

Linguistic Convention and the Architecture of Interpretation

Responding to Lepore & Stone (L&S 2015)

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The usual **neo-Gricean/Relevance approach** to pragmatic enrichment is a **static, icing-on-the-cake process** whereby:

- ‘what is said’ (roughly, the proposition expressed) is calculated (say, compositionally), with context filling in any indexical or anaphoric values
- what is said then serves as the basis for an inferential process whereby the assumption that the speaker was being cooperative and following Grice’s maxims (in some form) is a guide to appreciating what she must have meant by what was said, with conversational implicatures generated, as needed, to satisfy that assumption. See Neale (1992) for a nice outline of the inferential process in a neo-Gricean vein. Such accounts satisfy Grice’s requirement that implicatures be **calculable on the basis of what is said**.

Some variants of this general approach engage in **Wild West pragmatics** with inferential enrichment that is unconstrained (Recanati), or limited only by an arbitrary quantitative limit (Sperber & Wilson 1985).

L&S present a bracing alternative, **Direct Intentionalism**, wherein:

- “[M]eaning is a matter of conventions, and listeners normally recover the meanings of utterances by recognizing the conventions involved, not by reasoning about the speaker in any deeper sense.” (p.199) Accordingly, the set of “possibilities a particular language allows for organizing discourse into patterns of inquiry, argument, and negotiation. . . goes beyond syntax and semantics as usually conceived, but. . . is **part of the speakers’ linguistic grammar** nonetheless.” (p.92) They argue that a very large number of the types of implications that Grice and his followers have taken to be conversational implicatures instead arise largely as a function of conventional content; these implications are thus not **non-detachable**, they argue, and so **not conversational** at all.
- There remain aspects of utterance meaning which *do* clearly go beyond what is given by “linguistic grammar”, even so broadly conceived; these include metaphorical meanings, sarcasm, irony, humor, and hints. But still, they argue, in recognizing these aspects of the meaning of a particular utterance, Grice’s Cooperative Principle (CP) and maxims play no role at all. Instead, these types of meanings draw on the imaginations of both speaker (in generation) and addressee (in interpretation), involving a wide range of types of eclectic inferences. These enrichments of meaning are thus creative and improvisatory rather than regular and conversational in Grice’s sense.

On the basis of extended arguments for these claims L&S claim that **there is no place in pragmatic theory for Gricean conversational implicature** as understood in the theories they discuss, and ultimately that the cooperative principle and maxims play no important part in pragmatic theory.

Pragmatics can be, at most, a theory of disambiguation; pragmatic reasoning never contributes content to utterances. Thus (p.88):

where alternative approaches have postulated pragmatic processes of enrichment, what’s really going on is disambiguation: finding the right reading of the utterance, understood as a grammatically specified pairing of form and meaning..

L&S and I agree that
we need:

- (a) the most constrained theory that
 - (b) makes the correct predictions about attested meanings with
 - (c) the fewest assumptions—preferably all independently motivated, and
 - (d) in the most perspicuous fashion;
- our theory should:
- (e) avoid Wild West pragmatics (unconstrained theory which lacks systematicity and predictive power;
- and:
- (f) calculation of implicatures as illustrated by Grice is cognitively implausible and intractable.

However, L&S also argue that:

- (i) anaphora resolution (or domain restriction, or disambiguation more generally) takes place without access to non-linguistic information of the sort encoded in the Common Ground, and
- (ii) there is no role for Gricean principles in anaphora resolution.

But I think that we need to give Grice his due, in this as in other pragmatic matters in interpretation.

I will argue for a third conception wherein Gricean Relation emerges as a generalization about the interpretive system in which the interlocutors' mutually recognized goals and intentions play a central, on-going role in meaning generation. Grice's requirement that implicatures be calculable doesn't mean that these calculations are done at run-time.

Calculability is a statement about affordances, not real-time inference-making.

So implicature generation, like other pragmatic processes, is

- **dynamic**, emerging during the course of compositional interpretation;
- **constrained** by both the regular Character of the expressions uttered and strong contextual constraints on felicity; and
- **expectation-driven**, much like other cognitive processes that facilitate intention-recognition, the expectations arising from the goals, tasks and QUD that are mutually understood to drive the conversation in which the utterance is made.

I'll first introduce some useful terminology, then present some examples representing benchmarks a pragmatic theory should account for; offer a critique of L&S' approach, focusing here on what they say about anaphora resolution, and then offer some general remarks intended to support the model I prefer.

I. Some terminology and distinctions

what is said: the asserted/queried/directed content of an utterance, aka its truth conditional content

the **CHARACTER** of a linguistic expression:¹ its regular contribution to the meaning of an utterance in which it occurs. The CHARACTER of an expression reflects (at least) three kinds of content that it regularly contributes to the meaning of an utterance in which it occurs:

- Presupposed content
- Proffered content
- Auxiliary content²

¹ This differs from Kaplan's (1977) Character, but is a convenient term in homage to the latter.

² A term I borrow from David Beaver (p.c.), for what Potts (2005) called the Conventional Implicature(s) triggered by the expression.

All these aspects of the CHARACTER of an expression play a role in dynamic compositional semantics (Anderbois et al. 2015, Martin to appear, etc.).

E.g., consider *that bastard*, used as an epithet:

(1) John thinks that that bastard_x is a sweetheart.

CHARACTER of *that bastard*_x:

Presupposed: x is weakly familiar
there is a familiar perspectival anchor α for *that bastard*³
Proffered: $g(x)$, g the relevant assignment of values to variables
Auxiliary: α doesn't think well of $g(x)$

(linguistic) expression: one or more words in a constituent, under a grammatical analysis

utterance: ordered pair of a linguistic expression (under an analysis) and a context of utterance (Bar-Hillel 1971), where the context itself is a complex database (cf., Lewis 1979, Roberts 1996)

ambiguous: 'having more than one possible meaning' [Merriam-Webster on-line]

L&S use this term in a way that differs from my practice, making clear that *ambiguous* is itself potentially ambiguous:

ambiguous in CHARACTER: (of a linguistic expression) having more than one CHARACTER

pragmatically ambiguous: (of an utterance) having more than one meaning in the context of utterance (see L&S, p.12).

I'm skeptical of whether a felicitous utterance is ever pragmatically ambiguous in the sense of having more than one set of truth conditions *consistent with the context of utterance*. I would call such an utterance unclear, and say that its context is defective. There may or may not be a species of pragmatic ambiguity wherein context fails to make clear the speaker's emotive tone or intended imaginative content (the latter in something like L&S' sense).

N.b.: this is not a terminological wrangle: it is a question of understanding the nature and role of linguistic context in interpretation. **A non-defective context should make clear to the competent interlocutor the proposition expressed/question posed/direction proposed.**

context of utterance: a body of information including the interlocutors Common Ground (CG), their evident goals and intentions (joint and individual), and the Question Under Discussion (QUD), *inter alia*.

II. Some benchmarks to keep in mind

In the general case, what is said cannot be reduced to proffered content, or to presupposed plus proffered content. Why not?

Two kinds of cases we'll attend to today bear on the question of how meaning arises partly as a function of the context of utterance (ignoring some others that L&S consider at length: e.g., speech act determination, imaginative enrichment):

1. **Resolution:** indexical and anaphoric elements must have their values contextually resolved

We might charitably include among these cases those involving implicit restriction of the domains of operators (following von Stechow 1995).

L&S treat these as involving ambiguity; by this they clearly mean their pragmatic ambiguity, because these cases arguably involve neither lexical nor syntactic-structural ambiguity.

³ Amaral, Roberts & Smith (2007), Harris & Potts (2009)

2. **Enrichment:** additional content “enriches” the CHARACTER of the expression. Some instructive cases:
- a) presupposition projection (wherein what is presupposed escapes the scope of an entailment cancelling operator like negation, etc.) triggered by non-anaphoric expressions.
In the classical literature on presupposition, it has been assumed that presupposition projection is conventionally triggered. But that now seems questionable.
- some classical “triggers” fail to lead to projection, depending on contextual factors: semi-factives, preadjacent of *only*. See examples and discussion, below, from Roberts (2011).
 - some non-triggers *do* lead to projection in the right contexts: *believe* (see Simons et al., to appear, “The Best Question” for several examples and extended discussion.)
- These lead to projection via inferences about relevance to the QUD.
Moreover, it seems that the presuppositions associated with the classical triggers are non-detachable cross-linguistically.
Because presupposition projection makes a difference to the meaning conveyed, pragmatic theory must account for when projection occurs and what factors govern it.
It seems implausible to try to attribute the options to ambiguity alone, in either sense of the term (above). Instead, it arguably involves inferences based on relevance to the QUD.
- b) conversational implicatures, especially those that are **intrusive**, having truth conditional effect under the scope of an operator. See Simons’ examples, below.

In my response paper I focus on type 1 examples. But those of type 2 are at least as important in the debate over the nature and role of pragmatic inferencing in interpretation, and I’ll say something brief about them in the last part of this talk.

only and presupposition projection:

Only is a trigger for projection; i.e. its preadjacent tends to project in the test contexts for projection, as we see in (20):

- (2) Projection tests for the preadjacent of *only*:
It’s not the case that only Lucy came to the party./Not only Lucy came to the party.
Did only Lucy come to the party?
If only Lucy came to the party, it must have been pretty quiet.
Maybe only Lucy came to the party.

All of the variants in (2) seem to implicate that Lucy came to the party. Hence, (3) (with a single speaker) sounds like a contradiction (marked as infelicitous: #):

- (3) Did only Lucy come to the party? #Of course, SHE didn’t.

But just like a possessive NP or the complement of a factive verb, the preadjacent of *only* is pretty clearly not presupposed, but only *supposed*, or backgrounded, so that the preadjacent can be novel in the Common Ground. One argument for this is the felicity of B’s response in (4), where the truth of the preadjacent is the very question under discussion:

- (4) A: Did Lucy come to the party?
B: Actually only Lucy came.

Then just like the outcome of a performative like (1) or (2), or after utterance of novel factive complements like (6) or (7), an addressee who finds the preadjacent of (19) or (2) or that of B’s answer in (4) uncontroversial will be inclined to accommodate it.

But not always. When the prejacent is controversial, or, especially, would contradict information in prior context, it fails to project, i.e. is not accommodated to the Common Ground:

- (5) And contrary to what many say I found the level of violence high but not excessive. This isn't only a "shoot 'em up" pointless movie; there's more than just stage blood. (web example reported in Beaver & Clark 2008:235)
- (6) [about a family where women generally have lots of kids]
QUD: How many kids does each of these siblings have?
Mary's the blacksheep. As far as I know she doesn't have any kids, but I can't remember for sure. Maybe she only has one kid? George, do you remember?

In (5), the writer is clearly arguing that the movie in question is worthwhile, hence it would be inconsistent for the prejacent of the second clause 'this is a shoot 'em up pointless movie' to project from under negation. In (6) the question of how many kids Mary has is under discussion, and the speaker makes it clear that for all she knows Mary may not have any; hence the prejacent 'she has one kid' doesn't project from under the modal in the third sentence. To sharpen our grasp of the flexibility of the projective behavior of the prejacent, see how it contrasts with that of the non-restrictive relative clause *who has one kid* in (7), which obligatorily projects, leading to a contradiction with the last sentence:

- (7) QUD: How many kids does Mary have?
George told me that Mary, who has one kid, is the blacksheep of her family. She doesn't have any kids.

These examples illustrate the requirement of **consistency**: The interlocutors' Common Ground must be logically consistent. Nothing can be accommodated which would make it inconsistent.

Conventional triggering of *only* would predict that it should always project; whereas in fact we have to abductively infer what the speaker *must have meant* by her utterance in context in order to determine whether she was committed to the truth of the prejacent.

Simon's intrusive implicatures:

- (8) A: How will you get to SALT?
B: Either I'll rent a car or I'll fly.
'Either I'll rent a car **and drive that car to SALT** or I'll fly **to SALT**' (Simons 2011)
- (9) If you need to get to SALT, you could rent a car or you could fly.
Local issue: how to get to SALT

In (8), each disjunct is understood to be about a way of getting to SALT. In (9), the speaker doesn't implicate that the addressee definitely *will* go to SALT, but the disjunctive consequent of the conditional has the same interpretation as the matrix disjunction in (8). These are, thus, embedded just like the scalar implicatures in (10) and (11):

- (10) Kai ate the broccoli or he ate some of the peas. (Sauerland 2004)
- (11) If I give an extension to some of my students, the others will be upset. (Simons 2011)

But unlike the response to examples like (10) and (11) in the work of Chierchia et al. (2012), we cannot explain the implicatures in (8), (9) by positing an implicit operator like their EXH at LF.

III. Critique of L&S on anaphora in discourse

Recall their general story: interpretation is disambiguation, it's all in "the grammar" (though they aren't clear about what the grammar *is*)

But:

- (a) Rather than disambiguation, the psycholinguistic evidence argues strongly that in many or most cases of anaphora across discourse anaphora resolution is effected in a *prospective* manner, by limiting attention (say, in a visual array) to what's relevant to the task at hand or QUD.
 - (b) The same knowledge that permits the addressee to appropriately, prospectively constrain the search space for antecedents also permits the speaker to appropriately choose the form of NP with which to refer to some salient entity, determining whether a pronoun would suffice or some richer descriptive content is required *as a function of the task-relevant domain*.
- (a) strongly argues for a role for relevance in efficient, accurate anaphora resolution, while (b) argues that this is effected on the basis of the CG.

L&S argue for a different view of anaphora resolution:

As when we disambiguate speech acts, we may need pragmatic principles to recognize the preferred resolution of anaphora and presupposition. But accounts of pragmatic inference err when they attribute the specifics of interpretation to the action of the principles themselves. The content of interpretation must be licensed by the conventional, rule-governed dynamics of discourse anaphora. (p.93)

So if anaphora resolution across discourse is a function of the grammar, there must be grammatical rules that determine the intended resolution in a particular context of utterance.

3 sets of "rules" might be said to play a role in the "disambiguation" that is anaphora resolution (the first two appealed to by L&S):

- Centering Theory: empirically ill-founded claims, so lame
- Coherence relations: strategies of inquiry, grounded in the QuD
- Prosodic focal structures: indicators of QUD and other relevant alternatives

Centering Theory:

Centering Theory (Grosz, Joshi & Weinstein 1983; see Walker et al. 1998): a set of heuristics for determining the likely occurrence and intended resolution of pronominal anaphora in an uttered sentence as a function of

- (a) the syntactic structure of the target sentence (including word order and the grammatical or thematic role of a target pronoun) and
- (b) that of the immediately preceding sentence uttered (and in particular, the word order and/or grammatical role(s) of any potential antecedent NPs in that preceding sentence).

Arguments in an utterance are ranked as a function of these syntactic factors; for example, the sentence-initial topic or subject of a sentence is typically ranked higher than other arguments both as a potential antecedent (in the preceding sentence) and as most likely to be pronominalized (in the target sentence). Principles are proposed which predict the likelihood of pronominalization and coreference resolution as a function of the relations between the ranked arguments ("Centers") in the two utterances, relating the highest-ranked "Backward Looking Center" of the second utterance to the set of "Forward Looking Centers" of the previous sentence (its ranked potential antecedents).

Centering does not play the independent role in anaphora resolution that L&S seem to assume, and that to the extent that such principles are applicable, they are instead subordinate to a requirement of relevance to task:

- Gordon, Grosz & Gillion (1993) argue that there is no psychological or empirical evidence for the claims of Centering Theory about preferences for certain types of transitions (pronominal coreference relations) between utterances in discourse, e.g. for Continuations (wherein a subject argument is more likely than others to be pronominalized if it is coreferential with some argument of the preceding sentence) to be preferred over other kinds of transitions.
- Poesio et al. (2004), considering a variety of realizations of Centering Theory, argue that rhetorical relations are more important in determining pronominal relations between utterances than Centering principles *per se* (“an analysis in terms of underlying semantic connections between events or propositions is more perspicuous than one in terms of entity coherence”, p.80), and that “Topic Continuity” in particular—whereby supposedly there is a preference for same-Topic from one utterance to the next, is not terribly robust. Since Topic Continuity for subject-initial languages like English is a way of encoding a preference for the subjects of adjacent sentences to be coreferential, this is an argument that there is no strong preference for subject antecedents.
- Tetreault & Allen (2004) conclude that some essentially semantic information (about events and situation types, object types, and other content that could be automatically retrieved) significantly improved pronoun resolution algorithm, but Tetreault (2005) found that “naive versions of Grosz and Sidner’s theory and Kameyama’s intrasentential centering theories” did not, concluding that “Our results show that incorporating basic clausal structure into a leading pronoun resolution [algorithm] does not improve performance.”
- In one of the most sophisticated computational models of anaphora resolution, Poesio & Rieser (2011, especially §5.4,261ff) Centering principles are only invoked as a last resort. The model takes into account the relevant psycholinguistic evidence that anaphora resolution is incremental, which is to say that it tends to take place in real-time, prior to the completion of utterance interpretation. A central element of their system is the modeling of **incremental shifts in joint focus of the interlocutors. These shifts take place as a function of joint tasks**, e.g. interlocutors moving together through areas on a map (the TRAINS corpus, Allen et al. 1995) or in visual world studies as a consequence of instructions like *Pick up the cube. Put it in...*, where attention is thereby focused in the visual array on the set of containers into which the cube would fit (Brown-Schmidt et al. 2005). The expectations established through such joint tasks affect what Brown-Schmidt et al. call a “rapid restriction of referential domains”, limiting the set of potential antecedents for any anaphoric elements. As part of their system, Poesio & Rieser do use a version of Centering theory as one among many tools: “The establishment of (Centering-guided) bonding [anaphoric] links is one trigger for further inference processes that hypothesize dominance/satisfaction precedes relations between the core speech acts generated by the two utterances, **if they haven’t already been established by coherence assumptions, or by previous intention recognition processes**” [my emphases, CR]. So on this model Centering principles only come into play if coherence (rhetorical relations) and/or the joint attention restriction [presumably including the sort observed in the eye-tracking studies] have failed to resolve the anaphoric relation, and even then are at best a default (over-rideable) feature of anaphora resolution.

Coherence relations:

Rhetorical relations have been argued to play a prominent role in discourse coherence (Asher & Lascarides 2003, Kehler 2002, etc.), and in anaphora resolution in particular:

- Kehler and associates (Kertz, Kehler & Elman 2006; Rohde, Kehler & Elman 2006 and 2007; Kehler, Kertz, Rohde & Elman 2008; Rohde & Kehler 2008a and 2008b) provide evidence that coherence, as reflected in felicitous rhetorical relations, is more successful than grammatical role parallelism in

predicting the preferred resolution. Parallelism is thus just epiphenomenal, reflecting certain common rhetorical relations, but can be readily over-ridden when other kinds of relations are brought to bear. For example, consider the following from Kertz, Kehler & Elman (2006):

- | | | |
|------|--|------------|
| (12) | Samuel threatened Justin with a knife, and | |
| | a. ...Erin blindfolded him (with a scarf) | [Parallel] |
| | b. ...Erin stopped him (with pepper spray) | [Result] |
| | c. ...he blindfolded Erin (with a scarf) | [Parallel] |
| | d. ...he alerted security (with a shout) | [Result] |

When the follow-up stands in a Parallel rhetorical relation with the first conjunct, we find the expected parallel thematic roles, as in (12a) and (12c). But when the (just as easily processed) Result relation is more plausible, as in (12b) and (12d), subjects prefer to resolve the object pronoun *him* to the non-parallel prior subject *Samuel*:

In Parallel relations, 98% of subject pronouns and 90% of object pronouns were interpreted to refer to the previous subject and object respectively, as predicted by both analyses. However, in Result relations, 95% of the subject pronouns were assigned to the previous object, and 94% of object pronouns were assigned to the previous subject. (Kehler 2009:8)

- Kehler (2009) points out that in their experimental materials Rohde et al. (2006) used different types of questions to bias to different coherence relations—e.g., *What happened next?* to bias to the relation Occasion, or *Why?* to bias to Explanation. He agrees with Roberts (2004) that we can understand different coherence relations as reflecting different strategies of inquiry in a Question-Under-Discussion (QUD)-based discourse structure. Hence, the relation of the target utterance to the QUD, reflecting the speaker’s adopted strategy, is the central factor in predicting anaphora resolution:

...at any point during comprehension the hearer will have expectations about how the discourse will be continued with respect to coherence, and...the difficulty in interpreting the linguistic material to follow will be conditioned in part on those expectations. These expectations will then evolve based on subsequent linguistic input. (Kehler 2009)

Again, we find expectations, here based on prior discourse structure, to play a crucial role in anaphora resolution. Roberts (1996/2012) argues that the **QUD reflects the interlocutors’ immediate joint goal in discourse—to address that question—and that, in turn, this goal is subordinate to any overarching goals and intentions**, such as those associated with joint tasks. From that perspective, the findings of Kehler and associates are consistent with those of Tanenhaus and associates about the expectation-driven resolution of anaphora on the basis of common ground and task, and with the results of Allen, Poesio, Tetreault et al. showing that Centering principles, insofar as they are useful, are subordinate to task structure.

Prosodic focus:

This is another type of conventional element which plays a strong role in anaphora resolution which L&S fail to mention in this regard. Consider the well-known example-types (after Lakoff 1971):

- | | |
|------|--|
| (13) | [Bernie supporter:] Julie said Alice was a socialist, and then she INSULTED her. |
| (14) | [Trump supporter:] Julie said Alice was a socialist, and then SHE insulted HER. |

We can explain this difference straightforwardly on the basis of the different prosodic prominences in the two—with the pronouns unaccented in (13), accented in (14)—and an independently motivated semantics and pragmatics of prosodic focus.

Rooth (1992): prosodic focus conventionally presupposes a certain set of alternatives.

second conjunct of (13): {*she Red her*, *R* a two-place relation }

(14): {*x insulted y*: *x* and *y* individuals }.

Roberts (1996/2012): the alternative set presupposed by prosodic focus must be congruent with the QUD.

Semantically, a question is itself a set of alternatives—the possible answers to the question, and congruence requires that the focally determined alternative set is the set of answers to the QUD:

(15) What does Alex like to eat?

(i) Alex likes PASTA.

(ii) #ALEX likes pasta.

(16) Who likes pasta?

(i) #Alex likes PASTA.

(ii) ALEX likes pasta.

Both conjuncts of a conjunction address the same question, as constrained by the prosody;

Together, these independently motivated assumptions predict the attested readings for (13) and (14): it is natural to resolve *she* in (13) to Julie, *her* to Alice, yielding the question ‘what did Julie do to Alice?’. But in (14) the presupposed question is ‘who insulted who?’; then this implies that calling someone a socialist is an insult (in order for the first conjunct to constitute a partial answer), and in turn, implies that the order of the referents is reversed in the second (in order for it to be informative, given the first conjunct).

So the role of prosodic focus in anaphora resolution, when it comes to bear, is conventionally triggered and very robust, but again, it is itself a function of the QUD.

Since the QUD reflects the discourse task at hand, **relevance to task again is argued to be a central factor in anaphora resolution.**

So once again, though I agree with L&S that both the understood structure of discourse and conventional features like prosodic focus play central roles in anaphora resolution, we cannot resolve anaphora as intended without taking into account the common ground, the QUD, and pragmatically inferred rhetorical relations. Though there are well-known inventories of rhetorical relations, I know of no successful attempt to determine *on purely conventional, syntactic or other structural grounds* which rhetorical relation is intended between any two given adjacent utterances.

IV. A constraint-based dynamic account

Recall that L&S and I agree (I think) that the calculation of implicatures on the basis of what-is-said, as realized by the neo-Griceans, is cognitively implausible and intractable. Some evidence that goes beyond what L&S present:

- i. Open-ended, free pragmatic enrichment in the determination of what is meant over-generates wildly: at what point is the inferential process called to a halt?
- ii. We produce and understand in real-time, quickly and efficiently, without evidence of time-consuming post-compositional interpretive inferences.
- iii. There is experimental evidence that implicatures are calculated in the course of compositional interpretation.

Recent experimental studies on scalar implicatures (SI) converge on the conclusion that these are drawn in real-time during the course of processing.

- In cases where such implicatures play a role in directing attention to an intended referent in a visual array, fixation on the SI-indicated referent takes place prior to the utterance of the target NP and completion of compositional interpretation (Huang & Snedeker 2009,2011).
- The calculation of an SI may be cognitively costly, slowing down processing by as much as 400 msec (Bott & Noveck 2004, 2012; Katsos et al. 2005; Huang & Snedeker 2009,2011), though this is controversial (Sedivy 2003, Grodner et al. 2010, Breheny et al. 2012).
 - The reported delays are consistent with Newell's (1990:122) characterization of the "time scale of human action", according to which it takes approximately 100ms to conduct a cognitive action like drawing an inference, and with the evidence (e.g., see Allopenna et al. 1998) that it takes about 150 msec to plan and make a saccade after the required inference is drawn (and hence shift gaze to the inferred target).
 - Closely related experimental work by Atanassov et al. (2013) on NOT-*must* implicatures associated with use of *might* found the same delay in processing as that found by Huang & Snedeker (2008).

The evidence on timing in SI-generation is consistent with the eye-tracking evidence (cited above) that anaphora resolution takes place prospectively, in real time, as well as with:

- Ito & Speer (2008) study the use of contrastive accent cues to permit hearers to anticipate upcoming referents in a visual array via implication of a contrast set; they argue that, like the SIs, this effect takes place early and rapidly, well in advance of confirming lexical information from a target NP; moreover, (Ito & Speer 2008,2011) infelicitous use of contrastive accent results in slower detection of the correct target, a sort of prosody-driven garden-path effect. Again, such processing is "guided not only by the discourse context, but also by the task-relevant referential context of the visual field" (Ito & Speer 2011:86).

Also recall from III above the experimental evidence that a *central mechanism* in anaphora resolution is the restriction of the referential domain based on the assumption of relevance to the QUD and/or the joint task at hand. This is consistent with experimental evidence of the role of inferential processes based on task in the generation of SIs:

- Several studies argue that SIs are neither automatic nor default, but only take place in response to appropriate contextual factors (Katsos & Cummins 2010), like the QUD (Tian et al. 2010).
- ERP studies (Politzer-Ahles et al. 2013) on utterances whose meanings involve SIs argue that "inferential pragmatic aspects of meaning are processed using different mechanisms than lexical or combinatorial semantic aspects of meaning, that inferential pragmatic meaning can be realized rapidly, and that the computation of meaning involves continuous negotiation between different aspects of meaning", supporting an incremental theory of processing where semantics and pragmatics interact (see below).

If other kinds of implicatures—including relevance implicatures like those involved in Simons' intrusive implicature examples (8) and (9) above—involve similar kinds of inferential mechanisms to those observed in the SI and prosody studies, it is reasonable to assume that they also take place in real-time during semantic compositional processing, rather than post-compositionally

Consider all of this evidence against the backdrop of a more general view of the ways in which different aspects of complex cognitive systems interact in processing:

In such systems, pragmatic reasoning based on background knowledge and expectations takes place in parallel with bottom-up processing of percepts. For example,

- according to contemporary theories of vision (especially the work building on Marr 1982, e.g. the summary in Shimojo et al. 2001, and overview and introduction in Smith & Kosslyn 2006), rapid processing of the distribution of image intensity on the retina produces **percepts**; this production

itself is arguably accomplished via a set of parallel processes, as required to accomplish this sophisticated task in real-time. This process is

- **bottom-up**, in the sense of being driven by the sensory stimulus, and
- it is largely **cognitively impenetrable** in Fodor's (1983) sense—neither accessible to conscious introspection nor affected by explicit reasoning.
- But there is also evidence of real-time constraints brought to bear on this bottom-up process by **top-down selective attention and expectations**, both **based on contextually available information, goals, and conceptual sets** (e.g., Allport 1989, Corbetta & Shulman 2002, Balceris & Dale 2007).
 - Recent work by Fecteau & Munoz (2006) present evidence that the two kinds of processes yield **distinct neural signals** (p.387).
 - See especially the work on **inattention blindness** (Simons & Chabris 1999, Simons 2000), wherein subjects regularly fail to consciously notice otherwise salient phenomena in a visual field if those are irrelevant to what the subjects are attending to. These constraints influence bottom-up pattern-recognition, **using information which is (at least in part) non-perceptually derived**. That is not to say that this top-down influence itself is cognitively penetrable; there is **no evidence that it involves conscious reasoning**, for example; and according to Fecteau & Munoz, the two processes are at least **partially concurrent in the pre-attentive phase**, that which precedes conscious attention.
 - Bottom-up processing, based on salience, seems to proceed in a fairly automatic, rapid way, entertaining whatever comes to attention as a function of visual salience, up to a point. There is evidence that unattended stimuli (both words and visual objects) do have priming properties, so that they are *perceived* at the first stage of processing of stimuli (Mack & Rock 1998, Mack 2003). But according to the contingent capture model of pre-attentive processing, a person's "**current intentions and/or goals affect the speed and efficiency of pre-attentive processing**", so that those stimuli that match what one is looking for "will be processed faster at the pre-attentive stage and will be more likely to be selected for attentive processing" (Folk & Remington 2006).

Hence, the top-down processes in vision clearly draw on background knowledge, goals, and rational expectations, unlike the sensory input itself. The way in which the two kinds of processes work together lends far greater speed and accuracy to visual processing; the expectations help to constrain, from the outset, the set of reasonable "parses" of the purely perceptual information that have to be entertained. But the bottom-up production of percepts is the stronger constraint on out-put—it is these that trigger processing after all. In experiments involving visual perception in monkeys, "salience and relevance yield distinct neural signals – salience is reflected in the initial registration of the target, and relevance is reflected in the elevated activity following the predictive cue." (Fecteau & Munoz 2006:387)

Given this common feature of human cognitive architecture (see recent work on attentional selection across cognitive domains in Schneider et al. 2013), where parallel bottom-up and top-down processes converge for greater speed and accuracy, we might expect to find similar bottom-up and top-down parallel processes in the real-time course of processing linguistic input. **The work on anaphora resolution discussed above provides ample experimental evidence that linguistic interpretation does involve this type of parallel architecture.**

Thus, we want a constraint-based account of pragmatic processes and principles that interact with the regular CHARACTER of an expression to predict its meaning in context.

The derivation of truth conditional content—what is said—requires interaction between compositional interpretation and abductive inference based on contextual information.

The kind of theory of context one needs to explain this, and to predict the attested interpretations may be understood as a realization of Grice's basic program, albeit perhaps not in the way he or the neo-Griceans have described it.

Returning to the benchmark examples we began with:

Type 1 cases: anaphora

There are no **discourse rules that disambiguate**. Instead, prospective resolution is facilitated by interlocutors' recognition of what's relevant to their immediate goals and the QUD.

Type 2 cases: Neither of these types is plausibly about ambiguity resolution in any ordinary sense.

In the presupposition-recognition and projection cases, these are not conventionally triggered; so, again, it is not a question of ambiguity: e.g., is the content merely proffered, or is it also presupposed?

The implicature "enrichments" in (2b), as just discussed, arise in part via consideration of what's relevant to interlocutors' goals and the QUD, and they do so in real time, during determination of what is said

Thus, the same kind of constraints which guide anaphora resolution both guide and constrain presupposition and projection, and implicature, in these cases crucial to making it clear that the enrichments in question are *intended*, i.e. crucial to **enrichment recognition**, on-line.

V. Conclusions

Interpretation, as Grice argued, is cooperative and collaborative: the consistent role of the CG and of intention-recognition in the processes considered above argues that this is a central feature of how we actually grasp what each other means in conversation.

Gricean relation (and, I would argue, other "maxims") are emergent generalizations, not rules that are applied after the determination of what is said.

Consider Anders Schoubye's (to appear, *Nous*) argument that what is said, in something like Grice's sense, is a function of the QUD and relevance.

Where I differ from Grice: it is not that first we determine what is said—the proposition expressed—and then calculate implicatures on the basis of that. Rather, the constraints brought to bear prospectively by mutually recognized goals, plans, tasks and the QUD drive and constrain an on-going inferential process that yields the attested implicatures in real time, during processing.

References:

- Allopenna, P. D, Magnuson, J.S. & Tanenhaus, M.K. (1998). Tracking the time course of spoken word recognition: evidence for continuous mapping models. *Journal of Memory and Language* 38, 419-439.
- AnderBois, Scott, Adrian Brasoveanu & Robert Henderson (2015) At-issue proposals and appositive impositions in discourse. *Journal of Semantics* 32:93-138. Doi:10.1093/jos/fft014.
- Asher, Nicholas & Alex Lascarides (2003) *Logics of Conversation*. Cambridge University Press.
- Allport, A. (1989) Visual attention. In M.E. Posner (ed.) *Visual Attention*. Cambridge, MA: MIT Press, pp.631-682.
- Atanassov, Dimka, Florian Schwarz & John C. Trueswell (2013) On the processing of "might". *U.Penn Working Papers in Linguistics* 19.1:1-10.
- Balcetis, Emily & Rick Dale (2007) Conceptual set as a top-down constraint on visual object identification. *Perception* 36:5581-595.

- Bar-Hillel, Yehoshua (1971) Out of the pragmatic wastebasket. *Linguistic Inquiry* 2.3:401-407.
- Bott, L. & Noveck, I. (2004). Some utterances are underinformative: The onset and time course of scalar inferences. *Journal of Memory and Language* 51, 437-457.
- Bott, Lewis, Todd M. Bailey & Daniel Grodner (2012) Distinguishing speed from accuracy in scalar implicatures. *J. Memory and Language* 66:123-142.
<http://00t0holtgrav.iweb.bsu.edu/Lab/BottBaileyGrodner12.pdf>
- Breheny, Richard, Heather J. Ferguson & Napoleon Katsos (2012) Investigating the timecourse of accessing conversational implicatures during incremental sentence interpretation. *Language and Cognitive Processes* 28.4:443-467.
- Brown-Schmidt et al. (2005) [anaphora resolution, cited in poesio & Rieser]
- Brown-Schmidt, Susan & Tanenhaus, Michael K. (2008). Real-time investigation of referential domains in unscripted conversation: a targeted language game approach. *Cognitive Science* 32(4):643-684.
- Büring, Daniel (2003) On D-Trees, Beans, and B-Accents. *Linguistics and Philosophy* 26(5):511-545.
- Chambers, C.G., Tanenhaus, M.K., Eberhard, K.M., Filip, H. & Carlson, G.N. (2002). Circumscribing referential domains in real-time sentence comprehension. *Journal of Memory and Language*, 47, 30-49.
- Chambers, C.G., Tanenhaus, M.K & Magnuson, J.S. (2004). Action-based affordances and syntactic ambiguity resolution. *Journal of Experimental Psychology: Learning, Memory & Cognition*, 30, 687-696.
- Chierchia, Gennaro, Benjamin Spector, & Danny Fox (2012) The grammatical view of scalar implicatures and the relationship between semantics and pragmatics. In C. Maienbor, P. Portner & K. von Heusinger (eds.) *Handbook of Semantics*, Berlin: de Gruyter.
- Clark, Herbert H. (1996) *Using Language*. Cambridge University Press.
- Corbetta, Maurizio & Gordon L. Shulman (2002) Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience* 3:201-215. doi:10.1038/nrn755.
- Fecteau, Jillian H. & Douglas Munoz (2006) Saliency, relevance, and firing: a priority map for target selection. *Trends in Cognitive Sciences* (review) 10.8:382-390.
- von Fintel, Kai (1994) *Restrictions on Quantifier Domains*. Ph.D. Dissertation, University of Massachusetts, Amherst.
- Fodor, Jerry A. (1983). *Modularity of Mind: An Essay on Faculty Psychology*. Cambridge, Mass.: MIT Press.
- Folk, C. L., & Remington, R. (2006) Top-down modulation of preattentive processing: Testing the recovery account of contingent capture. *Visual Cognition* 14:445-465.
- Frazier, Lyn (1979): *On comprehending sentences: Syntactic parsing strategies*. PhD Dissertation, Indiana University Linguistics Club, University of Connecticut.
- Frazier, Lyn & Janet D. Fodor (1978): The sausage machine: a new two-stage parsing model. *Cognition* 6, 291-325.
- Gordon, P.C., B. J. Grosz & L.A. Gillion (1993) Pronouns, names and the centering of attention in discourse. *Cognitive Science* 17:311-348.
- Grice, H.P. (1967) *Logic and Conversation*, William James Lectures, Harvard. Published in Donald Davidson and Gilbert Harman (eds.), 1976, *The Logic of Grammar*. Reprinted in Grice (1989) *Studies in the Way of Words*, Cambridge, MA: Harvard University Press.
- Grodner, D., Klein, N. M., Carbary, K. M., & Tanenhaus, M. K. (2010). "some", and possibly all, scalar inferences are not delayed: evidence for immediate pragmatic enrichment. *Cognition* 116, 42 - 55.
- Grosz, Barbara J. (1977) *The Representation and Use of Focus in Dialogue Understanding*, Technical Report No. 151, Artificial Intelligence Center, SRI International, Menlo Park, CA.
- Grosz, B. J., A. K. Joshi & S. Weinstein (1995) Centering: A framework for modeling the local coherence of discourse. *Computational Linguistics* 21(2):202-225, 1995. (The paper originally appeared as an unpublished manuscript in 1986.).
- Ito, Kiwako & Shari R. Speer (2008) Anticipatory effects of intonation: Eye movements during instructed visual speech. *Journal of Memory and Language* 58:541-573.

- Ito, Kiwako & Shari R. Speer (2011) Semantically-independent but contextually-dependent interpretation of contrastive accent. In S. Frota et al. (eds.) *Prosodic Categories: Production, Perception and Comprehension, Studies in Natural Language and Linguistic Theory* 82, DOI 10.1007/978-94-007-0137-3_4, _ Springer Science+Business Media B.V.
- Katsos, Napoleon & Chris Cummins (2010) Pragmatics: From theory to experiment and back again. *Language and Linguistics Compass Teaching and Learning Guide*, 3/1:1-7. Available at <http://crcummins.com/publications.html>
- Kehler, Andrew (2002) *Coherence, Reference, and the Theory of Grammar*. CSLI Publications, Stanford, CA.
- Kehler, Andrew (2009) Ellipsis and anaphora in a QUD model of discourse. Talk presented at the University of Michigan Workshop in Philosophy and Linguistics.
- Kehler, Andrew, Laura Kertz, Hannah Rohde & Jeffrey L. Elman (2008) Coherence and coreference revisited. *Journal of Semantics (Special Issue on Processing Meaning)* 25(1):1-44.
- Kertz, Laura, Andrew Kehler & Jeffrey L. Elman (2006) Grammatical and coherence-based factors in pronoun interpretation. In *Proceedings of the 28th Annual Conference of the Cognitive Science Society*, Vancouver, Canada.
- Lakoff, George (1971) The Role of Deduction in Grammar. In Fillmore and Langendoen (eds.), *Studies in Linguistic Semantics*. Holt, Rinehart and Winston.
- Mack, A. (2003) Inattention blindness: Looking without seeing. *Current Directions in Psychological Science* 12(5):180-184.
- Mack, A. & I. Rock (1998) *Inattention Blindness*, MIT Press.
- Marr, David (1982) *Vision: A computational investigation into the human representation and processing of visual information*. NY: Freeman.
- Martin, Scott (to appear) Supplemental update. To appear in *Semantics and Pragmatics*. http://www.coffeblack.org/publications/Martin-Supplemental_Update.pdf.
- Stephen Neale (1992) Paul Grice and the Philosophy of Language. *Linguistics and Philosophy* 15.5:509-559.
- Newell, Allen (1990) *Unified Theories of Cognition*. Harvard University Press.
- Poesio, Massimo & Hannes Rieser (2011) An incremental model of anaphora and reference resolution based on resource situations. *Dialogue and Discourse* 2(1):235-277. doi:10.5087/dad.2011.110.
- Poesio, Massimo, Rosemary Stevenson, Barbara di Eugenio & J. Hitzeman (2004) Centering: a parametric theory and its instantiations. NLE Technical Note TN-02-01, CS Technical Report CSM-369, available at: <http://cswww.essex.ac.uk/staff/poesio/publications/CL04TN.pdf>. Appears in abridged form in *Computational Linguistics* 30(3):309-363, 2004.
- Politzer-Ahles, Stephen, Robert Fiorentino, Xiaoming Jiang & Xiaolin Zhou (2013) Distinct neural correlates for pragmatic and semantic meaning processing: An event-related potential investigation of scalar implicature processing using picture-sentence verification. *Brain Research*, 1490:134-152. Available at: <http://users.ox.ac.uk/~cpgl0080/papers.html>.
- Roberts, Craige (1989) Modal Subordination and Pronominal Anaphora in Discourse. *Linguistics and Philosophy* 12.6:683-721. Reprinted in Javier Gutierrez-Rexach (ed.) *Semantics: Critical concepts in linguistics*, Routledge, 2003.
- Roberts, Craige (1995) Domain Selection in Dynamic Semantics. In Emmon Bach, Eloise Jelinek, Angelika Kratzer, and Barbara H. Partee (eds.) *Quantification in Natural Languages*, Kluwer, Dordrecht.
- Roberts, Craige (1996/2012) Information Structure in Discourse: Towards an Integrated Formal Theory of Pragmatics. In Jae Hak Yoon and Andreas Kathol (eds.) *Ohio State University Working Papers in Linguistics* Volume 49. Reprinted in the 1998 version with a new Afterword in *Semantics and Pragmatics*, Volume 5, 2012.
- Rohde, Hannah & Michael C. Frank (2011) Markers of Discourse Structure in Child-Directed Speech. To appear in the proceedings of the 33rd annual conference of the cognitive science society, Boston, MA.

- Rohde, Hannah & Andrew Kehler (2008a) The bidirectional influence between coherence establishment and pronoun interpretation. Poster presented at the 21st Annual CUNY Conference on Human Sentence Processing, March, 2008.
- Rohde, Hannah & Andrew Kehler (2008b) Coherence-driven expectations in discourse and dialog. Poster presented at the 21st Annual CUNY Conference on Human Sentence Processing, March, 2008.
- Rohde, Hannah, Andrew Kehler & Jeffrey L. Elman (2006) Event structure and discourse coherence biases in pronoun interpretation. In *Proceedings of the 28th Annual Conference of the Cognitive Science Society*, Vancouver, Canada, 697-702.
- Rohde, Hannah, Andrew Kehler & Jeffrey L. Elman (2007) Pronoun interpretation as a side effect of discourse coherence. In *Proceedings of the 29th Annual Conference of the Cognitive Science Society*, Memphis, TN, 617-622.
- Rooth, Mats E. (1992) A theory of Focus Interpretation. *Natural Language Semantics* 1:75-16.
- Schneider, Werner X., Wolfgang Einhäuser & Gernot Horstmann (2013) Attentional selection in visual perception, memory and action: a quest for cross-domain integration. Introduction to a special issue on Attentional selection in visual perception, memory and action, in *Philosophical Transactions B* 368(1628). DOI: 10.1098/rstb.2013.0053.
<http://rstb.royalsocietypublishing.org/content/368/1628/20130053>
- Shimojo, Shinsuke, Michael Paradoso & Ichiro Fujita (2001) What visual perception tells us about mind and brain. *Proceedings of the National Academy of Sciences of the United States of America* 98(22):2001.
- Simons, Daniel J. & Christopher F. Chabris (1999) Gorillas in our midst: Sustained inattentive blindness for dynamic events. *Perception* 28:1059-1074.
- Smith, Edward E. & Stephen M. Kosslyn (2006) *Cognitive Psychology: Mind and brain*. Pearson. See Chapter 2: Perception.
- Stone, Matthew (1997) *The anaphoric parallel between modality and tense*. IRCS TR 97-06. University of Pennsylvania.
- Tanenhaus, Michael K., Craig G. Chambers. & Joy E. Hanna (2004). Referential domains in spoken language comprehension: Using eye movements to bridge the product and action traditions. In J.M. Henderson & F. Ferreira (Eds.), *The Interface of language, vision, and action: Eye movements and the visual world*. New York: Psychology Press, pp. 279-318.
- Terken, Jacques, & Julia Hirschberg (1994) Deaccentuation of words representing “given” information: Effects of persistence of grammatical function and surface position. *Language and Speech* 37(2):125-145.
- Tetreault, Joel R. (2005) Decomposing Discourse. In Antonio Branco, Tony McEnery & Ruslan Mitkov (eds.) *Anaphora Processing*. John Benjamins.
- Tetreault, Joel R. & James F. Allen (2004) Dialogue Structure and Pronoun Resolution. In *Proceedings of the Discourse Anaphora and Anaphora Resolution Colloquium (CDAARC'04)*, Azores, September 23-24, 2004.
- Tian, Y., Breheny, R. & Ferguson, H.J. (2010) We Simulate Negated Information: A Dynamic Pragmatic Account. *Quarterly Journal of Experimental Psychology*. 63(12), 2305-2312.
- Walker, Marilyn A., Aravind K. Joshi & Ellen F. Prince (1998) Introduction. In Walker, Joshi & Prince (eds.) *Centering Theory in Discourse*. Oxford University Press, 359-400.