

Motivating the procedural analysis of logical connectives¹

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Résumé

With a view to addressing the non-truth-conditional meaning of discourse connectives from a cognitive perspective, relevance theorists have for long pursued the argument that the relevant expressions do not carry conceptual (≈denotational) meaning, but rather encode procedures, i.e. instructions which guide pragmatic inference by creating cognitive 'shortcuts' that the hearer takes advantage of during utterance interpretation. At the same time, they assume that logical connectives are conceptual, rather than procedural encodings. In this paper, I explore the extent to which an analysis of logical connectives along procedural lines is viable, by offering a number of arguments which suggest that logical connectives can and should be studied on a par with discourse ones.

Mots clés : *logical connectives, logical operators, internalist semantics, relevance theory, procedural meaning*

1. Setting the scene

One of the less-known facts about Grice's 'Logic and Conversation' (1975) is that the motivation behind it was not strictly speaking to develop a theoretical framework for systematically studying inferential pragmatics. Even though this paper is famously considered to have pretty much given birth to this domain of enquiry, Grice's original aim in laying out his theory of implicature was essentially to defend the formal description of logical 'devices' against informalist claims that it falls short of capturing the explicit meaning of their natural language counterparts. In the Gricean picture then, the common binary logical connectives 'and', 'or' and 'if' manage to sustain their logical, truth-tabular semantic content, but their use can give rise to generalized conversational implicatures, as the following examples show:

(1) John woke up and got out of bed.

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- (2) I've probably left the keys at the office or in the car.
 (3) If you keep shouting, I'll have to ask you to leave.

It should be pretty obvious that in most – if not all – contexts of utterance, the presence of the logical connective in each of these sentences would communicate more than what the relevant logical connective logically encodes. In (1), John did not just wake up and get out of bed, but most probably did so in that order. Then, in (2), the keys must have been forgotten either at the office or in the car, since it is unimaginable that they can be in two places simultaneously. Finally, in (3), there is clearly a cause-effect relation between the two events described in the antecedent and the consequent of the conditional, which is again communicated over and above the logical meaning of 'if'.

This analysis of the enriched meaning(s) that logical connectives tend to communicate in terms of generalized conversational implicature has, of course, not gone undisputed. Relevance theorists, for example, have pursued the argument that the pragmatic enrichment of and-conjunctions belongs to the explicit rather than the implicit side of communication (cf. Carston 2002). Still, if one leaves this debate to the side, it seems that there is general agreement among most theorists of linguistic semantics/pragmatics that 'and', 'or' and 'if' directly inherit the semantics of the corresponding logical operators, $\&$, \vee and \rightarrow , and that their semantic description is exhausted by the relevant truth tables.

Even though I do not intend, in this short paper, to contest the truth tabular approach as a means of capturing the semantic content of logical connectives, I would like to question its adequacy as a way of identifying what the relevant terms actually encode in the mental lexicon – assuming of course that there is such a structure in human cognition. The distinction I have in mind in this regard is one between the *semantic description* of lexical meaning in theoretical terms and with reference to the external world, and the identification of a lexical item's *semantic import* when it is uttered, i.e. the actual information that its use triggers in the mind of the language user. This distinction is squarely based on the cognitive outlook that several theories have adopted with respect to the study of linguistic meaning, with relevance theory (henceforth RT) being the most notable such theory in the area of pragmatics. And indeed, it seems to be in line with what relevance theorists also have in mind, since, as Carston notes, what is meant by 'semantics' on "the internalist, cognitive processing (performance) view" that RT embraces, "is a relation between bits of linguistic form and the cognitive information they encode, rather than

a relation between forms and entities in the external world” (1999, 114).

Against this background, the broader, underlying question that motivates the present discussion is: What does it practically mean for a lexical item to encode a truth table? Useful though it may be for the theoretical description of logical connectives, I believe that the truth-tabular approach does not have any cognitive substance when it comes to the identification of what it is that the utterance of a logical connective triggers in the mind of the language user. I therefore wish to propose that the RT distinction between *conceptual* and *procedural* meaning, which Carston also alludes to in the citation above, can be highly informative in this respect. More specifically, my aim in this paper is to challenge the standard RT view that logical connectives are exclusively conceptual encodings, opening up the possibility of identifying a procedural component in their encoded meaning. To this end, I will start off my discussion by briefly presenting the conceptual/procedural distinction within RT, before turning to make a case for the analysis of logical connectives on a par with that of discourse ones.

2. The conceptual/procedural distinction

The RT notion of procedural meaning was first approximated by Blakemore (1987), in a treatise that reappraised the Gricean category of conventional implicature from a cognitive angle. For Grice, the category of conventional implicature comprised the conventional meaning of certain lexical items – typically discourse markers and connectives, such as ‘*but*’, ‘*moreover*’ or ‘*therefore*’ – which do not make a truth-conditional contribution to the proposition explicitly expressed by an utterance that contains them. The difference between this type of implicature and the aforementioned category of generalized conversational implicature is that conventional implicature is not defeasible and remains unaffected by contextual considerations altogether². From an RT perspective, however, it is precisely because these particular meanings are not subservient to pragmatic enrichment processes, like all other kinds of implicature, that their classification as implicatures is a misnomer. In search of a psychologically plausible alternative, Blakemore reanalysed the encoded meaning of the relevant terms along procedural lines, by suggesting that their cognitive role is to impose semantic constraints on the derivation of pragmatic inferences. A procedure, in this

² For example, the generalized conversational implicature communicated by (1) could easily be cancelled with just a small emphatic addition, as in “*John woke up and got out of bed, but not in that order*”.

context, is an instruction that guides pragmatic inference by creating a cognitive ‘shortcut’ that the hearer takes advantage of during utterance interpretation. Take for example the use of the discourse connective ‘so’ in the following utterance:

- (4) So, Mary won’t go to the party.

Even though the meaning of ‘so’ does not affect the truth conditions of the proposition explicitly expressed by the utterance in (4), it still seems to provide the hearer with a directive to compute this proposition as a conclusion derivable from some readily available contextual assumption(s) – be it information in the previous discourse about Mary’s workload or alternative plans for the night, or just the mere realization that Mary is still watching TV in her pyjamas and does not look like she is willing to go out.

In this picture, procedural encodings lie at the other end of the scale from conceptual ones, which comprise the representational/denotational meaning typically attributed to open-class words, like ‘tree’, ‘run’ or ‘dog’. As Wilson acknowledges, “although concepts and procedures themselves are not part of the linguistic system proper, the relation between a word and the concept or procedure it encodes is properly regarded as semantic” (2011, 10), since, from a psychological perspective, it has to do with the kind of cognitive information that the word at hand encodes. So, in RT, while the use of the word ‘dog’ in an utterance triggers the concept DOG, which will then be included, either in its current or in some pragmatically enriched form, in the explicitly expressed proposition it forms part of, using a word like ‘so’ or ‘but’ triggers an instruction of the type ‘do X with proposition *p*’ or ‘treat proposition *p* as *Y*’.

Despite the originally perceived one-to-one correspondence between procedural encodings and conventional implicatures, further research within RT has revealed that the distinction between concepts and procedures is no longer co-extensive with that between truth-conditional and non-truth-conditional meaning, which in the first place motivated the Gricean postulation of conventional implicature. In this respect, relevance theorists have used the notion of procedural meaning as a means of describing the encoded content of not only further truth-conditionally irrelevant linguistic devices, but also of truth-conditional ones, such as tense and pronominal expressions.

3. The case for a procedural analysis of logical connectives

Given the presentation of the RT distinction between concepts and procedures above, it seems natural at this point to wonder what it is that the logical connectives ‘and’, ‘or’ and ‘if’ encode. The standard answer that RT provides to this question is that they are conceptual

encodings, mainly because of their truth-functional nature. Even though this is the view that I wish to challenge in this short paper, I need to make a crucial clarification before I go on. My aim here is not to argue that the encoded content of the relevant terms is exclusively procedural rather than conceptual; it is actually far more modest than that. What I wish to do is provide some reasons that open up the possibility of approaching this encoded content in procedural terms, despite the rigid and, to my mind, unjustified conviction that logical connectives have a special position in the mental lexicon just because their logical counterparts have a special position in truth calculi. It may very well be that further scrutiny reveals that logical connectives encode both conceptual and procedural information, but as I will attempt to show in what follows, there is hardly any reason to *a priori* dismiss their analysis along procedural lines, and quite a few ones to seriously consider such an analysis on a par with the one reserved for discourse connectives in RT.

3.1. *The special status of logical connectives*

As I have already mentioned above, one of the main reasons for considering logical connectives special is that the corresponding logical operators also have a, pretty much undisputed, prominent role in logic. The argument that I wish to pursue in this section is that there is no guarantee that this very same role should be inherited in the description of natural language, which has after all always been considered “imperfect” from the logician’s point of view.

Even a quick look at an introductory textbook on *Logic in Linguistics* (Allwood & al 1977) seems to corroborate this point. As Allwood, Andersson and Dahl discuss, there are two reasons why logical analysis has concentrated only on ‘and’, ‘or’ and ‘if’, despite the presence of many more connectives in natural language. The first one is that “logic has been studied primarily for its mathematical interest, which has led to a concentration on those types of inference which are common in mathematical reasoning” (1977, 27); hardly a reason for *a priori* excluding other connectives from the logical analysis of natural language (insofar as they can be shown to be of relevance to it). The second one, i.e. “the extent to which the connectives of natural language are truth-functional” (ibid.) is also, obviously, the more serious too. Even though this is a point that I will return to discuss in more detail later on (cf. section 3.3.3.), it could still be argued, even if somewhat superficially, that ‘and’, ‘or’ and ‘if’ are not the only natural language connectives that are truth-functional. Despite its well-attested difference in meaning from ‘and’, ‘but’ is also strictly speaking truth-functional, since knowing the truth values of the conjuncts that

it connects, is sufficient for calculating the truth value of the full propositional compound.

But even if we are to leave the, admittedly debatable, characterisation of *'but'* as truth-functional to the side, the one-to-one correspondence between logical operators and their linguistic counterparts has also been challenged in the light of cross-linguistic data (cf. Mauri 2008; Mauri & van der Auwera 2012). For one, it is not just the case that the distinction between inclusive and exclusive disjunction is not encoded in any natural language, but there also seem to be languages that lack a connective meaning *'or'* altogether³, or even a connective meaning *'and'*⁴. Then, several languages also seem to have dedicated connectives that underlie semantic distinctions which are not identified within logic. For example, the SerboCroatian *'pa'* (=and then) encodes sequential conjunction (Mauri 2008, 90), while the *Tukang Besi 'kene'* (=and at the same time) encodes non-sequential conjunction (Mauri 2008, 94).

Clearly, this representative set of examples does not show anything extraordinary. It just reinforces the observation that, although logic can be usefully implemented in the description of natural language (and perhaps vice versa too), natural language and logic are inherently different. This much should not be surprising, if one considers that

« it is systems of thought, rather than linguistic systems, for which a truth calculus should be devised. If this is right, there is no obvious reason to suppose, or to consider it desirable, that what natural-language connectives and determiners encode is identical to the context-free, truth-based properties of logical operators; rather, there is some reason to expect differences in at least some cases. » (Carston 2002, 257)

3.2. *The functional role of logical connectives*

My discussion has so far concentrated on establishing some grounds for questioning the assumption that logical connectives perfectly match logical operators, in an attempt to substantiate the claim that logical connectives might not necessarily have the special status that formal logical analysis reserves for the them. I will now try to further motivate this possibility by comparing them to discourse connectives, which are unambiguously treated as procedural encodings in RT. To this end, I will present in this section a recent argument, according to which, both logical and discourse connectives ultimately have the same functional role to play in human cognition, before moving on, in

³ For example, Wari, a Chapacura Wanham language spoken in South America (Mauri 2008, 167).

⁴ For example, Maricopa, a Hokan Yuman language spoken in Arizona (Gil 1991)

the next one, to discuss how logical connectives fare in relation to the tests for procedurality that relevance theorists have come up with.

One of the latest developments in RT is the postulation in the human cognitive system of “a capacity for ‘epistemic vigilance’, which helps hearers avoid being accidentally or intentionally misinformed” (Wilson 2014, 145; cf. also Sperber & al 2010), over and above the dedicated relevance-oriented capacity that enables them to pragmatically infer speaker-intended meaning. This proposal is of course based on the empirically-supported argument that the main function of our reasoning ability is “to devise and evaluate arguments in order to persuade” (Mercier & Sperber 2011, 57), rather than to discover truth, and therefore improve knowledge and enhance individual cognition, as it has been traditionally assumed. While this may seem irrelevant to the present discussion, in a recent paper revisiting the conceptual/procedural distinction, Wilson, following Sperber (2001), suggested that it opens up the possibility that “the use of (conceptual) logical connectives such as *and*, *or* and *if . . . then* and (procedural) discourse connectives such as *but*, *so* and *after all* may be more closely linked to the capacity for epistemic vigilance targeted at communicated contents than to pragmatics proper” (2011, 24). If this is correct, it would suggest that logical and discourse connectives are functionally equivalent, which could in turn mean that they have common characteristics, since they have both emerged in our vocabulary for the same purpose.

3.3. RT tests for procedurality

In the previous section, I noted that logical and discourse connectives could exhibit common characteristics due to their common function in cognition. There is of course a sense in which this is trivially true, since both type of expressions are higher-order predicables, which by definition take full propositions as arguments. Going beyond the formal description of both types of connectives, however, I think that they also share certain features in view of their semantics. In an attempt to identify these features, I will now turn to the three tests that, according to RT, reveal the “properties we can expect an expression which encodes procedural meaning to have” (Blakemore 2002, 82).

3.3.1. Accessibility to consciousness

The description of word meaning has proven to be one of the thorniest challenges in semantic theory, with a number of philosophers and linguists alike debating about the most accurate way of approaching the matter. Even so, a native speaker of any

language seems to be perfectly capable of paraphrasing or simply describing the meaning of any lexical item in her vocabulary, insofar as it has some denotational value, in the sense that it manages to pick out some entity or event in the external world. As Wilson and Sperber note, however, this is not the case with discourse connectives:

« Discourse connectives are notoriously hard to pin down in conceptual terms. Conceptual representations can be brought to consciousness: procedures cannot. We have direct access neither to grammatical computations nor to the inferential computations used in comprehension. » (Wilson & Sperber 1993, 16)

Clearly, the same could be argued to hold for logical connectives as well; that is, one would not normally expect anyone to be able to describe the meaning of *'and'*, *'or'* and *'if'*, with the same ease as s/he would explain the meaning of open-class words, such as *'tree'* or *'dog'*. Some training in philosophy definitely seems to be necessary in order to provide an informed answer to some informal query about what a logical connective mean.

3.3.2. *Compositionality*

As anyone with even some minimal knowledge of semantics could assert, our ability to combine lexical meanings by positioning constituents in a particular order is one of the most fundamental traits of human language. It is after all the ability that gives human language its extraordinary expressive power, since it can account for the fact that we are capable of producing an infinity of meanings by creatively, yet systematically, manipulating finite linguistic means. With respect to conceptual encodings, for example, one can easily concatenate several of them in order to make a description more specific than it would otherwise be. So, while one might opt to refer to Nemo as just a *'fish'*, one could also be more precise by combining the concept FISH, with BEAUTIFUL, SMALL, RED and WHITE STRIPED.

However, the situation is quite different when it comes to procedural encodings. As Blakemore notes, "one would not expect expressions which encoded procedures to combine to be a constituent of a complex expression" (2002, 84). This indeed seems to be the case with discourse connectives. Even though they do combine, they can only do so minimally (e.g. *but still*, *but after all*, etc.), and far less productively than conceptual expressions (cf. Rouchota 1998). The same, however, seems to also apply in the case of logical connectives. And even more interestingly, logical connectives do not just combine only minimally with each other (e.g. *and if*, *or if*), but also exhibit the exact same behaviour when combined with discourse connectives too (e.g. *and so*, *but if*). If anything, this is a further indication that both

logical and discourse connectives are functionally equivalent expressions.

3.3.3. *Truth-evaluability*

What I hope to have shown so far is that logical connectives are suspiciously similar to discourse connectives, as far as certain properties that RT views as pertaining predominantly to procedural information are concerned. In this respect, the only reason that could justify their 'conceptual' description in RT would be that, being truth-functional, logical connectives seem to affect the truth conditions of the propositional compounds that they are part of. As Blakemore discusses, this is a final feature that can help distinguish between concepts and procedures: "an expression which encodes procedural information encodes information which is not a constituent of the conceptual representations over which inferential computations are performed" (2002, 82). On the basis of this feature then, logical connectives would fall under a conceptual characterisation, since they are by definition truth-functional. However, such a conclusion could still be contested.

For one, the criterion of truth-evaluability seems to directly clash with the pronounced aim of RT in relation to the investigation of semantics in cognitive processing terms. As I already noted in the introductory section of this paper, quoting Carston (1999, 114), and as Blakemore also asserts, "the question that matters [for RT semantics] is not whether a linguistic expression contributes to something with truth conditions, but rather what kind of cognitive information an expression encodes" (2000, 464). Against this backdrop, it could be argued that the introduction of truth-evaluability as a defining factor for the classification of a lexical item in terms of the cognitive information it encodes trivialises the underlying distinction that relevance theorists draw between externalist and internalist semantics in the first place.

Even so, let's assume for a moment that this evident clash does not exist, and that the truth-conditional contribution of an expression does play a role in figuring out whether it encodes conceptual and/or procedural information. There is still a way in which it could be maintained that logical connectives do not fulfil the criterion of truth-evaluability posed above. Since logical connectives do not affect the truth conditions of the individual propositions they conjoin, the encoded meaning of 'and', 'or' and 'if' could be characterised as a 'constituent of a conceptual representation' only if it makes some truth-conditional contribution to the whole propositional compound in which it is included.

To the best of my knowledge, this argument has been pursued within RT only in relation to and-conjunction, with evidence provided through the use of the operator-scope embedding test, as in the example that follows:

- (5) He didn't get rich and get married; he got married and got rich.

Given the traditional logical description of &, the order in which the two conjuncts (*he got rich*, *he got married*) appear in the two conjunctions in (5) should not have any effect on the truth conditions of either one of the two conjunct propositions that (5) encodes. If that were the case, the juxtaposition of these two complex propositions, with the first one being embedded in the scope of negation as it is, would patently result in a contradiction of the form 'Not p ; p '. However, the full statement in (5) is far from contradictory, which in turn suggests that the presence of 'and' does affect the truth conditions of a conjunct proposition that contains it.

This discussion of and-conjunction seems to point towards the conclusion that, given the criterion of truth-evaluability, 'and' encodes conceptual information. However, looking into the RT research on conjunction, an alternative, cognitive-based explanation as to why 'and' exhibits this behaviour can be located. As Blakemore and Carston discuss in their latest paper on sentential coordination with 'and', what justifies the effort involved in processing an and-conjunction is that "the conjuncts function together as premises, whether conjoined or not, in the derivation of a cognitive effect" (2005, 588), which, in RT terms, signifies a logical consequence that is brought about through the addition of the conjunct proposition as a whole to a hearer's belief-system. In this respect, the apparent truth-conditional contribution of 'and' to a conjunct proposition that contains it could be approached as a means of ensuring the derivation of some cognitive effect following a particular inferential route, rather than as a piece of evidence that 'and' encodes exclusively conceptual information.

4. Concluding remarks

As I have already noted, my present inquiry into the type of cognitive information that the lexical items 'and', 'or' and 'if' encode stems from a genuine curiosity about the status of the relevant truth tables as actual psychological constructs that speakers and hearers employ when using these logical connectives in verbal communication. If, as I suspect, truth tables have no such cognitive substance, they are nothing more than tools for describing the semantic content of logical operators, and, perhaps, by extension logical connectives too, and we

had better start looking for alternative answers to the question of what it is that their use triggers in the mind of the language user.

In this paper, I have suggested that a plausible such answer could lie in the RT notion of procedure meaning. And if the arguments I have offered above are on the right track, it should not be too extravagant to suppose that, much like discourse connectives, logical connectives are also primarily markers of ‘the inferential computations that are performed over conceptual representations’ rather than ‘constituents of these conceptual representations’ as such. If anything, such a conclusion would be consonant with the Tractarian analysis of logical constants as “operations” (Wittgenstein 1922, 60) that “do not represent” (Wittgenstein 1922, 42), and particularly fruitful in the context of discussing logic not just as a system of truths, but as a system that “allows us to represent all kinds of arguments and assess them from the point of view of their validity” (Fràpolli & Assimakopoulos 2012, 628).

Naturally, a particularly pertinent question that still remains unanswered concerns the actual procedures that the logical connectives under question could be taken to encode in the alternative cognitive account that I have tried to motivate here. This is a question that deserves much more thought than I have been able to give it so far, but I think that I can already offer a couple of remarks, especially in relation to the procedures encoded by ‘and’ and ‘if ... then’. In this respect, even though the aforementioned analysis of ‘and’ by Blakemore and Carston was not originally meant as an analysis along procedural lines, I believe that the answer to the question of what linguistic sentential conjunction encodes could actually lie in it. After all, an instruction of the type ‘look for a cognitive effect by taking both conjuncts as premises’ already seems to have a procedural flavour to it. Then, when it comes to ‘if ... then’, I think that the overwhelming discomfort with the truth table for the material conditional, on the grounds that some of its predictions are completely counter-intuitive, provides enough reason to seriously consider the possibility that the procedure it encodes includes a link of some sort between the propositions expressed in a conditional’s protasis and apodosis (cf. van der Auwera 1986).

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