Local Implicatures and Double Negatives

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1 Introduction

According to the classical Neo-Gricean (Horn, 1972, 1989; Atlas and Levinson, 1981) view on disjunction, the truth conditions of a sentence like (1a) do not exclude situations where both disjuncts are simultaneously true. This inclusive meaning is reinforced by inferential processes: sentence (1b) is minimally different and informationally stronger (it asymmetrically entails sentence in 1a). Therefore, if (1b) is true, it is more cooperative (cf. Grice, 1989) to utter it instead of (1a). Simplifying a bit, we can then derive that when uttering (1a) rather than (1b), a speaker implicates that the stronger (1b) is false.

(1) a. John is singing or dancing.
    b. John is singing and dancing.

Thus, the meanings of items such as *or* are enriched by scalar reasoning: more informative alternatives must be false. Chierchia (2004) departs from this view by proposing that "implicatures are not computed *after* truth conditions of (root) sentences have been figured out" but rather "phrase by phrase in tandem with truth conditions".

The aim of this note is to discuss a very specific aspect of Chierchia's proposal, namely that downward entailing (DE) operators weaken the implicatures predicted by the localist approach. More specifically, it is proved that strong meanings associated to sentences Φ and $\neg\neg\Phi$ differ.

2 Chierchia's mechanism

In this section, we transpose Chierchia's mechanism into propositional logic; this is intended to simplify the mechanism and make its workings more transparent. Nothing hinges on this for the purposes of our discussion.

First, we need to specify the alternatives to be considered by the mechanism:

$$\Phi^{\mathrm{ALTc}} = \begin{cases} \{\Phi\} & \text{if } \Phi \text{ is atomic} \\ \{\neg\psi \mid \psi \in \Psi^{\mathrm{ALTc}}\} & \text{if } \Phi = \neg\Psi \\ \{\Psi_1 \wedge \Psi_2, \Psi_1 \vee \Psi_2\} & \text{if } \Phi \in \{\Psi_1 \wedge \Psi_2, \Psi_1 \vee \Psi_2\} \end{cases}$$

Note that this is different from a neo-Gricean understanding of alternatives which systematically projects the alternatives of the subparts into higher levels alternatives:

$$\Phi^{\mathrm{ALTg}} = \begin{cases} \{\Phi\} & \text{if } \Phi \text{ is atomic} \\ \{\neg\psi | \psi \in \Psi^{\mathrm{ALTg}}\} & \text{if } \Phi = \neg\Psi \\ \{\psi_1 \wedge \psi_2, \psi_1 \vee \psi_2 | \psi_1 \in {\Psi_1}^{\mathrm{ALTg}}, \psi_2 \in {\Psi_2}^{\mathrm{ALTg}}\} & \text{if } \Phi \in \{\Psi_1 \wedge \Psi_2, \Psi_1 \vee \Psi_2\} \end{cases}$$

Both mechanisms then need an operation to undertake scalar reasoning: comparison of a proposition to a set X (which will generally be the set of its alternatives)[1]:

$$S_{[\![\Phi]\!]}(X) = \begin{cases} \Psi & \text{where } \Psi \text{ is the weakest member of } X \text{ such that } \Psi \\ & \text{entails } [\![\Phi]\!] \text{ and not vice versa, if there is such a } \Psi \\ \perp & \text{(the contradiction) otherwise} \end{cases}$$

Finally, the following gives the full derivation of the strong meaning *à la* Chierchia $[\![\Phi]\!]^{Sc}$ of a proposition Φ[2]:

(1) $$[\![\Phi]\!]^{Sc} = \begin{cases} [\![\Phi]\!] & \text{if } \Phi \text{ is atomic} \\ [\![\Phi]\!] \wedge \neg S_{[\![\Phi]\!]}([\![\Phi^{\mathrm{ALTc}}]\!]) & \text{if } \Phi = \neg\Psi \\ ([\![\Psi_1]\!]^{Sc} \wedge [\![\Psi_2]\!]^{Sc}) \wedge \neg S_{[\![\Phi]\!]}([\![\Phi^{\mathrm{ALTc}}]\!]) & \text{if } \Phi = \Psi_1 \wedge \Psi_2 \\ ([\![\Psi_1]\!]^{Sc} \vee [\![\Psi_2]\!]^{Sc}) \wedge \neg S_{[\![\Phi]\!]}([\![\Phi^{\mathrm{ALTc}}]\!]) & \text{if } \Phi = \Psi_1 \vee \Psi_2 \end{cases}$$

Strong meanings of the subparts are taken into account (cf. the last two lines): this is where localism comes into play.

3 Comparison with globalism

The globalist view relies on a single mechanism which can be straightforwardly expressed with the tools introduced in the previous section:

$$[\![\Phi]\!]^{Sg} = [\![\Phi]\!] \wedge \neg S_{[\![\Phi]\!]}([\![\Phi^{\mathrm{ALTg}}]\!])$$

In the globalist framework, the special status of DE operators comes for free whereas localist computations require special operations to rule out embedded implicatures when a DE operator is encountered (cf. the asymmetry between line 2 and lines 3 and 4 in equation 1). Consequently, localists also need to assume that the monotonicity properties of intervening operators are computed locally (or marked within the lexicon).

Beside, when a proposition ends up with a DE operator, both approaches behave very similarly: both predict that implicatures comes from a neo-Gricean comparison of the global logical meaning and a set of alternatives. There is a subtle difference, however, which is that the localist framework only considers the topmost scalar term for calculating the relevant alternatives: embedded scalar terms do not generate alternatives at the global level.

Before elaborating on the consequences of this setup, I will first illustrate how these two accounts work.

[1] This is taken from Chierchia (2004) with minor modifications. We depart from Chierchia's implementation in that S applies to a set of denotations rather than actual propositions.

[2] Note the abuse of notation: $[\![\Phi^{\mathrm{ALTc}}]\!]$ is the set constituted by the denotations of the elements of Φ^{ALTc}.

4 Disjunction and double disjunction

4.1 Disjunction...

For simple disjunctions, both accounts predict an exclusive reading ($\vee^S$ stands for the exclusive disjunction; a, b and c are independent atomic propositions). The globalist computation goes as follows:

$$\begin{array}{rcl} [\![a \vee b]\!]^{Sg} & = & [\![a \vee b]\!] \wedge \neg S_{[\![a \vee b]\!]}(\left\{ \begin{array}{c} [\![a \wedge b]\!], \\ [\![a \vee b]\!] \end{array} \right\}) \\ & = & ([\![a]\!] \vee [\![b]\!]) \wedge \neg([\![a]\!] \wedge [\![b]\!]) \\ & = & [\![a]\!] \vee^S [\![b]\!] \end{array}$$

Only the first line is different for the localist computation (strong meanings of atomic propositions coincide with their denotations):

$$\begin{array}{rcl} [\![a \vee b]\!]^{Sc} & = & ([\![a]\!]^{Sc} \vee [\![b]\!]^{Sc}) \wedge \neg S_{[\![a \vee b]\!]}(\left\{ \begin{array}{c} [\![a \wedge b]\!], \\ [\![a \vee b]\!] \end{array} \right\}) \\ & = & [\![a]\!] \vee^S [\![b]\!] \end{array}$$

4.2 ... and double disjunction

The globalist computation fails to predict any consistent implicature for double disjunction:

$$\begin{array}{rcl} [\![(a \vee b) \vee c]\!]^{Sg} & = & [\![(a \vee b) \vee c]\!] \wedge \neg S_{[\![a \vee b \vee c]\!]}(\left\{ \begin{array}{c} [\![(a \vee b) \vee c]\!], \\ [\![(a \vee b) \wedge c]\!], \\ [\![(a \wedge b) \vee c]\!], \\ [\![(a \wedge b) \wedge c]\!] \end{array} \right\}) \\ & = & ([\![a]\!] \vee [\![b]\!] \vee [\![c]\!]) \wedge \neg(([\![a]\!] \wedge [\![b]\!]) \vee [\![c]\!]) \end{array}$$

This in the end entails $\neg[\![c]\!]$. A speaker who utters sentence (2a)[3] may implicate (2b) but certainly not (2c).

(2) a. John ate an apple, a banana or an orange.
 b. John only ate one of these fruits.
 c. John did not eat an orange.

Here is how localists would proceed and obtain (2b):

$$\begin{array}{rcl} [\![(a \vee b) \vee c]\!]^{Sc} & = & ([\![a \vee b]\!]^{Sc} \vee [\![c]\!]^{Sc}) \wedge \neg S_{[\![(a \vee b) \vee c]\!]}(\left\{ \begin{array}{c} [\![(a \vee b) \vee c]\!], \\ [\![(a \vee b) \wedge c]\!] \end{array} \right\}) \\ & = & (([\![a]\!] \vee^S [\![b]\!]) \vee [\![c]\!]) \wedge \neg(([\![a]\!] \vee [\![b]\!]) \wedge [\![c]\!]) \end{array}$$

[3]Note that the sentence may have a different constituency structures, it does not make things any better for our purpose.

Although it may take a while to see it[4], this excludes the cases where several disjuncts are true. This implicature consists of two parts, which could be derived independently from each other: 1) the first two disjuncts are not simultaneously true unless the third disjunct is also true, this implicature comes out through the computation of the strong meanings of the subparts into the first conjunct above; 2) the last disjunct is not true if any of the first two disjuncts is true, this implicature is the result of a comparison with alternatives which now safely ignore embedded scalar terms. None of these "covert" implicatures seems felicitous on its own; so far, the core of the localist approach does not have to consider them independently either.

On the face of it, it seems that the localist view has an empirical advantage over its globalist opponent although it is driven by a surprising combination of two covert implicatures which seem implausible on their own. Nevertheless, the following section will show that Chierchia's mechanism predicts that these implicatures could in principle be isolated.

5 Double negation

In section 3, we discussed the fact that DE operators require a special rule in the localist framework. This section investigates the effect of the combination of two DE operators (which cancel each other at the logical level).

Let us first see how the mechanisms work:

$$\begin{aligned}
[\![\neg\neg((a \vee b) \vee c)]\!]^{Sg} &= [\![\neg\neg((a \vee b) \vee c)]\!] \wedge \neg S_{[\![\neg\neg((a\vee b)\vee c)]\!]}(\left\{\begin{array}{c} [\![\neg\neg((a \vee b) \vee c)]\!], \\ [\![\neg\neg((a \vee b) \wedge c)]\!], \\ [\![\neg\neg((a \wedge b) \vee c)]\!], \\ [\![\neg\neg((a \wedge b) \wedge c)]\!] \end{array}\right\}) \\
&= [\![(a \vee b) \vee c]\!]^{Sg} \\
[\![\neg\neg((a \vee b) \vee c)]\!]^{Sc} &= [\![\neg\neg((a \vee b) \vee c)]\!] \wedge \neg S_{[\![\neg\neg((a\vee b)\vee c)]\!]}(\left\{\begin{array}{c} [\![\neg\neg((a \vee b) \vee c)]\!], \\ [\![\neg\neg((a \vee b) \wedge c)]\!] \end{array}\right\}) \\
&= (([\![a]\!] \vee [\![b]\!]) \vee [\![c]\!]) \wedge \neg(([\![a]\!] \vee [\![b]\!]) \wedge [\![c]\!])
\end{aligned}$$

The globalist prediction falls right back into the same troubles it encounters for $(a \vee b) \vee c$; this is a systematic result since the logical meaning of the proposition does not change, nor do the denotations of the alternatives. Interestingly, this is very different for the localist approach: two propositions with the exact same logical meaning are attributed different strong meanings[5].

More specifically, the first implicature described in section 4.2 disappears. This is a consequence of the otherwise harmless pair of DE operators on top of the proposition: the

[4]The easiest way to come to it might be to consider each possible value for $[\![a]\!]$, $[\![b]\!]$ and $[\![c]\!]$ and see whether it makes this expression true or false.

[5]Surprisingly, similar results can be found in the globalist framework (e.g. $[\![(a \vee b) \wedge a]\!]^{Sg} = [\![a]\!] \vee^S [\![b]\!] \neq [\![a]\!]^{Sg}$). However, these examples are qualitatively very different since they rely on the usage of a different set of scalar terms for the logically equivalent propositions.

most embedded *or* is not taken into account by the first conjunct (and the calculus of alternatives remains blind to it)[6]. In the end, we are left with an implicature which excludes that the last disjunct be true simultaneously to any of the first two disjuncts. Applying it to a natural language example, this suggests that sentence (3a) implicates (3b).

(3) a. It is not true that John did not eat an apple, a banana or an orange.
b. If John ate an orange, he did not eat any apple or banana.
c. If John ate an apple and a banana, he also ate an orange.

In the case of double disjunction, this implicature combines successfully with (3c); it is certainly unsatisfying on its own. Admittedly, there are independent reasons to assume that a sentence has a stronger implicature than its counterpart with double negation: the sentence is easier to process in the first place so this leaves more room for implicature computation (this is certainly in line with the relevance theory of Sperber & Wilson, 1985/1996). Nevertheless, this should lead to an autonomous implicature; moreover, the result here is due to the special treatment of DE operators which had nothing to do with processing load considerations.

Let us take another example. Extending the formalism very slightly would provide a parallel analysis for sentence (4a): (4b) and (4c) are the two parts of the implicature which would come out.

(4) a. Some students read Chomsky or Montague.
b. At least some students read none of them.
c. At least some students read only one of them.

This example patterns exactly as Chierchia predicts, the subparts of the implicature seem actually independent from each other. Although they also seem to have the same empirical strength, Chierchia would predict that (4b) will survive to embedding under double negation but not (4c). Processing load considerations may explain why implicatures are weaker in complex environments (implicature computations require resources which may be recruited for other purposes in complex environments) and this is predicted by the localist approach but the asymmetry between (4b) and (4c) is unwarranted.

We take it as a satisfying result that the actual surface form of a sentence can induce pragmatic differences (focus marking and it-clefts are well studied reliefs which give rise to presuppositional effects for instance). However, the differences which come out on the localist approach only reveal the weak empirical motivation for technical manipulations required to recover the special status of DE operators (which is just a by-product on the globalist approach).

6 Concluding remarks

In this note, we exemplified a systematic interaction between surface forms and the kind of local mechanisms proposed in Chierchia (2004) to recover scalar implicatures. Although

[6] Simple negation has the same effect, examples involve scalar terms from the other end of the scale: $[\![\neg((a \wedge b) \wedge c)]\!]^{Sc} = \neg([\![a]\!] \wedge [\![b]\!] \wedge [\![c]\!]) \wedge (([\![a]\!] \wedge [\![b]\!]) \vee [\![c]\!])$.

this kind of interaction is not problematic *per se*, we argued that it is caused by a poorly motivated technical treatment of DE operators and only highlights empirical discrepancy.

These results call for deeper investigations of the motivations for the technical operations underlying localism. How an implicatures theory may mesh with psychological studies (about syntactic complexity for instance) is another issue we raised timidly.

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References

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