The Semantics/Pragmatics Interface*

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Abstract: We survey three domains – scalar implicatures, presupposition, and conventional implicatures – in which the division of labor between semantics and pragmatics has given rise to new empirical and formal insights in the last decades. In each case, there is a vibrant contemporary debate concerning the modular decomposition of rich arrays of data.

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1 Introduction

1.1 Goals

The informational content conveyed by utterances has two sources: meaning as it is encoded in words and rules of semantic composition (often called 'literal' or 'semantic meaning'); and further inferences that may be obtained by reasoning on the speaker's motives (the conjunction of these inferences with the literal meaning is often called the 'strengthened' or 'pragmatic meaning' of the sentence). While in simple cases the difference can seem obvious enough, in general this is not so, and the investigation of the semantics/pragmatics interface has proven to be one of the most vibrant areas of research in contemporary studies of meaning. We will survey three domains – scalar implicatures, presuppositions, and conventional implicatures – in which there are considerable empirical benefits to be obtained from this enterprise. But it is also of foundational and methodological interest: knowledge of semantic meaning is part of knowledge of language; by contrast, pragmatic inferences are derived in part from the assumption that the speaker obeys certain rules of behavior – typically ones dictated by rationality (which may for instance lead to the maximization of the utility of an utterance to the speaker or to others). Due to foundational interest in the interaction between language and reasoning, the study of the semantics/pragmatics interface originated in philosophy; but it quickly became a central topic within linguistics and psycholinguistics, and the convergence of results from the latter two fields has resulted in rich cross-disciplinary exchanges. For reasons of space, we do not consider psycholinguistic results in this survey, but it should be said at the outset that they have changed the face of the field by providing new and more reliable data (for instance on processing and language acquisition), and sometimes by challenging data that had too quickly become solidified on the basis of unsystematic introspection alone.

As we will see, the debates are more open than ever. Scalar implicatures, which were usually considered a staple of pragmatic reasoning, have recently been re-assigned to the semantics or even to the syntax by proponents of 'locally computed implicatures' ('localists' for short). For their part, presuppositions were in the 1980's one of the success stories of dynamic semantics, with its program of 'semanticization' of large parts of pragmatics; but they too have recently been re-assigned, with some researchers claiming, in a Gricean vain, that presuppositions should be viewed as part of the post-semantic component. Finally, conventional implicatures were originally left by Grice in a somewhat informal state because his primary interest was in scalar implicatures; their formal study was pioneered by Chris Potts, who took them to argue for a multi-dimensional semantics – but other researchers have sought to develop pragmatic alternatives. In each case, there is a very fruitful tension between considerations of empirical adequacy and of explanatory depth: pragmatic approaches are often considered to be deeper (all other things being equal) than semantic ones, at least to the extent that they can be grounded in a theory of communicative rationality; but the data don't always go this way ('all other things' usually *aren't* equal!), and the rational foundations are only beginning to emerge rigorously (the latest developments, based on game theory, will not be reviewed in this survey; see Franke 2011 and Rothschild 2011 for two recent discussions).

1.2 Quality, quantity and Grice's maxims

Two examples will immediately illustrate the importance of pragmatic reasoning.

1.2.1 Moore's paradox

Moore (1942) noticed that conjunctions of form *p but I don't believe that p* are decidedly odd; an example is given in (1)a:

(1) a. #It's already past midnight but I don't believe/know that it is.
b. It's already past midnight but John doesn't believe/know that it is.

Certainly a conjunction of the form *p and x doesn't believe that p* isn't a logical contradiction – and in fact the third person version of the statement, provided in (1)b, doesn't sound nearly as odd as (1)a. This first vs. third person asymmetry can be explained on the assumption that in normal circumstances speakers believe (or present themselves as believing) the content of their statements. Under this assumption, (1)a is deviant because its utterance leads to the inference that the speaker has contradictory beliefs. The contradiction is derived on the basis of the 'principle of quality' in (2), combined with standard assumptions about the logic of belief (we write *B F* for: the speaker believes that *F*, an abbreviation we use both in the object- and meta-language).

(2) **Principle of Quality:** If the speaker uttered *F*, the speaker believes that *F*.

1. The speaker uttered *p and not B p*.
2. By (2), the speaker believes this, hence: *B (p and not B p)*
3a. *Assumption:* Someone who believes a conjunction believes each conjunct; formally: *B(F and G)* implies *B F; B G*
3b. By 2. and 3a., *B p; B not B p*
4a. *Assumption:* Someone who believes something is aware of this, i.e. believes that he believes it; formally: *B F* implies *B B F* – hence *B B p*
4b. By 3a. and 4., *B B p* and also *B not B p*.

In other words, the speaker holds inconsistent beliefs. This account in a simple way for the contradictory nature of (1)a; importantly, it is a 'pragmatic contradiction', which was derived on the basis of the pragmatic principle in (2).

1.2.2 Conversational implicatures

Grice 1975 discussed the example in (3):

(3) "A is writing a testimonial about a pupil who is a candidate for a philosophy job, and his letter reads as follows: 'Dear Sir, Mr. X's command of English is excellent, and his attendance at tutorials has been regular. Yours, etc.'"

We clearly infer that Mr. X is a terrible philosopher; this momentous inference is not derived from the fact that the speaker believes what he said, but from the observation that he *failed* to say something which would have been more useful, e.g. that Mr. X is a good student. Our reasoning falls under a broad principle which we will, for the moment, state in a vague fashion:

(4) **Principle of Quantity:** If the speaker uttered *F*, *F* is optimally informative within a class (to be defined) of alternative utterances.

It can be checked that our inference is not due to an *entailment* of (3): if the discourse – call it *D* – entailed that Mr. X is a bad philosopher, we would expect any *strengthening* of D to yield this inference as well. But such is not the case – although (5) contains D as a subpart, it certainly doesn't yield the inference that X is a bad philosopher.

(5) Dear Sir,
Mr. X's command of English is excellent, and his attendance at tutorials has been regular. I mention these secondary facts at the outset because Dr. Wittgenstein, with whom X is always – and rightfully – compared, lacked either of these qualities. In my view, Mr. X's philosophical talent surpasses that of Dr.

> Wittgenstein; but he will also prove to be a considerably more reliable colleague, and a far better teacher. Yours, etc.

An analysis of (3) can be developed on the basis of the principle in (4).[1]
1. In a letter of recommendation, one is supposed to describe the greatest academic qualities that an applicant has.
2. (3) only mentions X's command of English and attendance at tutorials.
3. Hence X probably lacks greater academic qualities, such as talent as a philosopher.

1.3 Grice's maxims of conversation

Grice sought to state general 'maxims of conversation' of which Quality and Quantity are just sub-cases. They fall under a general rule of 'cooperative rationality' in discourse. They are listed here in Grice's formulations:
(i) *Quality:* 'Try to make your contribution one that is true.', and more specifically: '1. Do not say what you believe to be false. 2. Do not say that for which you lack adequate evidence.'
(ii) *Quantity:* 1. 'Make your contribution as informative as is required (for the current purposes of the exchange).' 2. 'Do not make your contribution more informative than is required.'
(iii) *Relation:* 'Be relevant.'
(iv) *Manner:* 'Be perspicuous.', and more specifically: '1. Avoid obscurity of expression. 2. Avoid ambiguity. 3. Be brief (avoid unnecessary prolixity). 4. Be orderly.'
In the present survey, we will be solely concerned with sub-cases of (i), (ii), and (iv).[2]

2 Scalar Implicatures

2.1 The Neo-Gricean Picture

2.1.1 Basic picture

Scalar implicatures are a species of quantity implicatures characterized by the fact that the class of alternatives of a given sentence is obtained by replacing any number of words with members of their *scales*, which are contextually provided sets of lexical alternatives (traditionally, these sets are ordered by logical strength, but this ordering turns out to be redundant because informativity considerations must play a role anyway when implicatures are triggered (e.g. Geurts 2011)). A well-worn example is offered by the behavior of the word *or*. Traditionally, it was thought that natural language disjunction is ambiguously inclusive or exclusive. In (6)a, an exclusive paraphrase (*I will invite Ann or Mary but not both*) seems plausible enough; by contrast, in (6)b an inclusive paraphrase seems more appropriate (*I bet you 5$ that John will invite Ann or Mary* <u>*or both*</u> – and in particular I'll win if he invites both).

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[1] Here we depart from the letter of Grice's text, whose analysis is based on the *flouting* a maxim.
[2] See Sperber and Wilson 1995 for an attempt to get all of pragmatics to follow from a broader version of (iii). When we discuss presuppositions, we will also consider an additional maxim which was later proposed in Grice 1981 (in our terms, *Be Articulate*). See also Wayne 2010 for other maxims.

(6) a. I will invite Ann or Mary.
b. I bet you 5$ that John will invite Ann or Mary.

The alternative, however, is to posit that *or* is semantically inclusive, but that in some cases a scalar implicature is derived by drawing inferences on the speaker's informational state, along the following lines (see Horn 1989 for further arguments and a historical perspective):

(7) a. *Sentence uttered:* S = I will invite Ann or Mary.
b. *Scalar alternative:* By replacing *or* with *and* in *S*, we obtain an alternative S' = I will invite Ann and Mary.
c. *Informativity: S'* asymmetrically entails *S*, and thus would have been a more informative sentence to utter.
d. *Primary Implicature:* The speaker decided not to utter *S'*, presumably because he was not in a position to do so: not B S'.
e. *Secondary Implicature:* On the assumption that the speaker had an opinion (B S' or B not S'), this implies: B not S'

Importantly, it is usually traditionally that implicatures are *optionally* derived (but see Section 2.3 for an argument that some implicatures are obligatory). It should be noted, however, that two steps must be distinguished in this reasoning:
–An analysis based solely on informativity and cooperative behavior will only yield the inference in (7)d, namely that *the speaker does not hold the belief that S'* – which is compatible with the a situation in which the speaker doesn't know whether *S'* is true. This inference is often called a 'primary implicature' in the literature (e.g. Sauerland 2004; see also Hirschberg 1985 for qualifications).
–Researchers have posited that one often derives a stronger inference, namely that *the speaker believes that S' is false*, as shown in (7)e. In the present framework, this clearly requires a further assumption; one possibility is that one assumes (for whatever reason) that the speaker is 'opinionated', i.e. believes *S'* or believes *not S'* – which suffices to infer from the primary implicature that the speaker holds the belief that *not S'*, i.e. what is often called a 'secondary implicature' (e.g. Sauerland 2004).

So we now have two candidates to explain the variable behavior of disjunction: an analysis based on lexical ambiguity, and one based on scalar implicatures combined with a single ('inclusive') lexical entry. How can we decide between the contenders? One important argument is that the ambiguity view predicts some readings that the scalar view does not. The key is that scalar implicatures are only generated in case the informativity condition in (7)c is satisfied. But it systematically fails in non-positive environments.[3] For instance, in (8)a-b *or* appears in a 'downward-monotonic' context, and thus the version with the sentence with *or* is more (rather than less) informative than the version with *and*: (8)a and (8)b are thus strictly more informative than (8)a' and (8)b' respectively.

(8) a. I doubt that John will invite Ann or Mary.
a'. I doubt that John will invite Ann and Mary.
b. Whenever John invites Ann or Mary, his parties are a success.
b'. Whenever John invites Ann and Mary, his parties are a success.

The implicature-based analysis predicts that no scalar implicature should be triggered when (8)a-b are uttered, and that we should obtain the behavior of an unadorned inclusive disjunction. This appears to be correct: unless a very special intonation is used, it seems that (8)a implies, *a fortiori*, that I doubt that I will invite both Ann and Mary; and similarly the prediction in (8)b appears to hold of cases in which John invites both Ann and Mary: in those cases too, his parties are predicted to be a success.

[3] We slightly revise this view in Section 2.2, where we argue that it is only in downward-monotonic environments that these implicatures are not generated (the difference concerns non-monotonic operators, which are discussed in due course).

There are also more theory-internal arguments in favor of the implicature-based view.
–*Lexical accidents:* On an unadorned version of the ambiguity view, it is an accident that we systematically find expressions that are ambiguous between an inclusive and an exclusive reading (in fact, cross-linguistically it appears that purported 'exclusive disjunctions' turn out to have an inclusive reading after all; see Horn 1989 for discussion).
–*Semantic universals:* A possible generalization about lexical determiners found in the world's languages is that all of them are 'monotonic', either positive or negative. If *P* entails *P'*, and if *Op* is a positive operator, and then *Op P* entails *Op P'*; while if *Op* is negative (for instance *Op* = negation), *Op P'* entails *Op P*. It is clear that inclusive *or* is positive in both of its arguments: if *P* entails *P'*, *(P or Q)* entails *(P' or Q)*, and *(Q or P)* entails *(Q or P')*. But exclusive *or* would crucially *fail* to yield such patterns; for instance, if *P* entails *P'*, in a situation in which *P* is false, *Q* is true, and *P'* is true, we have that *P* or^{excl} *Q* but *P'* or^{excl} *Q* is false. Hence if the broader generalization about possible lexical determiners is correct, we might want to extend it to logical operators quite generally, which would yield an indirect argument against the existence of exclusive disjunction.[4]
(Another empirical argument against ambiguity-based treatments is discussed in Section 2.1.2; it is based on truth-conditional intuitions, but requires a more sophisticated way to compute alternatives.)

We can now state the procedure to derive scalar implicature in a somewhat more precise fashion. This analysis is 'neo-Gricean' because it adds to a Gricean analysis a precise definition of alterantives (Horn 1972; as can be seen, informativity plays a role in (9)b but is not needed in (9)a)

(9) a. *Alternatives of S:* Alt(S) = {S': S' can be obtained from S by replacing one or more expressions with one of their lexical alternatives}.
b. If *S* was uttered, *S'* is a member of Alt(S), and *S'* is more informative than *S* (i.e. asymmetrically entails it), one may:
–derive a *primary implicature:* not B S'.
–on the assumption that (B S' or B not S'), this yields a *secondary implicature:* B not S'.
With the content of the secondary implicature, an utterance of *S* yields a strengthened meaning akin to: *S and not S'*.

It is often thought that the relation 'is a lexical alternative of' is symmetric (a point we revisit below): if *and* is a lexical alternative of *or*, it should also follow that *or* is a lexical alternative of *and*. This immediately yields an interesting prediction: we noted above that (8)a-b asymmetrically entail (8)a'-b' respectively. Focusing now on (8)a'-b', we predict that these should implicate the negation of (8)a-b respectively. This seems correct (to simplify the discussion, we focus our attention on secondary implicatures):

(10) Predicted implicatures for (8)a'-b'
a. *Strengthened meaning of (8)a':* I don't doubt that John will invite Ann or Mary, i.e. I believe that John will invite one of them (but not both due to the assertion).
b. *Strengthened meaning of (8)b':* it's not the case that whenever John invites Ann or Mary, his parties are a success, i.e. sometimes when John invites just one of them his parties are not a success.

For clarity, we have conducted the discussion on the scalar set *{or, and}*, but the analysis has considerable bite in much richer empirical domains. To give but one example: it

[4] The details matter: Barwise and Cooper 1981 state, more cautiously, that "the simple NP's of any natural language express monotone quantifiers or conjunctions of monotone quantifiers"; the second disjunct is motivated by the behavior of *few NPs,* which they analyze as meaning *some but not many NPs,* obtained from a conjunction of monotonic determiners. Still, the NPI-licensing behavior of *few* casts doubt on this analysis, and the stronger statement might be preferred. Note that *P* or^{excl} *Q* could be analyzed as *(P* or^{incl} *Q) and not (P and Q),* i.e. as a conjunction of monotonic constructions. (Note also that when applied to the determiner *most*, generalizations about monotonicity would have to be stated cautiously: while *most* is upward-monotonic in its VP-argument, it is non-monotonic in its NP-argument.)

has been argued that {some, most, all} form a scalar set (though sometimes we will simply discuss the scalar set {some, all}). This correctly predicts the secondary implicatures in (11):

(11) a. Some Frenchmen are clever.
i. => Some Frenchmen are not clever – because of the inference: not [All Frenchmen are clever]. [redundant given ii.]
ii. => A minority of Frenchmen are clever – because of the inference: not [Most Frenchmen are clever].
b. Most Frenchmen are clever.
=> Some Frenchmen are not clever – because of the inference: not [All Frenchmen are clever].
c. I doubt that most Frenchmen are clever.
=> Some Frenchmen are clever – because of the inference: not [I doubt that some Frenchmen are clever].
d. I doubt that all Frenchmen are clever.
i. => Most Frenchmen are clever – because of the inference: not [I doubt that most Frenchmen are clever].
ii. => Some Frenchmen are clever – because of the inference: not [I doubt that some Frenchmen are clever]. [redundant given i.]

Horn, the pioneer of the neo-Gricean approach, provides quite a few other examples of scales (see Horn 1989 and Hirschberg 1985; the case of numerals is in fact more complicated, as we will briefly discuss below):

(12) {certain, {probable/likely}, possible}, {..., 6, 5, 4, 3, 2, 1}, {boiling, hot, warm}, {adore, love, like}, {excellent, good, okay}

2.1.2 On alternatives

A crucial component of the generation of scalar implicature is the appropriate definition of scalar alternatives; let us pause to discuss some issues one might raise. (The role informativity might seem trivial enough, but as we will see in Section 2.2 this is not so: recent accounts posit that not only stronger alternatives, but more generally non-weaker ones can give rise to implicatures.)

- *Why lexical alternatives?*

In the neo-Gricean tradition (Horn 1972), the alternatives of a sentence *S* are computed by making all the possible replacements of scalar items in *S* with their lexical alternatives, as was summarized in (9)a. This raises two questions: (i) Do we really need to specify a set of alternatives in some way – couldn't a *pure* Gricean approach do the job? (ii) If a set of alternatives needs to be specified, does this have to be done by way of lexical stipulations?
Ad (i): the answer to the first question seems to be a clear 'yes'. If we didn't specify a set of alternatives in some way, we would simply have *too many more informative sentences to negate*, as is shown in (13) on the example of *some*:

(13) The 'symmetry problem'
Someone passed the exam.
Literal meaning: at least one person passed the exam
a. Plausible hypothesis: *Everyone passed the exam* is an alternative, hence the inference:
not Everyone passed the exam. Strengthened meaning: someone but not everyone passed the exam.
b. Incorrect hypothesis: *Exactly one person passed the exam* is an alternative, hence the inference:
not Exactly one person passed the exam. Strengthened meaning: at least two people passed the exam.

If there are no constraints whatsoever on the set of alternatives, we can even derive a more absurd result: any sentence *S* could have as alternatives *S and S', S and not S'* (for some *S'*). Both are more informative than *S* – and triggering a secondary implicature for both yields the strengthened meaning *S and not (S and S') and not (S and not S')*, hence *S and not S' and S',* which is a contradiction.

- *Are lexical replacements sufficient to derive all the necessary alternatives?*

Once it is established that alternatives must be specified in some way, we should ask whether lexical replacements are the way to go. They turn out to be insufficient to derive all the necessary alternatives. Consider again the case of a simple disjunction:

(14) a. John will invite Ann or Mary.
b. Observed primary implicatures
not B John will invite Ann
not B John will invite Mary
c. Predicted primary implicatures with a scalar set {or, and}
not B [John will invite Ann and Mary]

Intuitively, primary implicatures are obtained to the effect that the speaker is not in a position to assert either disjunct. But with the scalar set {or, and}, a theory based on lexical replacements alone just derives the inference that the speaker is not in a position to assert the corresponding conjunction; importantly, this is not sufficient to exclude the possibility that the speaker asserted (14)a because he believed with certainty that John will invite Ann (as long as the speaker didn't *also* believe that John will invite Mary).

The correct result is derived if (14)a has as alternatives *John will invite Ann, John will invite Mary, John will invite John and Mary*.[5] The standard procedure to compute alternatives on the basis of lexical replacements cannot derive this result without serious complications (see Sauerland 2004 for such a procedure; see also Levinson 1983). We could posit that, in addition to lexical replacements, we allow for alternatives that are obtained by deleting part of a target sentence; in this way, *p* as well as *q* could both be alternatives to *p or q*. This solution might pose a dilemma, however:

–If we stick to the assumption that the relation 'is an alternative of' is symmetric, we obtain absurd results: since *p* has *[p or q]* as one of its alternatives, we predict that *not p* should have an alternative of the form *not [p or q]* – one which is more informative than *not p*. Hence an utterance of *not p* should yield a secondary implicature that *not [p or q]* is false, and hence that *[p or q]* is true; with the assumption that *not p*, we thus infer that *q*. This is rather absurd: *not p* shouldn't in general yield the inference that *q* (furthermore, note that a similar reasoning with the alternative *[p or not q]* yields an inference that *not q!)*.

–Of course we could deny that the relation 'is an alternative of' is symmetric. Intuitively, we are willing to say that *p* is an alternative to *[p or p']* because it is syntactically simpler than it; but *p* shouldn't have as an alternative *[p or p'],* which is more complex. Still, if we just abandon the symmetry requirement in all cases, our theory will lose some of its predictive force: the implicatures we predicted for conjunctive statements in negative environments, as in (10), were correctly derived on the basis of an analysis of the implicatures triggered by *or*, together with the assumption that if *and* is a lexical alternative of *or*, *or* is also a lexical alternative of *and*. This was a positive result that we would prefer not to lose.

- *Katzir's procedure I: alternatives for scalar implicatures*

Katzir 2007 (followed by Katzir and Fox 2011) provides an elegant way out of the dilemma: his procedure to compute alternatives of a sentence *S* allows for all lexical replacements permitted by the standard neo-Gricean procedure; but in addition, it allows sub-constituents of *S* to be replaced with other sub-constituents (as well as certain other 'salient' constituents – a point we disregard in our simplified discussion). Katzir and Fox's version is defined in (15) and (16):

[5] One could ask whether it is necessary to *[p and q]* as an alternative to *[p or q]* once *p, q* are themselves alternatives. Given standard procedures to derive secondary implicatures (see Section 2.2), *[p and q]* turns out to be necessary in order to derive the 'not both' inference. This is not so in all theories, however (e.g. Spector 2003, 2007).

(15) Computation of alternatives
S' is an alternative of *S* if *S'* can be derived from *S* by successive replacements of sub-constituents of *S* with elements of the substitution source for *S* in C, SS(S, C)

(16) Substitution Source
SS(X, C), the substitution source for X in context C, is the union of the following sets:
a. the lexicon
b. the sub-constituents of X
c. the set of salient constituents in C

Since *and*, *or* are part of the lexicon, alternatives can always be generated by replacing one with the other in a sentence *S* – hence we preserve the alternatives we had in the neo-Gricean analysis. Since *p* is a sub-constituent of *[p or q],* it is a member of the substitution source of the latter. Since *[p or q]* is a sub-constituent of itself, by (16) we can replace it with *p* and obtain a new alternative, which is just *p*; and by similar reasoning, *q* is also an alternative of *[p or q]*. Thus we obtain the desirable result that each disjunct counts as an alternative to the entire disjunction. Still, we do *not* obtain the undesirable result that *[p or q]* counts as an alternative to the disjuncts: certainly *[p or q]* cannot be obtained from *p* by any substitution operation (unless *[p or q]* is itself salient in the discourse). In effect, we have preserved the symmetry of the relation 'is an alternative of' for those alternatives obtained by lexical replacements; for those obtained by non-lexical replacements, symmetry isn't preserved, which appears to be a good thing.

Once this more sophisticated way of computing alternatives is introduced, we can provide a further truth-conditional argument in favor of scalar implicatures over ambiguity-based treatments of *or*. The observation is that (17) yields an inference that *it's not the case that each of us will invite Ann, and it's not the case that each of us will invite Mary*. This inference isn't predicted by the exclusive reading of *or:* (17)a2 is perfectly compatible with a situation in which each of us is to invite Ann and only her. By contrast, the desired inference is adequately predicted once alternatives are computed *à la* Katzir: *Each of us [P or Q]* has as alternatives *Each of us P, Each of us Q,* hence the result.

(17) Each of us will invite Ann or Mary.
a. Readings predicted by the ambiguity view
a1. Inclusive: Each of us will invite *Ann or Mary or both*.
a2. Exclusive: Each of us will invite *Ann or Mary but not both*.
b. Readings predicted by the scalar implicature view (with Katzir's procedure)
b1. Literal reading: Each of us will invite *Ann or Mary or both*.
b2. Strengthened reading:
(i) (b1), with the primary implicature: not B Each of us will invite *Ann,* not B Each of us will invite *Mary*, not B Each of us will invite *Ann and Mary*
(ii) (b1), with the secondary implicature: B not Each of us will invite *Ann,* B not [Each of us will invite *Mary*].

❑ *Katzir's procedure II: manner implicatures*

Katzir's theory has an unexpected benefit: although it was motivated on the basis of scalar implicatures, it predicts some cases of manner implicatures, specifically in cases in which a sentence *S* is ruled out because there is an *equally informative* but *syntactically simpler* alternative that should be prereferred to it.

To see how this case follows from Katzir's procedure, let us start with the following intuitive principle:

(18) *Conversational principle:* Do not assert *F* is there is a better *G* which could have been asserted instead.

Within Katzir's framework, *G* counts as *at least as good* as *F* (when the latter is considered) in case *G* is an alternative to *F* and *G* is at least as informative as *F:*

(19) *G* is *at least as good as F* when *F* is considered, $F \leq G$, if (i) *G* is an alternative of *F*, and (ii) *G* entails *F*.

Naturally, *G* is strictly better than *F* ($F < G$) just in case $F \leq G$ and not: $G \leq F$. Given the conjunctive nature of (19), $G \leq F$ can fail to hold because either *F* isn't an alternative of *G*, or it is one but it doesn't entail *G:*

(20) *G* is *better than F*, $F < G$, iff $F \leq G$ but not: $G \leq F$, iff $F \leq G$ and (i) *F* is not an alternative of *G*, **or** (ii) *F* doesn't entail *G*.

Case (20)(i) corresponds to the standard neo-Gricean case: an alternative *G* to *F* is better than *F* just in case *G* is strictly more informative than *F*. Now case (20)(ii) is satisfied in a situation in which *G* is equally informative as *F*, but is syntactically simpler than it, with the effect that *G* is an alternative to *F* but *F* is *not* an alternative to *G;* this is the key to account for some violations of Manner. Consider (21): if one utters *The President from Chicago gave a good speech* in a context in which only the President of the United States could be intended, we obtain an odd sentence. Within Katzir's system, the reason is not hard to find: even though in the context at hand both sentences are equally informative, the one with *from Chicago* is strictly more complex and hence worse than its alternative.

(21) a. ?The President from Chicago gave a good speech.
b. The President gave a good speech.
(b) is an alternative to (a) [replace *President from Chicago* with *President*] but (a) isn't an alternative to (b). Hence (b) is better than (a) because it is simpler, even though though relative to common knowledge, it is not more informative.

- *How pragmatic is the derivation of alternatives?*

Even if one adopts Katzir's procedure, context must play a role in the derivation in the derivation of alternatives; in fact, Katzir explicitly proposes that some constituents must be considered as possible replacements because they are 'salient'. In principle, one could also add further constraints to prevent some replacements to be considered because they are somehow unnatural. This measure might well be necessary: Geurts 2011 observes that (22)a naturally leads to the inference that the speaker was not in a position to assert that he saw a dog – *animal* evokes *dog* as a possible alternative. But the same reasoning fails in (22)b: *dog* does not seem to evoke *poodle* as an alternative (or if it does, no implicature is derived from it). Furthermore, it would be gratuitous to posit a syntactic difference between the two cases.

(22) a. I saw an animal on the lawn this morning.
=> not B I saw a dog on the lawn this morning.
b. I saw a dog on the lawn this morning.
≠>not B I saw a poodle on the lawn this morning.

Geurts concludes that the difference between the two cases is pragmatic in nature: "if an individual x is introduced as an "animal", the hearer is likely to wonder what species of animal x is", but if x is introduced as a "dog", the same question doesn't arise with equal force". The question, of course, is whether in the end a pragmatic procedure that explains *this* fact couldn't also derive the observations that Katzir's procedure was supposed to handle. For lack of an explicit pragmatic procedure with the required properties, this is a question we are not currently in a position to answer.

2.2 Localism vs. Globalism

The neo-Gricean view offers (with some amendments) an appealing picture of implicatures, which are derived from the interaction the interaction of a theory of linguistic alternatives and a theory of rationality. The latter component is crucially based on the assumption that utterances are acts, and that all other things being equal a more informative utterance is a more cooperative act than a less informative one. But interest in implicatures was revived in

the late 1990's when precisely this picture was called into question by Landman (2000), Schwarz (2001), and most notably Chierchia (2004), who all proposed that (some) implicatures should be integrated to a recursive semantic procedure, and for this reason cannot (easily) be computed with respect to communicative acts. The debate has had numerous twists, and it has led to empirical generalizations and formal theories of great subtlety, making this one of the most dynamic fields in contemporary semantics. We will provide a brief sketch of the main developments.

2.2.1 Initial truth-conditional arguments for localist solutions

- *Two problems*

Chierchia 2004 initially produced two kinds of arguments against standard neo-Gricean treatments.

–*Predictions that are too strong:* In some cases, a mechanical application of neo-Gricean recipes yields secondary implicatures that are too strong. Consider for instance (23)a. It has, among others, the alternative in (23)b – which yields the secondary implicature in (23)c. This is clearly absurd: from (23)a we derive the implicature that John isn't a musician, and by symmetry we infer just as well that he isn't a philosopher or a poet! Furthermore, the problem is entirely general and occurs whenever one of the disjuncts contains a weak scalar term, as is illustrated in (23)d.

(23) a. [p or q] or r
[John is a philosopher or he is a poet] or he is musician
b. [p and q] or r
[John is a philosopher and he is a poet] or he is musician
c. not [p and q] and not r
d. Asserted: ... weak scalar term... or r
Alternative: ... stronger scalar term... or r
Implicature: not [... stronger scalar term...] and not r

Clearly, a mechanical application of a simple-minded version of the neo-Gricean procedure goes wrong in this case.

–*Predictions that are too weak:* In other cases, standard neo-Gricean predictions are arguably too weak. Chierchia 2004 considers (24)a-b, which according to him carry the implicatures in (24)a2-b2, where it seems that the meaning of the minimal clause containing *some* is strengthened (to *some but not all*) *before* it is composed with the next higher operator.

(24) a. All my students have read some book by Chomsky
a1. *Predicted implicature:* It's not the case that all my students have read all books by Chomsky.
a2. *Actual implicature according to Chierchia:* None of my students have read all books by Chomsky.
b. John believes that some students are waiting for him.
b1. *Predicted implicature:* It's not the case that John believes that all students are waiting for him.
b2. *Actual implicature according to Chierchia:* John believes that not all students are waiting for him.
c. John knows that some students are waiting for him.
Actual presupposition according to Chierchia: some but not all students are waiting John.

The example in (24)c yields an additional argument, based on presuppositions: according to Chierchia, the sentence presupposes that some but not all students are waiting for John; he suggests that this is expected if the meaning of *some* is strengthened *before* the embedded clause is composed with *know* (a presupposition trigger), but that these judgments are unexpected if a standard procedure is adopted. Importantly, some of the judgments given in this section are controversial. But they have given rise to sophisticated developments in the experimental literature, with the result that the debate is now on much stronger methodological footing (see Geurts and Pouscoulous 2009 and Chemla and Spector 2011 for highly relevant experimental discussion, which we do not survey for reasons of space).

❑ *A localist treatment*

A simplified version of the localist treatment offered by Chierchia 2004 is summarized in (25) (Landman 2000 and Schwarz 2001 sketch related proposals):

(25) Computation of strengthened meanings with local implicatures
a. When a non-negative operator is encountered: a 'strong meaning' is obtained by applying
–the meaning of the operator to the *strong* meaning of its argument
–and possibly adding implicatures triggered by the operator.
b. When a negative operator is encountered: a 'strong meaning' is obtained by applying
–the meaning of the operator to the *literal* meaning of its argument (otherwise the supposedly 'strong' meaning would be weaker than the literal meaning!);
–and possibly adding implicatures triggered by the operator.

The 'local strengthening' at work in this analysis bears a family resemblance with some ideas of dynamic semantics, where some pragmatic conditions are thought to apply at the level of 'local contexts' (see Section 3.2 for discussion). The special treatment of negative operators is motivated by the fact that the 'strong meaning' should never be weaker than the literal meaning – hence when a negative operator is applied, its argument should never be given a strengthened meaning.

To illustrate (25)a in greater detail, we will consider how it addresses an early challenge, which is to derive the appropriate secondary implicature for *A or B or C*. As shown in (26), we would like to obtain a strong meaning to the effect that *exactly one of A, B, C is true*.

(26) a. Rick is a philosopher or he is a poet or he is a musician.
b. *Observed implicature:* Rick has at most one of these occupations.

But how is the observed implicature to be derived? Doing so with lexical ambiguity isn't trivial; for instance, it can be checked that two instances of an exclusive disjunction or^{excl} won't do the trick: *[[A* or^{excl} *B]* or^{excl} *C]* turns out to be true, in particular, when *each* of *A, B, C* is true, because in this case the disjunct *[A* or^{excl} *B]* is false while *C* is true. Furthermore, as we argued at the outset, there are good arguments against positing an exclusive disjunction in the first place. So let us see how the localist view can solve the problem. In this special case, the necessary rules are given in (27), and illustrated in the case at hand in (28) (for notational simplicity, we write **F** for the literal meaning of a clause *F*, and $\mathbf{F^S}$ for its strengthened meaning; note that in the following we use or^{excl} to abbreviate certain truth conditions, not as a primitive element of the vocabulary of English):

(27) Definition of the strong meaning $\mathbf{F^S}$ of a clause *F*
a. If *F* is an elementary clause, its strong meaning $\mathbf{F^S}$ is the conjunction of the meaning of *F* together with the implicature predicted by the neo-Gricean analysis. In particular:
b. If F = (A or B), $\mathbf{F^S = (A^S \text{ or } B^S) \text{ and not } (A \text{ and } B)}$

(28) G = A or [B or C]
a. Step 1: Compute the strong meaning of *[B or C]*
By (27)b, $\mathbf{[B \text{ or } C]^S = [B \text{ or}^{excl} C]}$
b. Step 2: Compute the strong meaning of *A or (B or C)*
By (27)b, $\mathbf{[A \text{ or } [B \text{ or } C]]^S = [A^S \text{ or } [B \text{ or } C]^S] \text{ and not } [A \text{ and } [B \text{ or } C]]}$
c. Hence $\mathbf{G^S = [A \text{ or } [B \text{ or}^{excl} C]] \text{ and not } [A \text{ and } [B \text{ or } C]]}$

It can be checked that the strong meaning obtained in (28)b is equivalent to: *exactly one of A, B, C is true*.[6] It can also be checked that it is essential that the strengthened meaning in (27)b

[6]It is immediate that if exactly one of *A, B, C* is true, G^s is true. Conversely, suppose that G^s is true. Clearly, clearly, at least one *A, B, C* must be true. It couldn't be that *A* and *B* are true, because this would make the second conjunct in (28)c false. By the same reasoning, it couldn't be that *A* and *C* are true. It couldn't be that *B* and *C* are true, because if so *A* would have to be true to make the first conjunct true, and the second conjunct would be false. So it couldn't be that at least two of *A, B, C* are true, hence exactly one of them is.

must be obtained by negating the normal rather than the strengthened meaning of *(A and B)*. The alternative, stated in (29), would predict incorrect results: in the case of *((A or B) or C),* the strengthened meaning would just be *((A or^{excl} B) or^{excl} C),* i.e. the incorrect meaning we got in the first place with exclusive disjunction.

(29) a. *Incorrect rule:* If *F = [A or B]*, $\mathbf{F^S}$ = **[$\mathbf{A^S}$ or $\mathbf{B^S}$] and not [$\mathbf{A^S}$ and $\mathbf{B^S}$]**
b. *Incorrect strengthened meaning predicted for G = [[A or B] or C]*: $\mathbf{G^S}$ = **[[A or^{excl} B] or^{excl} C]**

In this case, then, we avoid the first problem noted by Chierchia, namely that sometimes the secondary implicatures predicted by a mechanical neo-Gricean procedure are too strong. Let us now see how we solve the second problem, that of implicatures that were too weak. Since *all of my students, believe* and *know* are all positive operators, we obtain a strengthened meaning for the examples in (24) by composing these operators with the strengthened meaning of their argument (following the rule in (25)a). Writing *some^s N* for the strong meaning of *some* (= *some but not all*, or even: *some but not most*), we obtain the following strengthened meanings for the relevant sentences; it is clear that they are stronger than the meanings with global implicatures (in addition, (30)c immediately explains why a presupposition of the form *some but not all students are waiting for John* is generated).

(30) a. **All my students have read some^s book by Chomsky**
b. **John believes that some^s student is waiting for him.**
c. **John knows that some^s student is waiting for him.**

❑ *Globalist responses*

The globalist response to these problems is different . It consists in three main measures (see Spector 2003, 2006, 2007, Sauerland 2004, van Rooij and Schulz 2004, Sevi 2005, Russell 2006).

(i) First, it expands the set of alternatives – for instance using Katzir's procedure, which yields for *[p or q]* not just *[p and q],* but also *p, q* as alternatives. The result is to predict primary implicatures that are least as strong and sometimes stronger than those predicted by a standard neo-Gricean treatment; this will solve the problem of implicatures that were too weak.

(ii) Second, we need an explicit method to explain which primary implicatures become secondary implicatures. It won't do to propose that *all* do. In the case of *p or q*, a strengthening of *not B p, not B q* to *B not p, B not q* respectively would be absurd, as the speaker couldn't assert that *p or q* while believing that *not p* and also that *not q*. Following Sauerland 2004, one can propose a theory in which primary implicatures are strengthened into secondary implicatures just in case this strengthening does not contradict the literal meaning combined with all primary implicatures. In some cases, this measure combined with the first step ('more alternatives') will have the effect of *weakening* the secondary implicatures that are derived in a naive neo-Gricean procedure: with more alternatives, we generate more primary implicatures; but this also means that more potential strengthenings into secondary implicature will be ruled out for fear that they contradict these primary implicatures. This might solve the problem of secondary implicatures that were too strong.

The spirit of Sauerland's procedure is simple: we start by generating all the primary implicatures of a sentence *S*; then we strengthen a primary implicature of the form *not B S'* into *B not S'* just in case this strengthening does not contradict the literal meaning (more precisely: the epistemic statement *B S),* combined with the primary implicatures, of the form *not B S'$_1$* , *not B S'$_2$,* etc. We illustrate this procedure for *p or q*:

(31) Primary and secondary implicatures of *p or q*
a. Asserted: *p or q*
hence by Quality: B (p or q)
b. Primary implicatures: not B p, not B q, not B (p and q)
c. Secondary implicatures:
If compatible with a. and b., strengthen *not B F* to *B not F*
• Can we get *B not (p and q)*? Yes: this is coherent, and it is the secondary implicature we in fact want.
• Can we get *B not p*? No: if *B (p or q)* and *B not p*, it must be that *B q* - which contradicts b.
• Can we get *B not q*? No: Same reason.

For *p or q*, we get exactly the results we want. It can be shown that in the case of the multiple disjunction *[[p or q] or r],* this procedure derives the correct primary implicatures, and also the correct secondary implicature, namely that at most one of *p, q, r* is true. Briefly, the reason is that Katzir's procedure in (15) yields, among others, the alternatives:
–[p and r]: in *[[p or q] or r],* replace *[p or q]* with *p*, and replace the remaining *or* with *and*;
–[q and r]: same reasoning;
–[p and q]: replace *[p or q]* with *p* and *r* with *q;* then replace *or* with *and*. It turns out that each of these alternatives can be negated without contradicting any of the primary implicatures, in particular that *not B p, not B q, not B r*. When all three alternatives are negated in this way, we get a strengthened reading to the effect that *exactly one of p, q, r* is true – as desired (though showing this rigorously would require a longer discussion).

Importantly, this derivation was offered on the basis of mechanisms that are independently motivated: (a) we enriched the set of alternatives of *F or G* to include *F, G* in order to get the primary implicatures of disjunction; (b) once this move was made, the mechanism to derive secondary implicatures *had* to be made more sophisticated: negating *F, G* in a secondary implicature would have lead to a contradiction. So it seems that the globalists can justifiably claim that, in this case at least, they have a good way to solve the problem of implicatures that were too strong.

(iii) There is also a third component to the globalist response, which is essential to address the problem of some overly weak implicatures (Spector 2006). The main idea is that implicatures are obtained not just by negating more informative alternatives, but more generally non-weaker ones, i.e. ones not entailed by the literal meaning and which, for this reason, can be negated coherently. To see this procedure at work, consider again (32)a, with the strengthened reading predicted by localist accounts in (32)b. For simplicity, we restrict attention to the set of alternatives generated on the basis of the lexical alternatives *some, each*.

(32) a. Each of my students has read some book by Chomsky.
b. Each of my students has read some^{s} book by Chomsky
c. Alternatives of (b)
c1. Each of my students has read each book by Chomsky.
c2. Some of my students has read some book by Chomsky.
c3. Some of my students has read each book by Chomsky.

Consider the alternatives in (32)c. (c2) is entailed by (32)a, hence it cannot yield a primary implicature. (c1) yields an uncontroversial primary and secondary implicature – the latter to the effect that *not every student has read every book by Chomsky*; but this isn't enough to emulate the strong localist reading represented in (32)b. By negating (32)c (i.e. by deriving from it a primary and then a secondary implicature), however, we do obtain the desired result: each of my students has read some book by Chomsky, and none of them has read all books by Chomsky; in other words, each of my students has read some but not all books by Chomsky, which is precisely the localist reading represented in (32)b.[7]

[7] For simplicity, we just worked with the scale {some, each}, but we could have emulated a local implicature just as well with the scale {some, most, each}.

Importantly, this result can only be achieved if non-weaker alternatives can be negated in addition to stronger ones, since it is immediate that (32)c3 does not entail (32)a. But how can we make sense of this assumption within a Gricean framework? The question is rather open: it's unclear why one could take an alternative that's not stronger than the original sentence to count as 'better' than it. Still, there is a way out, albeit of a somewhat stipulative nature (but see Spector 2003, 2007). Let us assume that, in addition to the alternatives *S'* to a sentence *S,* obtained by Katzir's procedure, we generate the *conjunction* of *S and S'* of the original sentence with each of these alternatives. Applying this procedure, we would in particular obtain for (32)a an alternative of the form *Each of my students has read some book by Chomsky, and some has read each*. It is immediate that *this* alternative asymmetrically entails (32)a (*[S and S']* clearly entails *S!*); and thus we can remain faithful to the Gricean idea that only stronger alternatives are considered as 'better' than the original sentence. On the down side, however, this analysis forces us to consider alternatives that are considerably more complex than the sentence uttered, which goes against the common intuition that only alternatives that are 'not too complex' are considered.

Going back to the issue of overly weak implicatures, we still haven't given a procedure to emulate the strong localist reading of (30)b, repeated in (33).

(33) John believes that some^{s} student is waiting for him.

The problem is that there is no reasonable alternative to *believe* that could play the role of the *some* alternative in (32)c3. So a different line is sometimes taken here (Spector 2006, followed by Geurts 2011; see also Russell 2006): the rough idea is that attitude verbs have a quotational component, and that the use of an embedded clause with *some* suggests that this roughly corresponds to the sentence that the agent had in mind. Note that when the attitude verb is *say* this line of thought has clear plausibility; but when the verb is *believe*, this line isn't trivial to develop (e.g. we would need to say that the speaker asserts (33) because John asserted the embedded clause, which in turn triggers a *not all* implicature); we leave this point open.

So far we have emphasized cases in which the same predictions can be achieved by localist and by sophisticated globalist treatments. But in the general case the two approaches make very different truth-conditional predictions, and thus the debate can and should be decided on empirical grounds (it would also be desirable to have *general* results of equivalence in subclasses of cases). To see a clear situation where the predictions differ, consider (34), investigated with experimental means in Chemla and Spector 2011.

(34) Exactly one student solved some of the problems.

–Chierchia's version (2004) of the localist theory predicts that (34) has a strong reading with a local implicature, as in (35)a, paraphrased in (35)b (here we apply (25)a, using the fact that *exactly one student* is a non-monotonic operator and is for this reason non-negative).

(35) a. Exactly one student solved some^{s} of the problems.
b. 'Exactly one student solved some but not all of the problems'

Importantly, this strengthened reading does *not* entail the literal reading of (34) (precisely because *exactly one student* is not upward-monotonic). And in the globalist approach, strengthened readings are *always* obtained by adding some implicatures to the literal meaning, hence they always entail the latter. In other words, in this case a localist approach makes a prediction that couldn't be matched by a globalist approach.

–Conversely, sophisticated globalist approaches predict for (34) a strong reading that cannot be emulated by unsophisticated localist approaches:

(36) a. *Alternative of (34):* Exactly one student some each of the problems.
b. *Strengthened reading (globalist view, with negation of non-weaker alternatives):*
exactly one student solve at least one of the problems, and it's not the case that exactly that exactly one

student solve each of the problems; *or in other words:*
exactly one student solve at least one of the problems, and that student didn't solve each of the problems.

To obtain this reading, non-weaker alternatives must negated. A localist analysis without such a mechanism couldn't derive this reading; notice in particular that (35)b doesn't entail (36)b, since (35)b doesn't entail the literal reading which is strengthened in (36)b.

2.2.2 Indirect arguments

As we just saw, it is in principle possible to tease apart the truth-conditional predictions of localist and of recent globalist accounts; but this is by no means trivial. Two further arguments, of an indirect nature, were adduced in the literature (one of them turns out to have subtle truth-conditional reflexes as well). For simplicity, we will henceforth represent the strong meaning of a clause by inserting an exhaustivity operator *Exh* at the beginning of the relevant constituent; the semantics of the exhaustivity operator is further explored in Section 2.2.3. (*Exh* has as a semantics similar to the word *only*, with some differences we will discuss later.)

- *An argument from intervention effects*

One can reconstruct from Chierchia 2004 an argument in favor of locally computed on the basis of intervention on the licensing of negative polarity items (NPI).
–The first observation is that, as a first approximation, an NPI is licensed as soon as is in an environment which is semantically negative ('downward-monotonic') with respect to at least one constituent – and this environment may but need not be the entire sentence.[8] The basic effect is seen in (37)c, where the NPI *any wine* is licensed despite the fact that with respect to the whole sentence the environment is positive (the two negations cancel each other out); still, with respect to the embedded clause the environment is negative, and this suffices to license the NPI.

(37) a. #There is any wine left.
b. There isn't any wine left.
c. It's not true that there isn't any wine left.

–The second observation is that implicatures 'count' when one determines whether an environment is semantically negative or not. This explains for instance the following contrast:

(38) a. I doubt that Theo drank the leftover wine or any coffee.
b. *I doubt that Theo drank the leftover wine and any coffee.

(39)a (38)b is deviant because *I doubt that p and q* triggers the implicature that *I don't doubt that p or q*. When the strengthened meaning is computed, *any* doesn't appear in a negative environment any more: the standard test for downward-monotonicity (truth preservation from the superset *coffee* to the subset *decaf coffee*) fails in (39)b (which contrasts with (39)a, which only takes into account the literal meaning).

(39) a. I doubt that Theo drank the leftover wine and coffee
=> I doubt that Theo drank the leftover wine and decaf coffee.
b. I doubt that Theo drank the leftover wine and coffee but I don't doubt that Theo drank the leftover wine or coffee
≠> I doubt that Theo drank the leftover wine and decaf coffee but I don't doubt that Theo drank the leftover wine or decaf coffee

Importantly, while the existence of implicatures yields a natural explanation of the contrast, it is entirely unclear why the implicatures in question cannot be canceled in order to 'save' these

[8] Our description is a simplification; see Homer (to appear) for a far more detailed analysis (see also Israel 2004).

constructions; we leave this question aside in what follows (a related problem is briefly discussed in Section 2.3).
–The third observation, which is implicit in Chierchia's work, is that the same intervention effect can be found with respect to embedded constituents:

(40) a. It is not true that [I doubt that Theo drank the leftover wine or any coffee].
b. #John thinks that [I doubt that Theo drank the leftover wine and any coffee].
b'. [John thinks that Exh[I doubt that Theo drank the leftover wine and any coffee]]
d. Exh [John thinks that I doubt that Theo drank the leftover wine and any coffee]]

In (40)a, the NPI must be licensed with respect to the underlined clause. The licensing fails in (40)b. This follows if a local implicature is computed, as in (40)b'. By contrast, the facts are surprising if no implicature is computed, or only a global ione, as in (40)c: not being targeted by a local implicature, the underlined clause should license the NPI. (Here too, what is *not* explained is why the presence of the embedded exhaustivity operator is somehow obligatory.)

❑ *An argument from Hurford's constraint*

Chierchia et al. (2012) make another indirect argument in favor of local implicatures (see Sauerland 2012 for important extensions). It has the following structure:
–A disjunction *(F or G)* is deviant if, *G* entails *F* ('Hurford's constraint'). Schematically:

(41) #... F or G ... if *G* entails *F*

–Still, there are cases in which *F* contains a scalar item and the effect *fails* to arise. This can be explained if a local implicature strengthens *F* to *Exh F*, which fails to be entailed by *G* – as is represented in (42):

(42) ... [Exh F] or G ..., where *G* entails *F* but *G* does not entail *Exh F*.

Basic instances of Hurford's constraint are illustrated in (43); its obviation is illustrated in (44):

(43) a. #John lives in France or in Paris.
a. #Mary saw a dog or an animal.

(44) a. Mary solved [the first problem or the second problem] or both problems.
b. Mary read some or she read all the books.
c. Either the first year students came or all of the students came.

Chierchia et al.'s analysis appeals to local implicatures, as shown in (45):

(45) a. Exh [Mary solved the first problem or the second problem] or both problems.
b. Exh[Mary read some of the books] or she read all the books
c. Either Exh[the first year students came] or all of the students came.

Consider for instance (44)b, of the form *F or G* with *F = Mary read some books* and *G = Mary read all the books*. It is clear that *G* entails *F*, hence if we restricted attention to the literal meanings of the disjuncts, we would be in violation of Hurford's constraint in (41). But with a local implicature added to the first disjunct, the problem disappears: with the scalar set {some, all}, the first disjunct becomes equivalent to *Mary read some but not all of the books*, and this is clearly not entailed by the second disjunct.

Chierchia et al. adduce a truth-conditional argument to further buttress their conclusion. Consider (44)c, which they claim must have the representation in (45)c in order to circumvent a violation of Hurford's constraint. Without the embedded exhaustivity operator, the sentence would be equivalent to its first (i.e. weakest) disjunct, hence to: *(at least) the first year students came*. On the assumption that alternatives to first disjunct include *the second year students came, the third year students came,* etc, the exhaustivity operator (which negates non-weaker alternatives) will yield for the first disjunct a meaning akin to

only the first year students came, with the effect that the entire disjunction entails that one of the following incompatible states of affairs holds:
–the first year students and no others students came;
–all the students came.
Chierchia et al. argue that the latter truth conditions are in fact found, which supports their analysis.[9]

In addition, Chierchia et al. argue that an embedded exhaustivity operator can have an effect on the implicatures triggered by the sentence it finds itself in. This is an important point because it suggests that the exhaustivity operator, which up to this point was just a notational convenience to encode the presence of locally computed implicatures, might have syntactic reality, at least if the alternatives are themselves computed by modifying the form of the target sentence. Consider the contrast in (46):

(46) a. Every student [is a syntactician or a semanticist].
does NOT implicate: at least one student is both a syntactician and a semanticist
b. Every student is [[a syntactician or a semanticist] or both].
implicates: at least one student is both a syntactician and a semanticist

The explanation of the contrast can be found once we taken into account the embedded exhaustivity operator needed to circumvent Hurford's constraint:

(47) a. Every student is [Exh[a syntactician or a semanticist] or both]
b1. Alternative 1: Every student is Exh[a syntactician or a semanticist]
b2. Alterntaive 2: Every student is both a syntactician and a semanticist

On the assumption that it is syntactically real, *Exh* will be found in the alternatives to (47)a, which include (by Katzir's procedure in (15)) (47)b1 and b2. Negating (b1) yields (with (a)) the inference that at least one student is both a syntactician and a semanticist.

- *Constraints on embedded implicatures*

Proponents of embedded implicatures must somehow constrain the mechanism by which they are generated; if local implicatures are cashed out in terms of the embedded insertion of *Exh*, its distribution must be limited. In particular, it is usually thought that embedded implicatures are dispreferred if their effect is to *weaken* the literal meaning of a sentence; for this reason, they are thought not to appear easily in downward-monotonic environments. This is in fact essential to account for some the examples we started out with: we argued in (8) that an ambiguity theory of disjunction couldn't account for the *lack* of ambiguity of *or* in semantically negative environments; but if exhaustivity operators could be inserted at will, we would generate all the readings obtained on the ambiguity view (and then some). To avoid this undesirable consequence, we must somehow rule the representations in (48) as unacceptable or at least dispreferred.

(48) a. *I doubt that Ex[John will invite Ann or Mary].
b. *Whenever John invites Exh[Ann or Mary], his parties are a success.

Arguably, the facts are different when *or* is focused, in which case many more 'embedded' readings arise. This highlights the importance of the relation between scalar implicatures and theories of focus – a topic we cannot discuss in the present survey (see Spector and Fox, to appear, for discussion).

[9] To detect this truth-conditional effect, it is essential that the exhaustivity operator present in the first disjunct should exclude more alternatives than just the second disjunct; for this reason, a similar truth-conditional effect won't be found in (44)a; and it will be found in (43)b with the scalar set {some, most, all} but not with the scalar set {some, all}.

2.2.3 Variety of exhaustivity operators[10]

When it has matrix scope, the exhaustivity operator can be seen as a convenient way to encode secondary implicatures, irrespective of the view (globalist or localist) that one has on how they are generated. When it is embedded, *Exh* serves to represent local implicatures, and it is taken to have syntactic reality by some analyses. But what is its precise semantics? A standard intuition is that *Exh* has the same semantics as the focus-sensitive particle *only,* with the difference that the latter has presuppositions that the former lacks, in particular a presupposition that at least one alternative is true (e.g. *Will John only invite Mary?* triggers the inference that John will invite someone).[11] This connection with *only* is important for two reasons: it has made it possible to borrow from theories of *only* lexical entries for the exhaustivity operator; and it highlights the connection between implicatures and focus – a connection which should not come as a surprise since both are based on the consideration of alternatives to a sentence uttered.

Three main lexical entries have been proposed in the literature for the exhaustivity operator. The first, which we call $Exh_{Sauerland}$, is Fox's (2007) reconstruction of Sauerland's (2004) procedure to compute secondary implicatures. The second one, $Exh_{minimal\text{-}models}$, originates in Schulz and van Rooij 2006, who partly follow Spector 2003, and build on Groenendijk and Stokhof's (1984) analysis of *only,* as well as ideas developed in artificial intelligence by McCarthy (1980, 1986) (see also Sevi 2005). The last one, Exh_{Fox}, results from Fox's attempt (2007) to combine empirical advantages of both operators.

(49) If S is a proposition and Alt is its set of alternative propositions:

a. $Exh_{Sauerland}(S, Alt)$ = {w: S is true in w and
for every S'∈ Alt, if (i) S does not entail S', and (ii) ¬∃S" ∈ Alt s.t. (a) S doesn't entail S" and (b) (S and not S') entails S",
then S' is false in w}

b. $Exh_{minimal\text{-}models}(S, Alt)$ = {w: S is true in w and ¬∃w': S is true in w' and w' $<_{Alt}$ w} where for all worlds w', w,
w' $<_{Alt}$ w iff {S': S' ∈ Alt and S' is true in w'} ⊂ {S': S' ∈ Alt and S' is true in w} (where ⊂ is strict inclusion)

c. $Exh_{Fox}(S, Alt)$ = {w: S is true in w and for all S' ∈ IE(S, Alt), S' is false in w}
where IE(S, Alt) = ∩{A ⊆ Alt: A is a maximal subset of Alt such that A^{-} ∪ {S} is consistent}
where A^{-} = {¬p: p ∈ A}
Terminology: IE(S, Alt) is the set of 'innocently excludable alternatives'.

We will briefly discuss these operators in turn.

The definition in (49)a is in two steps, following Sauerland's procedure: (i) first, we consider each alternatives *S'* to *S* which is not entailed by *S* – and thus can give rise to a primary implicature of ignorance; (ii) second, we negate *S'* to obtain a secondary implicature, *unless* doing so contradicts the literal meaning *S* together with some other primary implicature.[12] This operator encounters a problem, however: while it is checked that each

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[10] This section is intended for readers interested in issues of technical implementation.

[11] Another presupposition triggered by *only* is that the alternative which is asserted to be true is low on some salient scale. For instance, *Does John only earn $1 million a year?* makes the (non-standard) presupposition that $1 million a year is a small amount of money.

[12] To be more precise: we wish to avoid the case in which for some non-entailed alternative *S"* to *S,*

(i) for every belief operator B, B (S and ¬S') ⇒ B S"

(i) corresponds precisely to the case in which strengthening ¬*BS'* to *B*¬*S'* has as a necessary consequence that some other primary implicature ¬*BS"* is contradicted (on the assumption the literal meaning of *S* is believed). Assuming that belief operators are closed under logical consequence, we have the following equivalence:

secondary implicature *on its own* does not contradict any primary implicature combined with the literal meaning, there is no guarantee that the secondary implicatures *taken together* won't have such an undesirable consequence. Under certain assumptions, this problem does arise in (50), as analyzed in (51):

(50) –Who did Fred talk to? –Some GIRL. (Fox 2007)

(51) Assume that there are three girls in the domain of discourse, and that the alternatives we have are: {Fred talked to some girl, Fred talked to g1, Fred talked to g2, Fred talked to g3}, abbreviated as: {p, g1, g2, g3}.
a. Primary implicatures: not B g1, not B g2, not B g3
b. Secondary implicatures: B not g1, B not g2, B not g3

In (51), each of *g1*, *g2*, *g3* can be coherently negated given the primary implicatures (this is so because there are more than two individuals that are quantified over: knowing that Fred didn't talk to one doesn't imply that one knows who he in fact talked to). But taken together, these negations imply that Fred talked to none of the three girls – which contradicts the literal meaning.

The minimal model operator in (49)b is designed to avoid this problem, among others. A world w' is taken to be 'smaller' or 'more minimal' than a world w (in symbols: $w' <_{Alt} w'$) relative to the set of alternatives *Alt* just in case w' makes fewer members of *Alt* true than w where 'fewer' is construed, as is standard, in terms of proper subset-hood). With this definition, the minimal model operator applied to *S* only keeps from the worlds that satisfy *S* those that are minimal relative to *Alt,* i.e. that make false as many alternatives as possible. In simple cases, such as a disjunction *p or q*, this operator derives the results of the standard analysis: with the alternatives *p, q, p and q,* the minimal worlds satisfying the disjunction are those that make true exactly one of the disjuncts:

(52) a. S = p or q
b. Alt = {p, q, p and q}
c. $Exh_{minimal\text{-}models}$(S, Alt) = {w: S is true in w and ¬∃w': S is true in w' and w' $<_{Alt}$ w}
= {w: exactly one of *p, q* is true in w}

But in the case of (51), the minimal models operator avoids the problem encountered by Sauerland's operator: the minimal worlds that satisfy the literal meaning are those that make true exactly one of the alternatives *g1, g2, g3* – as is desired:

(53) a. S = Fred talked to some girl
b. Alt = {g1, g2, g3, Fred talked to every girl}
c. $Exh_{minimal\text{-}models}$(S, Alt) = {w: S is true in w and ¬∃w': S is true in w' and w' $<_{Alt}$ w}
= {w: exactly one of *g1, g2, g3* is true in w}

Still, this operator, as well as Sauerland's, encounters difficulties in another case which we haven't discussed at all so far, that of 'free choice permission', illustrated in (54):

(54) a. You may have tea or coffee.
Inference: you may have tea and you may have coffee
b. Some passengers got sick or had trouble breathing. (Klinedinst 2007)
Inference: some passengers got sick and some passengers had trouble breathing

Space does not allow us to do justice to the important recent literature on this topic (see Aloni 2007, Aloni and van Rooij 2004, Barker 2010, Franke 2009, Schulz 2005). For present

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(ii) (i) iff
a. for every belief operator *B*, B[S and ¬S') ⇒ S"], iff
b. |= (S and ¬S') ⇒ S"

(ii)b immediately entails (ii)a. For the converse, notice that /= (i.e. logical validity) counts a belief operator, representing the epistemic state of an agent with no beliefs whatsoever, one who thus believes a proposition just in case it is *a priori* true.

purposes, the important observation is that (54)a, which is of the form *may (p or q)*, gives rise to an inference that *may p* and *may q* ((54)b has a similar structure, but with an existential quantifier replacing the existential modal). Now with Katzir's procedure to generate alternatives, *may p* and *may q* are alternatives to *may (p or q)*, hence in Sauerland's system we obtain a primary implicature *not B may p,* as well as *not B may q*. Alas, this squarely contradicts the inference we intuitively derive. The minimal models approach doesn't do any better, as it implies that exactly one of *may p, may q* is true – which contradicts the inference we find, as shown in (55)c.

(55) a. S = may (p or q)
b. Alt = {may p, may p, may (p and q)}
c. $Exh_{minimal\text{-}models}(S, Alt)$ = {w: S is true in w and ¬∃w': S is true in w' and w' $<_{Alt}$ w}
= {w: exactly one of *may p, may q* is true in w}
d. $Exh_{Sauerland}(S, Alt)$ = {w: S is true in w and *may (p and q)* is false in w}

Interestingly, Sauerland's operator in (49)a does not lead to this problem. The reason is the following: *not B may p* and *not B may q* are generated as primary implicatures; but *not may p* is *not* generated as a secondary implicature: if it were, we could infer from *may (p or q)* that *may q*, which would contradict the primary implicature *not may q*. By a symmetric argument, *not may q* is not generated as a secondary implicature. Now this suggests that if we take Sauerland's to have some reality *independent from* the pragmatic procedure that Sauerland sketches (so that we can have the secondary implicature without having the primary implicatures!), we might have a chance of solving the free choice puzzle. Fox 2007 takes one additional step: he notices that when Sauerland's is iterated, it gives rise to exactly the inference we want, as is seen in (56) (since we now need to put the operator in the object language, we write it as $Exh_{Sauerland}{}^{Alt}$ *S*; for simplicity, we disregard the alternative generated by replacing *may* with *must*):

(56) a. S = may (p or q)
b. Alt = {may p, may p, may (p and q)}
c. $Exh_{Sauerland}(S, Alt)$ = {w: S is true in w and *may (p and q)* is false in w}
a'. S' = $Exh_{Sauerland}{}^{Alt}$ may (p or q)
b'. Alt' = {$Exh_{Sauerland}{}^{Alt}$ may p, $Exh_{Sauerland}{}^{Alt}$ may q, $Exh_{Sauerland}{}^{Alt}$ may (p and q)}
c'. $Exh_{Sauerland}(S', Alt')$ = {w: S is true in w and *may (p and q)* is false in w and $Exh_{Sauerland}{}^{Alt}$ *may p* is false in w and $Exh_{Sauerland}{}^{Alt}$ *may q* is false in w}

The result is derived as follows: the alternatives to *S'* = $Exh_{Sauerland}{}^{Alt}$ *may (p or q)* are $Exh_{Sauerland}{}^{Alt}$ *may p,* $Exh_{Sauerland}{}^{Alt}$ *may q,* $Exh_{Sauerland}{}^{Alt}$ *may (p and q)*. The last one is equivalent to *may (p and q),* which is already excluded by the literal meaning of *S'*. The first and the second have the meaning *only may p*, *only may q* – and both can be denied coherently. We end up with a meaning akin to: (a) literal meaning of *S'*: *may (p or q) but not may (p and q);* (b) contribution of exhaustification: it's not the case that *only may p*, it's not the case that *only may q* – hence *both may p and may q*. This is precisely the result we want.

In Fox's final analysis, the exhaustivity operator is syntactically realized and can be iterated under certain circumstances. If one uses Sauerland's operator, the reduplicated exhaustivity operator derives the desired free choice inference. But Fox also offers a solution to the problem he noted in (50)/(53) (*Who did Fred talk to? –Some GIRL*). The operator in (49)c is intended to retain the good properties of Sauerland's operator (when iterated), while addressing this initial problem. In a nutshell, Fox's operator works in two steps:
–we first determine what are the maximal subsets of *Alt* whose members can be coherently denied in the presence of *S*;
–second, we end up denying those alternatives that are in each of these maximal subsets (intuitively, this is to avoid the case in which we are forced to make 'arbitrary choices' among the alternatives we choose to deny).

It can be checked this has the desired effect in (50)/(53): the maximal set of alternatives whose members we can coherently deny are {g1, g2}, {g2, g3}, {g1, g4} – but they have a null intersection, hence we get no secondary implicature, and we don't run into the same problem as with Sauerland's procedure. It can also be checked that for (56)a', we can – with come computations – derive the free choice inference *may p and may q* just as well with Fox's operator as with Sauerland's. (However, see Schulz 2005 and Aloni and van Rooij 2007 for an account of free choice based on minimal models.)

To summarize, here are some of the main motivations for each operator:

(57) a. **Exh$_{\text{Sauerland}}$**
–derives Sauerland's secondary implicatures;
–encounters problems with *Fred talked to some girl* (all the strengthenings together might be contradictory).
–iterated, can account for 'free choice readings'.
b. **Exh$_{\text{minimal-models}}$**
–is based on 'mimimal models';
–has no problem with *Fred talked to some girl*;
–cannot account for 'free choice readings'.
c. **Exh$_{\text{Fox}}$**
–is a refinement of $\text{Exh}_{\text{Sauerland}}$
–has no problem with *Fred talked to some girl*;
– can account for 'free choice readings'.

For readers who might want to delve into this topic in greater detail, we provide a preliminary description of the logical relations that hold among these exhaustivity operators (see Spector, to appear, for a detailed treatment):

(58) Logical relations among operators (further results can be obtained, for instane when additional constraints are introduced on sets of alternatives)
We write $F \geq G$ for: *F is at least as strong as G* and $F > G$ for: *F is at least as and sometimes stronger than G*
a. $\text{Exh}_{\text{minimal-models}}(S, \text{Alt}) > \text{Exh}_{\text{Fox}}(S, \text{Alt})$
[*Reason:* it can be shown (Spector) that $\text{Exh}_{\text{Fox}}(S, \text{Alt})$ = {w: S is true in S and for all $p \in \text{Alt}$, [if $\text{Exh}_{\text{minimal-models}}(S, \text{Alt})$ entails $\neg p$, p is false in w]}; and as shown in]

b. $\text{Exh}_{\text{Sauerland}}(S, \text{Alt}) > \text{Exh}_{\text{Fox}}(S, \text{Alt})$
[*Reason:* Suppose S' is negated by $\text{Exh}_{\text{Fox}}(S, \text{Alt})$. Then {S, $\neg$S'} is consistent, hence S' isn't entailed by S. Furthermore, there couldn't be an S" $\in$ Alt s.t. (a) S doesn't entail S" and (b) (S and not S') entails S", for if so {S, $\neg$S"} would be consistent but $\neg$S' couldn't be contained in any maximal superset A of {S"} such that $A^{-} \cup \{S\}$ is consistent. Therefore, S' is negated by $\text{Exh}_{\text{Sauerland}}(S, \text{Alt})$ – and $\text{Exh}_{\text{Sauerland}}(S, \text{Alt}) \geq \text{Exh}_{\text{Fox}}(S, \text{Alt})$. In the case of (51), $\text{Exh}_{\text{Sauerland}}$ yields a contradiction but Exh_{Fox} doesn't, hence in the end $\text{Exh}_{\text{Sauerland}}(S, \text{Alt}) > \text{Exh}_{\text{Fox}}(S, \text{Alt})$.]

c. It is not in general the case that $\text{Exh}_{\text{minimal-models}}(S, \text{Alt}) \geq \text{Exh}_{\text{Sauerland}}(S, \text{Alt})$, nor that $\text{Exh}_{\text{Fox}}(S, \text{Alt}) \geq \text{Exh}_{\text{Sauerland}}(S, \text{Alt})$
[*Reason:* in (53), $Exh_{Sauerland}$ yields a contradiction but the other two operators don't].

d. It is not in general the case that $\text{Exh}_{\text{Sauerland}}(S, \text{Alt}) \geq \text{Exh}_{\text{minimal-models}}(S, \text{Alt})$
[*Reason:* consider S = *p or q*, and take Alt = {p or q, p, q} (without *p and q*)].

2.3 Further questions

We end this section with some important questions for current and future research.[13]

[13] In addition to these, one would need to go back to examples such as (26) and explain how the exhaustivity-based approach can avoid generating a reading equivalent to *[[A or^{excl} B] or^{excl} C]*. Couldn't one be obtained with the Logical Form $Exh_2[Exh_1[A\ or_1\ B]\ or_2\ C]$? As B. Spector (p.c.) notes, the answer depends in part on the alternatives each exhaustivity operator has access to. For instance, taking the minimal models operator discussed in (49)b ('$\text{Exh}_{\text{minimal-models}}$'), we will obtain the wrong results if Exh_1 operates on {A, B} and their conjunction

❑ *Grounding implicature theory*

–From a globalist neo-Gricean perspective, there are important recent attempts to ground scalar reasoning in an explicit theory of rationality. An early proposal can be found in Spector 2003. More recent attempts use the tools of cooperative game theory; see Franke 2011 and Rothschild 2011 for discussion. The hope is that the choice among the various exhaustivity operators could be made on the basis of an independently motivated theory of rationality.

–From a localist perspective, several issues are open. (i) First, the distribution of the exhaustivity operator has yet to be constrained in a principled way. (ii) Second, so far the literature is compatible with two interpretations of it: according to one, there is an operation of 'semantic enrichment' that does *not* require the presence of an operator in the syntax; according to the other, the operator is really syntactically represented. The latter might be at an advantage to deal with (47), where the embedded exhaustivity operator has a consequence on the *alternatives* which are considered; but the issue is still quite open. (iii) Third, the very *existence* of the exhaustivity operator – or of the corresponding operation of semantic enrichment – is not very well motivated conceptually, though its proponents have provided quite a bit of empirical evidence for it. Unlike globalist theories, which might find some grounding in a theory of communicative rationality, localist theories are not currently derived from more primitive considerations; more foundational work might be helpful on this point.

Proponents of 'truth-conditional pragmatics' (see Recanati 2010 for recent references) suggest an interesting connection with other cases of 'pragmatic enrichment' that take place before the post-compositional level. One example is 'predicate transfer' (Nunberg 1995), which in Recanati's words (2010) takes us "from a certain property, conventionally expressed by some predicative expression, to a distinct property bearing a systematic relation to it", as is illustrated in (59).

(59) a. I am parked out back.
=> *parked out back* undergoes transfer to denote a property of cars rather than of individuals.
b. The ham sandwich left without paying
=> *ham sandwich* undergoes transfer to refer to an individuals who ordered a sandwich.
c. There is a lion in the courtyard.
=> *lion* can undergo transfer to refer to a representation of a lion (e.g. a statue)

Proponents of 'truth-conditional pragmatics' suggest that local implicatures should be seen in this broader class of pragmatic enrichments.

–As was mentioned in passing, the theory of scalar implicatures is intimately connected to the theory of focus and the theory of questions: all three make crucial use of 'alternative semantics', and the latter two might give a clue to the nature of the alternatives.

❑ *Further topics*

• *Numerals*

When standard tests for implicatures are applied, numerals show a dual behavior: they do give rise to implicatures; but at the same time these appear to be preserved in the scope of negative operators. A survey and possible explanation of their special behavior is offered in Spector 2011.

• *Blind implicatures*

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while Exh_2 operates on {Exh$_1$[A or B], C} and their conjunction, as this would yield a reading equivalent to *[[A or^{excl} B] or^{excl} C]*. But things are different if Exh_1 operates on {A, B} and their conjunction while Exh_2 operates on {A, B, C} and their conjunctions: the minimal worlds (according to Exh_2) satisfying *[Exh$_1$[A or$_1$ B] or$_2$ C]* would end up being those that satisfy exactly one of {A, B, C}, as is desired.

Magri 2009, 2011, 2012 discusses the deviance of examples such as (60):

(60) #Some Italians come from a warm country.

Intuitively, one would like to say that (60) is deviant because it triggers an implicature that *not all Italians come from a warm country*. The problem is that such a reasoning cannot be made if the comparison between *some Italians come from a warm country* and its alternative *all Italians come from a warm country* is effected relative to the context set. This is because relative to any reasonable context, the two sentences are equivalent: *some* Italians come from a warm country is true just in case *all* Italians do. As a result, there is no reason one should infer from the first sentence the negation of the second. Magri proposes that implicatures are *not* computed relative to the context set after all; rather, they are computed 'blindly', i.e. without access to the context set, and oddness ensues if the resulting inference contradicts information which is in fact taken for granted in the context. This has lead to empirically rich developments, which we do not survey here.

- *Psycholinguistic evidence*

Finally, and very importantly, it should be added that there is currently a very active debate about the reality of the various strengthened readings we have discussed. Sophisticated experimental techniques have been used to decide this question, but for reasons of space we cannot discuss the results here (see Chemla and Singh 2014a, b for recent references).

3 Presuppositions[14]

In our discussion of scalar implicature, we saw that part of the field moved from neo-Gricean pragmatic analysis to a semantic or even a syntactic one – though the debate is by no means closed. In part, the opposite historical movement occurred in presupposition theory: semantic approaches that dominated the field in the 1980's and 1990's have recently found renewed competition from more pragmatic corners.

3.1 Introducing presuppositions

As a *first approximation*, a sentence *S* has a presupposition *P* if *S* cannot be uttered felicitously unless the speech act participants take *P* for granted. Thus *S* may be deemed 'neither true nor false' unless it is common belief among the speech act participants that *P* is true. It is usually thought that presuppositions are triggered by some words ('presupposition triggers') such as *the*, *know*, *regret*, *stop*, as is illustrated in (61).

(61) Some Presupposition Triggers
a. The king of Moldova is powerful.
Presupposition: Moldova has a king.
b. John knows that it is raining.
Presupposition: It is raining
c. John regrets that he is incompetent.
Presupposition: John is incompetent.
d. John has stopped smoking.
Presupposition: John used to smoke.

[14] This section shares material (both in substance and form) with Schlenker to appear a, b, to which the reader is referred for further technical details. For a recent survey from a different perspective, see Beaver and Geurts 2011; see also Dekker 2008 and Geurts and Maier 2013, as well as the historically important Gazdar 1979.

This is only a preliminary definition, however. First, there are many other problems that can make a sentence less than felicitous (the speaker may say something irrelevant, or be overly familiar, etc.), and they need not form a natural class. Second, there are many cases in which a sentence is felicitous despite the fact that its presupposition is not initially believed by the addressee. For instance, if I have never heard of Moldova and someone utters (61)a, I will in many cases silently add to my initial beliefs the assumption that Moldova is a monarchy and has a king, thus ensuring that the sentence is felicitous after all. This process has been called *(global) accommodation* because the addressee somehow *accommodates* the speaker's presupposition to ensure that communication proceeds smoothly (Lewis 1979).

As a *second approximation*, then, presuppositions are better characterized by their 'projection' behavior. Clauses that include a presupposition trigger give rise to inferences such as those illustrated in (61). But presuppositions differ from other inferences in how they are 'inherited' by complex sentences. If the presupposition of an elementary part is inherited by the sentence it occurs in, it is said to 'project'; more generally, the problem of computing the presuppositions of complex sentences from the meaning of their parts has been called the 'projection problem'. The presuppositions of elementary clauses typically project out of questions, negations, and the antecedents of indicative conditionals, as is illustrated in (62)b, c, d; and they give rise to universal inferences when they are embedded under the negative quantifier *none of* …, as is illustrated in (62)e.

(62) a. Bill knows that he is incompetent. => Bill is incompetent.
b. Does Bill know that he is incompetent? => Bill is incompetent.
c. Bill doesn't know that he is incompetent. => Bill is incompetent.
d. If Bill knows that he is incompetent, he will resign. => Bill is incompetent.
e. None of my students knows that he is incompetent. => Each of my students is incompetent.

Although presuppositions yield inferences that could be mistaken for entailments in unembedded environments such as (62)a, with respect to the embeddings illustrated in (62) they systematically differ from entailments. Thus *Bill is in Paris* entails (given standard world knowledge) that *Bill is in France*, but as shown in (63) all our other tests show that this inference is *not* presuppositional.

(63) a. Bill is in Paris => Bill is in France
b. Is Bill in Paris? ≠> Bill is in France
c. Bill isn't in Paris. ≠> Bill is in France
d. If Bill is in Paris, he is staying near the Louvre. ≠> Bill is in France.
e. None of my students is in Paris ≠> Each of my students is in France.

In effect, projection tests are based on *global accommodation*: in the absence of sufficient information about the context, subjects will assume that it is one in which the presupposition holds. Importantly, there are cases in which *even* these tests fail because the presupposition is somehow turned into a part of the assertive component. Take the verb *stop*. In many contexts, *Has John stopped smoking?* gives rise to an inference that John used to smoke, and the other tests in (62) would also suggest that this inference is a presupposition. But in some contexts the expected projection behavior fails: Simons 2001, citing Geurts 1994, observes that one may without special presupposition ask a nervous stranger: *Have you recently stopped smoking?* In this case, the presupposition seems to become part of the assertive component. In technical terminology, it is 'locally accommodated'; we will come back to this phenomenon below.

We used the examples in (62) as *tests* for determining whether an inference is presuppositional or not; but they also illustrate results that should be *derived* from a general theory of presupposition projection. Before we turn to the major contenders, we should first ask whether these inferences could conceivably be treated as implicatures. Most of the literature assumes that they cannot be, in part because of the impression that sometimes a

presupposition which is not satisfied yields a genuine *failure* – unlike implicatures, which are thought to be cancellable.[15] Still, one could attempt to develop such a theory. How would one go about it? Suppose first that (62)a = *Bill knows that he is incompetent* just has the meaning: *Bill is incompetent and he believes that he is;* this immediately accounts for the inference in (62)a. Suppose further that (62)a forms a scale with: *Bill is incompetent*, which is clearly weaker. Because negation 'reverses' logical strength, the negation (62)c competes with the *stronger* scalar alternative: *Bill isn't incompetent*. An implicature that the latter is false just gives rise to the inference that *Bill is incompetent*. In other words, we have just sketched a way to explain why 'presuppositions are preserved under negation' – and this was done entirely in terms of scalar implicatures. Turning this welcome result into a full-fledged theory turns out to be difficult, however. Consider in particular (62)e. Due to the presence of the negative quantifier, the purported scalar alternative *None of my students is incompetent* is logically stronger than (62)e. As was the case with (62)c, a scalar implicature yields the inference that this alternative is false – and hence that *some of my students is incompetent*. But this is still a far cry from the universal inference obtained in (62)e, namely that *each of my students is incompetent*. In this case, an analysis of presuppositions as scalar implicatures delivers predictions that are too weak (but see Chemla 2009 for relevant experimental results, and Chemla 2007a for a theory that does handle scalar implicatures and presuppositions within a unified framework; see also Boër and Lycan 1976, Thomason 1990, Stone et al. 2007, and Romoli 2014 for relevant discussion.)

3.2 Dynamic Semantics

3.2.1 The Basic Account

From the start, a very simple account presented itself to account for the data in (62)a-d; we will call it the 'Basic Account'. Let us a say that a possibly complex sentence *S* containing a clause *S'* that triggers the presupposition *P* results in a semantic failure – and thus is neither true nor false – unless *P* is taken for granted by the speech act participants. In effect, we take *P* to be a condition that must be satisfied for *S'* to be meaningful; and the entire sentence *S* can't be meaningful unless each of its components – including *S'* – is meaningful. So a simple sentence like *Bill knows that he is incompetent* is neither true nor false unless it is taken for granted that Bill is incompetent; this is thus a very different analysis from the bivalent account ('presuppositions as implicatures') which was sketched in the previous paragraph. This analysis immediately explains why in simple examples the presuppositions of elementary clauses are 'inherited' by the complex sentences they appear in (technically, the requirement that each subcomponent of a sentence be satisfied can be formalized with the 'Weak Kleene' trivalent logic).

Unfortunately, the Basic Account fails in more complex examples (and this is so irrespective of whether one considers facts about *felicity* or about *projection*). On its own, the clause *John knows that he is incompetent* presupposes that (and yields an infelicity unless) John is incompetent. Hence the Basic Account predicts that all three sentences in (64) should presuppose this is as well. But this is not so: (64)a asserts rather than presupposes that John is incompetent; and (64)b-c neither assert nor presuppose it.

(64) a. John is incompetent and he knows that he is.
b. If John is incompetent, he knows that he is.
c. John is not incompetent, or else he knows that he is.

In the case of (64)a, there might be a way out. We could posit that the second conjunct is not evaluated in the initial (or 'global') context, but rather in that context *as*

[15] In Magri's analysis, however, 'blind implicatures' can yield deviance, as was illustrated in (60).

modified by the assertion of the first conjunct. The relevant notion of context is what Stalnaker calls the 'context set', which represents what the speech act participants take for granted at a certain point in a conversation.[16] If the addressee is willing to grant the first conjunct after he has heard it, the relevant context for the evaluation of *he knows that he is (incompetent)* will be the initial context updated with the assumption that John is incompetent. We will call this the 'local context' of the second conjunct. By construction, it does entail its presupposition. So if we ask what the entire sentence imposes on the *initial* ('global') context for this presupposition to be (locally) entailed, the answer is: 'nothing' - no matter what the initial context is, the local context of the second conjunct will always satisfy its presupposition. By developing an account of context change, we have been able to save the Basic Account – at least in this case. In addition, we have obtained an elegant account of an unexpected asymmetry:

(65) a. John is incompetent, and he knows that he is.
b. # John knows that he is incompetent, and he is.
a'. John used to smoke, and he has stopped smoking.
b'. #John has stopped smoking, and he used to smoke.

In each case, one much prefers the 'canonical order' in which what justifies the presupposition comes first, and the presupposition trigger comes second, as in (65)a-a'. The 'inverse order' is degraded, as in (65)b-b'. For Stalnaker, the reason is simple: context update follows the order in which the words are pronounced, and the local context of an expression incorporates information that comes before but not after it.

This, in a nutshell, is the justification for the strategy based on 'context change' developed by Stalnaker 1974 and Karttunen 1974. Stalnaker's analysis was pragmatic: he assumed that general considerations of communicative rationality were enough to develop rules of context update. We already discussed the case of conjunction. Stalnaker further thought that (64)b could be analyzed by observing that a conditional involves the hypothetical addition of the antecedent to the original context set; it then contributes the claim that the consequent follows from this modified context. Here too, the local context of the second clause is one which, by construction, entails that John is incompetent; so no matter what the initial context is, the presupposition of the consequent will be satisfied – which means that the sentence as a whole presupposes nothing. (A similar analysis could be extended to (64)c by taking *else* to mean something like *if not*, and reducing this case to (64)b[17]). Karttunen's analysis, by contrast, was semantic: he stated lexical rules that determined how each connective transmitted the presuppositions of its arguments; this presuppositional component had to be stipulated *in addition* to the truth-conditional behavior of the connectives (we will see shortly that in Heim's system, by contrast, the two are handled together).

The difficulty is that in its current form, based on the speech act participants' beliefs, the logic of context change does not easily extend to quantified cases. Consider the presuppositional predicate *stopped smoking* in *None of my students has stopped smoking*. We would like the prediction to be that its local context entails *used to smoke*. There is no formal difficulty in defining a generalized notion of entailment among predicates – and the correct result can be obtained if the local context of *stopped smoking* is the property of *being a student* (relative to the initial context C). But a property is not the right kind of object to be believed, which makes a pragmatic analysis difficult to pursue in this case (further difficulties

[16] In the literature on indexicals, the term 'context' refers to an object that determines the speaker, time and world of the utterance; the indexical notion should be clearly distinguished from the presuppositional one. A context set can sometimes be equated to a *set* of contexts in the indexical sense.
[17] This suggestion is explicitly made in Stalnaker 2010.

are discussed in Schlenker 2009; see also Cooper 1983, Heim 1983, Beaver 2001, George 2008a,b, Fox 2008, 2012 and Sudo 2012, among others, for a discussion of presupposition projection in quantified sentences).

3.2.2 Heim's Dynamic Semantics

Heim 1983 extended Stalnaker's theory by taking the very meaning of words to be instructions to update the context set (or 'Context Change Potentials'); the 'context set' became a technical notion, with no claim that the speech act participants literally believe local contexts (i.e. local context sets). In simple cases, Heim followed Stalnaker in taking the context to be a set of possible worlds; in particular, the global context is supposed to be the set of worlds compatible with what the speech act participants take for granted. In the final version of her system, which we will not review here, Heim took contexts to be sets of *pairs* of the form <world, assignment function>; the addition of assignment functions proved crucial to handle quantificational statements.

In simple cases, we just obtain a semanticized version of Stalnaker's pragmatic analysis. Let us assume for the moment that the context is a set of possible worlds. Now consider the clause *John stopped smoking*, which we will represent as *pp'*, with the convention that the underlined part is the presupposition and the non-underlined part is the assertive component (here: *p = John used to smoke*, and *p' = John doesn't smoke*). When *pp'* is uttered in a context set C, two things may happen:

• If C does not entail *p*, the update fails, which we will encode as: C[pp'] = # ('C updated with *pp'* yields a failure').

• If C does entail *p*, the update proceeds by only keeping those worlds of C (or those 'C-worlds', as we will say) which satisfy *p'*: C[pp'] = {w ∈ C: p' is true in w}.

These results are summarized in (66).

(66) C[pp'] = # unless C ≠ # and for each w ∈ C, *p* is true in w. If C[pp'] ≠ #, C[pp'] = {w ∈ C: p' is true in w}

The key step is to provide rules of context update for connectives and quantifiers. For the first case, Heim posits the rules in (67) for any clauses *F, G*.

(67) a. C[F and G] = # unless C[F] ≠ # and C[F][G] ≠ #. If C[F and G] ≠ #, C[F and G] = C[F][G][18]
b. C[not F] = # unless C[F] ≠ #. If C[not F] ≠ #, C[not F] = C – C[F]
c. C[if F, G] = # unless C[F][G] ≠ #. If C[if F, G] ≠ #, C[if F, G] = C – C[F][not G]

These rules can be justified as follows.

-(67)a simply captures the intuition, inherited from Stalnaker, that the update of C with *F and G* is the successive update of C with *F*, and then with *G* (note that C[F][G] is the same thing as (C[F])[G]: first we update C with *F*, and then with *G*); a failure arises if any step of the update process yields one.

-(67)b tells us that we obtain the update of C with *not F* by 'throwing out' of C those worlds that survive the update of C with F (C – C[F] is C *minus* the update of C with *F*). But for this operation to be defined, C[F] should be defined in the first place. So we derive in this way the result that *not F* has the same presupposition as *F*: in both cases, the condition on C is that C[F] ≠ #.

-(67)c defines a dynamic version of conditionals viewed as material implications. Recall that in classical logic a conditional *if F, G* is false just in case *F* is true and *not G* is true; in all other cases, the conditional is true. The rule in (67)c says that we obtain the update of C with *if F, G* by 'throwing out' of C those worlds that survive the update of C with *F* and then with

[18]We could write this rule in (67)a more succinctly as: C[F and G] = C[F][G] (the right failure conditions automatically follow from the definition of basic updates).

not G. Intuitively, we throw out those worlds that make the material implication false. But for this operation to be defined, *C[F][not G]* should be defined in the first place. And by the rule in (67)b, this holds just in case *C[F][G]* is well-defined (since *(C[F])[not F]* is defined just in case *(C[F])[G]* is).

We can see in this way that *F and G* and *if F, G* are predicted to give rise to the same presupposition: in both cases the requirement is that *C[F][G]* should be defined. But of course conjunctions and conditionals have different dynamic effects: they update C in different ways. An example is given in (68), where we write *p* for *John is 64 years old*, *q* for *John can't be hired,* and *q'* for *John believes he can't be hired*; and we derive for *(p and q̲q')* a presupposition that *if p, q*. Application of (67)c to *(if p, q̲q')* would also derive the presupposition that *(if p, q)*.

(68) a. John is 64 years old and he knows that he can't be hired.
a'. (p and q̲q')
b. C[(a')] = # unless C[p][q̲q'] ≠ #, i.e. unless each world w in C[p] is such that *q* is true in w; this holds just in case each world w in C which makes *p* true also makes *q* true. In the case of (a), this means: each world in C in which John is 64 years old is one in which he can't be hired.
If C[(a')] ≠ #, C[(a')] = C[p][q̲q'] = ({w ∈ C: p is true in w})[q̲q'] = {w ∈ C: p is true in w and q' is true in w}. In the case of (a), the result of the update is the set of C-worlds in which John is 64 years old and he believes/knows he can't be hired.

In dynamic semantics, presupposition and truth are handled 'in tandem', whereas they were treated by different rules in Karttunen's system. But we can still recover from Heim's system a definition of 'presuppositional acceptability' and of 'truth'. A sentence *S* will be presuppositionally acceptable relative to a context set C just in case the update of C with *S* does not yield a failure; and the compositional system is set up in such a way that this happens just in case any presupposition triggered by an expression is entailed by its local context. As for truth, the definition is simply that a sentence *S* is true in a world w of C just in case w 'survives' the update with *S*. Both definitions are given (69)

(69) Let a sentence *S* be uttered relative to a context set C.
a. Presuppositional Acceptability
S is presuppositionally acceptable relative to C if and only if C[S] ≠ #.
b. Truth
If w ∈ C and if *S* is presuppositionaly acceptable in C, *S* is true in w relative to the context set C if and only if w ∈ C[S].

In the quantificational case, which we do not review here, Heim's system derives *universal presuppositions* when a trigger appears in the verbal argument of a generalized quantifier, as in *every student stopped smoking*, *no student stopped smoking*, *exactly four students stopped smoking*: each of those is taken to presuppose that *every student used to smoke*. Heim also predicts universal presuppositions when a trigger appears in the nominal argument of a quantifier: *every student who stopped smoking is nervous, no student who stopped smoking is nervous*, etc are predicted to yield an inference that *every student used to smoke*. We come back to these predictions below. (One could easily 'tweak' Heim's system to obtain different predictions; thus Beaver 1994, 2001 argues for existential presuppositions instead of universal ones. But as we discuss below, the ease with which the predictions can be changed is a symptom of another problem).

3.2.3 Assessment

Two main criticisms have been addressed at Heim's system: the first is that the theory is empirically inadequate; the second is that it is insufficiently explanatory.

- *The Proviso Problem*

Van der Sandt 1992 and Geurts 1999 argue that in many cases Heim's predictions are too weak (the following are modifications of examples discussed in Geurts's Chapter 3):

(70) a. The problem was easy / difficult and it is not John who solved it.
b. If the problem was easy / difficult, then it isn't John who solved it.
c. Peter knows that if the problem was easy / difficult, someone solved it.

In all three cases, Heim predicts a presupposition that *if the problem was easy / difficult, someone solved it*. But Geurts convincingly argues that there is a clear empirical difference between (70)a-b on the one hand and (70)c on the other: the expected presupposition is found in the latter case, but in (70)a-b one typically infers that someone did in fact solve the problem. Van der Sandt and Geurts argue that better predictions can be achieved if an alternative account of presupposition projection is given within the framework of Discourse Representation Theory (DRT), which unlike dynamic semantics is essentially representational; we come back to this theory below. Other researchers have tried to argue that pragmatic mechanisms can in some cases strengthen conditional presuppositions into unconditional ones (Beaver 2001, Heim 2006, Pérez Caballo 2009, Singh 2007, 2009, van Rooij 2007, Schlenker 2011b; see also Lassiter 2012).

- *The Explanatory Problem*

Soames 1989 and Heim 1990 noted that the dynamic account lacks explanatory depth. On the basis of simple sentences involving no presupposition triggers, we could certainly posit the lexical entry for *and* defined in (67)a, and copied in (71)a; but we could just as well posit one of the 'deviant' entries in (71)b-c:

(71) a. C[F and G] = C[F][G]
b. C[F and* G] = C[G][F] (i.e. C[F and* G] = C[G and F])
c. C[F and** G] = # unless C[F] ≠ # and C[G] ≠ #. If C[F and** G] ≠ #, C[F and** G] = C[F] ∩ C[G]

When *F* and *G* are non-presuppositional, all three lexical entries yield the same result: the update rule outputs the set of C-worlds that satisfy both *F* and *G*. But in presuppositional cases the three entries make entirely different predictions: *and** predicts that the presuppositions of the first conjunct can be satisfied by the second conjunct, but not the other way round; while *and*** predicts that the conjunction should inherit the presuppositions of each conjunct. It turns out that *and* is correct while *and** as well as *and*** are not; and most researchers' impression is that this conclusion holds in all known languages. But nothing in the theory explains why this is so. We come back to this point below.

3.3 Discourse Representation Theory

The analysis of presupposition projection offered by DRT seeks to offer a viable alternative to Heim's dynamic semantics, one that does not suffer from the Proviso Problem (van der Sandt 1992, Geurts 1999). The basic idea is that presuppositions are parts of a Logical Form that want to 'percolate up' as far as possible in a Logical Form. Whenever possible, they are given matrix scope, though other – and less preferred – options are also open.

3.3.1 Basic DRT

To illustrate, we start from a sentence such as (72)a, which is given the initial representation in (72)b (here too the presupposition is underlined). Following Kamp's analysis of anaphora (Kamp 1981), the formal representation contains two components, separated by a semi-column: a list of discourse referents (here: the variable *x*); and a list of conditions on these discourse referents. Van der Sandt's innovation is to underline certain conditions – the presuppositional ones – and to require that they be accommodated by being moved upwards.

(72) a. If John is realistic, he knows that he is incompetent.
b. [$_1$ x: John x, [$_2$: realistic x] ⇒ [$_3$: <u>x is incompetent</u>, x believes that x is incompetent]]

There are various 'projection sites' that the underlined material could land to. We obtain three possible readings depending on the landing site: in (73)a the presupposition appears at the matrix level, and we obtain an unconditional inference that John is incompetent – which is the preferred reading; in (73)b, the presupposition lands in the antecedent of the *if*-clause ('intermediate accommodation'), while in (73)c it stays in its original position ('local accommodation'). In this case these readings are not plausible, but they have been claimed to be instantiated in other examples (this is not debated for local accommodation; intermediate accommodation is far more controversial, as is for instance discussed in Beaver 2001[19]).

(73) a. **Reading 1 [preferred]: Global Accommodation**
[$_1$ x: John x, **x is incompetent** [$_2$: realistic x] ⇒ [$_3$: x believes that x is incompetent]]
b. **Reading 2: Intermediate Accommodation**
[$_1$ x: John x [$_2$: realistic x, **x is incompetent**] ⇒ [$_3$: x believes that x is incompetent]]
c. **Reading 3: Local Accommodation**
[$_1$ x: John x [$_2$: realistic x] ⇒ [$_3$: **x is incompetent**, x believes that x is incompetent]]

Since DRT offers a variety of landing sites for presuppositions, it generates many more readings than satisfaction theories do. But it cuts down on these readings by adding constraints on interpretation (see Geurts 1999 p. 59 for a more detailed discussion). For instance, it posits a constraint of 'informativeness' which prohibits a clause from being replaceable with a tautology or a contradiction in the environment in which it appears. This explains why, *despite* the general preference for matrix accommodation, the latter is not an option in (74)a-b:

(74) a. If John is incompetent, he knows that he is.
b. **Matrix accommodation** *(violates local informativity)*
[$_1$ x: John x, **x is incompetent** [$_2$: incompetent x] ⇒ [$_3$: x believes that x is incompetent]]
c. **Local Accommodation** *(does not violate local informativity)*
[$_1$ x: John x [$_2$: incompetent x] ⇒ [$_3$: **x is incompetent**, x believes that x is incompetent]]

With matrix accommodation as in (74)b, the antecedent of the conditional becomes replaceable with a tautology – it is, in other words, locally uninformative. Local accommodation can solve the problem: when it is applied, as in (74)c, no other expression is made uninformative (though the presupposition is – but this is of course entirely in order).

DRT has great appeal, for at least two reasons. First, it offers a compelling solution to the Proviso Problem, which the satisfaction theories we considered earlier cannot handle without further additions. Second, it handles presupposition projection and anaphora resolution within a unified framework. Without discussing anaphora resolution proper, let us give an idea of the parallels that motivated the analysis (see Geurts 1999 p. 46 for a more detailed discussion of some of the same examples). In each case, the (a) example involves a pronoun (underlined) and its antecedent (in bold), while the (b) example displays a trigger (underlined) and what intuitively justifies the presupposition (in bold).[20]

(75) Conditionals
a. If Smith owns **a donkey**, he beats <u>it</u>. (Geach 1962)
b. Maybe **Mary proved the theorem** and John proved it, <u>too</u>.

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[19] The issue of intermediate accommodation is further discussed in Schlenker, 2011a; dubious cases of intermediate accommodation (into the restrictor of an operator) are contrasted with more robust cases, due to Bart Geurts (they involve intermediate accommodation within the scope of attitude operators).

[20] We write '*intuitively* justifies the presupposition' because the actual implementation in DRT is more complex, and does not just involve coindexation between a trigger and its antecedent.

(76) Disjunction
a. Either Morrill Hall doesn't have **a bathroom** or it is in a funny place. (attributed to Partee)
b. Either Morrill Hall doesn't have **a bathroom** or the bathroom is in a funny place.

(77) Modal subordination
a. It is possible that John has **children** and it is possible that they are away.
b. It is possible that John has **children** and it is possible that his children are away. (Gazdar 1979)

It is quite easy to construct systematic examples displaying the parallel between anaphora resolution and presupposition projection: start from an anaphoric sentence such as (76) and (77), and replace the pronoun with a definite description that is appropriate for the antecedent. For proponents of DRT, the similarity between pronouns and presuppositions holds because presupposition projection is a species of anaphora resolution. For some proponents of satisfaction theories, the similarity may well hold, but for the opposite reason: pronouns are a species of presupposition triggers. This analysis has some plausibility because an entire class of theories of anaphora, called 'E-type theories', treat pronouns as concealed definite descriptions (see for instance Elbourne 2005 for a detailed analysis and a survey); since definite descriptions are presupposition triggers, pronouns should be too – and they should behave like other triggers with respect to presupposition projection. Thus the similarity between presupposition projection and anaphora resolution need not favor one camp over the other, at least not without much more detailed argumentation.

3.3.2 Problems

- *Conditional Presuppositions*

One of DRT's advantages over satisfaction theories is that it can generate unconditional presuppositions. Still, it has been argued that in *some* cases *bona fide* conditional presuppositions do arise (e.g. Beaver 2001). By '*bona fide* conditional presuppositions', I mean conditional inferences that project like presuppositions, and thus cannot be explained away as mere entailments. I believe the examples in (78) have this property:

(78) a. If you accept this job, will you let your family know that you're going to be working for a thug?
=> If you accept this job, you're going to be working for a thug.
≠> You're going to be working for a thug.
b. If you accept this job and let your family know that you are going to work for a thug, they won't be happy.
=> If you accept this job, you're going to be working for a thug.
≠> You're going to be working for a thug.

(78)a has the form *if p, qq' ?* with *p = you accept this job* and *q = you will work for a thug*. If the conditional did not appear in a question, the inference we obtain (= *If you accept this job, you are going to be working for a thug*) could be treated as a mere entailment. But the fact that the conditional inference survives in a question suggests that we are dealing with a *bona fide* conditional presupposition. The same argument applies to (78)b, which is of the form *if p and qq', r*. Here we obtain the conditional inference predicted by Heim 1983: *p and qq'* presupposes *if p, q*, and this presupposition projects out of the antecedent of the conditional. Standard DRT does not account for these cases. Take for instance the case of (78)b, with the simplified representation in (79). The various accommodation possibilities are represented in (80):

(79) $[_1$ x: you x, $[_2$: x accepts this job] ⇒ $[_3$: x will work for a thug, x tells x's family that x is working for a thug]] ?

(80) a. **Matrix accommodation**
$[_1$ x: you x, **x will work for a thug**, $[_2$: x accepts this job] ⇒ $[_3$: x tells x's family that x is working for a thug]] ?
b. **Intermediate accommodation**

[$_1$ x: you x, [$_2$: **x will work for a thug**, x accepts this job] ⇒ [$_3$: x tells x's family that x is working for a thug]] ?

c. **Local accommodation**

[$_1$ x: you x, [$_2$: x accepts this job] ⇒ [$_3$: **x will work for a thug**, x tells x's family that x is working for a thug]] ?

None of these representations gives rise to the conditional inference *If you accept this job, you're going to be working for a thug*; in particular, (80)b does *not* predict this inference because the entire sentence is embedded under a question operator.

- *Quantified Statements*

Due to the architecture of DRT, a presupposition that contains a bound variable cannot be accommodated outside the scope of its binder, as this would 'unbind' the variable (this is sometimes called the 'trapping constraint'). In simple cases, we can still obtain the correct results through local or intermediate accommodation. For instance, (81)a gives rise to an inference that *each of these ten students is incompetent*, and this inference is captured by the reading with local accommodation in (82).

(81) a. Each of these ten students knows that he is incompetent
b. [[each x: student x] **x is incompetent**, x believes that x is incompetent]

(82) **Local Accommodation**
[[each x: student x] **x is incompetent**, x believes that x is incompetent]

As soon as we consider non-assertive uses of (81)a, however, the predictions are far more problematic.

(83) a. Does each of these ten students know that he is incompetent?
b. If each of these ten students knows that he is incompetent, they must be depressed.

In each case we find, as before, an inference that each of these ten students is incompetent. But this is not predicted by either local or intermediate accommodation; in particular, local accommodation fails to make the right predictions because in these cases the Logical Form in (82)a appears in a non-assertive environment.

The problems get worse when the quantifier *no* is considered. As mentioned, Chemla 2009 shows with experimental means that French sentences of the form *[No P] QQ'* yield the universal inference *[Every P] Q* (here capital letters stand for predicative elements). For instance, (84)a triggers an inference that *each of these ten students is incompetent*. But neither Logical Form in (85) derives the correct inference.

(84) a. None of these ten students knows that he is incompetent
b. [[no x: student x] **x is incompetent**, x believes that x is incompetent]

(85) a. **Local Accommodation**
[[no x: student x] **x is incompetent**, x believes that x is incompetent]
b. **Intermediate Accommodation**
[[no x: student x, **x is incompetent**] x believes that x is incompetent]

(It should be added that when a trigger with a variable finds itself in the restrictor of the quantifier that binds it, only local accommodation is available, because accommodating the presupposition in a higher position would unbind that variable. This predicts extremely weak inferences, which might be a good thing – Chemla 2009 suggests that no universal inferences are obtained in this case.)

- *Proviso Redux*

Even when DRT predicts appropriate inferences in simple quantified statements, further embeddings can lead to the re-appearance of the Proviso Problem.

(86) If I grade their homeworks, each of my students will know that he is {a genius | incompetent}.
=> Each of my students is {a genius | incompetent}

Due to the prohibition against 'unbinding', the presupposition triggered by *know* must be accommodated within the scope of *each of my students*. As a consequence, it must remain within the consequent of the conditional – and we just cannot obtain an unconditional presupposition in this case.

3.4 Further Developments[21]

We will briefly discuss two strands of recent research, which address two main questions: (i) how can the Explanatory Problem be addressed? (ii) can better predictions be obtained in the quantificational case?

The first question has direct consequences for the precise localization of presupposition projection at the syntax/semantics interface. The heart of the problem is that dynamic semantics is strictly more powerful than classical semantics; this made it possible for Heim's system to handle presuppositional data that classical semantics did not; but the very power of the framework also makes it possible to define all sorts of lexical entries which presumably do not exist in the world's languages. So solve the problem, several new approaches (a) start from a leaner semantics (which might be bivalent and classical), and (b) add to it a 'projection algorithm' which *predicts* the projection behavior of any operator once its syntax and classical (bivalent) semantics have been specified. Part (b) is often viewed as belonging in part or wholly to the realm of pragmatics. As a result, several recent approaches return to a pragmatic view of presupposition projection, one closer to architectures of the 1970's than of the 1980's.

3.4.1 Transparency-based approaches

Several recent 'Transparency-based theories' (Schlenker 2008 2009, 2010) address the Explanatory Problem by turning a derived property of dynamic semantics into the centerpiece of a theory of presupposition projection. These theories have two components: a *substantial component*, which explains under what semantic conditions a presupposition is 'licit'; and an *incremental component*, which derives the left-right asymmetries we observed at the outset in (65). Since these theories are built on the basis of a classical semantics, *pp'* will henceforth represent a classical meaning, equivalent to the conjunction of *p* and *p'*. For instance, we treat *x stopped smoking* as roughly equivalent to *x used to smoke and x doesn't now smoke*, with the specification (encoded by underlining) that one entailment, namely *x used to smoke,* has a special status. So in this case we have *p = x used to smoke* and *p' = x doesn't now smoke*, and the notation *pp'* indicates that the sentence will be pragmatically deviant unless *p* is entailed by its local context. It is then incumbent on the theory of presupposition projection to explain why the distinguished entailment behaves in a special way.[22] Importantly, nothing prevents us from working with a classical semantics while still claiming that sentences are pragmatically deviant if a presupposition fails to be entailed by its local context; this just means that 'deviance' could be encoded in the pragmatics rather than in the semantics.

Let us turn to a description of the two components of transparency-based theories.

1. *Substantial component*: A consequence of Heim's system is that presuppositions are semantically inert, in the following sense: if a sentence is felicitous, one can 'erase' from it all the presuppositions without affecting the truth conditions. Let us consider three examples. We saw at the outset that *pp'* and *(not pp')* both presuppose that *p*, and that *(p and qq')* as

[21] This section only surveys developments prior to 2010-2011. In particular, it does not take into account the innovative ideas of Sudo 2012.

[22] We could also ask a different question – namely why some entailments become 'underlined'. This is the 'Triggering Problem': the question is to determine how the presuppositions of elementary expressions are generated in the first place. We do not consider this problem here; see for instance Abrusan 2011 for a recent discussion.

well as *(if p, q̲q̲')* both presuppose that *(if p, q)*. But when these conditions hold, *(not p̲p̲')* is equivalent to *(not p');* similarly, *(p and q̲q̲')* and *(if p, q̲q̲')* are equivalent to *(p and q')* and *(if p, q'):* we can delete the underlined material without affecting the truth conditions. This is the sense in which presuppositions are 'transparent'. These simple results are summarized in (87), where *C |= p* means that *p* holds in each world of C (in other words, *p* follows from C).

(87) Uttered in a context set C:
a. *p̲p̲'* and *(not p̲p̲')* both presuppose that C |= p
… and when C |= p, C |= p̲p̲' ⇔ p', and C |= (not p̲p̲') ⇔ (not p')
b. *(p and q̲q̲')* and *(if p, q̲q̲')* both presuppose that C |= p ⇒ q
… and when C |= p ⇒ q, C |= (p and q̲q̲') ⇔ (p and q'), and C |= (if p, q̲q̲') ⇔ (if p, q').

Transparency-based theories start from the requirement that presuppositions should be 'erasable', or 'transparent', which in turn imposes constraints on C. For all these theories, it turns out to be essential that the equivalence should hold *no matter what the assertive component is*.[23] To take a very simple example, consider *(not p̲p̲')*. How can we guarantee that C |= (not p̲p̲') ⇔ (not p') no matter what *p'* turns out to be? The condition is equivalent to C |= p̲p̲' ⇔ p', and it will certainly hold if C |= p. Conversely, if C |= p̲p̲' ⇔ p' holds for all *p'*, the equivalence holds in particular when *p'* is a tautology – which implies that C |= p (recall that semantically *p̲* and *p* are the same thing). So in this very simple case, the condition that a presupposition should be 'transparent' suffices to derive the desired result, namely that *not p̲p̲'* presupposes *p*.

2. Incremental component: The substantial component on its own does not distinguish between, say, *(p and q̲q̲')* vs. *(q̲q̲' and p)*, which are equivalent in classical logic. In order to regain a difference, transparency-based theories require that the equivalence imposed by the substantial component should be guaranteed to hold as soon as one processes a presupposition trigger, *no matter how the sentence ends*. When the trigger is at the end of the sentence, this changes nothing – and thus the result we obtained for *(not p̲p̲')* still holds. But we will derive different results for *(p and q̲q̲')* vs. *(q̲q̲' and p):* although the two sentences are equivalent, the second will yield a stronger presupposition because the trigger is at the beginning, and as a result one cannot 'use' information about *p* to satisfy the substantial condition.

Transparency-based theories come in several varieties. In each case, the main question is *how the requirement that presuppositions are transparent should be derived*.

(i) A purely pragmatic theory was developed in Schlenker 2008 It may be seen as an attempt to formalize an insight due to Grice, who proposed to add a new maxim of manner to account for presuppositions: 'if your assertions are complex and conjunctive, and you are asserting a number of things at the same time, then it would be natural, on the assumption that any one of them might be challengeable, to set them out separately and so make it easy for anyone who wanted to challenge them to do so' (Grice 1981). This approach does not seek to *explain* what it means for an assertion to be 'complex and conjunctive'; rather, it takes for granted that certain components of an assertive meaning are somehow taken to be 'pre-conditions' of the rest, and are for this reason underlined in our formalization. Now a version of Grice's principle, called *Be Articulate* in Schlenker 2008 requires that *whenever possible* the distinguished status of a pre-condition should be made syntactically apparent, and thus that the meaning of an expression *d̲d̲'* should be preferably expressed as *(d and d̲d̲')*:

[23] To see why this is crucial, consider the sentence *It is Obama who won the election*. The cleft triggers a presupposition that *exactly one person won the election*. The assertive component seems to be that *Obama won the election*. But in this case the presupposition is entailed by the assertive component, so in all standard contexts C, C |= … p̲p̲' … ⇔ … p' … . This is an undesirable result, as it implies that *It is X who won the election* never presupposes anything.

(88) **Be Articulate**
In any syntactic environment, express the meaning of an expression *dd'* as *(d and dd')*
(... unless independent pragmatic principles rule out the full conjunction.)

Be Articulate is controlled by another Gricean principle of manner, *Be Brief*, which prohibits unnecessary prolixity, *and takes precedence over Be Articulate*. Now the suggestion is that *the theory of presupposition projection reduces to the interaction between these two principles*. *Be Brief* can be stated in various ways, and the choice one makes has momentous consequences for the theory of presupposition. In the following version, we state the principle with a left-right bias (the 'incremental component' we announced at the outset): a sentence of the form *blah (d and e) blah*' is ruled out if one can determine as soon as *blah (d* is uttered that no matter what the second conjunct *d*' will turn out to be, no matter what the end of the sentence is, *(d and d')* could be replaced with *d*' without modifying the truth conditions of the sentence relative to the context set:

(89) **Be Brief - Incremental Version**
Given a context set C, a predicative or propositional occurrence of *d* is infelicitous in a sentence that begins with α *(d and* if for any expression γ of the same type as *d* and for any good final β, C |= α (d and γ) $\beta \Leftrightarrow \alpha \gamma \beta$.

This principle is for instance justified by the deviance of *#If John is in Paris, he is in Paris and he is happy,* where the underlined expression is clearly redundant and is in violation of (89).

Equipped with *Be Articulate* and *Be Brief,* we can derive a principle of transparency – which we call 'incremental' because it incorporates a left-right bias. Briefly, a predicative or propositional occurrence of … *dd'*… is acceptable on its own (i.e. without being preceded by the words *d and*) in a certain syntactic environment just in case … *(d and dd')*… is ruled out because *d* is incrementally transparent:

(90) **Incremental Transparency**
Given a context set C, a predicative or propositional occurrence of *dd'* is acceptable in a sentence that begins with α *dd'*
if the 'articulated' competitor α *(d and d')* is ruled out because *d* is transparent,
if for any expression γ of the same type as *d* and for any good final β,
C |= α (d and γ) $\beta \Leftrightarrow \alpha \gamma \beta$

To see informally how this principle derives the result that *(p and qq')* presupposes that $p \Rightarrow q$, we argue in two steps.
–First, if C |= $p \Rightarrow q$ it is clear that the 'articulated' sentence *(p and (q and qq'))* is in violation of *Be Brief*: it can be determined as soon as *(p and (q* has been uttered that *q* is redundant because, relative to C, it already follows from *p*. Hence if C |= $p \Rightarrow q$, the sentence *(p and qq')* should be acceptable because its 'articulated' competitor.
–Second, we show that if the sentence *(p and qq')* satisfies the principle of Incremental Transparency in C, C |= $p \Rightarrow q$. Applied to *(p and qq'),* (90) implies in particular that C |= (p and (q and T)) $\Leftrightarrow$ (p and T), where *T* is a tautology; hence: C |= (p and q) $\Leftrightarrow$ p, from which it follows in particular that C |= $p \Rightarrow q$.

It was shown in Schlenker 2007, 2008 that the principle in (90) derives something very close to Heim's predictions, including in the quantificational case. The advantage, however, was that the theory was entirely general and could be applied to any number of new operators without first stipulating their 'Context Change Potential'. Schlenker 2009, 2010 further shows that related ideas can be used to reconstruction a notion of local context akin to that of dynamic semantics – but one which is computed in a post-semantic component, on the basis of a classical (bivalent) semantics. In its basic version, this theory makes predictions very close to Heim's. But the concept of 'local context' is rather versatile; one can also use it

to reconstruction a version of DRT, by allowing presupposition triggers to be indexed with contexts other than their local contexts – this view is developed in Zeevat 1992 and Schlenker 2011b.

3.4.2 Incremental Strong Kleene (= Middle Kleene)

Peters (1979) wrote a response to Karttunen's work in which he argued that a dynamic analysis was not needed to account for presupposition projection. He showed that in simple cases a trivalent approach could be made to work. As we saw above, it won't do to posit that a sentence *S* has the third truth value # in case any of its constituents does, as this would wrongly predict that each of the sentences in (64) inherits the presupposition that John is incompetent – the 'Weak Kleene logic' is not a good model of presupposition projection. But Peters observed that an incrementalized version of the Strong Kleene logic could derive far more adequate results. This trivalent approach was further developed in Beaver and Krahmer 2001; it was further refined in a way that meets the Explanatory Challenge we raised above in George 2008a,b and Fox 2008, 2012.

The basic idea of the Strong Kleene logic is to treat a semantic failure as an uncertainty about the value of an expression: if *qq'* is evaluated at w while *q* is false at w, we just don't know whether the clause is true or false (and the same holds if the presuppositional predicate *QQ'* is evaluated with respect to a world w and an individual d which make *Q* false). The semantic module outputs the value # in case this uncertainty cannot be resolved - which systematically happens with unembedded atomic propositions whose presupposition is not met. But in complex formulas it may happen that *no matter* how the value of *qq'* (or *QQ'*) is resolved at the point of evaluation, one can still unambiguously determine the value of the entire sentence. This is for instance the case if *(p and qq')* is evaluated in a world w in which *p* and *q* are both false: *qq'* receives the 'indeterminate' value #, but no matter how the indeterminacy is resolved, the entire sentence will still be false due to the falsity of the first conjunct *p*. Thus for any world w in the context set, the sentence will have a determinate truth value just in case either (i) *p* is false at w (so that it doesn't matter how one resolves the indeterminacy of the second conjunct); or (ii) *q* is true (so that the second conjunct has a determinate truth value). Since we are solely interested in worlds that are compatible with what the speech act participants take for granted, we derive the familiar prediction that the context set must entail that *if p, q*.

In this case, the Strong Kleene logic suffices to derive the desired results. But in its original form, this logic would also make the same predictions for *(qq' and p)*; in other words, it yields a 'symmetric' account of presupposition projection. Peters, Beaver and Krahmer, George and Fox propose to make the system asymmetric. There are several ways to do so. Peters stipulated appropriate truth tables; the resulting system is known as the 'Middle Kleene logic' because it treats propositional arguments that come early as in the Weak Kleene logic, and arguments that come late as in the Strong Kleene logic; this can be seen in the truth tables in (91). George defines an algorithm that takes as input the syntax and bivalent semantics of various operators, and yields a compositional trivalent logic which is sensitive to the linear order of its arguments[24]. By contrast, Fox proposes to make Strong Kleene incremental by adopting the (non-compositional) device of quantification over good finals (= possible sentence completions), as was the case in the bivalent theories we presented above.

[24] One could try instead to make the operators sensitive to the order given by constituency relations, but this would arguably yield incorrect results. *[q [and pp']]* is often assumed in syntax to have a binary- and right-branching structure, which would mean that the *second* conjunct would have to be evaluated 'before' the first one - an undesirable result.

(91) Middle Kleene Truth Tables (propositional case)

not p	
1	0
0	1
#	#

p and q	1	0	#
1	1	0	#
0	0	0	0
#	#	#	#

p or q	1	0	#
1	1	1	1
0	1	0	#
#	#	#	#

if p, q	1	0	#
1	1	0	#
0	1	1	0
#	#	#	#

In the propositional case, the Middle Kleene logic makes exactly the same predictions as Karttunen's or Heim's theories (and also *Be Articulate*). So the empirical debate revolves around the quantificational case. Three cases are particularly interesting.

–For sentences of the form *[Some P] QQ'*, Heim's approach and *Be Articulate* predict a universal presupposition: *[Every P] Q*. But Middle Kleene (or Strong Kleene, for that matter) doesn't: even if some P-individual fails to satisfy *Q*, yielding an 'uncertainty' for the corresponding value for *QQ'*, this need not affect the value of the entire sentence as long as there is some other P-individual that satisfies both *Q* and *Q'*. This *lack* of a universal inference might be an excellent thing, since it was observed early on that universal inferences are undesirable for existential statements (e.g. *A fat man was pushing this bicycle* doesn't presuppose that every fat man has a bicyle [Heim 1983]; see also Chemla 2009).

–The flip side of this positive result is that, by the rule of negation in (91), *not [Some P] QQ'*, or *[No P]QQ'*, has the very same presupposition as *[Some P]QQ'*. Experimental results suggest that for *[No P]QQ'*, a universal inference is in fact derived. By itself this need not be a problem, since the experimental results don't tell us whether this inference is a presupposition or an entailment. And in Middle or Strong Kleene, if *[No P]QQ'* is true, then so is *[Every P]Q:* if any P-individual d failed to satisfy *Q*, then the value of *QQ'* at d would be uncertain and we couldn't state with certainty that no P-individual satisfies *QQ'*. The difficulty, however, is that the question *Does none of your students know that he is incompetent?* does seem to carry the same universal inference that *each of your students is incompetent*. Treating this inference as an entailment does not appear to be feasible in this case. Further refinements are needed to derive the desired (Fox 2012).

–Finally, for *[Exactly two P]QQ'* the trivalent theory derives results that appear to be too strong: here too, we get an entailment that *[Every P]Q* (if any P-individual d failed to satisfy *Q*, then the value of *QQ'* at d would be uncertain and we couldn't determine with certainty the number of P-individuals that satisfy *QQ'*). Experimental results suggest that this is too strong (Chemla 2009).

While dynamic semantics and DRT remain important points of reference, it is clear that a combination of methodological and empirical considerations has led to renewed debate and to new frameworks. Presuppositions seemed to have been safely anchored to the semantic side of the semantics/pragmatics divide after the successes of dynamic semantics in the 1980's. But in view of recent developments, it seems plausible again that presuppositions might a post-semantic and possibly even a Gricean phenomenon.

4 Conventional Implicatures

In addition to the notion of 'conversational implicatures', Grice 1975 introduced that of 'conventional implicatures', which he illustrated on the example of *therefore* and *but*; for instance, the latter was taken to have a conjunctive literal meaning, but to carry a conventional implicature that distinguishes it from *and*. But as Potts 2005 points out, the notion was 'born into neglect': Grice's primary interest was in conversational implicatures, and his goal in defining conventional implicatures was just to distinguish them from the former.

In the 1970's, Karttunen and Peters (1979) had argued that some presuppositions should be handled in terms a multidimensional semantics in which presuppositions are

computed in a separate semantic dimension from assertions. Their framework was superseded by dynamic semantics (in part because it did not make correct predictions about the interaction between presuppositions and quantification). Interestingly, however, Potts 2005 used multidimensional ideas to revisit a different empirical terrain: he argued that two phenomena, supplements (e.g. appositive modifiers) and expressives (e.g. the derogatory term *honky*), trigger inferences that are *neither* conversational implicatures *nor* presuppositions, and should be handled within a multidimensional framework. He proposed to call these phenomena 'conventional implicatures'[25].

4.1 Supplements

4.1.1 Potts's analysis

Let us start with supplements (examples minimally modified from Potts 2005):

(92) Uttered in 1998:
a. Lance Armstrong, a cancer survivor / who survived cancer, will win the Tour de France.
(i) –No – he certainly won't.
Inference: Armstrong survived cancer
(ii) –#?No, he didn't survive cancer; it was a different disease.
b. I doubt that Lance Armonstrong, a cancer survivor / who survived cancer will win the Tour de France.
Inference: Armstrong suvived cancer.

We immediately note two properties of the inference triggered by the underlined nominal appositive:
(i) *Non-deniability:* as shown by the contrast between (92)a(i) and (92)a(ii), it is very difficult for the negative response *no* to target the inference that Armstrong survived cancer; *no* is take to target the main point of the assertion, namely that Armstrong will win the Tour de France.
(iia) *Scopelessness – negation:* Relatedly, despite the fact that the nominal appositive is in the scope of *doubt* in (92)b, the inference that Armstrong survived cancer is inherited by the entire sentence.

In these two respects, the inference behaves very much like a presupposition – and it clearly differs from a scalar implicature. But Potts convincingly argues that in other respects his 'conventional implicatures' sharply differ from presuppositions.
(iib) *Scopelessness – quantifiers:* Presupposition triggers that are in the scope of the negative quantifier *none* are acceptable, as in (93)b, and they typically trigger universal inferences, as was noted above (see also Chemla 2009). But appositive modifiers appear to be unacceptable in similar environments, as shown in (93)b'.

(93) a. John knows that he is incompetent.
a'. John, an incompetent semanticist /who is incompetent, will fail the test.
b. None of my students knows that he is incompetent.
b'. #?None of my students, an incompetent semanticist / who is incompetent, is able to pass the test.

(iii) *Non-triviality:* Even though they often allow for accommodation, presuppositions are certainly allowed to be trivial – in fact, the 'transparency-based theories' which we discussed above take this fact to be at the very core of theories of presupposition projection. But the facts are entirely different with appositives, which must be *non*-trivial:

(94) Lance Armstrong survived cancer.
a. #When reporters interview Lance, a cancer survivor / who survived cancer, he often talks about the disease.
b. And most riders know that Lance Armstrong is a cancer survivor. (after Potts 2005)

[25] Karttunen and Peters 1979 used the same term to refer to certain classes of presuppositions. See Potts 2008 for a survey of work on conventional implicatures.

By virtue of the beginning of the discourse, the information that Armstrong survived cancer is redundant in both (94)a and (94)b. In the presuppositional case, this is at is should be; but in the case of supplements, the result is markedly deviant.

Potts 2005 proposes that supplements belong to a new dimension of meaning, the conventional implicature (or CI) dimension. He develops a multidimensional analysis by duplicating logical types, as shown in (95) (refinements of the type system are offered in McCready 2010).

(95) Potts's type system for conventional implicatures

i. e^a, t^a, and s^a are basic at-issue types.

ii. e^c, t^c, and s^c are basic CI types.

iii. If τ and σ are at-issue types, then $\langle \tau, \sigma \rangle$ is an at-issue type.

iv. If τ is an at-issue type and σ is a CI type, then $\langle \tau, \sigma \rangle$ is a CI type.

v. The full set of types is the union of the at-issue and CI types.

It is noteworthy that type duplication is not complete: while each of the basic types exists both in an 'at-issue' and in a 'conventional implicature', this is not the case of all complex types; specifically, (95) (especially (iv)) guarantees that no expression will ever take an expression with a CI type as one of its arguments. At this point, we can already see what the strategy will be:

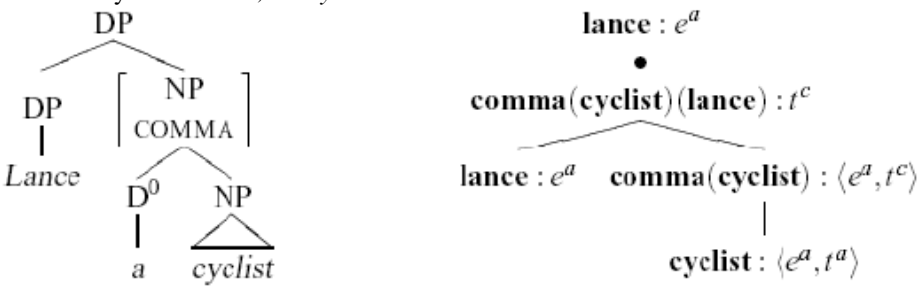
(i) *Non-deniability:* By assumption, we will take the new dimension not to be the 'main' one, which will presumably explain why it cannot be targeted by denials in discourse.

(ii) *Scopelessness:* By construction of the type system, no expression can ever be sensitive to the supplementary component of its argument, and for this reason the supplementary component of an expression will never interact scopally with negations and quantifiers.

(iii) *Non-triviality:* Since supplements have nothing to do with presuppositions, there is no reason to assume that they should have the trivial character of the latter.

On a technical level, an example of Potts's analysis is given in (96) for the expression *Lance, the cyclist*.

(96) Potts's analysis of *Lance, the cyclist*



Without going into full details, let us explain the ideas informally:

–The comma before *a cyclist* is taken to have a meaning, which transforms the at-issue expression *a cyclist,* of type $<e^a, t^a>$, into the CI expression *, a cyclist,* which has the complex type $<e^a, t^c>$, where t^c is crucially a CI type.

–New composition rules guarantee that:

a. the supplement *, a cyclist,* of type $<e^a, t^c>$, can compose with its argument *Lance*, of type e^a, to yield a CI meaning of type t^c.

b. at the same time, the at-issue meaning of *Lance* is entirely preserved in a separate (at-issue) dimension.

In (96), the two dimensions are separated vertically by the bullet sign •. An additional rule (called 'parsetree interpretation') will then collect all the meanings of propositional type that appear a semantic parsetree (of which the right-hand side of (96) would only be a part) to yield a pair of the form <at-issue meaning, {CI meaning #1, CI meaning #2, ..., CI meaning #n}>; the second coordinate of the pair if an unordered set that simply collects all the propositional CI meanings that appear in the semantic parsetree.

4.1.2 Questions

Several questions can be raised, both within a multidimensional framework and outside of it. Here we only aim to give a few examples of a very lively contemporary debate.

- *Compositional Interaction*

From the start, Potts 2005 noticed that the claim that supplements are never semantically embedded might be too strong. Thus in (97)a, the appositive clause is interpreted exactly as if it were in the scope of the speech act; and furthermore it appears in the 'Konjunktiv I', a mood which is characteristic of reported speech in German.

(97) a. Juan behauptet, dass Maria, die sehr schwach sei,
Juan maintains that Maria who very weak be.konj
krank sei.
sick be.konj
'Juan maintains that Maria, who is supposed to be really weak, is sick.' (Potts 2005)

b. Juan behauptet, dass Maria krank sei. Sie sei
Juan maintains that Maria sick be.konj *She be*.konj
sehr schwach.
very weak
'Juan maintains that Maria is sick. According to him, she is very weak.' (Potts 2005)

But as Potts 2005 is quick to point out, this is by no means a counterexample to his analysis: as (97)b shows, independent clauses in the Konjunktiv I can be understood *as if* they were semantically embedded – presumably by a mechanism of 'modal subordination' or 'perspective shifting'. Harris and Potts 2009 argue with experimental means that the latter mechanism is also available in English. Thus their subjects accepted to attribute to the agent (= Sid, rather than the speaker) the content of the supplement *a complete waste of time* both in (98)a and in (98)b.

(98) My brother Sid hates school.
a. He says that he puts off his homework, a complete waste of time, to the last minute.
b. He puts off his homework, a complete waste of time, to the last minute.

The fact that the nominal appositive in (98)a appears to be semantically embedded does not speak against Potts's multidimensional approach: as (98)b shows, it is independently possible to interpret such a nominal appositive *as if* it were embedded under an attitude operator – even when none is present (*put off* is certainly not an attitude verb!). Harris and Potts 2009 conclude that both examples in (98) should be analyzed by positing a pragmatic operation of perspectival shift – one that crucially does *not* require that the nominal appositive be semantically embedded under the verb *say*.

The logic that Potts applied to the German example in (97) leads to the opposite conclusion in other languages. For instance, it was argued in Schlenker (2010b, 2013) that the availability of appositive relative clauses in the subjunctive in French argues against Potts's proposal. In brief, the argument is that unlike the German Konjunktiv the French subjunctive cannot appear in an independent clause; and furthermore that when an appositive relative clause does appear in the subjunctive, it is in some cases interpreted with unambiguously narrow scope with respect to the operator that licenses it.

If correct, these facts suggest that under ill-understood conditions, appositives can be interpreted with narrow scope relative to other operators – which would seem to speak against Pott's multidimensional system. Schlenker 2010b, 2013 sketches a 'unidimensional' analysis of these data (but see AnderBois 2013 for a more sophisticated analysis within dynamic semantics). It has three main tenets:
(i) Appositives can be syntactically attached with matrix scope, despite their appearance in embedded positions; this is to account for *some* of the cases that motivated Potts's multidimensional analysis.
(ii) Appositives (a) are preferably attached with maximal scope (with the possible exception of attitude reports), but (b) they can in some cases be syntactically attached within the scope of other operators (whether attitudinal or not), in which case they semantically interact with them (this is intended to account for limited cases of semantic embedding discussed in the literature).
(iii) Appositives are semantically conjoined with the rest of the sentence, but they are subject to a pragmatic rule that requires that their content be relatively easy to accommodate ('Translucency') – hence some non-trivial projection facts for appositives that do not have matrix scope.

While (ii) is motivated by the data we saw above, independent arguments are needed for (i) and (iii). (iii) is too complex to go into here. As for (i), the argument crucially has to be based on *syntactic tests*, since the fact that appositives are *semantically* unembedded are a given for Potts's approach. Finding clearly *syntactic* arguments is not trivial; one line of argument goes back to McCawley 1988, who discussed (99)

(99) John sold a violin, which had once belonged to Nathan Milstein, to Itzhak Perlman, and Mary did too.

McCawley observed that the second sentence does not imply that the violin that Mary sold to Perlman had once belonged to Nathan Milstein. On the (non-trivial) assumption that ellipsis targets a constituent, this suggests that the appositive can be attached outside the constituent which is the antecedent of the elided VP. An alternative, however, would be to posit that ellipsis resolution is at bottom a *semantic* operation, and hence that McCawley's facts do not speak against Potts's 'in situ' analysis of appositive clauses, but rather argues *for* Potts's multidimensional semantics. Empirical developments will no doubt shed new light on this debate.

- *Varieties of appositives: nominal appositives vs. appositive relative clauses*

Wang et al. 2005 and Nouwen 2014 noted a contrast between some nominal appositives and some appositive relative clauses:

(100) a. If a professor, a famous one, publishes a book, he will make a lot of money.
b. If a professor, who is famous, publishes a book, he will make a lot of money.
a'. It is not the case that a boxer, a famous one, lives in this street.
b'. It is not the case that a boxer, who is famous, lives in this street.

As Nouwen notes, in (100)a-a' the nominal appositive is understood to further restrict the existential quantifier (*a professor*, *a boxer*); such a reading is unavailable or difficult in (100)b-b' (the remarks of the preceding paragraphs would lead one to expect that such a reading is available but dispreferred; Nouwen suggests in a note that in (100)b "*a professor* is read with wide scope with respect to the conditional" – which in turn allows the appositive relative clause to take maximal scope).

Still, Nouwen notes that it won't do to just posit that nominal appositives are more liberal in their attachment possibilities than appositive relative clauses; for when the modified NP is referential, the data change and a wide scope interpretation of the nominal appositive is once again preferred:

(101) If Jake, a famous boxer, writes a book, he will make a lot of money.
b. If Jake, a famous boxer, writes a book, he will make a lot of money.

Nouwen concludes that high attachment is preferred whenever it is available:

(102) A logical form in which nominal appositive is attached in a high position blocks competing logical forms in which the nominal appositive is attached in a lower position.

As Nouwen explicitly states, this generalization does not currently follow from anything (see AnderBois et al 2013 for an alternative analysis in terms of corrections).

4.2 Expressives

4.2.1 Initial Characterization

Potts 2005, 2007 provided another argument in favor of a multidimensional analysis, based on *expressives* such as *honky* or the antiquated term *Boche*, which refer to white people and Germans respectively, while conveying that the speaker has a negative attitude towards them (see Potts 2007 and the commentaries in the same volume of *Theoretical Linguistics* for a glimpse of the lively debates on this topic). According to Potts 2007, expressives are characterized, among others, by the following properties (see also Kaplan 2001):
i. *Independence:* 'Expressive content contributes a dimension of meaning that is separate from the regular descriptive content.'

(103) I enjoy working with honkies.
a. Descriptive meaning: I enjoy working with white people.
b. Expressive meaning: I have a derogatory attitude towards white people.

ii. *Nondisplaceability:* 'Expressives predicate something of the utterance situation.'
In particular, expressive meaning 'leaps out' of the scope of logical operators, as is illustrated in (104), where the inference that the speaker has a derogatory attitude towards white people is preserved under negation.

(104) I will never hire a honky.
a. Descriptive meaning: I will never hire a white person.
b. Expressive meaning: I have a derogatory attitude towards white people.

iii. *Perspective dependence:* 'Expressive content is evaluated from a particular perspective. In general, the perspective is the speaker's, but there can be deviation if conditions are right.'
Usually, the agent whose attitude is expressed is the actual speaker, but sometimes this is not so. Importantly, however, *some* perspective is needed.

(105) a. #I am not prejudiced against Caucasians. But if I were, you would be the worst honky I know.
b. I am not prejudiced against Caucasians. But John, who is, thinks / claims that you are the worst honky he knows. (Schlenker 2003, Potts 2007)

4.2.2 Multidimensional account and refinements

–Potts 2005, 2007 offers a multidimensional account, following the general spirit of his analysis of supplements. In particular, he develops a type system similar to (95), but with expressive types replacing the CI types.

(106) Potts's original type system for expressives
i. e and t are descriptive types.
ii. ε is an expressive type.
iii. If σ and τ are descriptive types, then $\langle \sigma, \tau \rangle$ is a descriptive type.
iv. If σ is a descriptive type, then $\langle \sigma, \varepsilon \rangle$ is an expressive type.
v. The set of types is the union of the descriptive and expressive types.

–As was the case in our discussion of types for supplements, the strict separation between expressive and descriptive types might be too radical. In particular, McCready 2010 shows that in some very simple cases the system fails:

(107) John is a honky.

The problem is that in Potts's original system, an expression either has a descriptive or an expressive type. But in (107) we both want *honky* to be predicated of John (which would require a type <e, t>) and to yield an expressive meaning that the speaker has a derogatory attitude towards white people (which would require a type <e, ε>, where ε is the expressive type). McCready argues for an enriched type system that addresses this problem.
–Just as was the case with supplements, Potts granted from the start that there are cases in which an expressive can be evaluated from a different perspective than the speaker's. But does this show that Potts's type system is incorrect? No, if it can be shown that the same interpretations are available in unembedded sentences. Just as was the case for supplements, Harris and Potts 2009 argue with experimental means that an operation of 'perspectival shift' is available in discourse given the right discourse conditions:

(108) Context: My classmate Sheila said that her history professor gave her a low grade.
Target: The jerk always favors long papers.
Experimental question: Whose view is it that the professor is a jerk?

An important proportion of the subjects have for *the jerk* a subject-oriented reading, whereby it is implied that *Sheila* takes the professor to be a jerk.

Still, it is rather unclear that these measures are sufficient to account for cases such as (105)b, where it seems crucial that *honky* be genuinely interpreted in the scope of *claim/believe*. This can be seen by embedding the attitude verb under further operators:

(109) I am not prejudiced against Caucasians.
a. And if John, who is, claimed that you are the worst honky he knows/a honky, I would punch him in the face.
b. And even John, who is, will never say that you are a honky.

If we were to posit an operation of perspectival shift to account for these examples, it could not be a *discourse* operation that only operates at the unembedded level, since in these cases it is crucial that the perspectival element should be interpreted within the scope of logical operators. For instance, (109)b cannot be interpreted as: *John will never say that you are a white person, and John has a derogatory attitude towards white people*. Furthermore, even allowing perspectival shift to be somehow negated as part of a separate operation won't work. This might provide an inference of the form: *John will never say that you are a white person, and John doesn't have a derogatory attitude towards white people*. But the first part of the entailment is still too strong: there is nothing in (109)b that entails that John will never express the content of the embedded clause *devoid* of its expressive component; rather, what is denied is that John will express something that *conjoins* the descriptive *and* the expressive component of the term *honky*.

4.2.3 Presuppositional account[26]

Several authors have explored a presuppositional account of expressives (e.g. Macià 2002, 2006, Sauerland 2007, and Schlenker 2003, 2007). In one version, the hypothesis is that *expressives are lexical items that carry a presupposition of a particular sort,* namely one which is *indexical* (it is evaluated with respect to a context), *attitudinal* (it predicates something of the mental state of the agent of that context), and sometimes *shiftable* (the context of evaluation need not be the context of the actual utterance). To make the discussion

[26] This section shares some material with Schlenker 2007.

concrete, we provide in (110) lexical entries for two prototypical expressives, the ethnic slur 'honky' (Kaplan 2001), and the French familiar pronoun *tu*. Our framework is two-dimensional, and thus we evaluate each lexical entry with respect to a context (*c*) and a world (*w*). As usual, # indicates presupposition failure:

(110) a.⟦honky⟧(c)(w) ≠ # iff the agent of c believes in the world of c that white people are despicable. If ≠ #, ⟦honky⟧(c)(w) = ⟦white⟧(c)(w)
b. ⟦tu⟧(c)(w) ≠ # iff the agent of c believes in the world of c that he stands in a familiar relation to the addressee of c. If ≠ #, ⟦tu⟧(c)(w) = the addressee of c

Let us now see how a presuppositional analysis might derive the main properties that expressives have according to Potts's analysis (see for instance Schlenker 2007 for a more detailed discussion):

i. *Independence:* 'Expressive content contributes a dimension of meaning that is separate from the regular descriptive content.' This result is immediate: the lexical entries in (110) are presuppositional, and on any account, presuppositions are a dimension of meaning that is separate from the 'regular' content of an utterance.

ii. *Nondisplaceability:* 'Expressives predicate something of the utterance situation.' This result follows from the *indexical* character of expressives (Schlenker 2003, Sauerland 2007). It is not entirely common to define presuppositions that are indexical, but nothing prohibits their existence. Furthermore, there might be independent reasons for treating some expressions as triggering an indexical presupposition. Thus the pronoun *you* is sometimes analyzed as a variable that carries the presupposition that it denotes the addressee[27]:

(111) $[\![\text{you}_i]\!]^s$ (c)(w) ≠ # iff s(i) = the addressee of c. If ≠ #, $[\![\text{you}_i]\!]^s$ (c)(w) = s(i)

The entry we posited in (110) has the same general form[28].

iii. *Perspective dependence:* 'Expressive content is evaluated from a particular perspective. In general, the perspective is the speaker's, but there can be deviation if conditions are right.' We account for this fact by suggesting that some expressives are *shiftable indexicals* (Schlenker 2003, Saulerand 2007). Standard indexicals are expressions that must be evaluated with respect to the context of the actual speech act. Shiftable indexicals are more promiscuous, and may be evaluated with respect to any context (e.g. the context of a reported speech act). For the sake of concreteness, we adopt the assumptions of Schlenker 2003: context variables are explicitly represented in the object language, with the convention that a distinguished variable *c** represents the context of the actual speech act. A shiftable indexical may take as argument any context variable; a standard indexical may only take the variable *c**. As far as we can tell, *honky* is shiftable (it may be represented as *honky-*c_i or *honky-c**), while *tu* is unshiftable (it may only be represented as *tu-c**).

Importantly, this account must be supplemented with a pragmatic analysis to explain *how expressive presuppositions differ from other presuppositions,* in particular in that they appear never to give rise to cases of presupposition failure. The strategy adopted in Schlenker 2007 is to treat expressive presuppositions as 'informative presuppositions', as in (112):

(112) a. The stupid president will cause a disaster.
b. The fantastic president will take us out of this quagmire.

Stupid and *fantastic* need not be expressive: when I say that *John isn't stupid* or *John isn't fantastic*, no negative or laudative inference is preserved – unlike what happens when I say

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[27] The motivation for this approach lies in demonstrative uses of second person pronouns: *You* [pointing] *should stop talking to you* [pointing] (Schlenker 2003).

[28] It is easy to combine the analysis in (110) with that in (111):
$[\![\text{tu}_i]\!]^s$ (c)(w) ≠ # iff s(i) is the addressee of c and the agent of c believes in the world of c that he stands in a familiar relation to the addressee of c. If ≠ #, $[\![\text{tu}_i]\!]^s$ (c)(w) = s(i)

that *John isn't a honky* (the inference that I have a derogatory attitude towards white people is preserved). Still, the examples in (112) produce very much the effect of sentences containing expressives. The difference is that in (112) we can tell that the inferences are triggered by a presupposition trigger, *the*. Furthermore, these are cases in which the presupposition triggered – namely that the president is stupid or fantastic – must usually be taken to be *informative*. For the sake of this discussion, suppose it is clear in the context that there is only one president. Then *the stupid president* has the very same denotation than *the president*, hence *stupid* must have some other contribution, or else it would run afoul of Grice's principle of manner (discussed above when we introduced Katzir's derivation of it, see (21)). So a reasonable guess is that these inferences belong to a class of *informative presuppositions,* which have been discussed from an empirical as well as formal perspective in the literature (e.g. Stalnaker 2002, von Fintel 2008, Schlenker, 2012).

From a formal perspective, Schlenker 2007 adopts an analysis based on Stalnaker 2002; it shows that under reasonable assumptions about the epistemic logic of presuppositions (namely that presuppositions must be common belief), *it is sometime enough to present oneself as presupposing that p to guarantee that p is indeed common belief.* The key observation in Stalnaker 2002 is that, *if it is common belief that the speaker believes that it is common belief that F*, and if in addition *the addressee believes that F*, then it is common belief that *F*. Now the idea in Schlenker 2007 was that because expressives are *attitudinal presuppositions*, if the speaker shows that he presupposes that he has a derogatory attitude towards white people, the addressee would have every reason to *grant* that the speaker indeed does have such an attitude, and thus to come to believe that he does; with *F = the speaker has a derogatory attitude towards white people,* we would be in precisely the kind of situation in which we can apply Stalnaker's result. If correct, this might provide a derivation of the fact that expressive presuppositions differ from standard presuppositions in being systematically informative.

Still, there are problems with this analysis, because there are differences between presuppositions and expressives (see Richard 2008 for further discussion).

–First, the pragmatic effects of expressives and of presuppositions are rather different.

(113) a. Everybody knows that I hate Caucasians. Are you one?
b. Are you a honky?

(113)a explicitly introduces a presupposition that the speaker has a negative attitude towards Caucasians – and yet (113)b appears to be far more offensive. This might suggest that (i) or (ii) are correct:

(i) the inference triggered by expressives is not just subjective ('the speaker has a negative attitude towards Caucasians') but objective ('Causians are despicable'); or

(ii) the inference in question is not a presupposition.

We could revise our view that expressives trigger attitudinal presuppositions; but then we would also lose the result that they are automatically informative presuppositions. Importantly, Potts 2007 devised a dynamic account in which expressives have a semantic effect which is *sui generis* and could in principle be distinguished from any other component of meaning that has been posited so far.

–Second, the projection behavior of expressives is not identical to that of presuppositions.

(114) a. Nobody stole my car, or it was John who did.
b. I am not prejudiced against Caucasians, or you are the worst honky I know.

In (114)a, the presupposition that someone stole my car is not inherited by the entire sentence, because no matter what the initial context is this presupposition is satisfied ('in its local context') by the negation of the first disjunct. But it is hard to see how the presupposition that I have a negative attitude towards white people can be 'filtered out' in

(114)b. One would have to say that the difference between the two cases stems from the fact that disjunctions introduce primary implicatures of ignorance that are never satisfied when one is talking about one's own attitudes – as is the case here:

(115) I am not prejudiced against Caucasians, or my colleagues know that I am.

But at this point it isn't quite clear how the presuppositional theory can account for these differences.

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While we have not surveyed the important results that have recently come from psycholinguistics, we hope to have shown that the study of the semantics/pragmatics interface is one of the most fertile grounds in contemporary research on meaning: it offers a rather exceptional interplay between important foundational questions (the modular decomposition of meaning and the division of labor between language and reasoning) and rich arrays of new data which are analyzed with very sophisticated formal – and now also experimental – techniques. The debate on scalar implicatures, presuppositions and conventional implicatures is probably more lively than ever – and this is a testament to the vitality of this field.

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