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Characterizing the time course of an implicature: An evoked potentials study

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Abstract

This work employs Evoked Potential techniques as 19 participants are confronted with sentences that have the potential to produce scalar implicatures, like in *Some elephants have trunks*. Such an Underinformative utterance is of interest to pragmatists because it can be considered to have two different truth values. It can be considered true when taken at face value but false if one were to treat *Some* with the implicature *Not All*. Two accounts of implicature production are compared. The neo-Gricean approach (e.g., Levinson, 2000) assumes that implicatures intrude automatically on the semantics of a term like *Some*. Relevance Theory (Sperber & Wilson, 1985/1996) assumes that implicatures are effortful and not automatic. In this experiment, the participants are presented with 25 Underinformative sentences along with 25 sentences that are Patently True (e.g. *Some houses have bricks*) and 25 that are Patently False (e.g. *Some crows have radios*). As reported in an earlier study (Noveck, 2001), Underinformative sentences prompt strong individual differences. Seven participants here responded true to all (or nearly all) of the Underinformative sentences and the remaining 12 responded false to all (or nearly all) of them. The present study showed that those who responded false to the Underinformative sentences took significantly longer to do so that those who responded true. The ERP data indicate that: (a) the Patently True and Patently False sentences prompt steeper N400's—indicating greater semantic integration—than the Underinformative sentences and that (b) *regardless of one's ultimate response* to the Underinformative sentences, the N400's were remarkably flat, indicating no particular reaction to these sentences. Collectively, the data are taken to show that implicatures are part of a late-arriving, effort-demanding decision process.

Keywords: Linguistic-Pragmatics; N400; Implicature; Scalar terms

1. Introduction

A large number of studies have employed ERP techniques to investigate semantic and syntactic aspects of sentence processing. These studies typically present specific anomalies in a sentence in order to capture a characteristic pattern that follows. Kutas and Hillyard (1980a, 1980b) pointed out how semantic anomalies give rise to a central parietal negative-going component that peaks about 400 ms after the appearance of an inappropriate word, like *socks* in (1); this is known as an N400. The word is not semantically associated with the rest of the sentence nor could one argue that it is anticipated. An ungrammatical structure gives rise to a late centroparietal positivity around 600 ms after this word's onset (this is known as a P600). For example, the word *to* in (2) points to such an anomaly.[1] In contrast, it is more difficult to study pragmatic anomalies because these often thrive on the anomalousness of the sentence itself. Consider (3) below:

(1) John buttered his bread with *socks*.
(2) The broker *persuaded to* sell the stock.
(3) *Some elephants have trunks*.

Syntactically and semantically, the sentence in (3) is correct and, taken quite literally, it is obviously true. We know that elephants in general have trunks, from which it logically follows that (at least) some of them do. What

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[1] As Osterhout and Holcomb (1995, p. 194) point out, the verb *persuade*, in an active form, does not allow for a prepositional phrase or an infinitival clause to occur immediately adjacent to the verb.

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might make the sentence seem odd, is not the syntax or the semantics but the pragmatic fact that it is much less informative than common knowledge would allow. Where the sentence says "some," "all" would be more appropriate. According to standard pragmatic views, when a speaker utters a relatively weak term (e.g. *Some*) on a scale of informativeness, it is an indication that she chose not to use a more informative term from the same scale (e.g. *All*).[2] She thereby conveys that the stronger term *All* is not applicable in the context, (or at least that she does not know whether it is). Thus, uttering *Some* implicates *Not All* (and *Not All* is logically equivalent to *Some are not*). This can lead one to interpret (3) as meaning also *Some elephants do not have trunks*. This kind of inference has been dubbed *scalar implicature* and has since become a paradigmatic case for the study of implicature in the linguistic-pragmatic literature. Understood as carrying a scalar implicature, a sentence like (3) is not true but false.

The application of ERP techniques to implicatures is useful because it could help resolve an ongoing debate in the linguistic-pragmatic literature. Although linguistic-pragmatists agree on the output of the implicature process, they differ with respect to its *automaticity*. One school of thought, which we will refer to as the "neo-Gricean" account (Levinson, 2000), assumes that while the logical interpretation is the more basic one (i.e. the one assigned to *Some* by grammar), the pragmatic interpretation is actually the *default interpretation* in concrete communicative situations. That is, such an interpretation tends to occur (as a consequence of the implicature) every time *Some* is encountered; cases of logical interpretations are those in which the implicature is undone by the context. A second approach, Relevance Theory, does not assume the implicature is automatic but that it is produced when searching for a relevant interpretation of an utterance (Carston, 1999; Sperber & Wilson, 1985/1996). Thus, Relevance Theory considers implicature an effortful, non-necessary inference, whereas, acording to the neo-Griceans it should be the occasional undoing of such an implicature that takes extra effort.

Here, we follow up on a previous investigation that focused on establishing the reality of scalar implicature in everyday reasoning by showing how implicatures became evident with age in standard developmental tasks (Noveck, 2001). That study employed five exemplars of the sort presented in (3) and showed that, whereas a significant majority of linguistically competent children tend to treat the sentence as true, adult participants tend to be equivocal between true and false. Roughly 33% of adult participants considered all five such items true and 40% false. The remaining participants tended to consider the items false by indicating that 3 or 4 of the five were false. (From here on we will refer to the true responses as "logical" and the false responses as "pragmatic.") That work presented the two theoretical accounts but was not designed to determine which of the approaches was better supported. The present work aims to adjudicate between the two accounts. It does so by presenting a longer series of sentences like (3), exclusively to adults, along with control items that are Patently True or Patently False, like in (4) and (5), respectively:

(4) Some houses have bricks.
(5) Some crows have radios.

One can consider two kinds of dependent measures that can help reveal the way implicatures are processed here—reaction times and ERP's. With respect to reaction time data, the neo-Gricean approach and Relevance Theory approach make opposing predictions. If the neo-Gricean approach is correct, logical responses to items like (3) ought to take longer than pragmatic responses because it is assumed that the implicature arrives by default and that the logical response is the due to a supplementary step of undoing the implicature. From a Relevance Theory perspective, the initial interpretation, taken at face value, should correspond to the true response and an implicature ought to prompt further responding and a false response. So, logical responses to these Underinformative sentences will be faster than pragmatic responses.

The literature reveals some indirect evidence for claims from a Relevance Theory perspective. Rips (1975) showed that participants take less time to evaluate categorization items like *Some congressmen are politicians* when instructions indicate that *Some* ought to be interpreted as *Some and perhaps all* than when the instructions indicate that *Some* ought to be interpreted as *Some but not all*. That study, however, used more complex materials, made comparisons across two somewhat different experiments, and did not allow for spontaneous interpretations of *Some*, as we do here.

With respect to ERP's, the items exemplified by (4) and (5) can act as benchmarks for determining the way participants treat the items exemplified by (3). On the one hand, if ERP profiles of participants for items like (3) resemble those found in responding to (4) it would be an indication that scalar implicatures are treated like Patently True items. On the other hand, if participants' ERP profiles of items like (3) resemble those found in responding false to (5), it would indeed be an indication that scalar implicatures are automatic or early in sentence processing. The second outcome would be in line with the neo-Gricean account according to which an implicature is automatic and intrudes on the semantic

[2] The scale of informativeness can be determined by entailment relations. The stronger term entails the weaker but not vice versa. *All* is a stronger quantifier than *Some* because *All* entails *Some* while *Some* does not entail *All* (to say that *All Italians like ice-cream* logically implies that *Some Italians like ice-cream*; however, *Some Italians like ice-cream* does not necessarily imply that *All Italians like ice-cream*).