE books.
#That's not true. Look, he read two books.

(55) $[[\text{only}]] = \lambda C_{<st,t>}.\lambda p_{st}.\lambda w: p(w) = 1.\ \forall q \in C.\ (q(w) = 1) \rightarrow (p \Rightarrow q)$

(56) **The alternatives of Scalar items are their scale-mates.**

Consequence of this observation: the focus value of a sentence, S, in which the set of focused constituents is the set of scalar items in S is Alt(S)

(57) a. John only read THREE books. He didn't read FOUR.
b. John only read SOME books. He didn't read ALL books.
a. John only talked to Mary OR Sue. He didn't talk to Mary AND Sue.

4.3. The Postulation of a null exhaustivity operator[5]

(58) Speaker A: Look at these 10 boys. Which of them do you know?
Speaker B: I know John and Bill.
Inference: B doesn't know any of the other boys.

(59) EXH(C)[I know [John and Bill]$_F$]

(60) $[[\text{EXH}]] = \lambda C_{<st,t>}.\lambda p_{st}.\lambda w.\quad p(w) = 1 \text{ and } \forall q \in C.\ (q(w) = 1) \rightarrow (p \Rightarrow q)$

4.4. The Exhaustivity Generalization

(39) The Exhaustivity Generalization: utterance of a sentence, S, licenses, as a default, the inference that (the speaker believes that) all of the scalar alternatives of S that are logically stronger than S are false.

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[4] See Fintel, K. v. (1997). "Bare Plurals, Bare Conditionals, and *Only*." Journal of Semantics **14**: 1-56.

[5] Groenendijk, J. and M. Stokhof (1984). Studies on the Semantics of Questions and the Pragmatics of Answers, University of Amsterdam. Our exhaustivity operator is taken from Krifka (1995) and is different from that of G&S. We might try to compare in the near future.

The Scalar Alternatives of a sentence S, Alt(S), are the set of sentences that can be derived from S by replacing scalar items in S by their scale-mates.

This generalization would seem to follow if, as-default, sentences are interpreted as answers to questions and the following stipulation holds:[6]

(61) Stipulation:
1. Scalar items are inherently focused.[7] Or alternatively
2. Alt(S) is most times contextually given
(the latter is essentially the Gricean stipulation)

(62) I have three children.
default structure: EXH(C)[$_S$ I have three$_F$ children].

[[(62)]] = 1 iff I have (at least) 3 children and every proposition in C that is true is entailed by the proposition that I have (at least) 3 children.
iff I have (at least) 3 children and every proposition in Alt(S) that is true is entailed by the proposition that I have (at least) 3 children.

Hope: We don't need a stipulation. The Exhaustivity Generalization holds only when the scalar item is focused which is often enough the case. (See von Rooy 2002.)

Welker (1994):
(63) a. I need four chairs.
b. JOHN has four chairs.

(64) a. I need four chairs.
b. John has TWO chairs.

Possible Conclusions:

1. If there is no focus on the scalar word, we don't get the implicature.
2. If the context makes a different set of propositions salient, we don't get the implicature (or rather we get a different implicature).

The New Ambiguity Hypothesis: All sentences are systematically ambiguous. The source of this ambiguity is an optional exhaustivity operator.

Chierchia's Pragmatic Principle (cf. Dalrymple et. al 1994, 1998): When a sentence is ambiguous the default interpretation is the strongest alternative.

[6] In the end, the generalization will turn out to be false. Instead the OIG will be true.
[7] See Krifka (1995) for a particular implementation of the stipulation.

Possible alternative (Irene Heim, pc.): Assertions are always understood as answers to questions, and they *always* come with the exhaustive operator. Implicature cancellation is the result of addressing a different question (as in (63))

Another possible alternative: *Exh* operator is totally optional. However, if it is not present, there will be an implicature that the speaker is ignorant about every stronger alternative. In most contexts the implicature is implausible, hence the *exh* is preferred.

4.5. Back to Stephenson's Objection

(65) John has 2 children. Bill does, too. In fact, Bill has 3 children.

This is no longer predicted to be bad. The VP meaning of the first sentence in (65) is the same whether or not there is an exhaustive operator above.

(66) A: Who did you say John talked to?
B: I only said that he talked to Mary_F.
A: Do you think Bill did <talk to Mary>?
B: I think he did <talk to Mary>. But I think that Bill talked to Sue as well.

4.6. Which is Simpler?

I think it's still hard to tell.

Assumptions of the neo-Gricean account:

a. Alt(S) is the relevant set of alternatives.
b. Hearer's assume that speakers are opinionated about the truth value of the members of Alt(S).

Assumptions of the syntactic alternative:

a. Alt(S) is the relevant set of alternatives.
b. Covert *Exh* is a lexical entry.
c. Strongest meaning hypothesis, or one of the alternatives suggested.