Spreading Ignorance*

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Abstract The notion of alternatives is one of the most pervasive notions in the modern study of meaning, and different characterisations of this notion have been proposed in the literature. In this paper, we focus on two them. The first one sees alternatives as alternative sentences derived through substitution operations. The second sees alternatives as alternative propositions associated with the presence of certain operators. While both these notions have been argued to be central to the derivation of a variety of inferences, it is an open question whether both of them are needed to account for pragmatically enriched meanings. This paper brings a novel perspective on this question by focusing on ignorance inferences coming from disjunctive sentences of varying complexity. We show that the predictions of the two approaches come apart for disjunction embedding conjunction and that only the notion of alternatives as alternative sentences can account for the range of ignorance inferences observed in these environments. We take this result to suggest that tightening alternatives to the presence of specific operators is too constrained of an assumption to adequately capture the distribution of ignorance inferences. We end by discussing a problematic case for the notion of alternatives as alternative sentences and sketch a solution based on formal constraints on alternatives which have been independently argued for in the literature.

Keywords: disjunction, conjunction, ignorance inferences, implicatures, Inquisitive Semantics, alternatives

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Contents

1 Introduction

A wide variety of phenomena at the semantics-pragmatics interface have been hypothesized to arise from a competition between alternatives, making the notion of alternatives one of the most pervasive notions in the modern study of meaning (see Gotzner & Romoli 2022, Repp & Spalek 2021 and references therein). Alternatives have been taken to represent, among other things, the relevant things that the speaker could have said in place of what she said, or the possible answers to a question that the speaker is raising. In this paper, we consider two distinct notions of alternatives which have been both argued to be at the core of various semantic-pragmatic phenomena, most notably implicatures, focus, and questions.

The first notion is that of alternatives *qua* alternative sentences, which has been developed in the literature on implicatures (Horn 1972, Sauerland 2004, Katzir 2007, Fox & Katzir 2011, a.o.). On this characterization, alternatives are formal objects which come to be associated with asserted sentences either through lexical associations with some of their parts or through a general algorithm relying on a dedicated set of substitution operations. The second notion is that of alternatives *qua* alternative propositions, which has been developed in the literature on focus and question and implemented in different, but related frameworks such as Alternative Semantics (Hamblin 1973, Karttunen 1977, a.o.), Partition Semantics (Groenendijk & Stokhof 1984, Groenendijk 1999, a.o.), and more recently Inquisitive Semantics (Ciardelli et al. 2018 among others). On this characterization, alternatives are distinct propositions which come to be associated with the meaning of a sentence due to the presence of specific operators such as disjunction.[1]

While both notions have been fruitfully applied to model various phenomena, it is an open question whether we need them both to account for pragmatically enriched meanings and if so, how both types of alternatives interact with one another. In this squib, we bring a novel perspective on this question by focusing on ignorance inferences coming from disjunctive sentences of varying complexity. We present a novel phenomenon, which we dub *ignorance spreading*, showing that, when conjunction is embedded under disjunction, ignorance may 'spread' to the embedded conjuncts. We explain how this phenomenon allows us to distinguish between the two notions of alternatives outlined above and we show that only the first notion of alternatives as formal objects can help us account for this phe-

1 A third notion of alternatives, originating in the seminal work by Paul Grice on implicatures (Grice 1975), and articulated in Fox 2007 among others, is that of alternatives as contextually relevant propositions. On a Gricean approach to ignorance inferences, this notion makes the same prediction as the first notion above with respect to the phenomenon that we discuss in Section 3. It is less clear, however, how the resulting approach could account for the problematic case that we discuss in Section 4. We also leave for future work an investigation of the notion of alternatives as alternative concepts, recently suggested in Buccola et al. 2022, in relation to ignorance inferences.

nomenon. We take this result to show that tying alternatives to the presence of specific operators is too constrained of an assumption to adequately capture the distribution of ignorance inferences. We end this squib by discussing problematic cases and open questions for implicature theories of ignorance inferences.

2 Background

2.1 Ignorance inferences

Disjunctive sentences are known to readily give rise to ignorance inferences (IIs). Thus for instance, an utterance of (1) strongly suggests that the speaker doesn't know which of the two disjuncts is true, i.e., which of Ed or Ed's friend is American. Here and in the following, we use $I_s(\phi)$ as an abbreviation for 'the speaker s is ignorant about ϕ', where $I_s(\phi)$ holds if and only if s does not believe ϕ and does not believe $\neg\phi$, that is, if and only if both $\neg B(\phi)$ and $\neg B(\neg\phi)$ hold.

(1) Ed is American, or his friend is. $\phi \vee \psi$
$\rightsquigarrow I_s(\textit{Ed is American})$ $I_s(\phi)$
$\rightsquigarrow I_s(\textit{Ed's friend is American})$ $I_s(\psi)$

IIs are not specific to simple disjunctive sentences. Similar IIs arise from more complex disjunctive sentences like (2), where another disjunction is embedded in the second clausal disjunct. In such cases, IIs are generated for each single disjunct. That is, an utterance of (2) strongly suggests that the speaker doesn't know which of Ed, Ed's friend or Ed's neighbor is American.

(2) Ed is American, or his friend is, or his neighbor is. $\phi \vee (\psi \vee \chi)$
$\rightsquigarrow I_s(\textit{Ed is American})$ $I_s(\phi)$
$\rightsquigarrow I_s(\textit{Ed's friend is American})$ $I_s(\psi)$
$\rightsquigarrow I_s(\textit{Ed's neighbor is American})$ $I_s(\chi)$

One way of sharpening intuitions about the IIs in (1) and (2) is to minimally modify the above sentences so as make one of the disjuncts about the speaker herself, e.g., by using a first-person pronoun. The corresponding IIs should now contradict the common assumption that people are normally knowledgeable about personal facts like their citizenship and, as a result, the sentences they arise from should be perceived as infelicitous – even though the speaker's citizenship is not known in the context. As exemplified in (3) and (4), the resulting sentences are indeed infelicitous, regardless of the position of the offending disjunct. The infelicity of these sentences evidence the presence of the IIs we described and suggest that, in the absence of further contextual specifications, the IIs associated with disjunction are not just readily generated, but also hard to suspend.

(3) a. #I am American, or Ed is.
b. #Ed is American, or I am.

(4) a. #I am American, or Ed is, or his friend is.
b. #Ed is American, or I am, or his friend is.
c. #Ed is American, or his friend is, or I am.

2.2 Ignorance as quantity implicature

A prominent approach to IIs derive these inferences as scalar implicatures (Grice 1975, Gazdar 1979, Sauerland 2004, Fox 2007, Singh 2010, Meyer 2013, Buccola & Haida 2019). For concreteness, we sketch here a common version of this approach, which builds on Sauerland (2004). On this view, IIs arise on the basis of two ingredients. The first is a version of Grice's Maxim of Quantity, according to which the speaker will contribute all relevant pieces of information that they believe to be true. For our purposes, we will adopt the formulation of this principle in (5).[2]

(5) **Quantity**
If ϕ and ψ are relevant to the topic of conversation and ψ is an alternative to ϕ and ψ's truth value is left underdetermined by ϕ, if the speaker believes that both are true, they should assert ψ rather than, or in addition to ϕ.

The principle in (5) makes reference to alternatives, which is the second ingredient needed on this approach. While different theories of alternatives have been proposed in the literature on implicatures, most of them agree as to what counts as an alternative in the cases that we are interested in. First, a sentence of the form $\phi \star \psi$, where '$\star$' is a binary connective, has ϕ and ψ among its alternatives. Second, a sentence involving two or more connectives combines all the alternatives of each connective. Hence, the alternatives to a sentence of the form $\phi \star (\psi \star \chi)$ include not only ϕ and $(\psi \star \chi)$, but also ψ alone, χ alone and all combinations thereof.

To illustrate, let us go back to the simple disjunctive sentence in (1). As we just discussed, the alternatives to this sentence include the sentences in (6-a) and (6-b):[3]

(6) a. Ed is American. ϕ
b. Ed's friend is American. ψ

Next, the principle in (5) tells us that, on the basis of the speaker asserting (1) and not one of its alternatives in (6), which are arguably relevant as well, the listener

2 This formulation is adapted from Sauerland (2004) and Fox (2007) to include logically independent alternatives, in addition to logically stronger ones; see Singh (2010) for a similar suggestion.

3 The alternatives to (1) also include the conjunctive alternative *Ed is American and Ed's friend is (too)*. We leave this alternative aside in the following as it is orthogonal to our discussion.

will conclude that the speaker is not in a position to assert either of the disjuncts alone, presumably because it is not true that she believes either of them. That is, the listener will draw the inferences in (7): it's not true that the speaker believes that Ed is American and it's not true that she believes that Ed's friend is American.

(7) a. $\neg B_s(\phi)$
b. $\neg B_s(\psi)$

These inferences, together with the Quality assumption that the speaker believes what she asserted, entail that the speaker is also not in a position to utter the negation of any of the alternatives in (6), that is, $\neg B_s(\neg\phi)$ and $\neg B_s(\neg\psi)$. From this point, the IIs that we were after follow: the speaker doesn't know whether Ed is American and she doesn't know whether his friend is, as shown in (8).

(8) a. $I_s(\phi)$
b. $I_s(\psi)$

This derivation extends to more complex cases like (2). The alternatives to the sentence in (2) include the disjuncts of the matrix disjunction, ϕ and $(\psi \vee \chi)$, as well as the ones of the embedded disjunction, ψ and χ alone, and their combinations.[4]

(9)

a.	Ed is American.	ϕ
b.	Ed's friend is American	ψ
c.	Ed's neighbor is American.	χ
d.	Ed's friend is American or Ed's neighbor is.	$\psi \vee \chi$
e.	Ed is American or Ed's friend is.	$\phi \vee \psi$
f.	Ed is American or Ed's neighbor is.	$\phi \vee \chi$

Note that the assertion in (2) does not determine the truth value of any of the alternatives above; in fact, it is easy to see that each of these alternatives asymmetrically entails the assertion. Thus, on the basis of the principle in (5), the listener will conclude that the speaker is not certain about each of these alternatives:

(10) a. $\neg B_s(\phi)$
b. $\neg B_s(\psi)$
c. $\neg B_s(\chi)$
d. $\neg B_s(\psi \vee \chi)$
e. $\neg B_s(\phi \vee \psi)$
f. $\neg B_s(\phi \vee \chi)$

4 Here again, we are ignoring the conjunctive alternatives obtained by replacing one or both disjunctions with a conjunction, as these alternatives are irrelevant to the present discussion.

From the implicatures above and the Quality assumption that the speaker believes what she asserted, the listener will conclude that the speaker is not certain that ϕ is false, nor is she certain that $\psi \vee \chi$ is false, that is, $\neg B_s(\neg\phi)$ and $\neg B_s(\neg(\psi \vee \chi))$, from which the ignorance inferences $I_s(\phi)$ and $I_s(\psi \vee \chi)$ follow. Note that these IIs are, in isolation, compatible with the speaker believing that one of ψ or χ is false. However, given the Quality assumption outlined above, if the speaker believed that ψ is false, she would believe that $\phi \vee \chi$ is true. But we already concluded in (10) that this is not the case. The same reasoning applies to χ with the alternative $\phi \vee \psi$. Therefore, it is not true that the speaker believes that ψ is false and it is not true that she believes that χ is false, that is, $\neg B_s(\neg\psi)$ and $\neg B_s(\neg\chi)$. Taken together, these inferences give us the desired result in (11): the speaker doesn't know whether Ed is American, whether his friend is or whether his neighbor is.

(11) a. $I_s(\phi)$
b. $I_s(\psi)$
c. $I_s(\chi)$

In sum, the implicature approach derives the desired IIs for simple and complex disjunctive sentences based on the Quality assumption that the speaker believes what she said, the Quantity principle in (5) and a theory of alternatives with the simple characteristics that we outlined.[5]

2.3 Ignorance as inquisitive sincerity

A different approach to IIs has recently been suggested in the literature, based on the second notion of alternatives that we mentioned in the introduction. This approach is implemented in Inquisitive Semantics, in which sentence denotations are downward closed sets of propositions. The maximal elements of such sets are referred to as 'alternatives'. In other words, on this view, alternatives are sets of possible worlds associated with the meaning of a sentence. The set of alternatives for a sentence ϕ is denoted $alt(\phi)$. A sentence is called 'inquisitive' just in case it is associated with more than one of such alternatives. Typically, in Inquisitive Semantics, simple disjunctive sentences like (1) are inquisitive because, in this framework, a disjunction is assumed to create a set of two distinct alternative possibilities corresponding to its disjuncts, as shown in (12).

(12) $alt([\![\phi \text{ or } \psi]\!]) = \{[\![\phi]\!], [\![\psi]\!]\}$

5 Another version of the implicature approach derives IIs within the compositional side of meaning. On this approach, IIs result from the interactions of silent operators quantifying over alternatives (a.o., Meyer 2013, Buccola & Haida 2019, Marty & Romoli 2021). For what is relevant for us, this approach derives for (1) and (2) the same inferences as those we described here.

Inquisitive Semantics has been fruitfully applied to a variety of phenomena, involving declarative and interrogative sentences (see Ciardelli et al. 2018 for an overview). What is most relevant for us here is the pragmatic principle in (13), which has been proposed as a way to derive IIs in this framework. This principle, called Inquisitive Sincerity, essentially states that an inquisitive sentence is felicitous only if each of the alternative possibilities it introduces is open in the speaker's mind (Groenendijk & Roelofsen 2009, Coppock & Brochhagen 2013).

(13) **Inquisitive Sincerity**
If ϕ is inquisitive, then ϕ is inquisitive in the speaker's information state.

The working of Inquisitive Sincerity is quite intuitive for questions: a speaker would not ask a question if she already knew which of the possible answer is true. But this principle also applies to disjunctive statements, deriving the IIs we are after. As shown above, the alternatives of an inquisitive sentence like (1) correspond to the meaning of its disjuncts in (6). Thus, the principle in (13) tells us that the speaker must not know which of the two disjuncts is true. This leads us to conclude that the speaker does not know whether Ed is American and she doesn't know whether his friend is, that is, $I_s(\phi)$ and $I_s(\psi)$.

This account straightforwardly extends to three-disjunct sentences like (2). We have two disjunctions in this case, each of which creates a set of alternative possibilities corresponding to its own disjuncts. As a result, a sentence like (2) has three distinct alternatives, as shown in (14). Thus, by the same reasoning as above, we conclude on the basis of (13) that each of these alternative possibilities must be open in the speaker's mind, that is, $I_s(\phi)$, $I_s(\psi)$ and $I_s(\chi)$.

(14) $alt([\![\phi \text{ or } (\psi \text{ or } \chi)]\!]) = \{[\![\phi]\!], [\![\psi]\!], [\![\chi]\!]\}$

In sum, the inquisitive approach derives the desired IIs for simple and complex disjunctions based on a notion of alternatives as alternative possibilities and a simple pragmatic condition on inquisitive sentences. Crucially, in this framework, alternatives arise only when certain inquisitive operators like disjunction are present. This key feature will lead to the divergent predictions associated to the new phenomenon we introduce in this paper and which we now turn to.

3 Spreading ignorance

3.1 The phenomenon

To introduce the phenomenon of interest, let us start by considering the interpretation of simple conjunctive sentences. Uncontroversially, a sentence of the form 'ψ and χ' like (15) conveys that the speaker is knowledgeable about ψ and about

χ and, specifically, that she believes each conjunct to be true. In other words, in contrast to the sentence (1), the one in (15) does not give rise to the inference that the speaker doesn't know which of Ed's friend or Ed's neighbor is American.

(15) Ed's friend is American and so is his neighbor. $\psi \wedge \chi$

As expected, if a conjunctive sentence like (15) is embedded under disjunction, as in (16), the resulting sentence now gives rise to IIs. More surprisingly, however, we observe that such sentences do not just give rise to IIs about each of the disjuncts. Rather, ignorance appears to 'spread' to the embedded conjuncts. That is, an utterance of (16) not only suggests that the speaker is ignorant as to whether both Ed's friend and Ed's neighbor are American, but in fact that she is ignorant as to whether either of them is. Crucially, the IIs associated with each embedded conjunct in (16) do not logically follow from the IIs associated with each clausal disjunct: $I_s(\psi)$ and $I_s(\chi)$ entail $I_s(\psi \wedge \chi)$, but the reverse is not true.

(16) **Ignorance spreading**

Ed is American, or his friend is and so is his neighbor.	$\phi \vee (\psi \wedge \chi)$
$\rightsquigarrow I_s(\textit{Ed is American})$	$I_s(\phi)$
$\rightsquigarrow I_s(\textit{Ed's friend is American})$	$I_s(\psi)$
$\rightsquigarrow I_s(\textit{Ed's neighbor is American})$	$I_s(\chi)$

The infelicity of the sentences in (17) provide further evidence for the existence of the IIs that we report on above. In line with the examples in (3)-(4), a sentence of the form '$\phi \vee (\psi \wedge \chi)$' is infelicitous if the speaker can reasonably be taken to be knowledgeable about ψ or about χ, that is, about any of the embedded conjuncts.

(17) a. #Ed is American, or I am and so is his friend.
b. #Ed is American, or his friend is and so am I.

Finally, we note that ignorance spreading is found in other environments like the antecedent of conditionals, as exemplified in (18). This additional data also shows that the IIs of interest arise independently from the exclusivity implicatures associated with disjunction, which are normally absent in these environments.

(18) If (either) Ed is American or his friend and his neighbor are, then he can apply for a scholarship in this school.
$\rightsquigarrow I_s(\textit{Ed is American})$
$\rightsquigarrow I_s(\textit{Ed's friend is American})$
$\rightsquigarrow I_s(\textit{Ed's neighbor is American})$

3.2 The inquisitive approach

The inquisitive approach correctly predicts that no conjunct-based IIs should arise for simple conjunctive cases like (15). This prediction follows from the fact that, in contrast to disjunction, conjunction is not an inquisitive operator. Specifically, a conjunctive sentence of the form $\psi \wedge \chi$ is associated with a unique alternative, consisting of those worlds where ψ is true and χ is true, as shown in (19). Since $\psi \wedge \chi$ is non-inquisitive, no II is predicted to arise from (15) on the basis of Inquisitive Sincerity.

(19) $alt([\![\psi \text{ and } \chi]\!]) = \{A \cap B : A \in [\![\psi]\!], B \in [\![\chi]\!]\}$

However, the inquisitive approach does not account for the phenomenon of ignorance spreading which we just introduced. On this approach, the alternative possibilities associated with a sentence like (16) are those introduced by the disjunction, as shown in (20). That is, the sentence in (16) has two distinct alternatives corresponding to the meaning of the two disjuncts in (20-a) and (20-b).

(20) $alt([\![\phi \text{ or } (\psi \text{ and } \chi)]\!]) = \{[\![\phi]\!], [\![\psi \text{ and } \chi]\!]\}$

a. Ed is American. ϕ

b. Ed's friend is American and his neighbor is American. $\psi \wedge \chi$

Given Inquisitive Sincerity, (16) should thus give rise to the IIs in (21): the speaker doesn't know whether Ed is American and she doesn't know whether both Ed's friend and Ed's neighbor are. The problem is that, based on these IIs alone, (16) is predicted to be compatible with the speaker being opinionated about any one of the embedded conjuncts, against intuitions. As a result, in a normal conversational context where speakers are assumed to be knowledgeable about their own citizenship, sentences like those in (17) are not expected to be infelicitous. Rather, these sentences are predicted to convey that the speaker is only ignorant as to whether Ed is American and as to whether Ed's friend is.

(21) a. $I_s(\phi)$

b. $I_s(\psi \wedge \chi)$

In sum, the inquisitive approach predicts certain IIs for a disjunction embedding a conjunction, but these IIs are too weak to account for ignorance spreading. The reason for this lies in the way alternatives arise in this approach and, specifically, in the assumption that alternative possibilities are induced by the presence of dedicated operators such as disjunction.

3.3 The implicature approach

Just like the inquisitive approach, the implicature approach correctly predicts that no conjunct-based IIs should arise for simple conjunctive cases like (15). On this approach, this prediction follows from the fact that (15) entails the truth of its conjunct-based alternatives in (22). Since the truth value of ψ and χ is determined by that of $\psi \wedge \chi$, no II is predicted to arise from (15) on the basis of Quantity.

(22) a. Ed's friend is American. ψ
b. Ed's neighbor is American. χ

In contrast to the inquisitive approach, however, the implicature approach accounts for the phenomenon of ignorance spreading. On this approach, the alternatives to a sentence like (16) include not just each disjunct, but also each embedded conjuncts, together with their combinations. For our present purposes, the alternatives of primary interest are given in (23).

(23) a. Ed is American. ϕ
b. Ed's friend is American ψ
c. Ed's neighbor is American. χ
d. Ed's friend is American and Ed's neighbor is American $\psi \wedge \chi$
e. Ed is American or his friend is. $\phi \vee \psi$
f. Ed is American or his neighbor is. $\phi \vee \chi$

None of these alternatives is entailed by the assertion and, therefore, given the Quantity principle in (5), the following inferences obtain:

(24) a. $\neg B_s(\phi)$
b. $\neg B_s(\psi)$
c. $\neg B_s(\chi)$
d. $\neg B_s(\psi \wedge \chi)$
e. $\neg B_s(\phi \vee \psi)$
f. $\neg B_s(\phi \vee \chi)$

Since we also have $B_s(\phi \vee (\psi \wedge \chi))$ by Quality, we conclude that it's not true that the speaker believes that ϕ is false, nor is it true that she believes that $(\psi \wedge \chi)$ is false, that is, $\neg B_s(\neg\phi)$ and $\neg B_s(\neg(\psi \wedge \chi))$. Similarly to the three-disjunct case above, these inferences are, in isolation, compatible with the speaker believing that one of ψ or χ is true. However, if the speaker believed that ψ is true, she would also believe that $\phi \vee \psi$ is true, but this would directly conflict with the implicature that we derived in (24-e). The same reasoning applies for the speaker believing that χ is true, with the alternative $\phi \vee \chi$ and the corresponding implicature in (24-f).

Therefore, it is not true that the speaker believes that ψ is false and it is not true that she believes that χ is false, that is, $\neg B_s(\neg\psi)$ and $\neg B_s(\neg\chi)$. The end result in (25) is thus similar to the one for the three-disjunct sentences: the speaker doesn't know whether Ed is American, whether his friend is or whether his neighbor is.

(25) a. $I_s(\phi)$
b. $I_s(\psi)$
c. $I_s(\chi)$

As is easy to see, the presence of similar IIs for sentences like those in (17) would account for their infelicity. This explanation, however, leads us to assume that, in such cases, the derivation of the IIs of interest is mandatory. The question, therefore, is why it should be so. We think that relevance-based considerations about disjunction can provide an answer to this question.

To illustrate, consider the idea from Simons 2001 and Marty & Romoli 2021, according to which, upon hearing a disjunctive sentence, speakers' default expectation is that the implicit Question under Discussion (QuD) being addressed is one that makes each disjunct relevant. For instance, in simple cases like (3-a), repeated below, the default QuD would be one that makes the citizenship of each protagonist relevant, e.g., a *wh*-question like *Who (amongst you) is American?* or *Which of you is American?*. On this view, a disjunctive sentence like (3-b) is thus predicted to be felicitous only if its disjuncts are relevant. But if (3-b)'s disjuncts are relevant, then the corresponding disjunct-alternatives should enter Quantity reasoning, giving rise to the II that the speaker doesn't know whether or not she is American, which is in conflict with what interlocutors can reasonably assume in ordinary contexts.

(3-b) #Ed is American, or I am.

Importantly for us, this explanation extends to more complex cases like (4-b) and (17-a). On the assumption that the QuD being addressed by such utterances is one that makes the (matrix) disjuncts relevant, the default QuD envisaged by speakers is presumably the same as above, that is, one that makes it relevant to know, for each protagonist, whether or not they are American. In particular, we note that such a QuD aligns well with the first disjunct, *Ed is American*, which strongly suggests that the intended level of granularity is that of the atomic individual.

(4-b) #Ed is American, or I am, or his friend is.

(17-a) #Ed is American, or I am and so is his friend.

In sum, the implicature approach predicts the full set of IIs observed for sentences like (16), accounting for ignorance spreading as well as for the infelicity effects associated with this phenomenon. This suggests that a notion of alternatives of

the kind developed by theories of implicatures is needed to account for the IIs associated with various disjunctive sentences.

4 A challenge for the implicature approach

4.1 The challenge

Before concluding, we would like to briefly discuss a challenge for the implicature approach and then offer a solution to it based on a constraint on formal alternatives independently suggested in the literature. To illustrate the challenge, consider a context in which Ed has a part-time job at a café we often stop by. We know that Ed generally works only one day of the weekend but that, on occasions, he has to work on both Saturday and Sunday. Imagine that yesterday was Saturday and that we saw Ed working there. Imagine now that, on Sunday, we see Ed coming in as we are sitting at the café. We could felicitously utter the sentence in (26).[6]

(26) **Context**: *We know that Ed was working yesterday (on Saturday) and we see him coming in today (on Sunday).*
Either Ed is just a customer today, or he is working on (both) Saturday and Sunday this week.

The sentence in (26) is structurally parallel to the ones in (17). On the implicature approach, this sentence is thus expected to be infelicitous for the same reason that the sentences in (17) are. The felicity of (26) is thus problematic for the implicature approach: why is (26) not giving rise to the same mismatching inferences as (17)? Why is ignorance not spreading to the conjuncts in this case?

To explain the challenge in more detail, let us consider the formal alternatives derivable for (26) according the general algorithm proposed by the structural approach to alternatives (Katzir 2007, Fox & Katzir 2011). For our purposes, we will assume that (26) can be simplified and schematized as shown in (27), where the embedded conjunction is analyzed as a nominal conjunction.

(27) $[_S\ [_{S_1}$ Ed is just a customer today$]$ or
$[_{S_2}$ he is working on (both) [Saturday and Sunday]]]

Fox & Katzir's algorithm allows us to construct for (27) the formal alternatives in (28). Each of these alternatives is derivable from (27) by successive replacements of one or more constituents in (27) with one of their sub-constituents: the alternatives corresponding to the matrix disjuncts, (28-a) and (28-d), are derived by replacing S

6 Many thanks to Ivano Ciardelli (p.c.) for pointing out the example in (26) to us and for helpful discussion.

with S_1 or S_2; the alternatives in (28-e) and (28-f) are derived by replacing the whole conjunction with one of the conjuncts in S_2; finally, the alternatives corresponding roughly to the embedded conjuncts, (28-b) and (28-c), are derived by replacing S with S_2 and by further replacing the whole conjunction with one of the conjuncts.

(28) **Formal alternatives to (27)**

a. [$_{S_1}$ Ed is just a customer today]
b. [$_{S_2}$ Ed is working on Saturday]
c. [$_{S_2}$ Ed is working on Sunday]
d. [$_{S_2}$ Ed is working on [Saturday and Sunday]]
e. [$_{S}$ [$_{S_1}$ Ed is just a customer today] or [$_{S_2}$ Ed is working on Saturday]]
f. [$_{S}$ [$_{S_1}$ Ed is just a customer today] or [$_{S_2}$ Ed is working on Sunday]]

Hence, the set of formal alternatives for (26) is not qualitatively different from that generated for sentences structurally similar to it, as previously exemplified in (23). As a result, each step of the Quantity reasoning that we described in Section 3.3 is expected to reproduce with the example in (26). This incorrectly predicts that (26) should give rise to the mismatching II that the speaker doesn't know whether Ed was working on Saturday and, therefore, should be infelicitous.

4.2 A more constrained notion of alternatives

The more flexible notion of alternatives developed in the literature on implicatures allows us to account for ignorance spreading by generating more alternatives than assumed on the inquisitive approach, but it also leads to over-generation issues in cases like (26). We believe, however, that previous attempts to address comparable over-generation issues in relation to the so-called *symmetry problem* can offer a solution to the present issue as well. Refining the general procedure in Fox & Katzir (2011), Trinh & Haida (2015) propose that the construction of formal alternatives is constrained by an extra condition, what they call the 'Atomicity' constraint, stated in (29).[7] In essence, the Atomicity constraint states that all expressions in the substitution source of a given sentence, which includes among other things its sub-constituents, are treated as if they were syntactically atomic, thus blocking further substitutions within them.

(29) **Atomicity constraint (Trinh & Haida 2015: (32))**
Expressions in the substitution source are syntactically atomic.

Let us see how the Atomicity constraint can help us account for the felicity of (26).

7 We refer the reader to Breheny et al. (2018) for a critical discussion of Trinh & Haida's original proposal and to the subsequent elaboration of this proposal in Trinh (2018) for refinements.

As a starting point, we note that the Atomicity constraint does not change the previous results that we derived for cases involving clausal binary connectives. The reason is that, in all these cases, the formal alternatives that we considered are all derivable from the base sentence by means of a single substitution operation, i.e., by replacing the whole sentence or one of its sub-clauses with another sub-clause. Hence, adopting the Atomicity constraint does not affect the implicature-based accounts of the 2-disjunct, 3-disjunct and ignorance spreading cases.

On the other hand, in cases like (26), the Atomicity constraint blocks the generation of two alternatives, (28-b) and (28-c). To see this, consider for instance how (28-b) could be derived. Since the substitution source contains S_2 and *Saturday*, we could try the derivation below. This derivation, however, violates the Atomicity constraint: after the first substitution, the sub-clause S_2 is now treated as an atom (indicated by the box) and, therefore, no further substitution within S_2 is allowed.

(27) [$_S$ [$_{S_1}$ Ed is just a customer today] or
[$_{S_2}$ he is working on [Saturday and Sunday]]]

a. $\boxed{S_2\text{: he is working on Saturday and Sunday}}$ ✓

b. $\boxed{S_2\text{': he is working on [Saturday]}}$ *

Note that substituting first the nominal conjunction in S_2 with *Saturday* and then substituting S with the resulting sub-clause is not possible, since this sub-clause is not in the substitution source of S (i.e., *he is working on Saturday* is not a constituent of S, nor a salient constituent in context). These observations, illustrated using the alternative in (28-b), also hold of the alternative in (28-c). Hence, once the Atomicity constraint is enforced, the resulting set of alternatives for (26) narrows down to {(28-a),(28-d),(28-e),(28-f)}. In the context of (26), applying the same Quantity reasoning as before over this reduced set of alternatives only gives rise to the II that the speaker doesn't know whether Ed is just a customer today or whether he came in to work, consistent with intuitions.

This explanation predicts that if we modify the sentence above to rule out a non-clausal analysis of the embedded conjunction, infelicity should re-emerge. The reason is that, on a clausal construal, the problematic alternatives are derivable by a single substitution operation, as previously shown. This prediction appears to be borne out: unlike (26), its clausal variant in (30) sounds odd in the relevant context.

(30) **Context**: *We know Ed was working yesterday (on Saturday) and we see him coming in today (on Sunday).*
#Either Ed is just a customer today, or he is working today and he was working yesterday as well.

Here gain, we believe that one way of sharpening our intuitions about the contrast of interest is to make one of the embedded conjuncts about a personal fact that the speaker is assumed to be knowledgeable about, at least in ordinary contexts. By way of illustration, consider for instance the minimal pair in (31). The embedded conjunctions in these examples are semantically equivalent; crucially, however, the conjunction in (31-a) allows a non-clausal (e.g., nominal) construal, as in (26), whereas the one in (31-b) doesn't, as in (30). In line with our predictions, we observe that (31-a) is felicitous whereas its clausal variant in (31-b) isn't.

(31) a. Either John has two children, or both Bill and I have three.
b. #Either John has two children, or Bill has three and I do too.

In sum, (26) is only superficially similar to (17) or (30): the conjunction in the latter are clausal conjunctions whereas the one in (26) is a nominal conjunction, or at least can be construed as such, if only to prevent the generation of a conflicting inference. This difference, while immaterial for the procedure in Fox & Katzir (2011), becomes crucial for determining the set of alternatives entering Quantity reasoning once a condition like the Atomicity constraint is considered. We have shown here that, once supplemented with such a constraint, the implicature approach can account for the contrast between (26), on the one hand, and (17) and (30), on the other.

5 Conclusion

Both the implicature and the inquisitive approach capture the IIs associated with simple disjunctive sentences, but only the former can account for the IIs associated with disjunctive sentences embedding conjunction. As we explained, this difference stems from the different notions of alternatives considered on the two approaches, which make distinct predictions regarding the alternatives (or absence of alternatives) associated with conjunctive sentences. All in all, we take the phenomenon of ignorance spreading to teach us that that an empirically adequate theories of IIs requires a flexible notion of alternatives of the sort developed by theories of implicatures. As discussed, however, this flexible notion also needs to include further constraints on alternative formation in order to avoid overgeneration.

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