Symmetric and Interacting Alternatives for Implicature and Accommodation*

Raj Singh, singhr@mit.edu

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1 Introduction

- this paper begins by trying to address the well-known proviso problem (Section 3): Why, when we hear two sentences that carry the same presupposition, do we sometimes accommodate different propositions?
- the intuition that I try to follow here for dealing with the proviso problem is that, at some level, the problem is identical to one that has been studied in the theory of implicature
- it is fairly standard to assume that implicatures are computed with respect to a candidate set $\mathcal{N}$ of potential implicatures (eg. Horn [39])
- these potential implicatures are derived from the so-called scalar alternatives of the asserted sentence
- the puzzle in this domain is: given a set of potential implicatures, what are the principles that determine which of these potential implicatures become actual? (Gazdar [28], Sauerland [62], Fox [22])
- I discuss the above approaches to addressing this problem in Section 4, and argue that the more recent suggestions of Sauerland [62] and Fox [22] are better predictors than Gazdar's of which potential implicatures become actual
- the key insight offered by these proposals is that candidate sets sometimes possess a certain logical property ('symmetry' among candidates, in a sense to be discussed in Section 4) that prevent potential implicatures from becoming actual

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- very roughy, two candidates are *symmetric* if they can't both be consistently negated as part of the implicature computation – the general result is that symmetric alternatives can not become actual implicatures

- after discussing this idea, I show (in Section 4.3) that it leads (straightaway) into an overgeneration problem: it predicts more actual implicatures than are actually attested

- taking these two puzzles as my starting point (the proviso problem, and overgeneration of implicatures in symmetry-based systems), in Section 5 I will argue that despite the well-known shortcomings of Gazdar's proposal, the key insight of his proposal (that implicature and presuppositional reasoning happens 'together', in some sense) is correct

- I will adopt this insight, but the details of my proposal differ from Gazdar's in several ways: (i) I assume that there is a projection component delivered by the grammar (eg. Karttunen and Peters [43], Heim [34], Schlenker [65]), (ii) Meaning *enrichments* (implicature and accommodation) are computed together, as part of one system (not projection and implicature), (iii) The algorithm that's used for computing enrichments is a symmetry based one (Sauerland [62], Fox [22]), (iv) The interaction between the implicature domain and the presuppositional domain is *bidirectional* (not unidirectional, as in Gazdar's proposal)

- more specifically, I will argue that, like scalar implicature, presupposition accommodation is made with respect to a set of candidates generated using formal principles (contra the standard view, eg. Beaver [1], Beaver and Zeevat [5], Heim [38], Thomason et al. [78], von Fintel [15])

- this candidate set, $\mathcal{H}$, will be argued to be derived from the same objects that give rise to $\mathcal{N}$ (the candidate set of implicatures), namely, the scalar alternatives of the asserted sentence

- moreover, I will argue that symmetry also determines which candidate accommodations become actual accommodations

- this raises a choice point: is symmetry computed for these sets along separate dimensions, or do they interact?

- I will argue that our two motivating puzzles can be solved only if the sets interact: the input to the symmetry-mechanism is the *union* of $\mathcal{N}$ and $\mathcal{H}$

- in effect, candidate implicatures and candidate accommodations are allowed to create symmetry problems for each other, wiping each other out (in Gazdar's proposal, potential implicatures can cancel potential presuppositions, but not the other way around)

- I will argue that this bidirectional interaction is the key to solving our motivating puzzles

- Sections 6-8 turn to some further consequences of our proposal

- Section 6 examines some mechanisms for breaking symmetry among candidate enrichments

- in Section 6.1 I look at the effect of universal operators (eg. *every*, *require*), which are known to break symmetry in $\mathcal{N}$ (eg. Fox and Hackl [24], Fox [22]), and show the their capacity to break symmetry actually comes apart in interesting ways that are predicted by our proposal concerning interacting alternatives

- more specifically, we will see that in certain cases where our system predicts symmetry between candidates in $\mathcal{N}$ and $\mathcal{H}$, *require* can break this symmetry, while *every* cannot, due to their differences in projection behaviour

- it is not clear (to me) how these facts could be captured without a system of interacting alternatives

- in Section 6.2 I turn to the relation between symmetry and relevance

- it has been argued (eg. Kroch [50], von Fintel and Heim [16], Fox [20], Katzir [46], Fox and Katzir [25]) that *formally* defined scalar alternatives can break symmetry among a contextually given set of relevant alternatives

- in Section 6.2, I (tentatively) propose that the converse also holds: a contextually given set of relevant alternatives can sometimes break symmetry that is generated by the set of formally defined alternatives

- in Section 7, I discuss a potentially fatal consequence of the system: we predict, contra common ground theories of presupposition (eg. Karttunen [42], Stalnaker [77], Heim [34], Beaver [1], Schlenker [65]) that presupposition accommodation (of a proposition stronger than the projected presupposition, as in standard cases of the proviso problem) should be possible even when the asserted sentence's presuppositions are satisfied by the context

- I will discuss, in this context, data from Katzir and Singh [47] that argues precisely for the need to allow accommodation to take place under such conditions

- if those arguments are correct, our prediction might not be as fatal as it appears to be

- in Section 8, I argue that the system developed here allows us to derive Heim's *Maximize Presupposition!*, contra arguments that the principle needs to be stated as primitive (Heim [36], Percus [54], Magri [53], Sauerland [63])

- as we will see, two assumptions are necessary for the derivation to succeed: (i) the assumption (already part of our system) that candidates for implicature and accommodation interact, (ii) the additional assumption that the procedure responsible for implicature and accommodation operates within a system encapsulated from contextual information, with access only to logical and structural properties of the sentence and its scalar alternatives

- if my arguments are correct, they call for a revision of various assumptions concerning the nature of implicature computation, accommodation, and their interaction

- specifically, they argue for a view under which implicatures and presuppositions share much more in common than standardly thought (cf. especially Chemla [9, 8])

- the paper might also have consequences for the organization of language and mind more broadly
- specifically, the paper argues for a view under which these seemingly pragmatic inferences are computed by a mechanical system that has no access to the system(s) responsible for rational inference and action, i.e. the inferences form part of semantic competence, not pragmatic competence
- an agent that acquires English, and knows nothing else about the world, should (under the view developed here) be capable of performing these inferences

2 Presupposition Projection and Accommodation

- there seems to be a distinguished component to the meaning of certain sentences, namely, a presuppositional component
- very roughly, there are two properties of interest, one grammatical, and one pragmatic
- the grammatical property is known as 'projection'

1. (a) John is from Paris $\Rightarrow$ John is from France
   (b) John isn't from Paris $\not\Rightarrow$ John is from France
   (c) Is John from Paris? $\not\Rightarrow$ John is from France
2. (a) It stopped raining $\Rightarrow$ It was raining
   (b) It hasn't stopped raining $\Rightarrow$ It was raining
   (c) Has it stopped raining? $\Rightarrow$ It was raining
3. (a) John's sister will pick him up from the airport $\Rightarrow$ John has a sister
   (b) John's sister won't pick him up from the airport $\Rightarrow$ John has a sister
   (c) Will John's sister pick him up from the airport? $\Rightarrow$ John has a sister

- those entailments of a sentence that survive embedding under operators like negation and questions are the presuppositions of that sentence
- eg. (3a) presupposes that John has a sister, but (1a) does not presuppose that John is from France (it only entails it)
- we can use this as a definitional property of presuppositions

Presupposition If ϕ entails p, p is a presupposition of ϕ iff $\neg\phi$ also entails p. When ϕ presupposes p, we will notate this as ϕ_p.

- it is NOT generally true that p follows from $Op(\phi_p)$ for arbitrary embeddings of ϕ_p

4. (a) If John has a sister, his sister will pick him up from the airport $\not\Rightarrow$ John has a sister
(b) Either John has no siblings or his sister will pick us up from the airport $\not\Rightarrow$ John has a sister
(c) Is it true that John has a sister and that his sister will pick us up from the airport? $\not\Rightarrow$ John has a sister

Projection Problem for Presuppositions Provide a procedure for determining the presuppositions of a complex sentence based on the presuppositions of its parts

- standard assumption since Karttunen [41]: there is a system of grammar responsible for providing a solution to the projection problem, hopefully related in some law-like way to that semantic component that assigns standard truth-conditional content to sentences
- assumption: the grammar encodes a projection function, π, which assigns a presupposition to arbitrarily complex sentences
- this is the grammatical property of interest: presupposition projection, and much of the work in presupposition has contributed to understanding the rules of projection, and their relation to truth-conditional content, on the one hand, and maxims of language use, on the other
- as for the latter, these are given in something like the following assertability constraint, connecting the semantics of presupposition to their use in context

Assertability Constraint If $\pi(\phi) = p$, then use of ϕ in c is felicitous only if c entails p.

- evidence in favour of the intuition comes from a certain diagnostic test due to Shanon [69] and von Fintel [14], the so-called *Hey wait a minute! Test*

***Hey wait a minute!* Test** If the speaker used sentence ϕ_p in a context that doesn't entail p, the hearer may object, *Hey wait a minute! I didn't know that p!*[1]

5. S: It stopped raining.
H: # Hey wait a minute! I didn't know it stopped raining!
H: Hey wait a minute! I didn't know it was raining!

6. S: Will John's sister pick him up from the airport?
H: Hey wait a minute! I didn't know John has a sister!

- Problem: I can quite easily get away with using ϕ_p in c even when it is not taken for granted that p

7. I'm sorry I'm late. I had to pick up my sister from the airport.

- you could, of course, all stand up in unison and object, *Hey wait a minute! I didn't know you have a sister!*

[1] In my dissertation I discuss cases that prevent this from turning into an 'if and only if' statement. As far as I can tell, that discussion does not bear on anything to be said here.

- a more likely response is to just sit quiet, and, so long as nothing is at stake, just accept that I have a sister and move on

- this process of accepting the presupposition 'quietly, and without fuss' (von Fintel [15]) is the process of presupposition accommodation[2]

- if one's interlocutor has used ϕ_p in a context not entailing p, one can ask, why did they do that? assuming they are cooperative, and are not misleading, since p is uncontroversial, they must want me to amend c to some context c' that does entail p, so I should just do that, rather than object

- thus, when faced with a potential presupposition failure, the hearer has two discourse moves available to her: (a) Object with a HWAM! for having to accommodate, or (b) Accommodate

- this gives rise to the following picture of the interaction between semantics and pragmatics

Presupposition Projection and Accommodation The grammar encodes a projection function, π, that assigns to any sentence ϕ a presupposition p. If ϕ_p is used in a context c that doesn't entail p, a pragmatic process of presupposition may kick in to amend c to a richer context c' that does entail p.

3 The Proviso Problem

- recall from (4a) that 'if ϕ, then ψ_p' does not always inherit the presupposition that p, i.e. π(if ϕ, then $\psi_p) \neq p$

- but then what is the presupposition of conditional sentences?

- standard answer:[3] π(if ϕ, then $\psi_p) = \phi \rightarrow p$

- but if that's so, then what are we to make of sentences like the following? (Gazdar [28], Geurts [30, 31])

8. If John flies to Toronto, his sister will pick him up from the airport

- the standard theories predict that sentence (8) presupposes that if John flies to Toronto, he has a sister

- but this seems unnecessarily weak

- there is a strong intuition that the sentence presupposes something stronger, namely, that John has a sister whether or not he flies to Toronto

- indeed, the HWAMT meshes well with this intuition

[2]cf. Karttunen [42], Stalnaker [77], Lewis [51], Heim [34] for the first important discussions of accommodation.

[3]cf. Karttunen [41, 42], Stalnaker [77], Karttunen and Peters [43], Peters [56], Heim [34], Beaver [1], Beaver and Krahmer [4], Schlenker [65, 67, 66], Chemla [9], Fox [21, 23], George [29]. For dissenting predictions, see Gazdar [28], van der Sandt [61], Geurts [31]. For overviews, see Soames [76], Heim [35], Beaver [1].

9. S: If John flies to Toronto, his sister will pick him up from the airport
   H: Hey wait a minute! I didn't know John has a sister!

- Standard Response:[4] There is no problem here.
- recall our architecture from Section 2: the projection component need not be troubled by facts like (8), so long as it coupled with a pragmatic system responsible for deciding what to accommodate[5]
- note that for this to work, accommodation cannot be trivial, in that if you need to accommodate in response to ϕ_p, it is not true in general that you simply accommodate p
- in accommodating, you ask yourself: is it more likely that the speaker wants me to move to a context that entails $\phi \rightarrow p$ while leaving open the question of whether John has a sister, or that she wants me to move to a context in which we close off that question as well?
- not a question for logic or grammar – but whatever it is that guides our beliefs about other people's beliefs, intentions, etc.
- note that this is not yet a predictive theory, but it provides an escape hatch – this is not the linguist's headache, but the psychologist's, or the computer scientist's, or whoever else might know how common sense, abductive reasoning works
- given various difficulties with the prospect of formalizing this reasoning (eg. Fodor [17, 18]), it has been standard (in linguistics) to just black-box out the functioning of this system
- say there is some (yet to be understood) function, R, which, given the semantic presupposition of the sentence, $\pi(\phi)$, and contextual information c, converges on a proposition to accommodate, q, i.e. $R(\pi(\phi), c) = q$
- problem (Geurts [30]): we can create pairs of sentences both of which have the same semantic presupposition, but which give rise to different accommodated presuppositions

10. Mary knows that if John flies to Toronto, he has a sister

- by standard theories of projection out of knowledge attributions (eg. Karttunen [41, 42]), *know* presupposes its complement
- thus, (10) presupposes that if John flies to Toronto, he has a sister
- this is the same presupposition assigned to (8)
- problem: in (10), as opposed to (8), we do not accommodate the proposition that John has a sister

[4] cf. Karttunen and Peters [43], Beaver [1, 3], Beaver and Zeevat [5], von Fintel [15], Heim [38], Pérez Carballo [55], van Rooij [57], Singh [70, 72].

[5] Although they don't discuss the proviso problem, Thomason et al. [78] also propose that presupposition accommodation is governed by principles of abductive reasoning.

The Proviso Problem Even if we grant the existence of an unanalyzed common sense reasoning function R, it is possible to construct sentences ϕ_p and ψ_p such that $R(p, c) = R(\pi(\phi), c) = q \neq r = R(\pi(\psi), c) = R(p, c)$, a contradiction.

- clearly, at least one of our assumptions has got to go
- Gazdar [28], Geurts [30, 31]: the projection function π is to blame
- but these theories have severe shortcomings of their own[6]
- various recent proposals have tried to argue that various properties of conditional sentences, along with various default assumptions made in the course of pragmatic reasoning, are to blame for the different accommodation patterns found in (8) and (10) (Beaver [3], Heim [38], Pérez Carballo [55], van Rooij [57])
- I believe this intuition is correct, and will follow it in my own proposal
- I won't have room to discuss these proposals in detail here,[7] but one worry I have is their lack of generality, for each rests on certain assumptions specific to conditionals
- but the proviso problem comes up other contexts as well
- for example, in attitude contexts, $B_j(\phi_p)$ is predicted to presuppose that $B_j p$ (Karttunen [41], Heim [37])

11. John believes it stopped raining

- the above sentence is predicted to presuppose that John believes that it was raining[8]
- however, the sentence clearly seems to convey something in addition to this, namely, that it was, in fact, raining
- and, Geurts [31] shows that, once again, we can construct a sentence with the same predicted semantic presupposition as (11), but which does not result in accommodation of the proposition that it was in fact raining

12. Mary knows that John believes it was raining

The Need for a Theory of Accommodation Assuming the theory of projection is correct, what we need is a predictive theory of accommodation that must, given the facts above: (1) allow non-trivial accommodations (i.e. accommodation of propositions that are sometimes richer than the projected presupposition), (2) provide a decision criterion that states which of the allowable propositions to accommodate

[6]See eg. Soames [75], Heim [34, 35], Beaver [1, 2], von Fintel [13], Singh [70], Schlenker [66] for discussion, especially concerning the interaction between presupposition and quantification.

[7]The full paper will contain more careful discussion. See also Singh [72].

[8]Based on sentences such as *John (mistakenly) believes that it was raining, and he believes it stopped raining* (Karttunen [41], Heim [37]).

4 An Analogous Problem in the Theory of Implicature

- begin by drawing an analogy to something that's been well-studied in implicature (eg. Gazdar [28], Sauerland [62], Fox [20])
- there are sometimes 'missing implicatures' – will argue that the mechanism responsible for missing implicatures is also responsible for some of the missing accommodations above
- *John ate some of the cookies* $\rightsquigarrow$ John didn't eat all of the cookies
- *John ate beef or pork at the party* $\rightsquigarrow$ John didn't eat both beef and pork at the party, and the speaker is ignorant about which of the two John ate
- *if John has a daughter, he is married to an American* $\rightsquigarrow$ the speaker is ignorant about whether John has a daughter, and is ignorant about whether John is married to an American

13. (a) $\exists \rightsquigarrow \exists \wedge \neg\forall$
(b) $X \vee Y \rightsquigarrow (X \vee Y) \wedge (\neg(X \wedge Y)) \wedge \Diamond_S X \wedge \Diamond_S \neg X \wedge \Diamond_S Y \wedge \Diamond_S \neg Y$
(c) $X \rightarrow Y \rightsquigarrow (X \rightarrow Y) \wedge \Diamond_S X \wedge \Diamond_S \neg X \wedge \Diamond_S Y \wedge \Diamond_S \neg Y$

Question We might ask ourselves: why doesn't $X \vee Y$ generate the implicature that not Y? We can ask the same thing about conditionals: why doesn't $X \rightarrow Y$ generate the implicature that not Y? Since Y is stronger than the disjunction (and the conditional), and since we do seem to conclude something about Y, namely ignorance, why isn't the inference we make $\neg Y$ instead of $\Diamond_S Y$? More broadly, why is it that the stronger alternative $X \wedge Y$ receives a scalar implicature $\neg(X \wedge Y)$, while the stronger alternative Y does not receive a scalar implicature $\neg Y$?

- I will argue that the answer to this question will help us solve the proviso problem – at some level, they are the same question
- i.e. potential implicatures and potential accommodations are governed by one and the same formal system
- eg. we will say that, in (8) (*if John flies to Toronto, his sister will pick him up from the airport*), the proposition that John has a sister has whatever property that $\neg(X \wedge Y)$ has that allows it to become an actual inference, while in (10) (*Mary knows that if John flies to Toronto, he has a sister*), the proposition that John has a sister has whatever property that $\neg Y$ has in the implicature case above, preventing it from becoming an actual inference
- if this intuition is to be followed, then, we need to set in place our assumptions about implicature, and, more specifically, to see how this question has been addressed in the implicature domain
- in the next two sections, we'll look at two proposals concerning the division of labour between ignorance inferences and scalar implicatures, Gazdar's [28] approach, and the more recent proposals by Sauerland [62] and Fox [22]
- we will try to adjudicate between these frameworks, and will then see how to use these insights to address the proviso problem

4.1 Two Approaches

4.1.1 Gazdar

Scalar and Clausal Implicatures There are two kinds of implicatures: (i) a set of *scalar implicatures*, (ii) a set of *clausal implicatures*. They are derived by different mechanisms. The first are derived by the use of Horn sets, and the second are derived for all constituents S of the asserted sentence ϕ such that neither S nor $\neg S$ follows from ϕ

- for Gazdar, you stipulate Horn sets, and these give you scalar implicatures
- thus, you either are a scalar alternative, or you're not
- in (13a), the only scalar alternative is $\forall$, and so the only scalar implicature is $\neg\forall$
- in (13b), the only scalar alternative is $X \wedge Y$, and so the only scalar implicature is $\neg(X \wedge Y)$
- neither X nor Y is a scalar alternative to $X \vee Y$, but both are clausal alternatives, and since neither X, Y, nor their negations, follow from $X \vee Y$, you get clausal implicatures (ignorance inferences) about both X and Y
- in (13c), there are no scalar alternatives, but only clausal alternatives (X, Y), so you get ignorance inferences about these constituents

4.1.2 Innocent Inclusion and Symmetry

Consistency and Symmetry Sauerland [62] proposes a uniform set of alternatives over which reasoning occurs, and proposes a 'consistency checking' algorithm for computing implicatures. The difference between scalar implicatures and ignorance inferences follows from logical properties of the set of alternatives alone.

- follow Fox's [22] implementation of Sauerland's idea here, what I'll call Fox's 'innocent inclusion algorithm'
- if the assertion is ϕ, compute a set of scalar alternatives, $A(\phi)$, a set of alternative LFs derived from the LF of ϕ (eg. Katzir [46])
- derive from $A(\phi)$ a set of potential implicatures, $\mathcal{N} = \{\neg p : p = [[\psi]], \psi \in A(\phi)\}$
- find all maximal consistent subsets of $\mathcal{N}$ that are consistent with the assertion
- call these sets *Maximal Consistent Inclusions* (MCIs)
- this will give a set $M_1, \ldots, M_k$ of MCIs
- the intersection of the MCIs are the set of 'innocently includable' propositions
- a candidate implicature $p \in \mathcal{N}$ is a scalar implicature iff it's innocently includable
- the remaining members of $\mathcal{N}$ are then subject to ignorance inferences

- eg. in (13a), the only alternative is $\forall$, and since $\exists \wedge \neg\forall$ is consistent, the only implicature is $\neg\forall$
- in (13b), the alternatives are $\{X \vee Y, X, Y, X \wedge Y\}$, generating potential implicatures $\mathcal{N}$ = $\{\neg(X \vee Y), \neg X, \neg Y, \neg(X \wedge Y)\}$
- the MCIs are: (i) $\{\neg X, \neg(X \wedge Y)\}$, (ii) $\{\neg Y, \neg(X \wedge Y)\}$
- note that any MCI containing $\neg X$ cannot also contain $\neg Y$ (since the result would contradict the assertion $X \vee Y$)
- when this is the case, call them symmetric alternatives

Symmetric Alternatives If two alternatives cannot both be in the same MCI, call them *symmetric alternatives*. Clearly symmetric alternatives can never become scalar implicatures.

- thus, the only scalar implicature is (i) $\cap$ (ii), i.e. $\neg(X \wedge Y)$
- the remaining elements of $\mathcal{N}$ whose truth-value is not determined yet, namely, X and Y, are then subject to ignorance inferences
- in (13c), the set of alternatives is (using Katzir's algorithm): $\{X, Y, \neg X, \neg Y\}$
- note that X is symmetric with $\neg X$, and similarly, Y is symmetric with $\neg Y$[9]
- thus no member of this set will become an actual scalar implicature – all we get is ignorance inferences

4.2 Adjudicating Among these Proposals

- recall that for Gazdar, you either are, or are not, a scalar alternative
- in the case of $X \vee Y$, the only scalar alternative is $X \wedge Y$, while X, Y are subject to clausal implicatures/ignorance inferences
- in the symmetry-based theory, lexical replacements and syntactically manipulated alternatives (eg. those derived by pruning the tree) are not treated differently by the implicature system
- rather, the difference between scalar implicatures and ignorance inferences derives entirely from the logical properties of the sets of alternatives
- both views are consistent with the facts discussed so far, but they make different predictions in more complex sentences where we embed $X \vee Y$ under an operator, Op
- consider assertion of $Op(X \vee Y)$

[9] The MCIs are: (i) $\{X, Y\}$, (ii) $\{\neg X, \neg Y\}$, (iii) $\{\neg X, Y\}$. We can't have $\{X, \neg Y\}$ as an MCI, for this would contradict the assertion (if X, then Y). Since the intersection of (i)-(iii) is empty, no candidate proposition is innocently includable.

- the symmetry based proposal predicts that so long as $Op(X \vee Y) \wedge \neg OpX \wedge \neg OpY$ is consistent, $\neg OpX$ and $\neg OpY$ should be implicatures of $Op(X \vee Y)$

- Gazdar, on the other hand, predicts that this is not possible, since OpX, OpY are not *scalar* alternatives, but mere clausal alternatives (i.e. you should get only ignorance inferences, not scalar implicatures)

- Fox and Hackl [24], Fox [20, 22] prove some theorems about the kinds of operators that are allowed to break symmetry in this fashion[10]

- for example, universal quantifiers like *require* should break symmetry

14. (a) You're required to eat beef or pork
(b) It's required that if you fly to Toronto, you have a sister

- consider (14a): this sentence clearly has two implicatures: (i) you're not required to eat beef, (ii) you're not required to eat pork (hence you're not required to eat both, of course)[11]

- (14b) also has a set of implicatures: (i) you're allowed to fly to Toronto, (ii) you're allowed to not fly to Toronto, (iii) you're allowed to have a sister, (iv) you're allowed to not have a sister

- Gazdar's system has no way of generating these implicatures

- consider (14a) for instance

- since the only scalar alternative to (14a) is *You're required to eat beef and pork*, the only scalar implicature predicted by Gazdar is that you're not required to eat both beef and pork

- Gazdar also predicts that this sentence should in addition have two ignorance inferences, namely, that the speaker is ignorant about whether you're required to eat beef, and they're ignorant about whether you're required to eat pork

- the latter is incorrect – in fact, assuming (uncontroversially) that scalar implicatures end up modalized under $\Box_S$, Gazdar's predicted ignorance inferences (eg. $\Diamond_S \Box B$) contradicts the (modalized output of) the scalar implicature that $\Box_S \neg \Box B$)

- as far as I can tell, there is no way to fix Gazdar's system to get the right meaning

- the symmetry account, on the other hand, generates exactly the right meaning

- (14a) is predicted to have as alternatives: (i) *You're required to eat beef*, (ii) *You're required to eat pork*, (iii) *You're required to eat beef and pork*

- all three alternatives are stronger, and all are innocently includable, since $\Box(B \vee P) \wedge \neg \Box B \wedge \neg \Box P \wedge \neg \Box(B \wedge P)$ is consistent

[10] See also Katzir [46], Chierchia, Fox, and Spector [11], Singh [73], Fox and Katzir [25], Fox and Spector [26] for more data and arguments of this kind. See also Section 6.1.

[11] This is presumably behind 'Ross' Paradox' [60], namely, why *You're required to eat beef* doesn't seem to entail *You're required to eat beef or pork*, although a standard semantics for *require* would predict the entailment.

- crucially, universal modals can break symmetry[12]
- similar reasoning applies to (14b) – symmetry gets the right result, while Gazdar does not
- I see no way to fix Gazdar's system to get this result

Conclusion Innocent inclusion is a better predictor of scalar implicatures than Gazdar's mechanism, and symmetry among the set of alternatives is a better predictor of ignorance inferences than Gazdar's clausal implicature mechanism

4.3 A New Puzzle: Overgeneration of Implicatures

- we convinced ourselves above that symmetry/innocent inclusion is a better predictor of ignorance inferences/implicatures than Gazdar's mechanism
- however, if this is correct, we seem to immediately run into an overgeneration problem
- consider, for example, belief attributions

15. John believes it's raining

- this sentence has three alternatives: (i) John believes it's raining, (ii) John knows it's raining, (iii) It's raining
- note that (ii) and (iii) are both innocently includable (it is consistent with the assertion to negate them both)
- thus, we need a way to block (the negation of) (iii) from becoming an implicature, while allowing (the negation of) (ii) to become an implicature
- it turns out that Gazdar's system predicts the right inferences here (ignorance about (iii), and the negation of (ii)), but we've seen already that this system is not tenable (we'll see further evidence later on that Gazdar's system continues to misfire on several fronts)[13]
- one potential response might be to exclude (iii) (by stipulation) from the set of alternatives entirely, or to restrict the implicature mechanism to only stronger alternatives (rather than non-weaker, as we've assumed so far with Fox [22] and Chemla [9])
- there are thus three proposals on the table for dealing with the lack of implicature in this case: (1) Gazdar's system, (2) Removing (iii) from the set of alternatives, (3) Restricting implicatures to only stronger alternatives
- it turns out that neither of these moves will suffice, given what happens when we emded the sentence under *require*

[12]See eg. Fox and Hackl [24], Fox [22], Chierchia, Fox, and Spector [11], Fox and Katzir [25], Fox and Spector [26] for more examples of this sort.

[13]See also Sauerland [62], Chierchia, Fox, and Spector [11], Singh [73] for more difficulties with this system with respect to implicatures in complex sentences.

16. Context: Suppose we want to surprise John on Saturday, but in order for the surprise to work, we need certain things to be in place.
S: It is required that John believe that it's raining

- this sentence clearly has an implicature that it is not required that it actually be raining
- Gazdar's system (again) misfires here, for $\Box r$ is not a scalar alternative of the assertion, so the scalar implicature is unavailable
- Gazdar incorrectly predicts instead that we should infer that the speaker is ignorant about whether it's required that it be raining (on Saturday)
- concerning move (2), I am unable to see any motivation for restricting r from being an alternative to $B_j r$ while allowing $\Box r$ as an alternative to $\Box B_j r$
- concerning move (3), $\Box r$ is not stronger than $\Box B_j r$, but we get the implicature anyway, so a brute force restriction to stronger alternatives will not work here
- the fact that the implicature is absent in (15), but reappears when (15) is embedded under *require*, suggests that the lack of implicature in (15) is due to symmetry, which is broken in (16) by the embedding verb *require* (cf. the discussion of (14))

Problem We don't have a symmetric alternative in (15) (to block the implicature that $\neg r$)

- even if we could come up with a symmetric alternative to (15), we would need to ensure that a symmetric alternative doesn't arise in (16) (so that the implicature that $\neg\Box r$ can go through, as needed)

5 Symmetric and Interacting Alternatives for Implicature and Accommodation

- in this section I develop a revised theory of meaning enrichment that solves both the proviso problem and the overgeneration problem
- before developing the formal system, I'd like to outline the core intuition behind the proposal

5.1 The Intuition Behind the Formal System

- the core of the proposal is to take the symmetry based implicature system, and enlarge the set of potential enrichments to include presuppositional information as well in order to account for accommodation
- first, I argue that, like implicature, accommodation is made with respect to a set of alternatives defined using formal principles
- this means that a sentence has two sets of potential enrichments: (1) A candidate set $\mathcal{N}$ of potential implicatures, (2) A candidate set $\mathcal{H}$ of potential accommodations

- I will argue that these sets are derived from a single source, namely, the scalar alternatives of the asserted sentence
- next, I argue that these sets interact, in that the *union* of the two constitutes the input to innocent inclusion
- this means that (in principle) potential implicatures can block potential accommodations from arising (by creating symmetry problems for them), and, conversely, potential accommodations can block potential implicatures from arising (again, through symmetry)
- in other words, potential implicatures and potential accommodations can be symmetric alternatives, wiping each other out, and this, I argue, is the key to solving both the proviso problem and the overgeneration problem discussed above
- I begin by putting in place a framework for accommodation (in order to deal with the proviso problem), and then argue that this framework suffices to solve the overgeneration problem for implicatures

5.2 Claim One: Restricted Alternatives for Accommodation

- recall that we need to allow for non-trivial accommodations, given sentences like (8), (11), and others
- one idea: any proposition will do, so long it makes sense, and the resulting context satisfies the presupposition
- consequence: suppose p and q are contextually equivalent, so that it is common knowledge that p iff it is common knowledge that q
- then, accommodation in response to ϕ in c should be such $(c\&p) + \phi$ works iff $(c\&q) + \phi$ works, since the effect on the context is identical
- either accommodation should work in both cases, or in neither

17. Context: Suppose it is common knowledge that John's family has a long history of breeding German Shepherds, and only German Shepherds. There are strict family rules dictating that if any family member is to have a dog, it will have to be a German Shepherd. Thus, it is common knowledge that John has a dog if and only if he has a German Shepherd. John's friend, Sue, comes knocking on his door one day in an unexpected visit. John's sister, Mary, answers the door.
    Sue: Hi Mary, is John home?
    Mary: Um, no, sorry, he's out walking his dog.

- at this point, accommodation is necessary
- given the contextual equivalence of John's having a dog and his having a German Shepherd, both are equally good as far as accommodation is concerned – as soon as you know one, you know the other, probability distributions relativized to your knowledge will not distinguish between them, etc.

- however, we find that the HWAMT, our probe for objecting to having to accommodate, *does* distinguish between them

- here is the dialogue, again, somewhat extended

18. Sue: Hi Mary, is John home?
    Mary: Um, no, sorry, he's out walking his dog.
    (a) # Hey wait a minute! I didn't know John has a German Shepherd!
    (b) Hey wait a minute! I didn't know John has a dog!

- this teaches us that, whatever the nature of the inference to John having a German Shepherd, it cannot arise from accommodation

- but nothing about the proposition that he has a dog is pragmatically better (more likely to be true, more informative, etc) than the proposition that he has a German Shepherd

- we conclude that this pragmatically equivalent proposition is simply unavailable to the accommodation system[14]

Claim One In deciding what to accommodate, the system responsible for this inference has restrictions on what it can consider as a candidate for accommodation.

5.3 Claim Two: A Theory of Alternatives for Accommodation

- recall that we need to allow the accommodation system access to multiple alternatives (cf. non-triviality)

- but the previous section teaches us that there are restrictions on the space of candidates

MAIN IDEA: use the objects that seem to be needed anyways for the computation of scalar implicature

- given the need for non-triviality, it would be very strange if the accommodation system used a different route to generating alternatives

- I propose that it uses the same objects to generate candidates for accommodation as are used to generate candidates for implicature, viz. $A(\phi)$

Claim Two The space of alternatives for accommodation in response to assertion ϕ, $\mathcal{H}$, is the set containing the projected presuppositions of the scalar alternatives of ϕ, i.e. $\mathcal{H} = \{\pi(\psi) : \psi \in A(\phi)\}$

- at this point, we now have an answer to the non-triviality requirement as well as the modularity argument from the HWAMT

- in response to atomic sentence ϕ_p without scalar alternatives, the only proposition available for accommodation is p itself

[14]For much more discussion, see Sections 5.3.4-5.3.5 of Singh [72].

- thus, in response to *He's out walking his dog*, the only proposition available for accommodation is that John has a dog; the proposition that he has a German Shepherd is unavailable, despite the fact that it's pragmatically equivalent to the proposition that John has a dog
- at the same time, despite the restrictions, we have a way to generate the additional alternatives needed for accommodation in cases like (8) and (11), repeated here as (19) and (20)

19. If John flies to Toronto, his sister will pick him up from the airport = 'if ϕ, then ψ_p'
Scalar Alternatives: $A(19) = \{$ if ϕ then $\psi_p, \phi, \neg\phi, \psi_p, \neg\psi_p\}$
Candidates for Accommodation $\mathcal{H} = \{\pi(\psi) : \psi \in A(S)\} = \{\phi \to p, p\}$[15]

- here, we have the required (unconditional) proposition that John has a sister as a candidate for accommodation

20. John believes it stopped raining
Scalar Alternatives $A(20) = \{B_j(S_r), S_r, K_j(S_r)\}$.[16]
Candidates for Accommodation $\mathcal{H} = \{B_j r, r, S_r \wedge K_j r\}$.[17]

- and here, recall that we needed to get r as an alternative, and we have it now in $\mathcal{H}$
- we haven't yet said anything about what the system does with alternatives
- for example, in (20), we have three candidates for accommodation, and we want only two of them to be accommodated ($B_j r$ and r), but not $S_r \wedge K_j r$ (we don't take away from this sentence that it did in fact stop raining, which would be entailed if we were to accommodate this proposition)
- this problem becomes especially important given that in (10) and (12), repeated here as (21) and (22), the accommodations we want to block (ψ in (21), i.e. that John has a sister, and r in (22), i.e. that it was raining) are actually generated as candidates

21. Mary knows that if John flies to Toronto, he has a sister = K_m(if ϕ, then ψ)
Scalar Alternatives: $A(21) = \{K_m$(if ϕ, then ψ), $K_m\phi$, $K_m\neg\phi$, $K_m\psi$, $K_m\neg\psi$, if ϕ then ψ, ϕ, $\neg\phi$, ψ, $\neg\psi\}$.
Candidates for Accommodation: $\mathcal{H} = \{$ if ϕ then $\psi, \phi, \neg\phi, \psi, \neg\psi\}$.

22. Mary knows that John believes it was raining
Scalar Alternatives: $A(22) = \{K_m B_j r, K_m r, B_j r, r, K_m K_j r, K_j r, B_m B_j r, B_m r, B_m K_j r\}$
Candidates for Accommodation $\mathcal{H} = \{r, K_j r, B_m r, B_j r\}$

[15] $\pi($ if ϕ then $\psi_p) = \phi \to p$, $\pi(\phi_p) = \pi(\neg\phi_p) = p$, and ϕ is presuppositionless.
[16] Legend: r = that it was raining, S_r = it stopped raining, $B_j\phi / K_j\phi$ = John believes/knows that ϕ.
[17] $\pi(B_j(S_r)) = B_j r, \pi(S_r) = r, \pi(K_j(S_r)) = r \wedge K_j r$ (Karttunen [41], Heim [37]).

5.4 Claim Three: Accommodation through a Revised Algorithm for Innocent Inclusion

- will argue that it is no mere coincidence that the implicature system and the accommodation system use the same objects
- will argue that thay are derived together by the same algorithm
- begin by adopting Fox's [20] theory of implicature (though changing some notation) (cf. our discussion in Section 4.1.2)

Algorithm for Implicature Computation: Innocent Inclusion Suppose ϕ is asserted. (i) Generate set of alternative LFs, $A(\phi)$, (ii) Generate candidate set of implicatures, $\mathcal{N} = \{\neg p : p = [[\psi]], \psi \in A(\phi)\}$, (iii) Take set of maximal consistent subsets of $\mathcal{N}$ that are consistent with ϕ, the set of *Maximal Consistent Inclusions* (MCIs), (iv) The intersection of the MCIs is the set of *Innocently Includable* propositions. $r \in \mathcal{N}$ is a scalar impicature iff r is innocently includable.

- now, returning to accommodation, what do we do with $\mathcal{H}$?
- I propose that the proviso problem can be solved if we revise the above algorithm by: (i) using as input not $\mathcal{N}$, but rather $\mathcal{N} \cup \mathcal{H}$, and (ii) adding the constraint that each MCI include the semantic presupposition of the assertion
- by making this move, we can accomplish our task of blocking unwanted accommodations by allowing candidate implicatures to create symmetry problems for them
- in the other direction, we are able to block certain unwanted implicatures by allowing members of $\mathcal{H}$ to create symmetry problems for members of $\mathcal{N}$ which would otherwise be generated (incorrectly) as implicatures (eg. $\neg S_r$ (= that it wasn't raining) would be predicted to be an implicature of (20) (= John believes it stopped raining) if we didn't allow $\mathcal{H}$ and $\mathcal{N}$ to interact
- in other words, our move allows certain candidate implicatures and candidate accommodations to wipe each other out, as X and Y do in disjunctions ($X \vee Y$)
- this will be the key to addressing the facts in (19)-(22)

Main Result Candidates in $\mathcal{H}$ get accommodated if and only if they are innocently includable, and those candidates in $\mathcal{N}$ arise as implicatures if and only if they are innocently includable

- again, this result holds, and makes correct predictions under our current assumptions, only on the assumption that the input to innocent inclusion is $\mathcal{N} \cup \mathcal{H}$
- this, then, is the third and final step of our solution

Claim Three The input to the innocent inclusion algorithm is not $\mathcal{N}$, but $\mathcal{N} \cup \mathcal{H}$, thereby allowing candidates for implicature and candidates for accommodation to create symmetry problems for each other.

- let's see how this applies to the proviso problem, as instantiated in (19)-(22)

19. If John flies to Toronto, his sister will pick him up from the airport
    - Asserted Sentence: S = if ϕ, then ψ_p
    - Scalar Alternatives: $A(S) = \{$ if ϕ then $\psi_p, \phi, \neg\phi, \psi_p, \neg\psi_p\}$
    - Candidate for Implicature: $\mathcal{N} = \{\{$ $\neg$(if ϕ then $\psi_p), \phi, \neg\phi, \psi_p, \neg\psi_p\}$
    - Candidates for Accommodation: $\mathcal{H} = \{\phi \rightarrow p, p\}$
    - Maximal Consistent Inclusions: (i) $\{\phi, \psi_p, \phi \rightarrow p, p\}$, (ii) $\{\phi, \neg\psi_p, \phi \rightarrow p, p\}$, (iii) $\{\neg\phi, \psi_p, \phi \rightarrow p, p\}$, (iv) $\{\neg\phi, \neg\psi_p, \phi \rightarrow p, p\}$
    - Innocently Includable Propositions: The only innocently includable propositions are the members of $\mathcal{H}$ itself, $\phi \rightarrow p$ and p, and since one of these propositions (p) entails the other, the accommodation is simply p

20. John believes it stopped raining
    - Asserted Sentence: ϕ = $B_j S_r$
    - Scalar Alternatives: $A(\phi) = \{B_j S_r, K_j S_r, S_r\}$
    - Candidate Propositions for Implicature: $\mathcal{N} = \{\neg B_j S_r, \neg K_j S_r, \neg S_r\}$
    - Candidate Propositions for Accommodation: $\mathcal{H} = \{B_j r, S_r \wedge K_j r, r\}$
    - Maximal Consistent Inclusions: (i) $\{\neg K_j S_r, \neg S_r, B_j r, r\}$, (ii) $\{\neg K_j S_r, B_j r, S_r \wedge K_j r, r\}$
    - Note that $\neg S_r \in \mathcal{N}$ and $S_r \wedge K_j r$ are symmetric alternatives, wiping each other out – without this interaction between $\mathcal{N}$ and $\mathcal{H}$, we would need additional principles to block them from arising
    - Given our MCIs, the set of innocently includable propositions is: $\{\neg K_j S_r, B_j r, r\}$
    - Thus, the only implicature is: $\neg K_j S_r$
    - The accommodation is: $r \wedge B_j r$

21. Mary knows that if John flies to Toronto, he has a sister
    - Asserted Sentence: $S = K_m$(if ϕ, then ψ)
    - Scalar Alternatives: $A(S) = \{K_m$(if ϕ, then ψ), $K_m\phi$, $K_m\neg\phi$, $K_m\psi$, $K_m\neg\psi$, if ϕ then ψ, ϕ, $\neg\phi$, ψ, $\neg\psi\}$
    - Candidates for Implicatures: $\mathcal{N}$ = $\{\neg K_\alpha$(if ϕ, then ψ), $\neg K_\alpha\phi$, $\neg K_\alpha\neg\phi$, $\neg K_\alpha\psi$, $\neg K_\alpha\neg\psi$, $\neg$(if ϕ then ψ), ϕ, $\neg\phi$, ψ, $\neg\psi\}$.
    - Candidates for Accommodation: $\mathcal{H} = \{$ if ϕ then $\psi, \phi, \neg\phi, \psi, \neg\psi\}$.
    - Innocently Includable Propositions: $\{\neg K_\alpha\phi$, $\neg K_\alpha\neg\phi$, $\neg K_\alpha\psi$, $\neg K_\alpha\neg\psi$, if ϕ then $\psi\}$
    - Thus, the implicatures are: (i) $\neg K_\alpha\phi$, (ii) $\neg K_\alpha\neg\phi$, (iii) $\neg K_\alpha\psi$, (iv) $\neg K_\alpha\neg\psi$
    - The only accommodation possibility is: if ϕ then ψ

22. Mary knows that John believes it was raining

   - Asserted Sentence: ϕ = $K_m B_j r$
   - Semantic Presupposition: $B_j r$
   - Scalar Alternatives: $A(\phi)$ = $\{K_m B_j r,\ K_m r,\ B_j r,\ r,\ K_m K_j r,\ K_j r,\ B_m B_j r,\ B_m r,\ B_m K_j r\}$
   - Candidate Propositions for Implicature: $\mathcal{N}$ = $\{\neg K_m B_j r$, $\neg K_m r$, $\neg B_j r$, $\neg r$, $\neg K_m K_j r$, $\neg K_j r$, $\neg B_m B_j r$, $\neg B_m r$, $\neg B_m K_j r\}$
   - Candidate Propositions for Accommodation: $\mathcal{H}$ = $\{r, K_j r, B_m r, B_j r\}$
   - Innocently Includable Propositions: Given our constraints (consistency with assertion, and inclusion of semantic presuppositions), the only innocently includable propositions are: (i) $B_j r$, (ii) $\neg K_m r$, (iii) $\neg B_m K_j r$, (iv) $\neg K_m K_j r$
   - Since (iv) is entailed by (iii), our implicatures are (ii) and (iii)
   - The only accommodation is the semantic presupposition itself, (i)

5.5 Back to the Overgeneration Problem

- recall that we are interested in the fact that (15), repeated here as (23a), does not have $\neg r$ as an implicature, while (16), repeated here as (23b), has $\neg\Box r$ as an implicature

23. (a) John believes it's raining
    (b) It's required that John believe it's raining

- we argued earlier that these facts are probably due to symmetry in (a), and the lack of it in (b)
- we have in place now an answer (cf. (20)) to the source of symmetry in (a), namely, the presupposition of one of the scalar alternatives to (a), *John knows that it's raining*
- let us work through this

23. (a) John believes it's raining

   - Asserted Sentence: $S = B_j r$
   - Scalar Alternatives: $A(S) = \{B_j r, K_j r, r\}$
   - Candidates for Implicature: $\mathcal{N} = \{\neg B_j r, \neg K_j r, \neg r\}$
   - Candidates for Accommodation: $\mathcal{H} = \{r\}$
   - Note that $r \in \mathcal{H}$ and $\neg r \in \mathcal{N}$ are symmetric, so that they end up wiping each other out
   - MCIs: (i) $\{\neg K_j r, \neg r\}$, (ii) $\{\neg K_j r, r\}$
   - Innocently Includable Propositions: The only innocently includable proposition is $\neg K_j r$, and this is the scalar implicature

- turning to (23b), we have the following set of scalar alternatives: $\{\Box B_j r$, $\Box K_j r$, $\Box r$, $B_j r$, $K_j r$, r, $\neg B_j r$, $\neg K_j r$, $\neg r\}$[18]

- the negations of the propositions denoted by the members of this set are the potential implicatures ($\{\neg\Box B_j r$, $\neg\Box K_j r$, $\neg\Box r$, $B_j r$, $K_j r$, r, $\neg B_j r$, $\neg K_j r$, $\neg r\}$

- we already see that a bunch of them will die because of symmetry ($B_j r$, $K_j r$, r, $\neg B_j r$, $\neg K_j r$, $\neg r$)

- what remains as potential implicatures are $\{\neg\Box K_j r, \neg\Box r\}$

- it remains to show that the candidate accommodations do not cause symmetry for these propositions, which are both implicatures of the sentence

- the only potential accommodations are r (the presupposition of $K_j r$ and $\neg K_j r$), and the presupposition of $\Box K_j r$

- we haven't yet established the projection properties of *require*

- the following facts suggest that $\Box\phi_p$ presupposes p,[19] i.e. that *require* is a 'hole' (Karttunen [41, 42]) for presupposition

24. (a) If John has a sister, he's required to bring his sister (local satisfaction)
(b) S: John is required to bring his sister to the party
H: Hey wait a minute! I didn't know John has a sister! (HWAMT, cf. Section 2)
(c) It's not required that John bring his sister because he doesn't even have a sister! (local accommodation)
(d) Is John required to bring his sister? (projection out of questions)

- thus, we conclude that $\Box K_j r$ presupposes r, which doesn't add anything to our current set of potetial accommodations (which just includes r, as discussed above)

- if so, it follows that no symmetry arises for the remaining potential implicatures, and the potential accommodation that r is killed by the potential implicature $\neg r$

- let's write this out in fuller detail

23. (b) It's required that John believe that it's raining

    - Asserted Sentence: $S = \Box B_j r$

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[18] The negated alternatives are arrived at by replacing the one-place sentential operator $\Box$ by the one-place sentential operator $\neg$.

[19] Somehow, this presuppositional constraint also seems to constrain the modal base so that it also has to entail p. See Kratzer [48] for how 'facts about the world' act to constrain modal bases. If so, this might help shed light on various 'paradoxes' in deontic logic, cf. the contrast between *It is required that we help John, who was robbed* versus *It is required that John be robbed and that we help him* (good samaritan paradox), or *It is required that John know the bank will be robbed* versus *It is required that the bank be robbed and that John believe it.* (paradox of epistemic obligation). When the complement presupposes p, *it is required that* ϕ_p no longer entails *it is required that* p, whereas when p is merely entailed by the complement, it does, as standard deontic logic would predict. The paradoxes arise only when the entailment is also a presupposition.

- Scalar Alternatives: $A(S) = \{\Box B_j r, \Box K_j r, \Box r, B_j r, K_j r, r, \neg B_j r, \neg K_j r, \neg r\}$
- Candidates for Implicature: $\mathcal{N} = \{\neg\Box B_j r, \neg\Box K_j r, \neg\Box r, B_j r, K_j r, r, \neg B_j r, \neg K_j r, \neg r\}$
- Candidates for Accommodation: $\mathcal{H} = \{r\}$
- Innocently Includable Propositions: Once we cancel out all the symmetric alternatives (as discussed above), the set of innocently includable propositions is $\{\neg\Box K_j r, \neg\Box r\}$

- we have thus substantiated our claim that symmetry was responsible for blocking the implicature in (23a), and that embedding under *require* broke the symmetry in (23b)
- given the importance of symmetry, we might like to investigate some more general conditions under which symmetry might be broken

6 Breaking Symmetry: Operators and Relevance

- we have argued in the above that the existence or absence of symmetry among formally defined alternatives is a key factor in the existence/absence of implicatures/accommodation
- this property distinguished (eg.) the current approach (following Sauerland [62] and Fox [22]) from Gazdar's [28]
- moreover, we've seen that there are mechanisms in place that can break symmetry, such as embedding under universal quantifiers (like *require*)[20]
- in a disjunction $X \vee Y$, for example, the disjuncts are symmetric, but embedding this sentence under *every* or *require* breaks the symmetry

25. (a) $X \vee Y$
$A(X \vee Y) = \{X \vee Y, X, Y, X \wedge Y\}$
No Implicature that $\neg X$, No Implicature that $\neg Y$

(b) $\forall x(Ax \vee Bx)$
$A(\forall x(Ax \vee Bx)) = \{\forall x(Ax \vee Bx), \forall x(Ax), \forall x(Bx), \forall x(Ax \wedge Bx)\}$
Implicatures: $\neg\forall x(Ax)$, $\neg\forall x(Bx)$, $\neg\forall x(Ax \wedge Bx)$

(c) $\Box(X \vee Y)$
$A(\Box(X \vee Y)) = \{\Box(X \vee Y), \Box X, \Box Y, \Box(X \wedge Y)\}$
Implicatures: $\neg\Box X, \neg\Box Y, \neg\Box(X \wedge Y)\}$

- for example:

26. (a) John ate beef or pork at the party $\not\Rightarrow$ John didn't eat beef at the party, John didn't eat pork at the party
(b) You're required to eat beef or pork at the party $\rightsquigarrow$ You're not required to eat beef, and you're not required to eat pork
(c) Every boy ate beef or pork $\rightsquigarrow$ it's not the case that every boy ate beef, and it's not the case that every boy ate pork

[20] cf. Fox and Hackl [24], Fox [22].

- we have extended the symmetry based proposal of Sauerland and Fox from the domain of implicature candidates alone to include presuppositions of scalar alternatives, as well, with symmetry operating over an enriched set of propositions
- how does this affect our capacity to break symmetry?
- for example, suppose we have a case of symmetry between implicature candidates and accommodation candidates
- can this symmetry be broken (as in standard implicatures, like above), or are we stuck?
- we will discuss here two potential routes to symmetry breaking: (i) Operators, (ii) Relevance

6.1 Embedding under Operators

- consider again a case like the following belief attribution, which (we argued) avoids overgeneration due to symmetry

27. John believes he got into MIT
$A(B_j m) = \{B_j m, K_j m, m\}$

- we want to know what happens when we embed this structure under an operator Op

28. $Op(B_j m)$
$A(Op(B_j m)) = \{Op(B_j m), Op(K_j m), Op(m), B_j m, K_j m, m\}$[21]

- this will give rise to two sets of potential enrichments, the potential implicatures, and the potential accommodations
- assuming that Op doesn't introduce presuppositions of its own, we have the following sets

28. (a) $\mathcal{N} = \{\neg Op(B_j m), \neg Op(K_j m), \neg Op(m), \neg B_j m, \neg K_j m, \neg m\}$
(b) $\mathcal{H} = \{\pi(Op(K_j m)), m\}$

- from these sets, we can read off analytically that the proposition that m (the complement of *believe*), if it is a member of the set of alternatives, is still doomed to symmetry, no matter what the operator
- for example, recall what happens under *require*

29. It is required that John believe he got into MIT

- here, we don't get any inference concerning whether John did or didn't get into MIT
- however, we do get the implicature that it's not required that John actually got into MIT ($\neg Op(m)$)

[21] Actually, under the theory of alternatives we're assuming here, the set of alternatives might be a proper subset of this set, for reasons having to do with variable binding in quantified structures (cf. Example (30) below).

- recall that this depended crucially on the fact that *require* is a hole for presupposition – i.e. it didn't give rise to a presupposition that created symmetry with $\neg Op(m)$

- thus, the projection properties of the embedding operator will be crucial in determining the extent of symmetry

- as opposed to the case of implicatures, for example, we see that *every* and *require* now differ in their capacity to break symmetry

- for example, the following sentence does not have the implicature that $\neg Opm$, i.e. that it's not the case that every boy got into MIT

30. Every boy believes he got into MIT = $\forall x(B(x, m(x)))$
$A(\forall x(Bx, m(x)))$ = $\{\forall x(B(x, m(x))), \forall x(K(x, m(x))), \forall x(m(x))\}$[22]
$\mathcal{N} = \{\neg\forall x(B(x, m(x))), \neg\forall x(K(x, m(x))), \neg\forall x(m(x))\}$
$\mathcal{H} = \{\pi(\forall x(K(x, m(x))))\} = \{\forall x(m(x))\}$

- the reason for this is transparent – given the projection properties of *every*,[23] the potential implicature that not every boy got into MIT has a symmetric alternative, the potential accommodation that every boy got into MIT

- because *every* projects a universal presupposition ($Opx(m(x))$), it prevents $\neg Opx(m(x))$ from becoming an implicature

- because *require* is a hole for presupposition (i.e. $\pi(Op(\phi_p)) = p$), this does not suffice to create symmetry for the potential implicature $\neg Op(p)$

- nevertheless, once a set of alternatives is given, and the projection properties are known, the innocently includable propositions will be determined – but whether an operator can or cannot break symmetry will depend crucially on its projection properties

6.2 Relevance

- we seem to have a problem

- consider the following contrast, from Gazdar [28] (p.60)

31. (a) If John sees me, he will regret seeing me
(b) If John tells Margaret, he will regret seeing me

- Gazdar points out that (a) generates an ignorance inference (clausal implicature) that the speaker does not know whether John will see him, while (b) does not

- instead, (b) seems to presuppose that John will see the speaker

[22] My symbolic translation is not exactly faithful to the corresponding syntactic structures. We should really have something more like: (i) Every boy x, x believes x got into MIT, (ii) Every boy x, x knows x got into MIT, (iii) Every boy x, x got into MIT.

[23] Eg. Karttunen and Peters [43], Heim [34], Schlenker [65], inter alia.

- however, since this is a potential implicature in both cases (since it's a constituent in both cases), and since (for Gazdar) potential implicatures cancel presuppositions, the contrast is surprising
- in response to this, Gazdar suggests a new constraint (p.59) to the effect that a constituent embedded under a presupposition trigger that is neither entailed nor contradicted by the assertion is unavailable for implicature computation
- thus, he suggests a brute-force constraint against an ignorance inference in conditionals in (b)
- in (a), the antecedent generates the required ignorance inference, and so cancels the potential presupposition embedded under *regret*
- our system currently (like Gazdar's before the new constraint) also predicts that it should not be possible to accommodate that John will see the speaker, because of symmetry
- the interesting case is (b): we predict symmetry because $\mathcal{H}$ contains a potential accommodation (that John will see the speaker, generated from the presupposition of the consequent), and $\mathcal{N}$ contains a potential implicature (that John won't see the speaker, generated by negating the proposition denoted by the complement of *regret*)
- these are symmetric alternatives, and so symmetry should prevent accommodation of John seeing the speaker
- consider now the following dialogue

32. A: Where are we?
    B: Well, if we're on Rte. 183, I know we're just outside Lockhart

- in this case, contra the predictions of Gazdar, there is no inference that speaker and hearer are outside Lockhart
- what is the difference between (31b) and (32)?
- I'd like to argue that the difference is one of *relevance*
- since Rooth [59], it has been argued that there is a systematic interaction between *formally* defined alternatives, and contextually relevant alternatives
- recently, Fox and Katzir [25] have investigated the nature of this interaction
- following Rooth [59] and others, they argue that the set of actual alternatives, $ALT(\phi)$, is not $A(\phi)$ (the set of scalar alternatives), but $A(\phi)\cap$**R**, where **R** is a set of relevant propositions[24]
- if so, we might say that the difference between these sentences is that in the first, the complement is not (necessarily) relevant, while in the second, it is (given the question under discussion)

[24] They propose that **R**, but not $A(\phi)$, is closed under negation and conjunction. The closure properties of this set might be important for us, as we'll see later on.

- assuming this to be correct, if **R** does not contain the proposition that John will see the speaker (= s) in (31b), then $s \notin ALT(\phi)$, and so $\neg s \notin \mathcal{N}$
- however, with $K(s) \in$ **R**, $s \in \mathcal{H}$, and so accommodation of s goes through
- in (32), the proposition that we are in Lockhart (= L) is presumably in **R** (given the question), and since it's also in $A(\phi)$, it's also in $ALT(\phi)$, and so symmetry should hold in this case
- I do not unfortunately have an account of what determines the makeup of **R**
- when there is an explicit QUD, we can appeal to certain well-understood notions of relevance (eg. Groenendijk and Stokhof [32], Lewis [52]) to guide us
- however, when there isn't one, as in (31b), what are the constraints on **R**?
- for example, the trick we used in (31b) (about excluding s from **R** by stipulation) does not work in (31a), for there is no way to read that sentence with the accommodation that s
- what we would like, therefore, is an account of why s is *forced* to be in **R** in (31a), but not in (31b)
- Fox and Katzir [25] argue for certain closure properties on **R** (namely, that it is closed under negation and conjunction) that shed light on certain forced relevance conditions
- more specifically, if a set of alternatives $A \subset A(\phi)$ is under consideration, then any $\beta \in A(\phi)$ that is defined using elements in A by $\neg$ and $\wedge$ must also be considered
- note however that this will not ensure that the antecedent of a conditional must be considered
- in general, it seems we need some constraint that ensures that the antecedent and consequent of a conditional (as well as each disjunct in a disjunction) are relevant
- for consider the following contrasts

33. (a) I have more than one son
(b) # I have two or more sons

34. (a) If John flies to Toronto, he has a sister
(b) # If I fly to Toronto, I have a sister

35. (a) If John has a daughter, he's married to an American
(b) # If I have a daughter, I'm married to an American

- although the two sentences in (33) both convey the same information, only (b) is odd
- why should this be?

- we could account for its oddness under the following assumptions: (i) the disjuncts are necessarily relevant, (ii) it is common knowledge that I know the makeup of my family[25]

- with these assumptions, (33b) sentence, but not (33a), will give rise to an ignorance inference that the speaker does not know whether he has (exactly) two sons or more than two sons[26]

- along with the idea that contradictions between implicatures and common knowledge result in oddness (eg. Hawkins [33], Heim [36], Fox and Hackl [24], Magri [53]), the contrast follows

- similar remarks apply to the other (b) sentences

- they sound bad, in contrast to the (a) sentences, because they give rise to crazy ignorance inferences (eg. that I don't know whether or not I have a sister, daughter, an American wife, etc.)

- I believe this teaches us that we need the antecedent and consequent of conditionals to be forced to be relevant

- the Fox and Katzir closure conditions do not derive this result, so something else will be needed

- moreover, the necessary relevance of these consituents should go away when embedded under *know*, for the following sentences do not necessarily result in oddness, but can

- the latter in itself is a surprising fact, for it shows that you can get *speaker* ignorance inferences even when embedded under *know*, and (as (37) and (38) below show) these can show up even in DE contexts (which are normally thought to shut off implicatures)

36. (a) Mary knows that I have more than one son
(b) # Mary knows that I have two or more sons (but oddness decreases if this is an answer to, *what has Mary figured out about your family life?*)

[25] These assumptions might also help to derive Hurford's Constraint [40], which states that a disjunction is odd if its disjuncts stand in an entailment relation (see also Gazdar [28], Fox [19], Singh [73], Fox [22], Katzir [45], Chierchia, Fox, and Spector [11], Fox and Spector [26]). For example, # *John was born in Paris or in France* would be odd because it gives rise (necessarily) to the ignorance inference that the speaker is ignorant about whether John was born in Paris, and about whether John was born in France, which would contradict the common knowledge (given the assertion) that the speaker is certain that John was born in France. This is obviated in the case of *John ate some or all of the cookies* if there is an embedded implicature at the first disjunct that John ate some but not all of the cookies (see Fox [19], Chierchia, Fox, and Spector [11], Fox and Spector [26], and see Singh [73] for an argument as to why this option is not available for the Paris-France type cases). Katzir [45] proposed a derivation of HC from pragmatic principles based on assertability conditions essentially along the above lines, i.e. once we put in place minimal conditions on assertability (eg. assert ϕ only if you believe ϕ), the implicature that the disjuncts in the Paris-France case are not assertable contradicts the assertability of the disjunction (since you could have asserted *John is from France*), while there is no such contradiction in the case of quantifiers (you could be in a position to assert 'some or all,' but not to assert 'some' (since doing so would give rise to the implicature that not all), nor to assert 'all'). As far as I know, Katzir's is the only current proposal for deriving HC from general principles. See Singh [72] for an argument that an embedded exhaustive operator is crucially involved. These issues are complex, and I leave them here.

[26] See Fox [22] for a discussion about the difference in implicature between 'more than n-1' and 'n or more' sentences.

37. (a) No one in this company knows that I have more than one son
(b) # No one in this company knows that I have two or more sons

38. (a) No one in this company knows that if John flies to Toronto, he has a sister
(b) # No one in this company knows that if I fly to Toronto, I have a sister

39. (a) Mary knows that if John has a daughter, he's married to an American
(b) # Mary knows that if I have a daughter, I'm married to an American (the oddness decreases if this is offered as an answer to the question, *What has Mary figured out about you?*)

40. (a) No one in this company knows that if John has a daughter, he's married to an American
(b) # No one in this company knows that if I have a daughter, I'm married to an American[27]

- I do not have an account that derives the facts about relevance above
- we might try adding a closure condition along the lines: if $\phi \wedge \psi$ is relevant, so are ϕ, ψ, although this is not as natural as the Fox and Katzir conditions, and so would need further motivation
- another alternative might involve closing under 'aboutness' in the sense of Lewis [52], which (I think) might also derive the above facts
- I leave this for future work, but believe that with some such notion in place, the above facts are consistent with our framework[28]
- if this is on the right track, it might teach us that not only can formal alternatives $A(\phi)$ break symmetry in **R** (as discussed in Fox and Katzir [25]), but that **R** can also break symmetry in $A(\phi)$
- thus, we have two ways of breaking symmetry in $A(\phi)$: certain operators (depending on their projection properties), and relevance

7 On Accommodation as Context Repair

- the system developed above seems to make a possibly fatal prediction
- since $\mathcal{H}$ contains propositions whether they're needed or not (it just juices the scalar alternatives without regard to what is or is not contextually given), we predict that we should sometimes find accommodation-like inferences even when the presuppositions of the asserted sentence are satisfied in the context of use

[27] It is noteworthy that the fact that the ignorance inference shows up here is further evidence that implicatures work over non-weaker alternatives, for the antecedent and consequent of the embedded conditional are neither weaker nor stronger than the assertion itself.

[28] Fox [20] speculates that there might be a general pressure to avoid ignorance inferences. If some such pressure is in place, we might expect it to put a pressure on the nature of relevance reasoning, where a set of alternatives that avoids symmetry is preferred to one that generates more symmetry (if the choice is available). Clearly this is far from an actual proposal.

- although some theories of presupposition are okay with such a result (eg. Gazdar [28], Karttunen and Peters [43], van der Sandt [61], Chemla [9]), such a prediction goes against a fundamental insight of all common ground theories of presupposition (eg. Karttunen [42], Stalnaker [77], Heim [34], Schlenker [65], von Fintel [15])

- presuppositions are contraints on the common ground, and if the context satisfies the presupposition, there is of course no need for accomodation, for the latter is a repair strategy made under threat of presupposition failure (eg. Lewis [51])

- for example, if the conditional presupposition of (8)=(19) (= *If John flies to Toronto, his sister will pick him up from the airport*) is met in the context of use, there should no longer be any inference to John actually having a sister

- here is evidence in favour of this idea (eg. Heim [38])

41. If John flies to Toronto, he has a sister. Moreover, if he flies to Toronto, his sister will pick him up from the airport

- in a recent manuscript, Roni Katzir and I (Katzir and Singh [47]) have tried to argue that there is a confound in (41)

- it is fairly well-established (eg. Geurts [31], Heim [38]) that if an ignorance inference concerning p has been introduced, accommodation of p is not possible

42. (a) # Either John has a sister or he has a brother. His sister will pick him up from the airport
    (b) # John might have a sister. His sister will pick him up from the airport
    (c) # If John has a sister, then I'm sure he has a brother too. His sister will pick him up from the airport.

- returning to (41), the first sentence of the text introduces an ignorance inference (that the speaker doesn't know whether John has a sister)

- this rules out accommodation of John having a sister

- however, if we can find a way to satisfy the conditional presupposition without introducing an ignorance inference, we should all of a sudden find an inference to John having a sister possible again

- here is a case (from Katzir and Singh [47]) that supports this prediction (assume that it is common knowledge that John works for Company X)

43. Every man who works for Company X and flies to Toronto has a sister. Moreover, if John flies to Toronto, his sister will pick him up from the airport

- it is entirely natural to infer from the above text that John has a sister

- moreover, the inference seems presuppositional in nature, given that it is possible to use von Fintel's HWAMT on it

44. S: Every man who works for Company X and flies to Toronto has a sister. Moreover, if John flies to Toronto, his sister will pick him up from the airport
H: Hey wait a minute! I didn't know John has a sister!

- this fact is unsurprising from the point of view of the system developed here

8 On the need for *Maximize Presupposition!*

8.1 *Maximize Presupposition!*

Maximize Presupposition! If you have two LFs, ϕ, ψ, that are contextually equivalent, but ψ has stronger presuppositions that are met in the context of use, then you must use ψ

45. (a) {#A / the} sun is shining
(b) {#All / both} of John's eyes had to be operated on

- Heim [36], who discovered the principle, first presented an argument suggesting that MP could be derived as an implicature
- the sentence with the weaker presupposition (A, All) would give rise to the implicature that the speaker was unable to utter the one with the stronger presupposition (the, both), which would result in the implicature that the speaker doesn't know the presupposition of (the, both) (eg. that she doesn't know that there is exactly one sun, that she doesn't know that John has exactly two eyes)
- following the standard terminology (eg. Percus [54], Chemla [7], Sauerland [63]), call such inferences 'implicated presuppositions,' to set them apart from standard implicatures
- Heim's goal was to show that implicated presuppositions are nothing more than run of the mill implicatures
- let's see how the oddness would follow from the theory of implicature
- note that these implicated presuppositions contradict common knowledge (eg. the common knowledge that the speaker knows that there is exactly one son), and Heim wanted *this* inference-common knowledge mismatch to be held responsible for the oddness, as we know happens with standard cases of implicatures (eg. Fox and Hackl [24], Magri [53], cf. also Hawkins [33])
- Heim notes that the reasoning can't go through, however, because, under a Gricean story, the two alternative sentences are contextually equivalent, and so the maxim of quantity is thereby made inert
- the conclusion is that MP needs to be stipulated as a primitive, and implicated presuppositions have to be derived from a separate component that does not follow from standard implicature reasoning
- this and related arguments have been made frequently in the literature (eg. Percus [54], Sauerland [63])

8.2 Grammatical Implicatures to the Rescue?

- Heim's derivation of MP from implicature-common knowledge mismatches could go through if the implicature mechanism had no access to contextual information, and instead operated over *logical* information alone
- suppose that this is a general phenomenon, i.e. that contradictions between blind scalar implicatures and common knowledge result in oddness (Fox and Hackl [24], Magri [53])
- Magri [53] uses this idea to shed light on a complex array of data concerning individual level predicates (inter alia)
- but, he argues, that this won't be enough to derive MP, because there are data that stubbornly remain beyond the scope of blind implicature computation, but seem to reflect an MP type principle
- I've argued elsewhere against this conclusion (Singh [74]), and I don't wish to discuss that issue here
- instead, I want to focus on three remaining difficulties that arise for any attempt to get MP facts out of a theory of implicature

Question 1: The Epistemic Status of Implicated Presuppositions Sauerland [63] has argued that, unlike implicatures, which come with a strong epistemic status (i.e. the speaker knows that not p), implicated presuppositions come with a weak epistemic status (ignorance inferences)

Question 2: Equivalent Sentences Percus [54] discovered that there are sentences that presuppose the same thing (nothing at all), and are truth-conditionally equivalent, but which still give rise to MP effects

46. Every teacher who has exactly two students gave an A to them {# all / both}

- since the two sentences above are true and false in the same worlds, there should be no implicature

Question 3: DE Contexts If MP is indeed an instance of mismatch between blind scalar implicature and common knowledge, why do we still find MP type oddness in DE contexts, which normally shut off implicatures? (Sauerland [63])

47. # A sun isn't shining

48. Context: We know John has two sons.
If all of John's sons come to the party, I'll be happy

- will argue that our system developed above, crucially the interaction between $\mathcal{N}$ and $\mathcal{H}$, possesses different enough logical relationships among alternatives from standard cases of scalar reasoning to allow the required implicature to be generated, hence keeping alive the prospect of eliminating MP from the primitive inventory of natural language semantics/pragmatics

8.3 Question 1: Epistemic Status of Implicated Presuppositions

- the epistemic status of implicated presuppositions argued for by Sauerland [63] follows directly from our system without any further stipulations
- consider the contrast from (45b) again, repeated below as (49)

49. (a) # All of John's eyes are open
    (b) Both of John's eyes are open

- $A(a) = \{(a), (b)\}$
- $\mathcal{N} = \{\neg(a), \neg(b)\}$
- $\mathcal{H} = \{p\}$ (where p is the proposition that John has exactly two eyes
- $\neg(b)$ and p are symmetric alternatives, so there is no way to conclude $\neg(b)$, hence no way to get a strong epistemic status for the implicated presupposition
- the best you can do, is ignorance (given symmetry)

8.4 Question 2

- facts like (46), discovered by Percus [54], led Percus [54] and Singh [71] to argue for a revised statement of MP, and, in particular, to localize it (to words (Percus) or local contexts (me))
- the sentences presuppose nothing, and are equivalent in all contexts
- thus, implicatures seem to be unavailable here
- unless, of course, implicatures operate in a super-modular domain, namely, over Gajewski-LFs (Gajewski [27]), which are LFs stripped of all but logical information, with non-logical vocabular replaced by variables
- note that the Gajewski-LF of (46) containing *both* entails the Gajewski-LF of (46) containing *all*
- Fox and Hackl [24] provide evidence that Gajewski-LFs are the right level at which to compute implicatures
- this move, if correct, will allow us to overcome this difficulty

8.5 Question 3: DE Contexts

- this section makes a specific architectural assumption that wasn't made above, namely, that implicatures are computed by an exhaustive operator, exh, within the grammar[29]
- once we make this assumption, since exh is a syntactic device, we expect it to be able to show up in any embedded position (Fox [20], Chierchia, Fox, and Spector [11], Fox and Spector [26])
- thus, given sentence S containing sentence T, $S(T)$, we expect (given exh) the existence of rampant ambiguity, with parses like the following being possible: (i) $S(T)$, (ii) $exh(S(T))$, (iii) $S(exh(T))$, (iv) $exh(S(exh(T))$, etc.[30]
- Fox and Spector [26] present evidence that not all parses are available due to an economy condition on the licensing of exh:

Economy Condition on the Licensing of EXH The parse $S(exh(\phi))$ is licensed only if $S(exh(\phi))$ is not entailed by $S(\phi)$.[31]

- it turns out that in all the cases we will examine in this section, their economy condition will rule out all embedded occurrences of exh (with default pronunciation), so I will restrict my attention in what follows to a single ambiguity: the parse with exh taking matrix scope, or the parse without any exh at all
- it has been argued that when this choice is available, i.e. that when matrix exh is licensed, the grammar incorporates a disambiguation principle that prefers the parse with exh over the parse without
- such a principle has been argued to be needed (see especially Magri [53]) in order to make sense of the apparent obligatoriness of implicatures in certain contexts (eg. # *John gave the same grade to all of his students. He gave an A to some of them* (Schlenker [64], Magri [53], Singh [74])[32]
- the idea is that the grammar prefers to parse the sentence with an exh, generating the reading that John gave an A to some but not all of his students, which contradicts the common knowledge that he gave them all the same grade
- the more general principle is that oddness results if implicatures contradict common knowledge (Hawkins [33], Heim [36], Fox and Hackl [24], Magri [53], Singh [74])

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[29] I make this assumption because it will allow for the statement of fairly natural constraints governing the licensing of exh in a parse. Of course, it may well be possible to formulate the relevant constraints without this assumption, but I do not see a way to do that now, so will make this assumption, leaving open how crucial it is for the account.

[30] See Fox [22] (Note 39) for a proof that you always reach a fixed point, i.e. that there always exists a finite number n such that for all $k > 0$, $[[exh^k(exh^n(\phi))]] = [[exh^n(\phi)]]$, so long as the set of alternatives is finite.

[31] This is not accurate. Their actual proposal is more refined than this, but the additional complications will not be relevant in any way to what I say here (I think).

[32] I do not try to motivate this principle here. It has been suggested (eg. Chierchia [10], Chierchia, Fox, and Spector [11]) that the strategy might be derivable from something like a strongest meaning hypothesis (eg. Dalrymple et al. [12], Blutner [6]). Alternatively, it might be derived from a pressure to avoid unwanted ignorance inferences (Fox [20]).

Consistency Requirement on EXH $exh(\phi)$ is odd if $c[exh(\phi)] = \emptyset$.

- to derive the necessary oddness, then, exh must be obligatory[33]
- I will state this obligatoriness in terms of a (grammatical) parsing preference[34]

Parsing Preference If ϕ is the asserted sentence, and $exh(\phi)$ is an available parse, the grammar prefers to parse the sentence as $exh(\phi)$, rather than ϕ.

- with these assumptions in place, let's turn to the computation of implicatures in DE environments
- recall that what we want to do is argue that MP is an instance of a contradiction between the output of exhaustivity and common knowledge
- moreover, we want this difficulty to remain even in downward entailing environments (eg. # *A sun isn't shining*, # *John didn't get surgery on all his eyes*)
- however, Sauerland [63] raises the question of how this could be possible, given the well-known fact that implicatures are shut off in such environments
- the standard MP cases (eg. # *John got surgery on all his eyes*) lose out to an asymmetrically stronger alternative (eg. *John got surgery on both his eyes*), but in normal cases of scalar items, embedding under negation reverses the order of strength, making implicatures unavailable
- for example, consider a disjunction embedded under negation

50. John didn't eat beef or pork at the party

- this sentence has no implicature to speak of, for it entails all of its potential implicatures
- i.e. $exh(\neg(P \vee Q)) = P \vee Q$,[35]
- given the equivalence of the parse with exh and the one without, the parse with exh is not licensed by Fox and Spector's economy condition[36]

[33] See Magri [53] for much discussion.

[34] There is accummulating evidence for the correctness of this in matrix sentences (see, eg. Magri [53], Chierchia, Fox, and Spector [11], Singh [74]). However, it is not clear that the preference holds in all positions where exh might be licensed. For example, *every student did some of the homework* can have exh taking matix scope (every student did some of the homework and it's not true that every student did all of the homework), or scope over the nuclear scope alone (every student did some but not all of the homework). The preferred reading seems to be the matrix scope reading (as predicted, over the one without an exh at all). However, it is not clear (to me) how this choice (exh or not in matrix position) interacts with choices in embedded positions. It is to be hoped that tying this preference to a deeper motivation will yield insight into what preferences there are (if any) concerning exh in embedded positions (eg. if the motivation is to prefer the parse with the least number of ignorance inferences, then (as far as I can tell) the grammar will not decide between these two parses). In what follows, I will speak only of the matrix choice point, and accept the incompleteness of the discussion. This choice does not bear in any way on anything that follows, especially since embedded exh isn't licensed in any of the following examples.

[35] The set of alternatives is $\{\neg(P \vee Q)\neg P, \neg Q, \neg(P \wedge Q), P \vee Q, P, Q, P \wedge Q\}$.

[36] Trying to embed exh below negation won't help either, since $\neg(P \vee Q)$ asymmetrically entails $\neg(exh(P \vee Q))$. The former means $\neg P \wedge \neg Q$, while the latter is weaker, meaning $(\neg P \wedge \neg Q) \vee (P \wedge Q)$.

- thus, no implicature is available for a sentence like (49)
- now, if we want to get an implicature to capture the oddness of # *A sun isn't shining*, or # *John didn't get surgery on all his eyes* we need to show that one is actually available, despite having embedded the weaker alternative under negation
- i.e. we need to show that exh is licensed here, as opposed to the standard scalar cases (eg. $\vee$, $\wedge$)
- let's work through one of our examples to see that an implicature is licensed

51. # John didn't get surgery on all his eyes

- we have the following alternatives: {not All, not Both, All, Both}
- $\mathcal{N}$ = {not All, not Both, All, Both}
- $\mathcal{H}$ = {that John has exactly two eyes}
- we thus have: $\mathcal{N} \cup \mathcal{H}$ = {not All, not Both, All, Both, that John has exactly two eyes}
- now consider the parse $exh(\neg\forall)$
- it turns out that the parse ends up meaning, given our alternatives, that John has exactly two eyes and that he didn't get surgery on all his eyes[37]
- this means, in turn, that exh in this position strengthens the sentence, i.e. $exh(\neg\forall)$ asymmetrically entails $\neg\forall$, since it has the additional inference that John has exactly two sons
- why is this relevant? before stating the relevant principle, let's note that Sauerland's concern with the possibility of getting an implicature in DE environments is now overcome
- as we saw earlier, if we tried to exhaustify $\neg(P \vee Q)$, the parse $exh(\neg(P \vee Q))$ would not be licensed, since exh in this position is logically vacuous (i.e. $[[exh(\neg(P \vee Q))]] = [[\neg(P \vee Q)]]$)
- however, when there are scalar alternatives that carry presuppositions, this logical situation need not arise
- in this case, 'not all' introduces the alternative 'not both,' which brings the presupposition that there are exactly two – the latter proposition is innocently includable by our procedure, and thus exh actually strengthens the meaning
- crucially, this requires a theory of alternatives that looks at implicature candidates and presupposition candidates together

[37]The innocently includable propositions are {not All, not Both, that John has exactly two eyes}.

- so, again: what strengthens the parse $exh(\neg\forall)$ is that $\forall$ has *both* as an alternative, which gives us a presupposition that then gets 'innocently included'[38]

- in cases like $exh(\neg\vee)$, the exh is vacuous, since no new information can be extracted from the alternatives (since there are no presuppositions lying around)

- now, returning to (51), we have two parses that could go with the sentence: one with an exh, and one without[39]

- given the parsing strategy (prefer exh where it's licensed), the grammar selects the parse with exh

- but so what? why should *John didn't get surgery on all his eyes* be infelicitous?

- recall that the predicted meaning is that he didn't get surgery on all his eyes, and that he has exactly two eyes – there is no contradiction with context, which was crucial for us in attempting to derive MP from implicature

- in cases like this, I would like to argue, something else goes wrong, namely, the exh here might not be contextually contradictory, but it is contextually vacuous, in that $exh(\neg\forall)$ and $\neg\forall$ are contextually equivalent

- if we could show that this is a general constraint, i.e. that $exh(\phi)$ is infelicitous if $c[exh(\phi)] = c[\phi]$ (independently of the theory of maximize presupposition), then we would be done

52. Context: We're trying to figure out who is and is not coming to the party.
    A: What about John and Mary? Any word on them?
    B: Yes, I've learned at least that the two of them won't both be at the party.
    A: I see. Anyone else like to add anything?
    C: # Yes, either John or Mary will be at the party
    C: Yes, at least one of them will be at the party

- note that each of C's responses conveys the same new information (that at least one of John or Mary will be at the party)

- and, note that the response is informative (i.e. the content is not vacuous)

- however, in the disjunctive case, we have a contextually vacuous exh, since, in this case, $c[exh(J \vee M)] = c[J \vee M]$

- this seems to be the independent evidence we need for our new constraint against a contextually vacuous exh

[38]The fact that $\neg\forall$ doesn't give rise to the inference that John has exactly two sons in out of blue contexts will have to involve some assumption about those contexts, namely, that the alternative with *both* simply isn't relevant. Following Magri [53], what's special about the contexts where the presupposition of the *both* sentence is met is that the alternatives are contextually equivalent, which (under Magri's assumptions) suffices to ensure that both alternatives are necessarily relevant, hence ensuring that there's no escape from oddness. I hope a better understanding of relevance will make this seem less stipulative than it is here.

[39]An exh embedded below negation will not be licensed by Fox and Spector's economy condition.

- before turning to some more cases, here is the constraint on exh that seems to be needed

Informativity Requirement on EXH Use of LF $exh(\phi)$ in context c results in oddness if exh is contextually vacuous, i.e. if $c[exh(\phi)] = c[\phi]$.

- the contrast observed under negation comes up (of course) in all DE contexts sharing the same projection properties as negation
- for example, consider the antecedent of a conditional
- when there are no presuppositional scalar items involved, eg. *if John or Mary came to the party, I'm sure it was great*, we predict that there should be no implicature
- an exh that takes the entire conditional would be vacuous, and an exh inside the antecedent would weaken the sentence, hence no parse with an exh is licensed (by Fox and Spector economy)
- but when presuppositional items are involved, the logical properties are different

53. Context: John has exactly two sons.
If John brings all of his sons, the party will be great

Consider the following parses:

54. (a) We parse the sentence without an exh anywhere, i.e. as 'If $\forall$, Y'
(b) If $exh\forall$, Y
(c) exh (If $\forall$, Y)

- parse (a) is fine
- parse (b) is ruled out by Fox and Spector economy
- parse (c) yields a stronger meaning than the one in (a)
- here is why: it has an alternative: (if both, Y), which presupposes that 'exactly two'
- (c) thus means '(a) and exactly two'
- thus the parse in (c) is licensed
- by the preference for exh, (c) is preferred to (a)
- but then the occurrence of exh there is contextually vacuous, given our common knowledge that John has exactly two sons

9 Concluding Remarks

- have argued for a model of meaning enrichment under which candidates for implicature and candidates for accommodation are derived from the scalar alternatives of the sentence (subject to contextual pruning based on relevance)
- moreover, these sets interact, in that the union of the two sets constitutes the input to the enrichment algorithm (innocent inclusion)
- those candidates that survive innocent inclusion become the actual implicatures and actual accommodations
- we argued that symmetry is a major factor in preventing candidate enrichments from becoming actual enrichments
- moreover, crucially, candidate implicatures and candidate accommodations can create symmetry problems for each other
- we argued that with this architecture, the puzzles discussed in this paper (the proviso problem, overgeneration of implicatures, the elimination of *Maximize Presupposition!*) can be solved; without it, they remain mysterious
- if this approach is on the right track, presupposition accommodation and scalar implicature are much closer than normally thought
- I thus see this work as situated within a set of arguments found at various points, motivated by different data, arguing that the apparent divergence of implicatures and presuppositions is not quite accurate (eg. Gazdar [28], Karttunen and Peters [43], Soames [75], Katzir [44], Chemla [9, 8])
- but there are several arguments that point toward a separation of these domains (eg. projection tests)
- I don't quite know how to reconcile the apparent closeness with these arguments for divergence, but there is also evidence that the diagnostics are not as sound as they appear to be (again, see especially Chemla [9, 8])
- at another level of description, it has recently been argued that implicature computation takes place: (i) within an informationally encapsulated system (eg. Fox and Hackl [24], Magri [53], Chierchia, Fox, and Spector [11], Singh [74]), (ii) by means of an exhaustive operator (eg. (eg. Groenendijk and Stokhof [32], Krifka [49], Chierchia [10], van Rooij and Schulz [58], Fox and Hackl [24], Schulz and van Rooij [68], Fox [20], Magri [53], Chierchia, Fox, and Spector [11], Singh [72]))
- recall our discussion (Section 5.2) about the restrictions on the candidate sets for accommodation

- if our reduction of MP to this architecture is sound, we have new evidence that the restriction is quite severe: specifically, the system must be informationally encapsulated from common knowledge (i.e. the right notion of 'consistency' that is used by the system is not contextual, nor semantic, but purely logical, in the sense of Gajewski [27])
- moreover, to the extent that the reduction depends on constraints on exh, it might also argues for the existence of exh (cf. also Fox and Spector [26] and Singh [72] for arguments along these lines)
- if the arguments here are sound, they lead to a revised cognitive architecture, one in which various inferences (implicatures, accommodation, implicated presuppositions) thought to be central to pragmatic competence are actually more indicative of grammatical competence, computed by the linguistic system without access to the system(s) of the mind responsible for rational inference and action

10 Appendix: Summary of System

Suppose ϕ is asserted in context c. The implicatures and accommodated presuppositions in response to ϕ are computed by use of the exhaustive operator, as follows. The LFs are Gajewski-LFs, and the only information accessible to the system is logical and structural.

- generate the scalar alternatives to ϕ, $A(\phi)$ (using Katzir's [46] algorithm)

Scalar Alternatives Let ϕ be a parse tree. Then parse tree ψ is a scalar alternative to ϕ if ϕ can be transformed into ψ via a finite sequence of the following operations: (i) Deletion (removing edges and nodes from the tree), (ii) Contraction (removing an edge and identifying its edge nodes), (iii) Subsitution of structures for other structures from a substitution source.

Substitution Source The subsitution source for parse-tree ϕ is the union of the lexicon of the language with the set of all subtrees of ϕ.

The Actual Alternatives The actual alternatives used by the system, $ALT(\phi)$, is: $ALT(\phi) = A(\phi) \cap$ **R**, where **R** is a set of contextually relevant propositions (Fox and Katzir [25]).

- Generate candidate set of implicatures, $\mathcal{N} = \{\neg p : p = A(\psi), \psi \in ALT(\phi)\}$
- Generate candidate set of accommodations, $\mathcal{H} = \{\pi(\psi) : \psi \in ALT(\phi)\}$
- Form $\mathcal{N} \cup \mathcal{H}$
- Find Maximal Consistent Subsets M_i of $\mathcal{N} \cup \mathcal{H}$ such that: (i) The conjunction of the propositions in each MCI is consistent with $[[\phi]]$, and (ii) $\pi(\phi)$ is in each MCI
- Form the intersection of each MCI, $M_1 \cap \ldots \cap M_k = \mathcal{I}$ (these are the innocently includable propositions)

Symmetric Alternatives ϕ, ψ are *symmetric* alternatives if they cannot together belong to any MCI. It follows that symmetric alternatives will never belong to $\mathcal{I}$.

- $r \in \mathcal{N}$ is a *scalar implicature* iff $r \in \mathcal{I}$
- $r \in \mathcal{H}$ is an *accommodated presupposition* iff $r \in \mathcal{I}$

(Grammatical) Economy Condition Licensing EXH Parse $exh(\phi)$ is licensed (by the grammatical system) only if $[[exh(\phi)]]$ is not (logically) entailed by $[[\phi]]$ (Fox and Spector [26]

(Grammatical) Parsing Preference Given the parse ϕ and $exh(\phi)$ (for matrix ϕ), the grammar (by default) disambiguates in favour of $exh(\phi)$ (Magri [53]).

(Pragmatic) Consistency Requirement on EXH $exh(\phi)$ is odd if $c[exh(\phi)] = \emptyset$ (Fox and Hackl [24], Magri [53]).

(Pragmatic) Informativity Requirement on EXH Use of LF $exh(\phi)$ in context c results in oddness if exh is contextually vacuous, i.e. if $c[exh(\phi)] = c[\phi]$.

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