Exploring the pragmatic import of non-truth-conditional discourse connectives

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Grice famously made a distinction between conversational and conventional implicatures [1]. One important feature of conventional implicatures is that they, unlike their conversational counterparts, are assumed to contain a pragmatic component that is bound to a lexical item. To appreciate conventional implicatures, consider (1a-c.):

(1) Mary ate two apples {a. and/b. but/c. so} Luke ate one.

As one can see, the meaning of *and* in (1a) is compatible with a logical conjunction; in contrast, the discourse connectives in (1b) and (1c) additionally convey contrast and causality, respectively. These non-truth-conditional features are the focus of the current investigation.

Note that we adopt Grice's nomenclature of *conventional implicature* for historical reasons and convenience but not necessarily to indicate full endorsement of his account. In fact, several other accounts of DCs have been proposed since Grice first introduced the concept of conventional implicature. Sanders et al. have carefully examined the different types of discourse relations marked by DCs and proposed what they called a taxonomy of coherence relations [2]. Blakemore [3], Wilson [4] and Hall [5] have argued that DCs encode procedural meaning which makes the hearer shape expectations about the upcoming discourse. From a semantic perspective, DCs are generally seen as interacting with the entailments of a sentence. For example, the *but* in (1b), could be understood as denying the entailment that *Luke ate as many apples as Mary* [6,7]. Our overall goal is to determine whether those pragmatic features that are assumed to be intrinsic to the meaning of individual DC's add processing costs to them. All accounts would be edified by such an investigation.

Experimental studies using eye-tracking or ERP paradigms have reported fast integration of DCs to discourse representation in context-rich paradigms [8–12]. To our knowledge however, no studies have examined how the very presence of DC's, such as *but* or *so*, themselves in context poor scenarios force a reader to infer the corresponding discourse relation. Past studies on scalar implicatures, which have demonstrated that the pragmatic interpretation of an expression incurs higher processing costs relative to a straight-forward semantic reading, were the inspiration for the current study e.g., see [13], [for a review, see 14]. That said, scalar implicatures require contextual licensing [15] so it is unclear whether the discovered additional cognitive costs pertain to computing the contextual information, to the scalar inference itself or to both. Here, we set up a paradigm in which the DC's *but* and *so* arise as part of a sentence whose context is minimal as we aim to determine whether they are responsible for slowdowns with respect to *and*. In addition, we determine whether the slowdowns are arguably linked to creating discourse expectations. To anticipate, we indeed report that the DC's *but* and *so* lead to slowdowns while their pragmatic features appear to lead to precise discourse expectations.

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EXPERIMENT: In this pre-registered study (OSF link not disclosed to preserve anonymity), we tested 79 native English speakers on an online reaction time and truth evaluation task. Each participant completed 108 trials (36 fillers). As shown in Figure 1, trials displayed a fixation cross, a three-letter word, and then a two-part statement about the letters in the target word. Three dependent variables were recorded: 1) participants' reading time of Part 1, which includes the connective; 2) participants' accuracy in evaluating the full sentences and; 3) their (Part 2) answer reaction time.

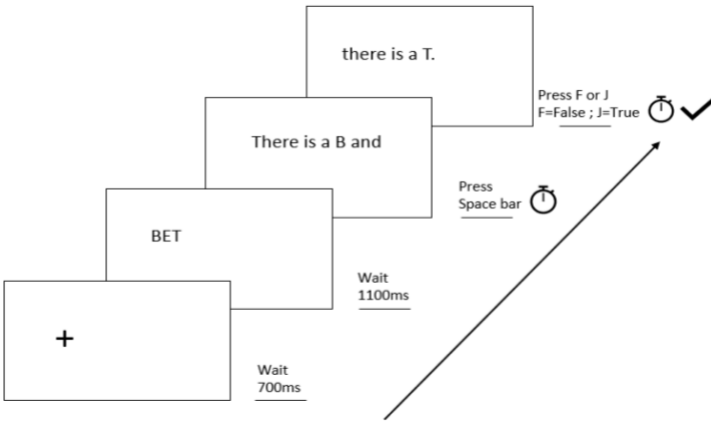

Figure 1 The unfolding of a single trial

The 72 test sentences were carefully designed to remove all possible sources of inference outside of the *but* and *so* implicatures. All told, our set up amounts to a 3 (and/but/so) X 2 (affirmative/negative expression of Part 2) X 2 (true/false statement) design. The example in Figure 1 is an *and-affirmative-true* trial. Keeping BET as the target word for expository purposes, other possible trials could be described as *so-affirmative-false* ("There is a B so there is a K."), or as *but-negative-true* ("There is a B but there is no F.") and so on. Note too that the task was designed to keep participants vigilant to each trial so filler items would include cases such as *There is no X but there is a B*.

PREDICTIONS: 1) As we indicated above, we expect the pragmatic import bound to *but* and *so* to lead to further inferencing when compared to *and*. We thus predict that Part 1's which end with *but* and *so* to be read more slowly than those which end with *and*. 2) For the answer reaction time (the truth-value-judgement of the trial), we predict that the processing of a negative Part 2 to be facilitated by the presence of *but* since this connective should prepare participants to process the contrasting negation. 3) For Part 2 experimental items that have true affirmatives, we also predict reaction times to be slower when they arise in the wake of *but* and *so* rather than for *and* in Part 1, due to the absence of any contextual contrast or causal link.

RESULTS: The reaction times in Part 1 and Part 2 were analysed using a Bayesian linear mixed effects model in R brms() [16]. Results revealed that Part 1's ending with *but* (1274.53*ms*) and *so* (1275.72*ms*) were indeed read on average more slowly than those ending with *and* (1239.09*ms*). The statistical analysis of the data (see the posterior distributions of the log-transformed reading times of the connectives in Figure 2) confirmed this difference. Furthermore, participants required more time to evaluate sentences containing *but* and *so* when the DC-specific inference was not realized in Part 2. However, when the *but*-contrast arose in the presence of a negation in Part 2, reaction times were not affected relative to *and* trials (Figure 3).

CONCLUSION: Our results revealed that the *but* and *so* sentences were costly to process relative to the logical *and*-reading. This suggests that even when pragmatic information is lexicalised in a DC, it is not as fast as those that arguably do not include such pragmatic information. Furthermore, the answer reaction time data suggests that participants created DC-specific expectations for the post-connective part of the sentence. Ongoing work aims to replicate these findings while avoiding cases whose Part 2's render the statement infelicitous.

REFERENCES: [1]Grice (1975), [2]Sanders et al. (1992), [3]Wilson (1994), [4]Blakemore (2000), [5]Halll (2007), [6]Winter et al. (1994), [7]Umbach (2005), [8]Xiang & Kuperberg (2015), [9]Koehne-Fuetterer et al. (2021), [10]Canestrelli et al. (2013), [11]Koehne & Demberg (2013), [12]Schwab & Liu (2020), [13]Chevallier et al.(2008), [14]Noveck (2018), [15]Breheny et al. (2006), [16]Buerkner (2018)

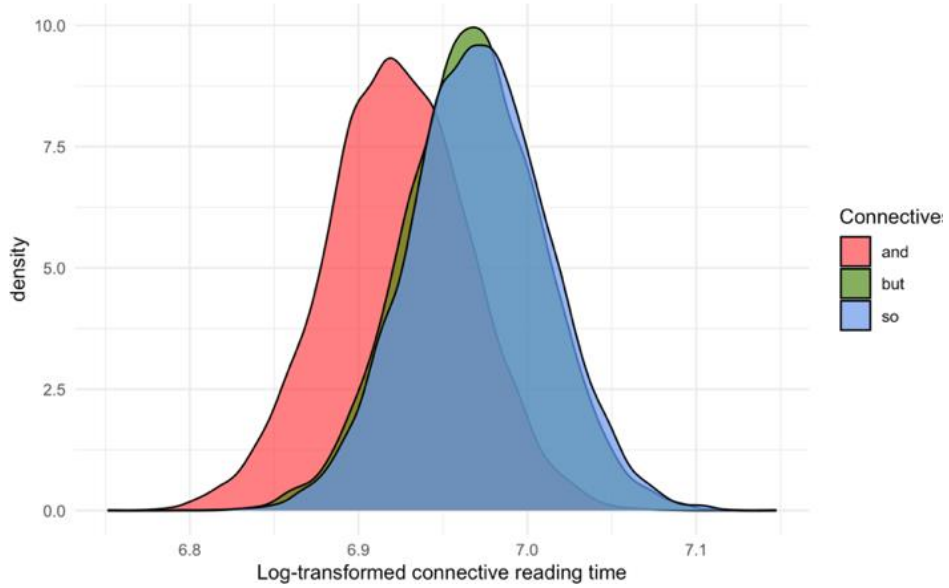

Figure 2 Posterior distribution of the log-transformed reading times for Part 1

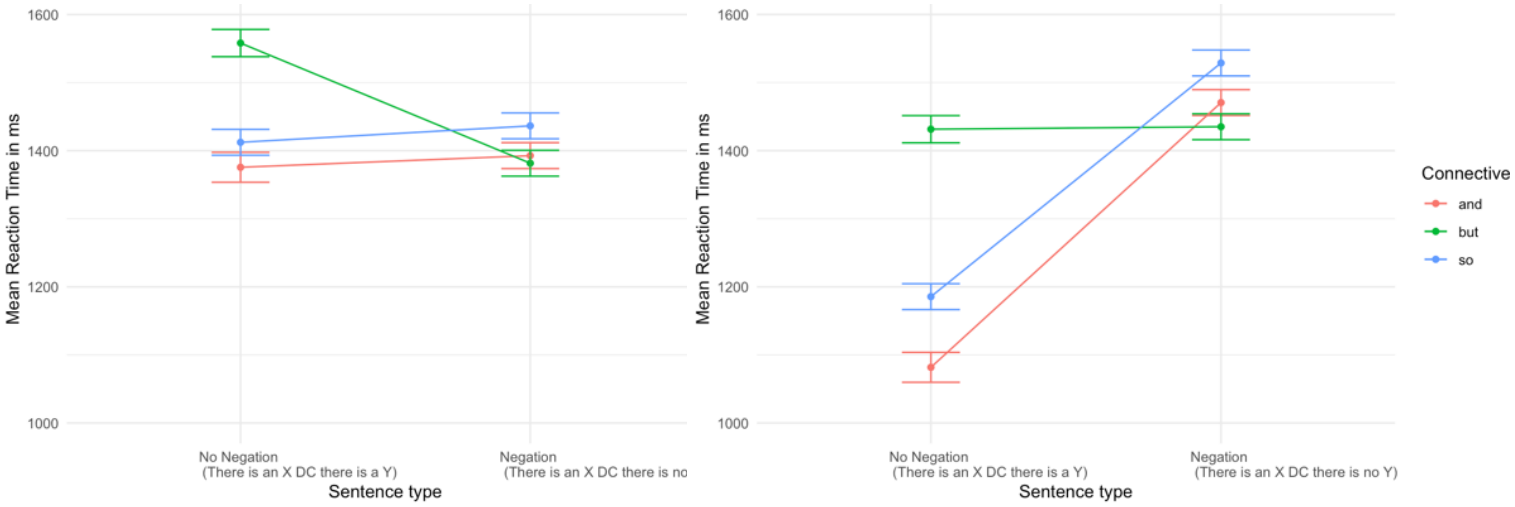

Figure 3 Mean answer reaction time (Part 2) by connective and sentence type.
Truth-value of sentence: top =TRUE, bottom =FALSE