

The Architecture of Interpretation: Dynamic pragmatics and pragmatic competence The Beth Lecture, Amsterdam Colloquium 2022*

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1. Introduction: Criteria of adequacy for pragmatic theory

I'm honored by the invitation to give this year's Beth Lecture. Over the years, my own work has been deeply influenced by that of my Dutch colleagues in logic, philosophy and linguistics (see the bibliography). I began my study of semantics by studying logic under Nino Cocchiarella, a student of Richard Montague, and remain thoroughly convinced that the logical structure underlying the way that human language conveys meaning (Bach 1989, Landman 1991) is simple, elegant, and reflected in the foundations of what Chomsky would call Universal Grammar. If we follow another of my teachers, Emmon Bach (1979), in taking semantics to be a rule-by-rule reflection of the syntactic structures given by UG, then syntax and semantics together characterize human grammatical competence, and we would expect all the features of logical languages to be reflected therein—predicate/argument structure, quantifiers, scope, binding, etc. We find these features in a number of central linguistic phenomena: generalized quantifiers (Barwise & Cooper 1982, van Benthem 1983, 1986, Bach et al. 1995, Bach 1989, de Swart 1991, Frank 1996); reflections of lattice theory (Link 1983, Bach 1986); degree semantics (Kennedy 2001); and other semantic universals (e.g., see Incurvati & Sbardolini forthcoming, Sbardolini forthcoming).

But it is also obvious to any who have studied semantics in natural language that this simple structure is often obscured by the complex ways in which contextual factors bear on semantic content in the course of interpretation. Hence, Bar Hillel's (1971) famous warning about the pragmatic wastebasket:

Be more careful with forcing bits and pieces you find in the pragmatic wastebasket into your favorite syntactico-semantic theory. It would perhaps be preferable to first bring some order into the contents of this wastebasket as is, to clarify somewhat better the explicandum—to use Carnap's undeservedly neglected slogan—before embarking on the explication. [Bar-Hillel 1971:405]

I would take Bar Hillel's warning not to imply that we should avoid the use of pragmatic explanations, but rather to urge us to avoid the attribution to the syntax or semantics of features of interpretation which more properly derive from the context of utterance and how it comes to bear on meaning. And to get this right, we have to offer an adequate, non-ad hoc account of pragmatics that makes clear predictions about the possible interpretations of particular

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utterances, then revising until we arrive at a relatively clear, perspicuous overall account that's empirically adequate.

Lacking an adequate pragmatics and rejecting ad hoc pragmatic explanations, many are tempted to capture in the logical form of an utterance—in its conventional contributions to proffered content—aspects of meaning_{nn} which properly belong to context.¹ Thus over-burdened, LF tends to become baroque and messy, with a variety of scattered silent operators, free variables not motivated by movement or ellipsis, and wild scopal relations similarly unmotivated by syntactic considerations. Such features of LF obscure rather than explaining, and are often empirically inadequate.

Moreover, we want an account of pragmatic **competence** which would provide a foundation for explaining why we find so many similar features of contextual influence across languages, e.g.:

- the role of the QUD (Question Under Discussion) and the way it is universally reflected in the focal prosody of utterances across contexts (Roberts 1996/2012, 1998);
- the widely-recognized fact that presuppositions are triggered by all near-translation equivalents of the same expressions across all languages (Roberts & Simons 2022);
- the close relationship across languages between imperatives and deontic modality (Portner 2004, 2007)
- the fact that across languages epistemic necessity modals universally receive a weak reading (Karttunen 1972, von Stechow & Gillies 2010, Roberts to appear)
- the fact that shifting indexicals are universally interpreted *de se* across languages (Roberts 2014, 2020);
- etc.

The approach sketched in Roberts (2017) aims to do this. Time precludes reviewing here the evidence in that earlier paper presented for this approach, evidence which consisted mainly of empirical studies on anaphora resolution. Instead, here I'll offer:

- a schematic picture of the central features of this approach to pragmatic theory, contrasting it with prominent earlier views of the semantics/pragmatics interface; and
- an illustration of its value: the interpretive role it affords for **auxiliary content**, the conventional contributions to interpretation that yield what Chris Potts (2005) calls *supplemental conventional implicatures*.

To provide motivation for the view I propose, let's briefly review some prominent earlier views of the semantics/pragmatics interface, along with a few problems for those conceptions of the relationship between semantics and pragmatics.

¹ It is important to note that we have no intuitions about the distinction between the conventional content of an utterance and the contributions of context. Rather, we have to do the careful, step-by-step work of proposing a formal pragmatics and its interaction with compositional syntax-semantics, and studying the predictions this makes. Without a well-developed, empirically and theoretically adequate account of pragmatic effects on meaning_{nn}, it is impossible to convincingly argue for a clear distinction between semantic content and pragmatic effects.

1.1 The classical two-phase view of the interaction between semantics and pragmatics

Figure 1 is a schematic representation of the components of semantics and pragmatics and their interaction in the classical two-phase view of pragmatic effects on interpretation. This general approach is that developed in Montague (1973), Kaplan (1977), and most recently adopted in Heim & Kratzer (1998).

On this approach:

- The conventional input to compositional semantics is given by the syntactic logical form (LF) of an utterance, along with the semantic values of its lexical components, as indicated by **red lines** in Figure 1.
 - What is interpreted is a *contextualized logical form* (LF) with its lexical entries, annotated with contextual information for resolution of indexicals, variables.
 - Context is a combination of Kaplan's tuple (speaker, addressee, time, etc.)—given once per LF—and a Tarskian assignment of values for free variables, the assignment function varied in the usual way solely in the interpretation of quantification..
 - The role of pragmatics is two-fold, indicated with **green lines** in the figure:
 - The context of utterance acts like a sky hook to magically pull values for variables from out of the ether.
 - Gricean maxims play a post-compositional role: generating implicatures on the basis of the output of the compositional rules.
- To the extent possible, the classicist avoids the wastebasket of post-compositional pragmatic explanation.
- In Heim & Kratzer (1998) (following Heim 1983): Presuppositions are made explicit. These bear indirectly on proffered content, via constraints on felicity in context.

But over the past forty years, a growing body of literature in linguistic semantics and philosophy of language has provided evidence that the classical two-phase view, with its static context given once and for all, is empirically inadequate. The most famous such evidence, of course, are the so-called donkey sentences of Geach (1962), like (1):

(1) If [s_1 a farmer₁ owns a donkey₂ s_1], [s_2 he₁ uses it₂ to plow s_2].

Such examples argue that the interaction between semantic content and context is dynamic, the context changing over a single utterance in such a way that different sub-constituents are interpreted with respect to different contexts. Such interpretations cannot be readily captured in the static semantics of the classical two-phase view of pragmatics.²

² Heim & Kratzer (1998) adopt an e-type approach to donkey sentences, of the sort later elaborated by Elbourne (2005). But note that Elbourne himself concedes that the account he offers doesn't suffice to distinguish definite NPs from indefinites unless one assumes that the definites are anaphoric, proposing that one take a DRT approach to nominal anaphora. So the e-type approach to donkey anaphora simply pushes the problem of dynamic context update down the road.

1.2 Dynamic semantics

Starting with the work of Kamp (1981) and Heim (1982), many authors have attempted to capture this more sophisticated conception of context with a dynamic semantics (Groenendijk & Stokhof 1990, Muskens 1996, Anderbois et al. (2015), Martin 2016, Dotlačil & Roelofsen 2019, etc.). Figure 2 is a schematic representation of the semantics-pragmatics relationship in this type of semantics.

There are three essential features of dynamic semantics that differ from the classical picture. First, the notion of context modeled in this framework is richer than in the classical account: We now track not only the Common Ground and utterance-internal assignment function shifts, but also crucially use referential indices and assignment functions to keep track of what has been referred to across utterances. When an entity is referred to with an NP, the NP's referential index is entered into the conversational record as a discourse referent, an entity "familiar" to the interlocutors. Further, that information about the relevant entity is encoded as constraints on possible values for variables bearing that referential index. In subsequent discourse, the only assignment functions that are admissible are those which assign values to that index which have the properties previously predicated of it. Then if the same familiar discourse referent is encountered in subsequent discourse—identified via the same referential index, its value then is already constrained to reflect the information in the CG about that entity.

Second, in the interpretation of an utterance in dynamic semantics, the context of interpretation for sub-constituents is no longer given once and for all as the context of utterance. Rather, just as Tarskian assignment functions can be shifted utterance-internally, so now the entire context is updated dynamically, with the meanings of some sub-constituents within an utterance updating the context for interpretation of other constituents.

Thus, dynamic semantics significantly expands the role of the assignment functions we found in classical semantics; they are no longer arbitrarily chosen, but are used to track information used for the resolution of non-bound anaphora, and of presuppositions more generally, including donkey sentences like (1) and comparable temporal phenomena (2), which are challenging for the classical view of semantics/pragmatics because, though unbound, their utterance-internal resolution crucially bears on truth conditions.

(2) Whenever Mary wrote a letter₃, Sam answered it₃ two days later. [Partee 1984]

A given context makes available a restricted set of assignment functions, those such that the values they would assign to variables previously used in the discourse are in keeping with what has already been asserted about those values. Technically, to do this we need world/assignment pairs, since the values of discourse referents may differ from possible world to possible world. As usual, the semantics uses the assignment functions and other contextual information in the CG to track information for the resolution of non-bound anaphora, and presuppositions generally, including the anaphoric presuppositions in donkey sentences (1) and comparable temporal phenomena (2). In this framework, any presuppositions triggered by a lexical item, including anaphoric presuppositions, constrain the felicity of the local context of interpretation, which must satisfy any presuppositions so triggered.

The third way in which dynamic semantics crucially differs from the static semantics is that to implement the utterance-internal dynamic context just described, the semantic content of an expression is itself taken to be dynamic: Instead of the classical static denotation—a property, proposition, or entity, etc.—a constituent denotes a Context Change Potential (CCP), a function taking the local context of interpretation to yield an updated context, as you see in Figure 2. Hence, e.g., the first conjunct of a conjunction or the *if*-clause in a conditional can contribute to the context of interpretation for the 2nd conjunct or the consequent—the context updated (at least provisionally, in the case of the *if*-clause) to reflect the information in the first conjunct or *if*-clause.

In Figure 2, as in other figures we'll consider, there are many ways of realizing the relations indicated by the arrows—see Heim's (1982) File Change Semantics, Kamp's DRS update functions (Kamp 1981, Kamp & Reyle 1993), Muskens' (1996) compositional dynamic semantics, Martin's (2016) compositional categorial dynamic semantics, and recent work on dynamic inquisitive semantics (Dotlačil & Roelofsen 2019, 2020; Roelofsen & Dotlačil 2022)—but, modulo the types required for dynamic inquisitive semantics, all assume something like CCPs and the same type of two-way flow of information between context and semantic content, wherein compositional semantics feeds the context of interpretation, which in turn feeds the compositional interpretation, etc.

Problems for dynamic semantics:

Dynamic semantics marked a vital step forward in understanding the relationship between semantics and pragmatics. But there are important respects in which this framework still fails to correctly capture the ways that context influences truth conditional content. For one thing, the assumption that the update of an indicative utterance is automatically a contribution to the Common Ground/Context Set of the input context is problematic from the point of view of Speech Act theory (see Portner 2018, Chapter 3 for an excellent overview of the literature; Roberts 2018). Consider (3):

- (3) A and B are strategizing about how their gang is going to rob a bank:
- i. A: Suppose the police arrive while we're cleaning out the vault.
 - ii. B: We'll elude them by escaping over the roof.
 - iii. A: What if our short-circuiting software fails and the alarm goes off?
 - iv. B: Grab the cash in the drawers and run!
 - v. A: Suppose the guard gets untied.
 - vi. Should I shoot him?

In (3) the interlocutors are negotiating a plan. Besides directly planning how to achieve their goals, they consider various possible obstacles and contingencies and speculate about alternative ways of proceeding *if/when* they arise. So there are branching possibilities. In each branch, they consider 'what to do' *as if* acting out the plan. Earlier B might have said *then tie up the guard*, etc., just *as-if* they were in an actual situation in which that action was appropriate, modulo the anaphoric *then*. In this extended irrealis context, all proffered content is relativized to the hypothetical scenario being entertained, and as in modal subordination generally (Roberts 1989),

the relativization has implications for the resolution of anaphora and other presuppositions. In (3i) A proposes consideration of one possible contingency; since this is a planning discourse, this raises the practical question of what to do in that circumstance. In (ii), B offers a plan to address that contingency; notably, the Reference Time for (ii) is clearly the immediate aftermath of the event described in (i), and *them* is resolved to the police. In (iii) A directly poses a question about how to plan for yet another possible contingency, and in (iv) B suggests what to do in that hypothetical circumstance, with the same relativization of Reference Time, and also domain restriction of *the cash* and *the drawers* to those in the bank. In (v), A proposes consideration of yet another contingency, and then in (vi) asks whether she should adopt a particular provisional plan in that case, shooting the arbitrary guard under discussion, thereby resolving *him* and, once again, the Reference Time—she’s asking whether she should shoot the guard *at that point in time*. Note that the imperative in (iv) is a conditional suggestion: ‘if the alarm goes off, grab the cash and run’. The modal *should* in (vi) takes the background scenario in the bank plus (v) as part of its modal base, and as its ordering source the understood goals and priorities both immediate (get the money) and longer-term (get away, avoid the worst potential legal consequences, stay alive), yielding a conditional interpretation of the question: ‘should I shoot the guard if he gets untied’. And just so, the imperative in (iv) takes (iii) as one of the premises for its modal base, and the same general priorities for the ordering source. In all these cases, relevance to the question under discussion (as part of the practical strategy being developed) and the interlocutors’ understood joint and individual goals in G play a direct role in restricting the applicable circumstances to yield the natural interpretation.

Taking an indicative as an assertion, an interrogative as a question, an imperative as a directive is arguably a pragmatic matter, not automatically part of compositionally determined meaning. So to build that into conventional content seems off the mark:

Grammatical mood does not determine speech act type.

Moreover, the architecture of information flow in dynamic semantics makes no allowance for non-CCP context update, though we know that modal subordination (from (3) above) and other contextually given domain restriction, as well as anaphoric bridging (4) and intrusive implicatures (5), (6) (Cohen 1971; Kadmon 2001; Chierchia 2004; Simons 2010, 2011, 2013) play a regular, presumably explicable role in truth conditional interpretation.

- (4) If a farmer₁ owns a John Deere₂, he₁ uses the tractor₂ to plow.
- (5) If the old king has died of a heart attack and a republic has been declared, then Tom will be quite content. [Cohen 1971]
- (6) Bill believes that some of his students are waiting for him. [Chierchia 2004]
 standard accounts predict: ‘it is not the case that Bill believes that all of his students are waiting for him’ [true if Bill has no beliefs about the students]
 attested implicature: ‘Bill believes that not all of his students are waiting for him’

About (5) (her (4)) and (6) (her (5)), Simons (2010) says:

As argued by Cohen 1971, the implication of temporal ordering and causal connection. . . is part of the content of the antecedent of [(5)]. Chierchia 2004 argues that an utterance

of [(6)] attributes to Bill the belief that some and not more than some of his students are waiting for him. . .

...

[With respect to (6):] As Chierchia points out, standard accounts predict that if this sentence gives rise to a scalar implicature, it is this:

(8) It is not the case that Bill believes that all of his students are waiting for him.

This, though, could be true if in fact Bill had no beliefs at all as to whether all of his students were waiting for him. The observed implicature, that Bill believes that not all of his students are waiting for him, cannot be generated directly from the asserted content of [(6)], but only from the clause embedded under *believe*. But, as the content of this clause does not count as said, then it should not trigger any implicature calculation. This, then, is the calculation problem.

[The compositionality problem, then, is that] in examples like [(5)] and [(6)], the implicatures apparently generated by embedded clauses seem to fall under the scope of the embedding operators, and thus to contribute to the truth conditional content expressed: that is, to what is said.

Some authors, including Roberts (1989) and Kadmon (2001), treat local contexts in DRT more like a Stalnakerian Common Ground than purely the result of CCP update, introducing the results of accommodation and intrusive implicature. But from the point of view of the architecture of information flow captured by the theory itself, this is an ad hoc elaboration.

Moreover, as Stalnaker (2014) pointed out, there is a sense in which dynamic semantics fails to clearly represent what is meant_{mn} by an utterance or its sub-constituents. An unembedded indicative clause not only serves to update the Common Ground, but also intuitively denotes something like a proposition, as we see when such a clause serves as complement to an attitude predicate. Yet in dynamic semantics its meaning is a function from contexts to updated contexts, the intuitive propositional content only retrievable indirectly via its effect on the CG. And while it is useful, e.g. for donkey anaphora, to capture the fact that the use of a quantificational NP leads to the introduction of a new discourse referent and the update of the local context with the information in its nominal complement, the latter then serving as a new local context for its second argument, we might still want to insist that such a constituent *denotes* a generalized quantifier, with all the properties universally observed in that type captured as relations over two static argument types. This is a conceptual problem, not empirical. But I think it underlines the empirical problem illustrated by the intrusive phenomena, including modal subordination, anaphoric bridging, and perspective shift under attitudes, as well as intrusive conversational implicature:

Though context update is *driven* by explicit semantic content, it seems that semantic content does not *determine* context update:

It is the way that context is updated that is dynamic, not semantic content *per se*.

And hence, in keeping with the pragmatic character of speech act determination:

Context update is essentially pragmatic, not semantic.

1.3 Auxiliary content: a challenge to earlier views

There is another empirical challenge both for the classical view of the semantics/pragmatics interface and for dynamic semantics. This is the existence of another possible aspect of the semantic contribution of a constituent, besides its ordinary semantic content and any presuppositions it triggers. This is that aspect of meaning that contributes what Potts (2005) called *supplemental conventional implicatures*, contributed in English by nominal appositives, non-restrictive relative clauses (NRRs) and other constructions. Potts considered examples like (7), where the appositive *a very honest woman*, modifying *his wife*, is understood to reflect a belief of the speaker about Sam's wife, and *not* something that Sam himself believes, despite the fact that it occurs in the syntactic scope of *believe* with Sam as agent. So following (7a) with (7b) seems to be a contradiction, whereas (7c) is fine:

- Not locally entailed:
(7) a) Sam believed that his wife, a very honest woman, was lying to him.
b) #Sam's wife isn't an honest woman.
c) ✓Sam's wife wasn't lying to him.

Moreover, auxiliary content cannot bind or be bound by the semantic content of the clause in which it occurs, as we see in (8):

- (8) *No reporter₁ believes that Ames, often the subject of his₁ columns, is a spy. [Potts 2005]

On the basis of phenomena like these, Potts argued convincingly that auxiliary content does not directly contribute to the proffered semantic content of an utterance in which it occurs, instead acting as a sort of aside or parenthetical. He provides an account in a static semantics, where auxiliary content is always directly added to the globally available information about the speaker's "world view", except when shifted in direct quotation to the reported agent of the utterance quoted.

But as Amaral et al. (2007) pointed out, there are examples where auxiliary content has truth conditional effects which cannot be explained if we assume that context is static, the same across an entire utterance except as manipulated by quantifiers in the usual Tarskian manner. (9) is an example of donkey anaphora with auxiliary content; the antecedent of *it* in the main clause is *a bachelor's degree* occurring in a NRR which in turn is under the scope of *every professional man*:

- (9) [Every professional man I polled]₁ said that while [his₁ wife]₂, who had earned a bachelor's degree₃, had no work experience, he₁ thought she₂ could use it₃ to get a good job if she₂ needed one. [ARS 2007]

Thus, while auxiliary content does not interact compositionally with the ordinary semantic content of the utterance in which it occurs—as evidenced by the lack of local entailment and binding—it does come to have an essential effect on truth conditional interpretation. So if we want to capture the donkey anaphora in (9), we have to address this issue:

Auxiliary content updates context dynamically, intrusively, yet without contributing to the compositional semantics that yields proffered content.

Again, this argues that a purely semantic account will not suffice to explain the phenomena that drive dynamic accounts of interpretation.

1.4 An alternative view: Static semantics and dynamic pragmatics

To address the range of phenomena alluded to above, and others besides, I will offer an alternative picture of the interaction between semantics and pragmatics. Figure 3 sketches a schema for interpretation which crucially features a static semantics and a central role for a dynamic pragmatics (see Dever 2013, Stalnaker 2014, K. Lewis 2014, 2017, Portner 2018 for early discussions), the latter conceived of as a crucial non-grammatical component of the linguistic competence underlying interpretation. I will argue that the result has the virtues of dynamic semantics but without the drawbacks just discussed. To get a feeling for the basic differences between these different models of interpretation, the black lines in Figures 1b, 2b and 3b trace the flow of contextual information in the static semantics, the dynamic semantics, and the dynamic pragmatics. In the static semantics of Heim & Kratzer (Figure 1b), though the notion of context may be richer than that in classical Montague Grammar by virtue of assuming a CG for non-anaphoric presupposition satisfaction, there is no context update. Pragmatic input is two-phase, as in Kaplan/Montague, with Gricean maxims and the like yielding implicatures which enrich the compositional meaning to yield what is meant_{nn}. In dynamic semantics (Figure 2b), we have continuous update of the context of interpretation, some of this temporary, e.g. under the scope of an operator. But the only formal input to this update is given by the compositional semantic content of the utterance.

But on the view of dynamic pragmatics represented in Figure 3b, context revision is fed in multiple ways. As in dynamic semantics, the output of (partial) static compositional semantic interpretation feeds context revision over sub-constituents of the utterance: The loop on the right from the compositional semantics through the dynamic pragmatic update rules feeds the local context that is brought to bear on the interpretation of sub-constituents of a contextualized logical form. But independently, auxiliary content (top left) directly feeds context update in the dynamic pragmatics, while lexically triggered presuppositions constrain local context in the usual way. Neither the auxiliary content nor presuppositions interacts with operators at Logical Form. In addition, pragmatic constraints on well-formed context (bottom right), such as Relevance to the QUD and the Right Frontier constraint on anaphora resolution (Polányi 1985, Asher & Lascarides 2003, Roberts 2016), continuously constrain context update to play a role on-line in disambiguation, anaphora resolution, implicature generation, and speech act recognition. The dynamic pragmatics so-fed determines a local context of interpretation for a given constituent, which feeds the contextualized logical form, in turn feeding compositional semantics. Thus, on

this model there are multiple indirect contributions to truth conditional semantics, highlighted in **green** in Figure 3b; these contributions are not reflected in the syntactically determined LF, but only in the contextualized LF that is fed by the dynamic pragmatics.

2. Dynamic Pragmatics

All the elements of the architecture in Figure 3 are assumed to be language-specific developments of a general cognitive strategy for processing perceptual input. Such processes and their interactions are part of our linguistic competence.

Roberts (2017) explored psycholinguistic evidence for similarities between the interaction of the kinds of information processing we see in Figure 3, and that of two aspects of visual processing:

- Both visual and linguistic processing include both bottom-up (visual parsing/word recognition, syntactic parsing) and top-down (expectation/QUD-based) systems, operating in parallel and feeding each other in the course of interpreting sensory input.
- Both systems are pre-cognitive, cognitively impenetrable, and rapid, features typical of Fodoran mental modules.

And crucially, the two systems operate in parallel, with limited input into the bottom-up system from the top-down, expectation driven system. Roberts (2017) offered arguments from anaphora resolution that these systems constitute sub-modules of our linguistic competence.

So conceived, pragmatics is not a jumble of post-hoc rules for rational cooperation. Our semantic competence did not evolve and does not operate in a vacuum. Instead, pragmatics is a reflection of a specifically linguistic system for tracking particular types of information, the latter fed on-line to bottom-up semantic interpretation in very specific ways.

Assume that there is a rule-by-rule relationship between syntax and semantics (Bach 1979). Then syntactic parsing to determine Logical Form is the bedrock of the bottom-up compositional semantics that drives and tightly constrains interpretation, yielding the usual static results. Just as with percepts in vision, the LF imposes a hard constraint on interpretation, which cannot be readily over-ridden. But in parallel, a rich, specifically linguistic context evolves in a way constrained by expectations and intention-recognition. This context feeds the compositional semantics dynamically, yielding a contextualized Logical Form wherein different sub-constituents typically have distinct local contexts of interpretation. This evolving context is directly fed by the bottom-up semantic interpretation of sub-constituents of an utterance. But it is also affected by conventional elements of the utterance which do *not* directly feed Logical Form:

- Context update is constrained by presuppositions, including especially prosodically-given presuppositions (Rooth 1992), imposing felicity conditions on context (as in Heim 1983), and
- Context is directly enriched by the addition of auxiliary content (more below).

Moreover, context not only tracks the CG and discourse referents, but a much richer intentional structure of the interlocutors' interaction, guiding expectations about what's under discussion and what is being said (Roberts 2004, 2013, 2023). This richer context comes to bear top-down during compositional interpretation to constrain interpretations so that they are contextually

relevant, coherent and consistent, and thereby the evolving context plays a central role in disambiguation, anaphora resolution, presupposition accommodation, intrusive implicature generation, and speech act recognition. As with intentions in visual processing, expectations based on intentions tracked in linguistic discourse lead to a kind of inattentional blindness to irrelevant or infelicitous interpretations (see the review of the relevant literature on anaphora resolution in Roberts 2017), not only yielding a more relevant interpretation, but speeding processing.

All elements of the architecture in Figure 3 are thus language-specific developments of a general cognitive strategy for processing perceptual input: The result is faster, more accurate and efficient processing of complex sensory input, with selective inattention constraining the reasonable “parses” of the purely perceptual information that is the foundation of the process.

The context of interpretation represented in Figure 3 is thus a hypothesis about what kinds of information we track in the course of interpretation, and of how that information is brought to bear on interpretation.

2.1 What’s a context of interpretation?

I assume an evolving context of interpretation, along the lines of the InfoStructure scoreboard in Roberts (1996/2012), which one might represent as an elaborated version of the DRSeS in Kamp & Reyle (1993).

The **elements of a context of interpretation K** include:

- CS, the context set (Stalnaker 1979);
- DR, the set of familiar discourse referents (Kamp 1981; Heim 1982);
- QUD, the set of questions under discussion (Roberts 1996/2012);
- G, a set representing the interlocutors’ evident goals, intentions and plans (Roberts 2004, 2013, 2023; cf. the To-Do lists of Portner 2004, 2007); and
- \mathbb{C}_D , the set of discourse centers currently under discussion (Roberts 2014, 2020, to appear).

The inclusion of the set \mathbb{C}_D is motivated by work on the way that doxastic perspectives come to bear on interpretation. It is used to track the doxastic perspectives available (in DRT terms: accessible) at a given point in discourse. This set is updated and downdated dynamically, the dynamics modeled after the way the Reference Times are updated in Partee (1984):

The set of **discourse centers in context D**, \mathbb{C}_D :

A discourse center \mathbb{C} : an ordered set $\langle d_i, e_j \rangle$, s.t. $d_i, e_j \in DR_D$ and d_i is a doxastic agent whose beliefs in $e_j \in E_D$ are under discussion in D at speech time in the actual world.

\mathbb{C}_D is an ordered set. It always includes as its last element the unordered set of discourse centers involving the interlocutors $\{ \mathbb{C}_{i,j}^*, \mathbb{C}_{k,j}^@, \mathbb{C}^{*+@} \}$, where:

- $\mathbb{C}_{i,j}^*$ is a distinguished center corresponding to the speaker d_i in the actual event of utterance $e^* = e_j$,
- $\mathbb{C}_{k,j}^@$ corresponds to the addressee d_k in $e^* = e_j$,

- $\odot_{i+k,j}^{CS}$ ($= \odot_{i+k,j}^{*+@}$): inclusive ‘we’, the joint (purported) doxastic point of view of speaker and addressee $d_i \oplus d_k$ in $e^* = e_j$, as reflected in CS_D .³

Other elements of \odot_D are discourse centers introduced in conjunction with the interlocutors’ direct consideration of alternative doxastic states, i.e. attitudes:

- In the scope of attitude predicate *pred*, $\odot_{i,j}^{pred}$ (e.g., \odot^{know} , \odot^{hope} , \odot^{claim} , etc.) is introduced as the first element of the local \odot_D . \odot^{pred} : the ordered pair of the agent d_i of the attitude in the arbitrary eventuality e_j in which it obtains.
- In Free Indirect Discourse, reflecting the doxastic perspective of some third party: $\odot_{i,j}^{FID}$, the agent d_i whose perspective in a given (possibly fictional) eventuality e_j is being adopted globally in the narrative.
- Perspectival adverbials like *according to a* (at time t) or *from a’s point of view* (at time t): a new element $\odot_{i,j}^{POV} = \langle a, e \rangle$, d_i the agent a in the (possibly arbitrary) eventuality e_j , the point of view is available at $t = \text{time}(e_j)$.
- In an epistemic conditional, the *if*-clause enriches a presupposed modal base, MB, which introduces a doxastic perspective, $\odot_{i,j}^{episMB} = \langle d_i, e_j^{episMB} \rangle$, d_i the anchor of the epistemic modality, e_j^{episMB} the arbitrary eventuality where $\cap MB$ is true. The *if*-clause introduces a modified perspective: the same anchoring agent, a new arbitrary eventuality, where the *if*-clause is true as well as $\cap MB$: $\odot_{i,j}^{if} = \langle d_i, e_j^{episMB+if} \rangle$.

When the scope of the operator triggering introduction of some \odot is closed, \odot itself is removed from \odot_D . There is no other way to introduce discourse centers to \odot_D in English.

The salient discourse centers at a given time in discourse serve to anchor a wide range perspective-sensitive expressions, including *inter alia*: indexicals & shifting indexicals (Roberts 2014), deictic motion verbs (Barlew 2017), epistemic modals (Roberts in press), and, as we will soon see, auxiliary content.

2.2 Dynamically updated context feeds contextualized LF:

The **context updates highlighted in blue** in Figure 3 are modeled after the way that the CCPs of particular constructions in Heim (1982, 1983) dynamically update context. As in Heim, these updates enable donkey anaphora and presupposition filtering. The updates are simplified here for ease of exposition, initially considering only the way in which CS_D is updated, with CS treated as in Heim (1982) as a set of world/assignment pairs:

$$CS_K = \{ \langle w, g \rangle : \text{all the familiar discourse referents are assigned values by } g \text{ in } w \text{ that are consistent with the information interlocutors share about them} \}$$

As in Kamp (1981) and Heim (1982):

- the **global context** of utterance K typically serves as the default local context of interpretation for simple clauses, the prejacent of a negated clause, the first conjunct of a conjunction, and the *if*-clause of a conditional.⁴

³ where \oplus is the join operator of Link (1983).

⁴ This is not the case for utterances in FID or involving modal subordination, but we’ll ignore those for now.

- When we add the content of an indicative clause S to context K , we intersect the proposition expressed by S in that context to yield a new context $K+S$.
- The update for negation yields the complement in the global context K of the result of interpreting the prejacent of negation in K , thus effectively removing any worlds from CS_K in which S is true while guaranteeing that any presuppositions triggered in S are satisfied in K .
- In both conjunction and the conditional, the second conjunct/consequent are interpreted with respect to a context that is the result of updating the global context K with the content of the first conjunct/antecedent. As in Heim/Kamp, the update with a conditional antecedent is merely provisional, so that the resulting updated context after the whole conditional has been interpreted *removes* worlds from K in which the antecedent is true but the consequent is false. But the update with the first conjunct of a conjunction is stable, persisting in the result of update with the whole conjunction.

Unlike in Heim (1982), what's dynamic in these update rules, e.g. the presupposition-satisfaction asymmetry in conjunction, is the way the *context* differs for different sub-constituents, not the semantic content of the constituents themselves. Notably, the semantics for *and* is classical and static, the resulting interpretation commutative, unlike in Heim (1982) or Groenendijk & Stokhof (1990). What's asymmetric is that the interpretation of the second conjunct takes the content of the first as part of its local context. We'll use these updates to derive donkey anaphora.

2.3 What's lexical CHARACTER and how does it feed interpretation?

Unlike Kaplan's Character, lexical CHARACTER as given at the top left of Figure 3 is intended to reflect the fact that a lexical entry may have quite a rich body of semantico-pragmatic content:

- Only semantic content directly feeds compositional semantics, in logical form.
- Presuppositions constrain contextual felicity, as in dynamic semantics. Indexicals crucially involve anaphoric presuppositions which must be locally satisfied—in English for *I* and *you*, by the actual speaker/addressee, but in shifting indexical languages possibly by other salient perspectival centers in discourse (Roberts 2014,2020).
- Auxiliary content directly feeds context update, as we'll see below. This is similar to the way that Potts (2005) models the contribution of auxiliary content to interpretation: His conventional implicatures contribute directly to information about the speaker's beliefs, without contributing to the proffered content of the utterance in which they are conventionally triggered. But on the present account, auxiliary content is instead anaphorically anchored to a salient, relevant discourse center, which needn't be the speaker.

2.4 Deriving donkey anaphora:

Contextualized LFs reflect the ways that sub-constituents of an utterance may contribute to the local context for interpretation of other sub-constituents, as given by the **update rules**. We can see how this accounts for the possibility of donkey anaphora via the contextualized LF for (1) in (1'), with the updated context for the main clause highlighted in yellow:

(1') $K[s_0 \text{ if } ^K[S_1 \text{ a farmer}_1 \text{ owns a donkey}_2 \text{ s}_1] \text{ }^{K+S_1}[s_2 \text{ he}_1 \text{ uses it}_2 \text{ to plow } s_2]]_{s_0}$

Here is how context revision is calculated in the interpretation of (1'), with resulting CS updates:

1. $K+(1) = K + [if [S_1]^K \text{ then } [S_2]^{K+S_1}]^K = K \setminus (K+\|S_1\|^K \setminus K+\|S_1\|^K+\|S_2\|^{K+S_1})$
2. $K+S_1$: update DR_K to add d_1, d_2 ; update CS_K to yield $CS_{K+S_1} = CS_K \cap \{ \langle w', g \rangle \mid g(d_1) \text{ is a farmer in } w', g(d_2) \text{ is a donkey in } w', g(d_1) \text{ owns } g(d_2) \text{ in } w' \}$
3. $K+\|S_1\|^K+\|S_2\|^{K+S_1}$: update CS_{K+S_1} to yield $CS_{K+S_1} \cap \{ \langle w', g \rangle \mid g(d_1) \text{ uses } g(d_2) \text{ to plow in } w' \} = \{ \langle w', g \rangle \text{ in } w' : g(d_1) \text{ is a farmer \& } g(d_2) \text{ is a donkey \& } g(d_1) \text{ owns } g(d_2) \& g(d_1) \text{ uses } g(d_2) \text{ to plow} \}$

Substituting 2 and 3 into 1 yields 4:

4. $K+(1) = CS_K \setminus (\{ \langle w', g \rangle \mid g(d_1) \text{ is a farmer in } w', g(d_2) \text{ is a donkey in } w', g(d_1) \text{ owns } g(d_2) \text{ in } w' \} \setminus \{ \langle w', g \rangle \text{ in } w' : g(d_1) \text{ is a farmer \& } g(d_2) \text{ is a donkey \& } g(d_1) \text{ owns } g(d_2) \& g(d_1) \text{ uses } g(d_2) \text{ to plow} \})$

In step 2, we see that not only is the CS updated with the content of S_1 , but per usual in Heim/Kamp and other dynamic semantic accounts, we update the set DR_K with new dRefs for the indefinites *a farmer*₁ and *a donkey*₂, d_1 and d_2

If CS_K is the set of all $\langle w, g \rangle$ pairs, the set of worlds that are first elements in $K+(1)$ is the proposition expressed, (1)'s proffered content: 'the set of worlds in which either no farmer owns a donkey, or there are farmers that own donkeys and they use the donkeys they own to plow'. Since S has no other context-sensitive elements, this is the proposition expressed in that context. If there is already shared information reflected in CS, so that the domain is globally restricted, this will just be *the set of worlds in the domain in which...* In any case, the result of that interpretation is added to the global context for the next utterance.

(5) is a donkey sentence involving anaphoric bridging:

(5) If $^K[S_1 \text{ a farmer}_1 \text{ owns a John Deere}_5 \text{ s}_1], \text{ }^{K+S_1}[s_2 \text{ he}_1 \text{ uses the tractor}_5 \text{ to plow } s_2]$.

In determining the local context for the main clause of (5), the need to retrieve an antecedent for the definite description *the tractor* drives an abductive inference based on world knowledge that *John Deere* is the brand-name of a famous tractor manufacturer, plus the assumption that the *if*-clause is relevant to the consequent: We infer that the arbitrary farmer owns a John Deere tractor, introducing a discourse referent d_5 with the information that d_5 is such a tractor. Updating K with S_1 plus this accommodated inference then makes directly available d_5 to serve as a weakly familiar antecedent for *the tractor* in S_2 .

3. Dynamic update with auxiliary content

Auxiliary content, contributed by appositive NPs, nonrestrictive relative clauses (NRRs), and a variety of other triggers (Potts 2005) makes no direct contribution to the proffered content of the utterance in which it occurs, but nonetheless it may have a truth conditional impact in a dynamic fashion, straightforwardly afforded by this architecture.

3.1 Properties of auxiliary content:

The first two properties of auxiliary contents were mentioned in §1, but others are also worth noting.

- i. Auxiliary content doesn't directly contribute to the proffered content of the clause in which it occurs at LF, as we saw in (7). (Potts 2005)
- ii. Auxiliary content cannot be bound by/bind semantic content, as we saw in (8). (Potts 2005)

On the basis of examples like (7) and (8), Potts concludes that auxiliary content does not take scope at LF; Schlenker (2013, 2021) offers apparent counter-evidence, but I think those examples can be understood to involve modal subordination rather than scope at LF.

- iii. Chierchia & McConnell-Ginet 2000) observed that although the auxiliary content of an NRR is projective, as displayed in the family of sentences test in (10), unlike presuppositions NRRs and appositives carry an anti-novelty implication, as we see in (11). Hence, auxiliary content is not presupposed:

- (10) a. Monty, who's from Kentucky, doesn't like corn grits.
b. Does Monty, who's from Kentucky, like corn grits?
c. If Monty, who's from Kentucky, likes corn grits, it isn't surprising.
d. It's false that Monte, who's from Kentucky, like corn grits.
(a) – (d) all commit the speaker to the truth of the proposition that Monte is from Kentucky.

- (11) Monte was born in Louisville, Kentucky.

...
#Monte, who's from Kentucky, loves corn grits.
#Monte, a Kentuckian, loves corn grits.

- iv. Auxiliary content can't by itself serve to make an utterance RELEVANT to the QUD, hence is not part of what is proffered by an utterance in which it occurs. (Amaral et al. 2007)

- (12) Chris: What are Harvey's bad habits?
Tom: #Harvey, a heavy smoker, is from Kentucky.

Together, properties (i) – (iv) support Potts' argument that the implications in question are neither semantic content nor presuppositions. But properties (v) and (vi) were not noted by Potts, and are crucial to the analysis I will propose:

- v. Auxiliary content is perspectival: anchored to a salient doxastic perspective, which (*pace* Potts) is not always that of the speaker (Amaral et al. 2007, Harris & Potts 2009). So in (7) the appositive is anchored to the speaker, but in (13) the NRR *who has an awful lot of legos*

is anchored to the arbitrary kid on the arbitrary play visit, and in (14) the appositives are both anchored to the agent of belief, Lois.

- (13) [The speaker is a child psychologist studying play activity, with young subjects.]
Whenever I play with kids₂ in a poorly equipped daycare center₃, they₂ clearly hope that this stranger₄, who has an awful lot of legos₅, will leave some of them₅ behind when she₄ goes.
- (14) a) Lois believes that Clark Kent, the milquetoast reporter, is attractive. (False)
b) Lois believes that Clark Kent, the superhero, is attractive. (True)
[Zsófia Zvolenszky, p.c., after Saul 1997]

vi. Auxiliary content may contribute indirectly to the truth conditional content of a clause not only via anaphoric dependencies, as in (9) and (13), but non-anaphorically, as in (14). In the latter, the appositives suggest the (contradictory) ways that the agent Lois views Clark Kent which lead her to conclude that he is or is not attractive.

3.2 The interpretive contribution of auxiliary content

Constituents that contribute auxiliary content do show up in LF, because they are part of the syntactic structure of the utterance in which they occur. Among other things, their interpretation depends on what they modify in that structure: The denotation of the NP modified by an appositive or NRR serves as argument of the auxiliary content contributed. But a constituent contributing auxiliary content is so-marked in some fashion. E.g., in English, appositives and NRRs are typically marked by pauses on either edge, a prosodic feature Potts (2005) called COMMA; Schlenker (2013) claims that French *lequel* is a relative pronoun that can only occur in NRRs. A constituent so-marked does not contribute to compositional semantics directly, but instead directly contributes to context-update, as follows:

The interpretive contribution of auxiliary content:

- Auxiliary content is presuppositionally anchored to an available discourse center © in ©_D.
- If accepted, it directly updates the contextually available information about the belief state of ©: DOX(©), where DOX is a function that takes a discourse center © = <a,e> and yields the belief state of *a* in the world and time at which *e* occurs.
- Auxiliary content makes no direct contribution to compositional semantics.

Unlike Potts' proposal, here the context to which the auxiliary content contributes may be non-global, when it is anchored not to the perspective of the speaker, but to that of some embedding agent, which may even be arbitrary as in (9), (10) and (14).

To see how this works, consider the following characterization of the COMMA feature. For simplicity, we'll ignore type-shifting COMMA, so that it applies, e.g., to nominal appositives, considering only COMMA_i with a relative clause complement. COMMA_i presupposes the familiar

denotation of the coindexed head NP_i to which the NRR is adjoined, then takes a type $\langle s, \langle e, t \rangle \rangle$ syntactic complement RC to yield a proposition:

CHARACTER of COMMA_i: type $\langle \langle s, \langle e, t \rangle \rangle, \langle s, t \rangle \rangle$

Given local context $K = \langle CS_K, DR_K, \odot_K \rangle$, world and time of interpretation w and t , and relative clause complement RC (type $\langle s, \langle e, t \rangle \rangle$), for all CS_K -consistent assignments g , $COMMA_i(RC)$ makes the following contributions to interpretation:

Presupposed content: $\exists d_i \in DRef_K$ ‘there’s a familiar dRef coindexed with NP_i ’

$\exists \odot = \langle d_k, e \rangle \in \odot_K$ ‘there’s a salient discourse center anchor \odot ’

Auxiliary content: $\forall w' \in DOX(\odot)[\|RC\|^{DOX(\odot)(w)}(w')(g(d_i)(w'))]$

‘in her perspective in e , the agent d_k believes that the denotation of d_i has the property denoted by RC’

$COMMA_i(RC)$ takes the proffered content of its RC complement, as interpreted in the belief worlds of the center agent, and applies that to the denotation of the NP_i it modifies, whose corresponding dRef d_i is presupposed to be familiar in the local context, yielding the auxiliary content, a proposition about d_i . Crucially, the result of modifying RC with $COMMA_i$ does not yield any semantic content, and so does not contribute to the compositional determination of the proffered content of the utterance in which the NRR occurs.

Then just as compositional semantic content is added to the CG/CS, so long as it is understood to be asserted and is not rejected by the addressee(s), the auxiliary content so calculated is by default directly added to the contextual information about the doxastic state of the anchoring agent in the anchoring event: updating $DOX(\langle d_k, e \rangle)$ in CS. Since auxiliary content is non-proffered, an addressee cannot reject it with a simple *yes/no, I agree*, etc. Instead, objections must be made with something like the *Hey, wait a minute!* used to reject non-proffered content generally, including presuppositions and conversational implicatures. In the absence of such rejection, auxiliary content in (13) updates local context, as follows:

(13') Contextualized LF of (13), \odot anchored to the arbitrary kids d_2 , updates highlighted:
 $K_{[S_0]}$ Whenever $[S_1]$ I play with kids $_2$ in $[a$ poorly-equipped-center $_3]$ S_1 $K+S_1$ $[S_2]$ they $_2$ hope
 $K+S_1+\odot^{hope}$ $[S_3]$ that $[NP_4]$ this stranger NP_4 $K+S_1+\odot^{hope}$ $[COMMA_4]$ who has $[a$ lot of legos $_5]$ $COMMA_4$
 $K+S_1+\odot^{hope}+COMMA_4$ $[VP_3]$ will leave some of them $_5$ when she $_4$ leaves $[VP_3]$ $s_3]$ $s_2]$ $s_0]$

At the outset in the global context of interpretation K for (13), as usual in non-FID contexts the set of discourse centers includes only the speaker and addressee at utterance time. In the restriction on *whenever*, S_1 introduces discourse referents e_1 for the arbitrary playing event and d_2 for the kids the speaker plays with in e_1 . Then, as usual in such constructions in dynamic semantics, the semantic content of S_1 is part of the context of interpretation for the nuclear scope S_2 , d_2 serving as antecedent for *they* and the event time of e_1 as the reference time for the clause—the kids are the agents of the hoping, which occurs during the speaker’s arbitrary visit. Under the scope of *hope*, the discourse center $\odot_{2,1}^{hope} = \langle d_2, e_1 \rangle$ (the hoping agent/kid in the play situation) is introduced to the set of discourse centers, yielding the context $K+S_1+\odot^{hope}$ for the interpretation of the complement clause, which includes the NRR consisting of $COMMA_4$ and the relative clause. The NRR is then anchored to \odot^{hope} , satisfying the anchoring presupposition of $COMMA_4$. The resulting auxiliary content doesn’t contribute directly to the semantic content of

the complement. Rather the auxiliary proposition ‘this stranger has a lot of legos’, along with a discourse referent d_5 for the legos, is added to $\text{DOX}(\langle d_2, e_1 \rangle)$ —the set of beliefs attributed to the arbitrary kid at the time of the visit—enriching the local context of interpretation for the remaining nuclear scope, VP_3 . The auxiliary content then provides the locally available antecedent d_5 for *them*. Since the end of S_0 is the limit of the scope of both *hope* and *whenever*, at that point the content of the material under their scopes is removed from the resulting context and the set of discourse centers is down-dated to remove C^{hope} . But the proposition calculated partly on the basis of that content is added to the global context of interpretation K: ‘whenever the speaker plays with kids in a poorly equipped center, the kids think that this stranger has a lot of legos and they hope that she will leave some of them when she leaves’.

So paraphrased, the appositive appears to take narrow scope relative to both *hope* and *whenever*. But in the derivation, the wide syntactic scope of *hope* only matters because it introduces the anchor C^{hope} . In turn, the agent of C^{hope} d_2 is introduced by *kids*₂, which itself takes narrow scope relative to *whenever*. Since the anchor is thus *arbitrary*, the auxiliary content is roofed by the scope of *hope*, as well as that of *whenever*, and so does not contribute to the global context. In other words, this apparent narrow scope need not be represented at LF, but is a reflection of merely local presupposition satisfaction for the anchor of the presupposed C .

One more point about (13): The subject embedded under *hope*, *this stranger*, is clearly intended to refer *de dicto* to the speaker from the perspective of the kids. I have proposed elsewhere (Roberts 2014) an account of nominal content and belief attribution based on Aloní (2001), wherein nominal content is always understood to reflect a guise of the intended denotatum from the perspective of a salient discourse center. Aloní argues that in examples involving the classic puzzles about belief attribution, we capture the intended interpretation via a pragmatic perspective-shifting operator \wp : Her \wp takes a variable (that associated with the referential index on an NP) and yields a conceptual cover, a method of individuating entities which yields, for the index in question, what we might call the relevant guise of the *res* denoted by the NP. Roberts (2014) modifies \wp to require that it be anchored to a salient discourse center; in (13), the anchor is the salient C^{hope} , the same arbitrary kid that anchors the auxiliary NRR. The result is that *this stranger* means something like ‘the individual who, from the perspective of the arbitrary kid during the visit, is the salient, present (because of the proximal presupposition of *this*) stranger in that circumstance’, thus yielding a *de dicto* description of the speaker in her role as visitor in that eventuality.

With no additional assumptions, we can explain the truth conditional effects of the appositives in (14):

- (14) a) Lois believes that Clark Kent₅, the milquetoast reporter, is attractive. (False)
 b) Lois believes that Clark Kent₅, the superhero, is attractive. (True)

[Zsófia Zvolenszky, p.c., after Saul 1997]

We take the appositives *the milquetoast reporter* and *the superhero* to be anchored to the agent of *believes*, Lois, and hence they contribute information to the context of utterance about Lois’ beliefs. Lois believes both that the denotation of the modified head, who we know by the name Clark Kent, is a milquetoast reporter—hence, a wimp—and that he’s a superhero—hence, strong

and brave. Since these are incompatible traits, we assume that these are guises which Lois attributes to the familiar Kent without realizing that both guises describe the same *res*. Her beliefs aren't irrational; they're just ill-informed (due to Kent's own misrepresentations in the Superman story). So the appositives suggest guises of Kent with respect to which Lois holds her opinions about his attractiveness. They offer explicit content for the guise given by Aloni's \wp in this case, which operates on the rigid designator *Clark Kent* to pragmatically yield the attested interpretations, in turn explaining the attested judgments of truth and falsity.

Again, this relativization of content to an available doxastic perspective is much more general than just the application described here to auxiliary content. I argue in Roberts (to appear) that epistemic modal operators are quite generally anchored to some doxastic perspective available in discourse, using discourse centers, as above. Hence, all the tools used in this analysis are independently motivated. The only innovation is the dynamic pragmatics itself and the treatment of auxiliary content as anchored to a discourse center and contributing to the local context of interpretation. Since Potts (2005) had already argued for the direct contribution of conventional implicatures to context update, this way of modeling their contribution is just a way of using independently motivated dynamic pragmatics to capture Potts' idea, while permitting the merely local anchoring he had incorrectly taken to be impossible.

Finally, consider (15):

- (15) [Background: In (a) – (c) the speaker is gossiping about a prominent community member named Lauren and her son Spenser. The speaker doesn't know Lauren personally, but they have several mutual friends. The interlocutors know that Spenser has a boyfriend named George.]
- a) Spenser seems poised to propose to George.
 - b) Most of her friends think that Lauren, who would enthusiastically approve, would be misguided in that endorsement: George is handsome and intelligent, but he isn't kind or loving.
 - c) I myself don't know George, but he certainly hasn't made many friends around here.

The meaning of (b):

'most of Lauren's friends believe that **if Spenser proposes**, Lauren would enthusiastically approve **of the proposal**; and they think that **if Spencer proposes and Lauren approves** Lauren would be misguided in her endorsement **of the proposal**. **They believe this because they believe that** though George is handsome and intelligent, he is neither kind nor loving'

The highlighted elements in this paraphrase are not explicitly given in (b), but inferred as discussed below.

There are several notable features of this interpretation of (15b).

- i. The most likely understood anchor of the NRR *who would enthusiastically approve* is the arbitrary friend of Lauren; Lauren herself is understood not to know the principals well enough to know how Lauren would react.
- ii. The NRR contains an elided complement of *approves*, which must be retrieved from context; it also contains auxiliary *would* which requires domain restriction. If we take

would to be modally subordinate to the possible proposal from (a): ‘if Spenser proposed to George’, this supplies a plausible value for the ellipsis: ‘approve of the proposal’. In turn this implicates that the speaker believes that most of Lauren’s friends know of the possible pending proposal.

- iii. In the main clause, *would* is understood to be modally subordinate to the content of the NRR, and hence in turn to the possible proposal in (a): ‘if Spenser proposes and Lauren enthusiastically approves’. Then in the complement of the main verb *think*, the antecedent of *that endorsement* is ‘Lauren’s enthusiastic approval of the proposal’ from the modally subordinate NRR, so that an anaphoric presupposition in the main clause is satisfied by the content of the NRR. Thus, taking main clause *would* to be modally subordinate to the NRR both makes the NRR relevant to the main, proffered content, and also offers an antecedent for the descriptively abridged definite description.
- iv. Finally, the second sentence in (b) is understood as (i) an opinion of the arbitrary member of the group composed of those of Lauren’s friends who disapprove of Spenser proposing to George, and (ii) rhetorically, an explanation for the disapproval: ‘they say that he is handsome...’. On this interpretation, the speaker isn’t committed to the truth of this assessment of George, permitting consistency with the first clause of (c).

Hence, this complex but readily comprehensible example involves (i) anchoring NRR content to an arbitrary agent under quantification, (ii) the modal subordination of the NRR to the irrealis content of the prior utterance (a), in turn licensing anaphora resolution in the NRR, (iii) modal subordination of the main clause *would* to the NRR, in turn licensing anaphora resolution in the main clause, and (iv) an FID-like extension of the arbitrary friend’s perspective on the matter to the second sentence, so that the speaker isn’t committed to its truth in the actual world. Hence, the global perspective in (15) is that of the speaker, but in (b), both under the scope of *most of her friends* and in the FID-like continuation, the reported perspective is that of the arbitrary friend of Lauren, both modally subordinate to the possible proposal and with all the resulting auxiliary content dynamically contributing to information about that perspective. This kind of example offers strong support for the claim that context update via both proffered semantic content and auxiliary content is dynamic, taking place rapidly in real time as the utterance is processed, and that this update crucially involves the update of salient perspectives..

4. Conclusions

4.1 Logical form, Discourse Representations, and Kamp & Reyle’s (1993) logic of DRSEs

The remarks above were prepared for the annual lecture in honor of the Dutch logician Evert W. Beth. But in response, my colleague Frank Veltman asked: Where’s the logic?

There are two prongs to my response:

First, like Grice (1967) I am concerned that we not develop overly-complicated logical forms for linguistic expressions when the attested complications arguably arise not from their semantic content, but from the ways in which they are used in discourse. No one who studies natural language semantics doubts the importance of context in the determination of what is meant. But

not all would agree about what constitutes a context of interpretation, about what what kinds of contextual information are needed to model how natural language is actually interpreted. I have argued here (and elsewhere) that in order to capture the complex ways in which context comes to bear on interpretation, it should contain more than the classical assignment functions, common ground, and indexical values; there is now a growing body of empirical (including experimental) evidence that interlocutors also track the QUD, the evident goals and intentions to which they are committed, and the salient doxastic perspectives under discussion. In addition, here I have added new empirical support for the thesis that the interaction between compositional interpretation and discourse context is dynamic. But I have argued that instead of changing the semantics of the expressions interpreted—their contributions to logical form—it is preferable to change our understanding of the way that compositional interpretation draws on contextual information. In the human interpretation of sensory input generally, we find a general cognitive strategy of using parallel bottom-up parsing of input sensory data with top-down contextual input—driven by expectations based on intention-recognition—to yield rapid, accurate interpretation. I contend that only when we recognize how this more general cognitive strategy for interpretation is realized in the interpretation of linguistic expressions can the true logical form of the expressions themselves shine forth, elegant and simple.

But back to Frank’s question: We do still need to understand how in this interpretive process logical constraints are brought to bear on contextual factors in real time. And here, fortunately, I think we can address this question without re-inventing the wheel. Just as the update rules in Figure 3 replicate Heim’s (1983) rules for context update in dynamic semantics, so we can use Discourse Representation Theory as a representation of contexts, relying on the proof theory for DRSEs worked out by Kamp & Reyle (1993, 1996) to explain attested inferences and logical constraints.

Of course, the DRS construction rules in Kamp & Reyle (1993) are written as rules for directly translating syntactic phrase structure trees into DRS interpretations. But I see no reason why one could not instead take DRSEs to represent contexts of the sort proposed above, dynamically updated with the output of a static, rule-by-rule compositional semantics. Classical DRT already contains both discourse referents and conditions, and the latter are used by many authors (e.g. Roberts, 1989, Kadmon 2001) to represent the content of the interlocutors’ Common Ground. Roberts (1989) worked out an intensional DRT along those lines for modal subordination; other intensional versions have been proposed by Asher (1986) and Maier (2010, 2016). Adding discourse centers to an intensional DRS along those lines would be no more complex than Partee’s (1984) addition to DRT of Reference Times and rules for their update/downdate. To add the QUD to such a context would require elaboration of the classical DRTs, but the work on dynamic inquisitive semantics (Dotlačil & Roelofsen 2019) should prove useful there.

On this way of representing contexts, the static semantics would work off of Logical Forms that are contextualized to draw from DRS “contexts”—both global and local (sub-DRSEs under operators)—leading to updated contexts that feed other sub-constituents and subsequent utterances. And the addition of non-linguistically given content to a DRS can be appropriately constrained by pragmatic principles, including those for relevance (Roberts 1996), coherence (e.g., Asher & Lascarides, Roberts 2016), and, of course, consistency. Then for the last, and for drawing pragmatic inferences, we can rely on the Kamp & Reyle (1993, 1996) proof theory.

Of course, all this would have to be worked out in detail. But I see no reason not to build on the work in DRT to answer Veltman's question.

4.2 Summary and prospects

In this essay, we reviewed several challenges to earlier views of the semantics/pragmatics interface:

- intrusive Phase 1 phenomena: donkey anaphora, shifting indexicals
- intrusive Phase 2 phenomena: donkey bridging, modal subordination, intrusive implicature
- intrusive auxiliary content: dynamic contextual-dependence (both phase 1 and 2) between non-proffered, auxiliary content and the output of the semantic composition of proffered content, as in (15).

These challenges are met by a view of the semantics-pragmatics interface which involves:

- (a) a rich notion of a context of interpretation, tracking the kinds of information shown to have a consistent contextual influence on interpretation;
- (b) rules for the evolution of context across an utterance, operating (comparably to the parallel architecture in vision competence) on simultaneous processes:
 - bottom-up dynamic input from the grammar: compositional semantic output for sub-constituents of the utterance in question; and
 - top-down constraints and affordances from linguistic mechanisms designed to yield in run time the effect of abductive application of rationally motivated principles and constraints, without actually involving inferential processes, e.g.:
 - inattentional blindness (Simons & Chabris 1999) resulting from focus on the QUD/task structure of discourse yields
 - a metric for relevance (Roberts 1996/2012), a constraint yielding implicature
 - salience (Roberts 2016, drawing on Polanyi 1985), inducing restriction of domains for reference, anaphora resolution and quantification
 - the determination of modal and imperative flavor (Roberts 1989, 2018, 2023, to appear; Moss 2015)
 - contrastive prosodic cues (themselves related to the QUD, hence universally serving as clues to task, Roberts 1998) give rise to referential expectations, scalar implicatures (Rooth 1992), etc.: a structural mechanism reinforced by Relevance to the QUD
 - constraints on the relationship between QUD and G, to yield imperative flavor and the deontic implications of directives (Portner 2004, Roberts 2018)
 - lexical priming and spreading lexical associations triggered by lexical content (Simons & Danks 2020), which contribute to word recognition, disambiguation, bridging (donkey bridging being the utterance-internal version), and enrichment implicatures

This approach allows for the simplification and/or explanation of features of interpretation elsewhere treated as syntactically unmotivated principles of the grammar. For example:

- We can derive Heim’s Maximize Presupposition as a requirement to maximize cohesion across moves. Constraints on rhetorical relations can similarly be seen to characterize well-formed, maximally cohesive strategies of inquiry in the QUD (Roberts 2016).
- Some features commonly included in LF are arguably redundant and/or empirically inadequate e.g.: Hacquard’s (2010) binding of epistemic modal auxiliaries (as argued by Roberts, to appear), Chierchia’s (2004) use of a tacit operator EXH to generate intrusive scalar implicatures, Schlenker’s (2013, 2021) scope of NRRs at LF, etc.

Thus, the account tightly constrains context update/downdate in the course of interpretation, avoiding the over-generation associated with free pragmatic enrichment (Sperber & Wilson 1986, Recanati 2004, 2010). Linguistic pragmatics is an interface between grammatically given content and higher cognitive function, specifically designed for that linguistic purpose (e.g., as evident in the reflection of the QUD in prosodic focus), but is not itself a part of the grammar (*pace* Lepore & Stone 2015, Stojnić 2021).

This evidence argues, *pace* K. Lewis (2017) *inter alia*, that linguistic competence consists not just of knowledge of grammar—phonology, syntax, compositional semantics—and its realization in a given language, but also crucially includes the capacity to wield and update a specifically linguistic context in the course of interpretation.

Like UG, formal pragmatics so-conceived is a theory of competence, not performance:

- There are many ways the mind might store the kinds of information that we seem to track in order to interpret quickly and efficiently. The scoreboard is just an abstract characterization of certain kinds of information that we arguably need ready access to and track in the course of interpretation.
- There are many ways that the posited pragmatic constraints might be realized in an actual implementation, including statistically or in a connectionist system. The constraints in pragmatic theory just tell us what such an implementation must *do* in order to realize this competence.

Finally, we have taken Bar Hillel’s warning seriously: The pragmatics proposed here is not a wastebasket. Rather, we have been at pains to argue that the contents of a context of interpretation are organized in very specific ways that serve to constrain and facilitate rapid retrieval of the speaker’s reasonably intended meaning. Insofar as this approach has empirical substance, as I have argued above, then we are indeed embarked on the explication of the role of context in interpretation.

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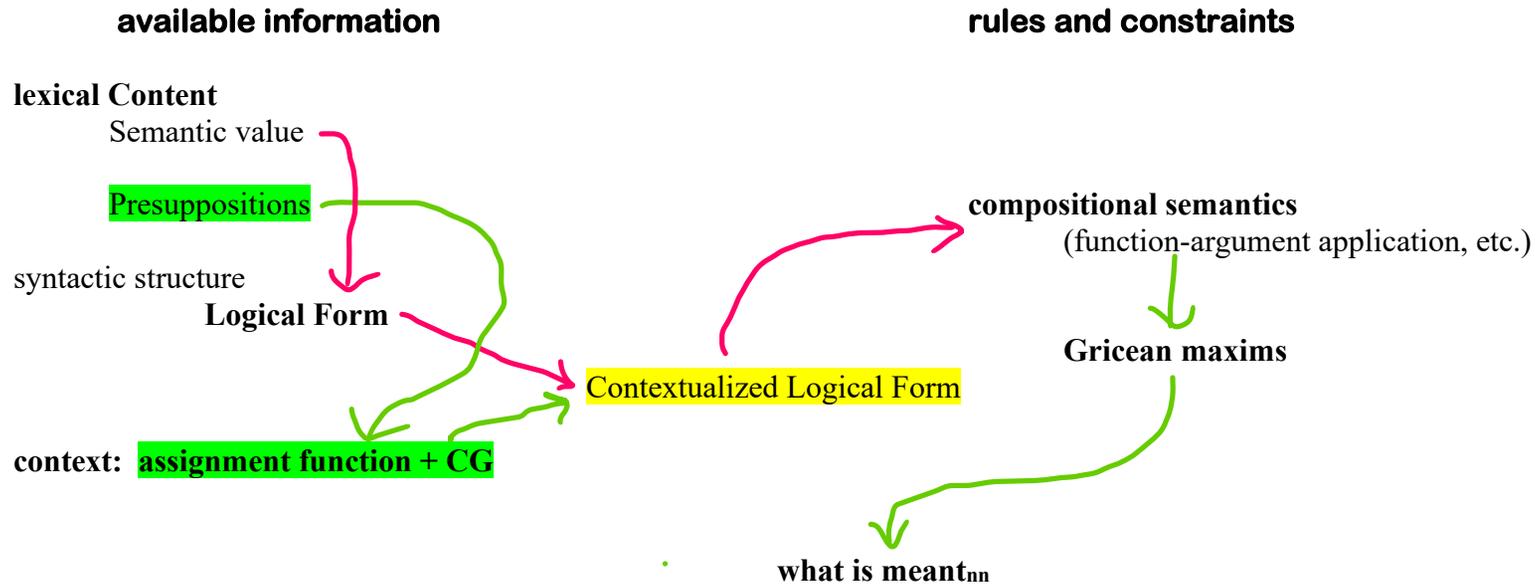
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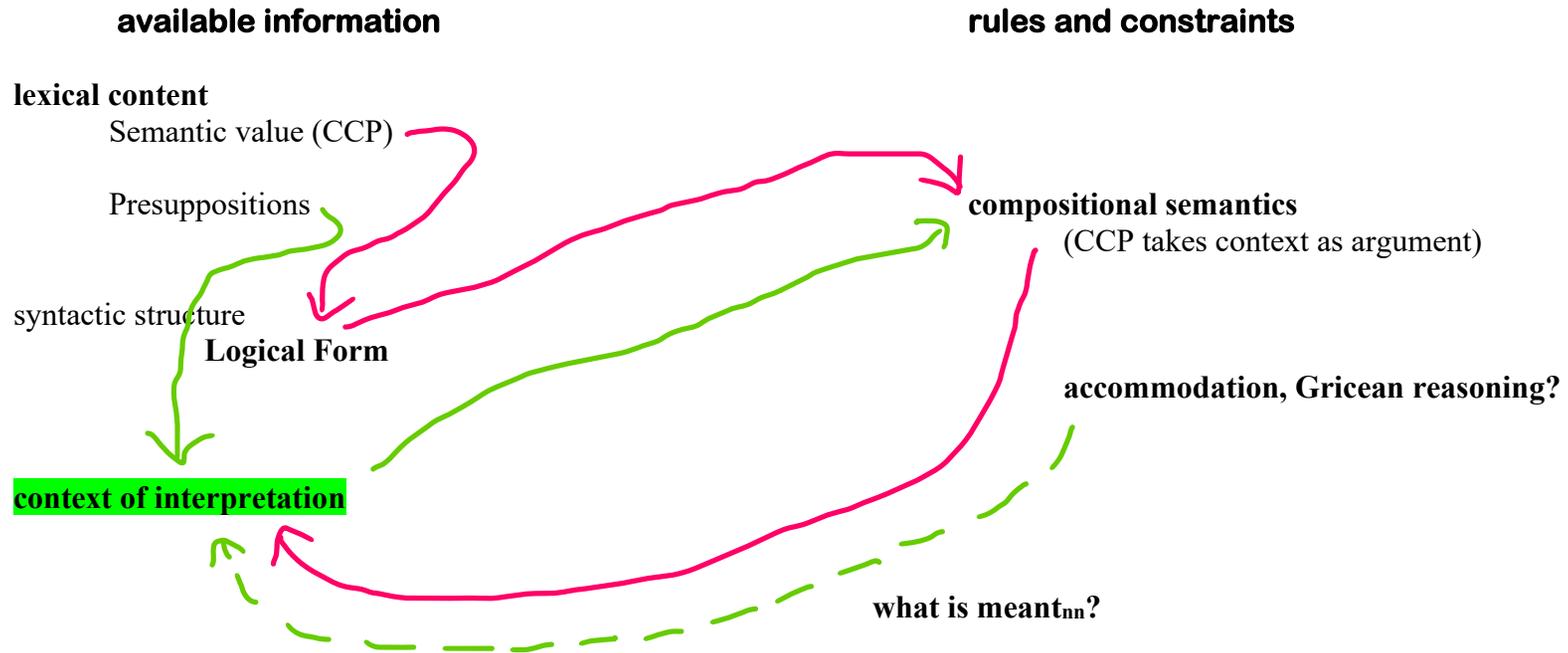
Figure 1: Heim & Kratzer static **Semantics** and **Pragmatics**



Presuppositions act as constraints on contextual felicity: Given an indexed definite NP_i, $g(x_i)$ must satisfy any presuppositions triggered by NP_i, e.g. its grammatical gender, number, etc. must be in accord with $g(x_i)$. H&K do not discuss, but following Heim (1983) they presumably intend a globally accessible Common Ground as part of the context of utterance, e.g. for satisfaction of the presuppositions of factives, etc.

Contextualized LF: syntactically given (static) LF annotated with a partial assignment function. Utterance felicity requires that the values of anaphoric triggers satisfy any presuppositions associated with the trigger (e.g. grammatical gender).

Figure 2: Dynamic **Semantics** (Kamp, Heim, Muskens)



context: a dynamically updated Discourse Representation K or File F

$K = \langle DRef, Conds \rangle$

$F = \langle \text{set of dRefs, set of world/assignment pairs} \rangle$

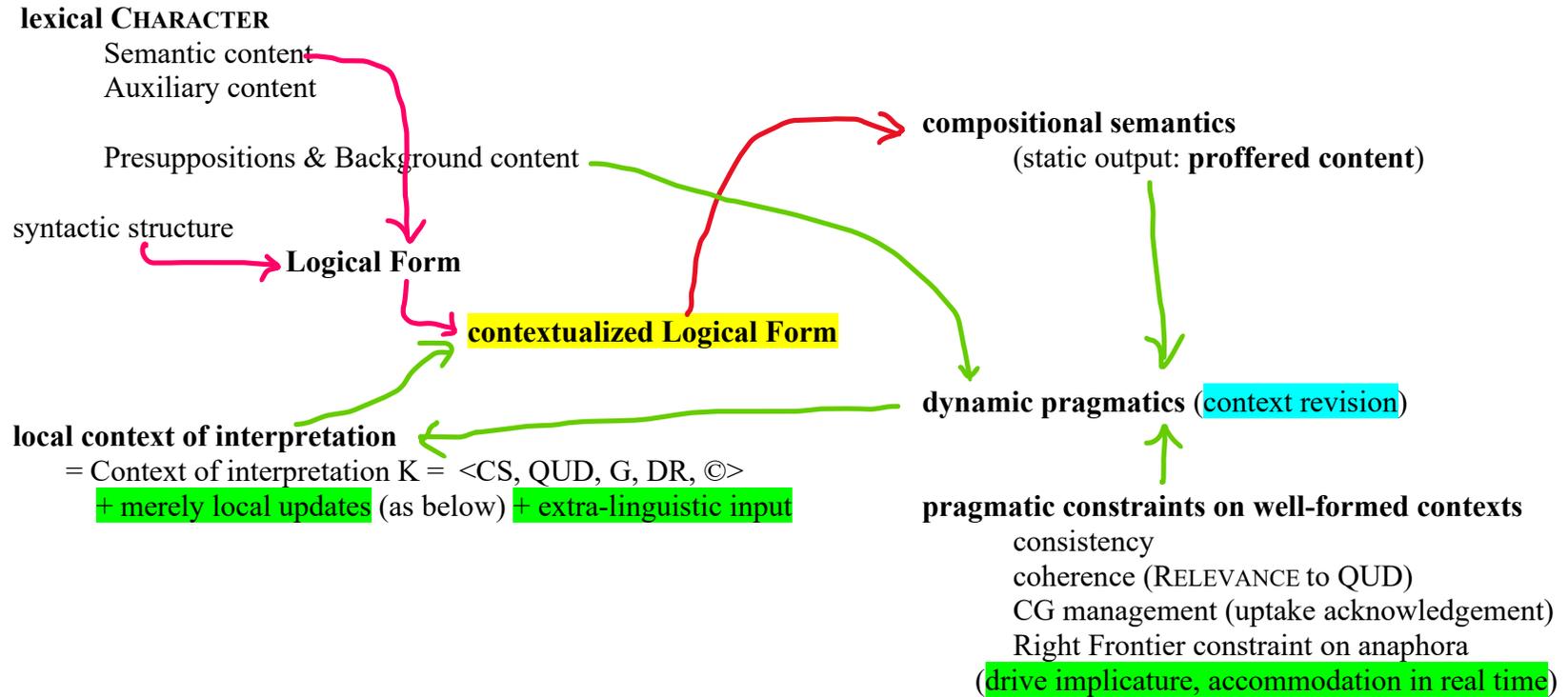
Pro:

- Context is no longer arbitrary: updated as a function of what is said, the CCP of prior content (full and partial utterances)

Con:

- Context contains some non-linguistically given information, but the theory makes no allowance for non-CCP update. E.g. for modal subordination and other contextually given domain restriction, intrusive implicatures, and intrusive Conventional Implicatures (coming up).
- Assumption that output of an indicative sentence is inconsistent with Speech Act theory.

Figure 3: The Architecture of Interpretation: dynamic Pragmatics

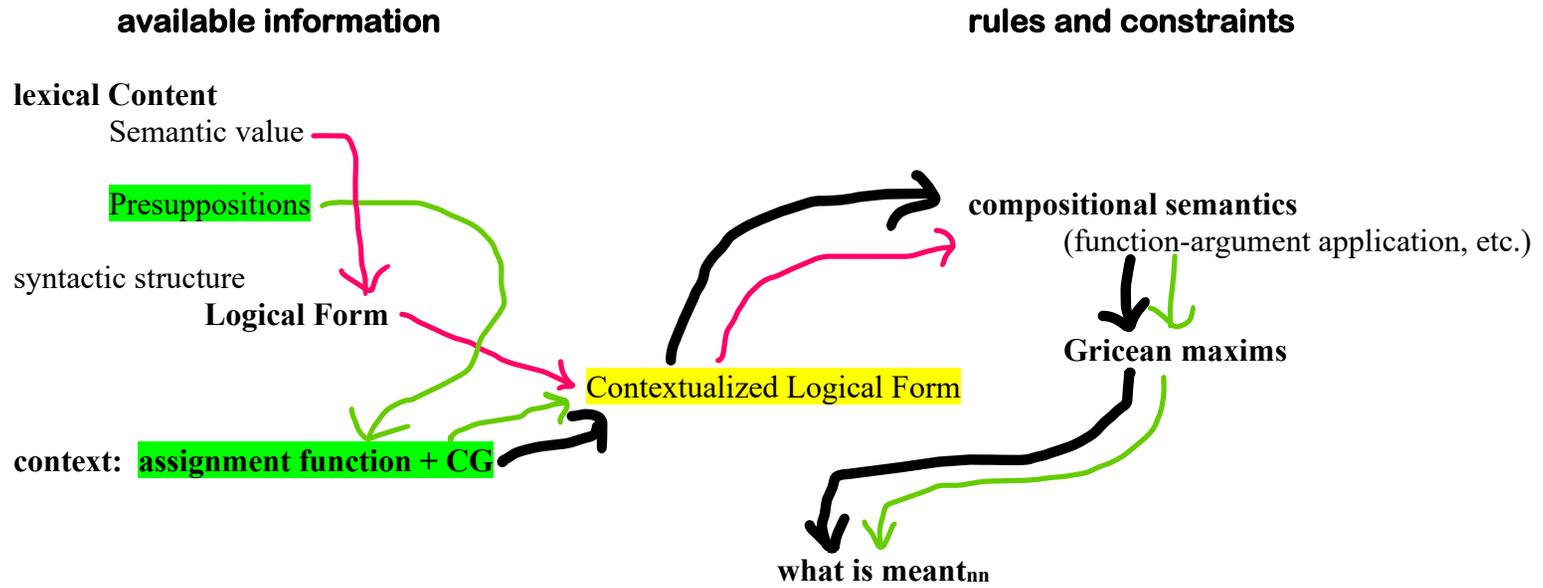


Contextualized LFs: syntactically given (static) LFs annotated with the pragmatically given contexts of interpretation for their parts. For simple declarative S, given a local context of interpretation K, we update CS_K as follows

Heim's (1983) **CS updates** follow from the contextualized LFs + semantics of any functors:

$$\begin{aligned}
 &S^K && K + S^K \text{ updates } K \text{ with proffered } \|[S]^K\|, \text{ so updated } CS_{K+S} = CS_K \cap \|[S]^K\| \\
 &[\text{not } [S]^K]^K && K + [\text{not } [S]^K]^K = K \setminus K + \|[S]^K\| \\
 &[[S_1]^K \text{ and } [S_2]^{K+S_1}]^K && K + [[S_1]^K \text{ and } [S_2]^{K+S_1}]^K = (K + \|[S_1]^K\|) + \|[S_2]^{K+S_1}\|, \text{ so } CS_K \cap \|[S_1]^K\| \cap \|[S_2]^{K+S_1}\| \\
 &[\text{if } [S_1]^K \text{ then } [S_2]^{K+S_1}]^K && K + [\text{if } [S_1]^K \text{ then } [S_2]^{K+S_1}]^K = K \setminus (K + \|[S_1]^K\| \setminus K + \|[S_1]^K\| + \|[S_2]^{K+S_1}\|)
 \end{aligned}$$

Figure 1b: Heim & Kratzer static **Semantics** and **Pragmatics**



The Flow of Contextual Information



Figure 2b: Dynamic **Semantics** (Kamp, Heim, Muskens)

