Recalling presupposed information.

Evidence from the online processing of presuppositions in political tweets

Viviana Masia[a], *Davide Garassino*[b], *Nicola Brocca*[c], *Louis de Saussure*[d]
[a]Roma Tre University, [b]Zurich University of Applied Sciences, [c]University of Innsbruck, [d]Université de Neuchâtel

Abstract

This article addresses, experimentally, the question of how presuppositions are cognitively processed and retrieved in discourse. In the proposed research, we have administered tweets produced by Italian politicians to native speakers so as to assess how easily they could retrieve the presupposed content of two presupposition triggers (definite descriptions and change of state verbs), as opposed to their explicit paraphrase, by answering verification questions. Results showed that content presupposed by change of state verbs was likely to receive more attention than content conveyed by definite descriptions; this could possibly be due to the greater effort involved in mentally representing the event taken for granted by the predicates. Definite descriptions, on the contrary, seem to instruct to a shallower processing modality, which means that their content is processed less attentively or in a "good enough" way.

Keywords: presupposition, shallow processing, information recall and retrieval, Twitter.

1. Introduction

This article addresses, experimentally, the question of how presuppositions are cognitively processed and retrieved in discourse. Particularly, we aim to understand whether presuppositions affect memory in a similar way as asserted content and if different presupposition triggers entail different mental processes. To do so, we focus on the comparison between stimuli containing a specific presupposition trigger, which can be represented by a definite NP or a change of state verb, and sentences presenting an explicit paraphrase of its presupposed content. An explicit paraphrase is meant in this study as a way of "bringing implicit information to explicitness" (Sbisà 2007: 162).

Moreover, this paper aims to strike a balance between controlled stimuli and ecological validity, by relying on data gathered from Twitter which was only slightly adapted to the purposes of the research design. The choice of using 'authentic' messages, i.e., political tweets, was motivated by the need to couch our research aims in a real-life context which has received considerable attention from recent corpus-based work (see a.o. Lombardi Vallauri & Masia 2014; Garassino et al. 2019, 2022). This strand of research has highlighted a tendency for politicians on Twitter to: (i) heavily rely on implicit communication, mostly due to the design of the medium (e.g., the brevity of texts), and (ii) to convey potentially manipulative content through implicit communication, especially when they express criticism against rivals or exaggeratedly boost their own achievements. In this light, the possible impact of implicit content on memory becomes socially relevant because such messages on social media can reach a very large audience. This paper offers a first glimpse into this research direction.

In the next sections, we will show that the cognitive processes of retrieving presupposed content is modulated by the different types of presupposition triggers. Our results suggest, in fact, that definite descriptions and change of state verbs may trace different recalling paths,[1] with change of state verbs inducing more accurate information retrieval than definite descriptions. Based on the results of the experiment, we argue that a shallower processing may be involved in the mental representation of presuppositions triggered by definite descriptions.[2]

The article is organized as follows. Section 2 surveys the existing literature on presupposition processing that discusses the most relevant findings on the mental representation of implicit information within the research domain of experimental pragmatics. This section ends with a concise description of Twitter discourse and the constraints of this medium that encourage implicit communication (§2.3). The experimental design, the stimuli and the research

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[1] For the sake of clarity, we deem it useful to highlight that the term "recalling", as used in this paper, refers either to retrieval of information in the preceding discourse context or to background knowledge (which may or may not have already been introduced in the universe of discourse).
[2] On 'shallow processing' see Barton and Sanford's (1993) seminal paper.

questions pursued in the present study are detailed in Section 3. Data analysis is reported in Section 4 and is followed by a general discussion in Section 5.

2. Research background

2.1 Presuppositions and experimental pragmatics

Within the realm of presumptive meanings, presuppositions share many properties with other implicit meanings. Wilson (1975) and Sperber & Wilson (1979) argued long ago that presuppositions are nothing else than sorts of entailments, among other ones, that contribute to providing relevance to the utterance in the circumstances. Some presuppositions work as implicit premises in inferences (*enthymemes*), and they have specific properties relating to how they are conceived. Moreover, they are communicated together with a presumption that they are preconditions for relevance (de Saussure 2013) but are not relevant in their own right, since they are – at least reputedly – given pieces of information as opposed to novel ones.

Even though Sperber & Wilson (1979; 1995) treat presuppositions as a pragmatic kind of information that is recovered during interpretation in the process of context construction, the notion that they are presented by the speaker as already mutually manifest at the time of speech give them a flavor of being 'taken for granted', or pieces of 'background information', as they are usually labelled (see for example von Fintel 2008). As such, they do not attract attention, nor do they trigger analytical judgment. This is argued by von Fintel (2008: 30) as well when he states that "instead of checking whether the presupposition is satisfied, the hearer will take for granted that it is satisfied". Furthermore, in more pragmatic terms, they seem to bypass checks of 'epistemic vigilance' (Sperber et al. 2010), at least to some extent. As a result, it has been repeatedly observed that they have a particular effect on the epistemic life of individuals – i.e., how interlocutors may be inclined to hold beliefs and opinions, possibly in relation to the

way cognition treats them. One interesting assumption is that presuppositions are usually treated below the level of consciousness, or 'shallow processed' (see de Saussure 2013).

A key problem about the epistemic effect of presuppositions relates to their integration and permanence in memory and a possible discrepancy between the lower level of vigilance that they activate in online processing and the deeper long-lasting effects that they have on the cognitive environment,[3] namely the epistemic life of individuals. In theory, there would be reasons to expect that contents that are exhibited as irrelevant and processed superficially will not bear a significant effect on the beliefs of individuals. However, data and the literature suggest the contrary, and we hope here to contribute to the investigation of this phenomenon experimentally.

By comparison, Drai & de Saussure (2016) show a similar discrepancy between how mainstream theories associate epistemic effects with types of meaning, on the first hand, and empirical and experimental data on the other hand. Their study focuses on the impression by the addressees that a given content is communicated explicitly or, on the contrary, implicitly. The results show that if a component of meaning appears relevant, it tends to be considered explicit – to be interpreted as 'committing' the speaker – even when it is actually implicit (i.e., an implicature). The feeling that a speaker is committed to a particular content does not match exactly what pragmatic theories envisage and, in particular, it does not systematically match the boundary between the explicit and the implicit levels of meaning.

A short overview of this background will help set the scene for the research questions of this study. Implicit components of verbal communication, 'implicatures', have a key property that is consequential of the explicit/implicit nature and features of the message.[4] There is something obvious, or trivial, about this property. Implicit messages are not plainly expressed,

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[3] The notion of 'cognitive environment' refers to the set or, more precisely, the 'array' of assumptions manifest to an individual at a given time (Sperber & Wilson 1995).
[4] We do not count Gricean 'conventional implicatures' among implicatures; see Bach (1999). As for generalized ones, they are indeed defeasible if using a strictly speaking logical criterion.

therefore there is, necessarily, some latitude in interpreting them. As a consequence, an audience can never be completely certain that the implicit message which is interpreted was really the right one. Sperber & Wilson (1995 [1986]) say that implicatures result from 'non-demonstrative inferences' in that sense. Conversely, verbalizing implicatures does not create a redundancy, for the same reasons.

These are very famous properties of the implicatures theorized by Paul Grice. However, the notion that implicatures are cancellable is an observation initially based on strictly logical facts. For example, when an implicature is canceled, the cancellation by means of a sentence that explicitly states otherwise, does not create a *logical* inconsistency. Further along, the notion that implicit components of meaning are defeasible was made more accurate in more psychological terms with the notion of 'speaker commitment', or, put otherwise, a notion of *commitment attribution to the speaker by the audience*. Defeasibility itself was questioned by looking at how an audience comes to consider that the speaker is committed to have meant something. The notion of cancellability was completed with a concept of 'retractability' (Morency et al. 2008), the test being about whether a speaker can retract from having meant something without raising a feeling of conversational oddness (a feeling of bad faith, typically), or not. From the idea of logical inconsistency, some pragmatic approaches, in particular within the trend of cognitive pragmatics such as Sperber and Wilson's Relevance Theory, moved to notions of retractability and 'pragmatic inconsistency' (de Saussure & Oswald 2009). A similar move appears in the works of Pinker et al. (2008) who elaborate a theory where implicit meanings are seen as means of achieving safe manipulative attempts, for the reason that they are overtly 'plausibly deniable'. Plausible deniability corresponds, in our words above, to the concept of 'retractability' (see also Müller 2018).

The motivations for this broad evolution of research about implicit meaning are both empirical and technical and go together with the consideration that not all types of what Grice

calls 'conversational implicatures' behave the same way when it comes to the plausibility of their deniability, while they are all perfectly well defeasible logically speaking. A typical example of this discrepancy concerns (at least some) 'generalized' implicatures, such as the implicature that Mary has exactly four children based on the sentence "Mary has four children". That Mary has *five* children raises no inconsistency with the fact that she has *four* children. Thus, it is defeasible and, therefore, it is an implicature. Looking at ordinary communicative situations, it is clear however that such components of meaning are not retractable, unless under very particular conditions. Because of such features, and others, more formal, Relevance Theory does not consider them implicatures proper but parts of the explicit meaning, even though they are constructed by the addressee in context (other approaches have labeled these contents with various names to account for these particularities).

The study by Drai & de Saussure (2016), which was designed to test observations found in Rubinelli et al. (2006), shows that contents that bear high relevance tend to be considered as having been conveyed more explicitly; but more importantly in the context of the present paper, the study shows how rigid the judgment of explicitness is. The subjects of the experiment were first given a medical advert to read. After reading the advert, they had to rate how explicit a number of claims made in the advert were. One group had to answer the questionnaire by heart, and the other group still had the original text with them, in case of need of verification. The interesting fact is that the two groups had similar results despite the different conditions. The experiment was meant to give supporting experimental evidence to the assumption that first-obtained judgments in the interpretation of language, relatively to the speaker's commitments, were stable and highly reliable, whatever their actual position – implicit or explicit – among the various components of the message.

2.2. Presupposition processing within behavioral and neurophysiological purviews

While implicatures were treated on a par with other asserted content in a text, the processing behavior of presuppositions produced an opposite body of evidence, especially in the behavioral domain, with some contradictory scenarios in the neurophysiological purview.

Early experimental studies on presupposition showed that different processing paths were activated based on the presence *vs.* the absence of presupposition triggers in a sentence. This was more or less consistently highlighted in both behavioral and neurophysiological investigations (a.o. Loftus 1975, Burkhardt 2007, Tiemann et al. 2011, Schwarz 2015, Masia et al. 2017, Domaneschi et al. 2018). For example, in a reading time experiment, Tiemann et al. (2011) noticed that the presence of a presupposition trigger (definite phrase or focus-sensitive operator) leads to a slower reading of the sentence as compared to sentences with only assertive information. This trend was interpreted as hinging on the fact that, as information taken for granted in the conversation (Stalnaker 1973, 2002), a presupposition imposes a backward-looking operation to search for an antecedent in the prior discourse, or, to put it more pragmatically, it imposes the requirement to search for a corresponding element in memory. These and other related findings are also outlined in a later work by Tiemann et al. (2014) in which it has been shown that presuppositions triggered by *wieder* ('again') elicit longer reading times when not entailed by the preceding context, and they were not always accommodated. The results show that in a context that does not support the presupposition of *wieder*, processing effects emerge as soon as the presupposition is known to the reader. This finding suggests that presuppositions are processed and evaluated immediately. In the complex interplay of semantic decoding and pragmatic inference, this might be an indication that the path to recovering the presupposition of '*wieder*' is semantically determined.

Based on a Visual World paradigm (with a mixed visual/auditory modality in which subjects are required to look at a picture while listening to a registered sentence containing a specific linguistic expression), Schwarz (2015), compared the processing time course of the presupposition triggered by *also* and that of the information asserted by *only*. Results showed more rapid shifts in fixations to target pictures based on the presupposition expressed by *also*, generally in a 0-400 ms time window. By contrast, the assertion introduced by *only* arises roughly 400 ms later as compared to the presupposition, suggesting that presupposed content is generally processed before the asserted content.

Also within the behavioral domain, Domaneschi & Di Paola (2018) ran a reading time experiment (with offline measures as well) in which they compared the processing costs of different presupposition triggers: definite descriptions, change of state verbs, iterative adverbs, and focusing operators. They found that the accommodation of definite descriptions takes longer (and is therefore costlier) at the word following the trigger, while for iterative adverbs accommodation is costlier on the trigger word than change of state verbs and focusing operators.

Furthermore, even more compelling evidence comes from the neurophysiological domain, and, notably, from studies using the electroencephalographic (EEG) technique. Several such studies focused on the interplay between presupposed information and the discourse context. For example, in an EEG study on discourse inference processing, Burkhardt (2007) compared definite noun phrases with different degrees of context dependency. In one case it was a NP directly anchored to a discourse-available antecedent, and in the other case it was the antecedent of a target NP, which had to be "inferred" by the reader since the NP conveyed thematically continuous but psychologically inactive information (cf. Chafe 1994). NPs to be linked to the foregoing discourse elicited more prominent P600 deflections, indicating more effortful discourse updating mechanisms. Other interesting findings have been achieved from

studies comparing different categories of presupposition triggers. In an EEG study, Masia et al. (2017) compared context-target pairs containing definite descriptions and subordinate clauses to their assertive counterparts. They noticed that both trigger types elicited a N400 response which developed in an earlier time window for subordinate clauses and in a later time window for definite descriptions, which suggests that processing difficulties arose earlier for the former. In another EEG study, Domaneschi et al. (2018) compared definite descriptions to change of state verbs in conditions of both satisfaction and accommodation of their presuppositions. They noticed that while both trigger types correlated with more prominent amplitudes in the N400 signature in the accommodation condition, change of state verbs were also associated with a much stronger P600 response. This result was interpreted as reflecting more taxing cognitive mechanisms in mentally representing temporally displaced events which, despite being presented as taken for granted, are new to the receiver. Shetreet et al. (2019) tested neural responses to factive vs. non-factive predicates in texts in which their complement clauses were followed by consistent and inconsistent information. They noticed that inconsistent information produced a much more prominent P600 effect in response to clauses projected by factive predicates. This shows that the restructuring of the discourse model costs more when a presupposition (as opposed to an assertion) is contradicted.

These studies, along with those conducted on implicatures interpretation mentioned in §2.1. (e.g. Drai & Saussure 2016), provide a solid groundwork to further investigate the interpretation and evaluation of texts with presupposition triggers. The study herein proposed wishes to be an integration to what has already been done with implicatures – especially with the conversational type (see the findings summarized in §2.1. and Drai & Saussure 2016 for a more exhaustive description of the experiment). Indeed, apart from inner neuropsychological measures, what is still missing from an empirical standpoint on presupposition processing is an in-depth investigation of receivers' reactions to presupposed contents in texts, especially

regarding the extent to which a receiver judges a presupposition as actually present or not in a given text. Some seminal work in this direction had already been pursued by Loftus (1975) although with a testing design that did not permit grasping differences between presupposition triggers, nor between presupposition and assertive packaging. This study aims at contributing to bridging this gap.

2.3 Implicit communication on Twitter

Before moving to the bulk of our analysis, it is necessary to describe the type of texts analyzed in this study. Twitter is one of the most powerful and pervasive means of today's political communication. Its effectiveness rests mostly upon its interactive nature which allows, on the one hand, to spread political opinions more rapidly (with real-time monitoring of the gathered consensus), and, on the other, to amplify the persuasive effects of a political message in the attempt to influence other users' minds and convictions on a given issue. Building on previous corpus-based work (in particular, Brocca et al. 2016; Garassino et al. 2019, 2022), we have acknowledged that the brevity of Twitter messages (with an overall limit fixed at 280 characters) have fostered particular characteristics of this kind of discourse. For example, because of the lack of space available, politicians and influencers may be induced to resort to implicit strategies to streamline the overall argumentative structure of the message. Further details on the presupposition triggers considered, as well as on the experimental design, will be provided in Section 3.

3. The research design

3.1 Research questions

Change of state verbs are typically interpreted as conveying novel, thus more *relevant*, information. Considering that they trigger other cognitive mechanisms than definite descriptions do, and assuming that they involve higher processing costs because of the more complex semantic representations that they involve, we expect that construing the presuppositions triggered by change of state verbs require a major allocation of cognitive resources. Accordingly, the recalling of their presuppositions should also be more accurate than the recalling of presuppositions triggered by definite descriptions because their mental encoding should involve less taxing cognitive processes. As for the reported differences between presupposition and assertion processing, it is reasonable to expect assertions to facilitate the recalling of some information because, representing the typical packaging of new information, they should attract the receiver's attention to their content. Previous psycholinguistic research (cf. for example, Loftus 1975, Tiemann 2014; Schwarz 2015) also demonstrates that contents encoded as assertions are more consciously noticed than contents encoded as presuppositions.

Moving from these premises, the present study aims to address the following research questions:

Q1. Does presupposition vs. its explicit paraphrase differently affect information recalling?

Q2. Do differences in the form of presupposition triggers - definite descriptions or change of state verbs - interact with differences in information recalling?

To address Q1, we used an information-recalling task whose aim is to compare assertions and presuppositions. To address Q2, we relied on presuppositions activated by definite descriptions and change of state verbs, since they are two common and well-studied presupposition triggers (Levinson 1983: 181).

Therefore, capitalizing on the foregoing, we may couch our predictions in the following terms: presuppositions relying on shallow processing may render information recalling less accurate; the mental operations involved in recalling information conveyed by definite descriptions differ as compared to those conveyed by change of state verbs. As illustrated in §2.2, the status of definite descriptions may render information-recalling processes less accurate in offline responses to verification questions because they are generally less predicative than pure verbs and are also more likely to be interpreted as topical in an utterance. This may render them overall less 'relevant' in the communicative task at hand, in the sense that they are mentally coded as backgrounded and thus not deserving the same bulk of attention devoted to verbs. It can therefore be expected that the content encoded by change of state verbs is recalled more accurately (because they are attended to more thoroughly) than those that are encoded by definite descriptions.

Within the realm of experimental studies on presupposition processing, this work wishes to shed some light on possible differences between definite descriptions and change of state verbs that can be consistently mapped onto specific neural structures. Put otherwise, the aim of this study is to assess to what extent the recalling of presupposed information – when conveyed by definite descriptions and change of state verbs – reflects the trends discussed in previous experimental investigations.

3.2 The experiment

3.2.1 The stimuli[5]
As already hinted at in the outset, the choice to select stimuli extracted from Twitter is grounded on the fact that – besides being one of the most typical examples of communication on social

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[5] The stimuli, the data and the R script are available online at:
https://osf.io/ekcqj/?view_only=849f6410a7434083a895a190f85ea474

media – this textual genre is particularly rich with implicit language devices because of the propagandistic function of political communication and the length constraints of this medium (Garassino et al. 2019, 2022; Lombardi Vallauri 2019). As for the types of triggers, definite descriptions were chosen because experimental evidence on their processing is more consolidated throughout different testing paradigms, either within behavioral or neurological investigations (Burkhardt 2007; Kirsten et al. 2014). This presupposition trigger thus also serves as a baseline condition for the proposed comparison with change of state verbs. As also rightfully stated in Domaneschi et al. (2018), change of state verbs belong to that category of triggers requiring mandatory processing (Domaneschi et al. 2014), which makes their analysis, compared to their assertive counterparts, worth undertaking.

To comply with the research hypotheses stated above, tweets have been slightly adapted according to layout, language, content, and pragmatic criteria – such as variation in the information status of the presupposition trigger. To further uniform the overall layout of the selected tweets, all hashtags, links, and pictures were excluded. Concerning morphosyntactic and pragmatic aspects, tweets with passive sentences and with multiple presuppositions were also excluded, due to their syntactic complexity. Each stimulus ranged from 151 to 162 characters and from 45 to 68 points of readability according to the *Gulpease* index (Lucisano & Piemontese 1988). In each tweet, the trigger appeared in the main clause. Syntactically marked constructions – such as cleft sentences, fronted constituents, or, in general, sentences with non-canonical word orders – were substituted by non-marked (i.e., 'canonical') ones.

To select the stimuli for the experiment, we first gathered a corpus of political tweets. The selected tweets were posted within the two years preceding the experiment, which was conducted in Spring 2021, and include topics such as migration, the COVID-19 pandemic, the mafia, EU-related matters as well as economy. The sources of the tweets were balanced according to political orientation: the stimuli were extracted from the Twitter profiles of Luigi

di Maio, Giorgia Meloni, Matteo Salvini, and Matteo Renzi. These public figures were chosen because at that time they were very active on Twitter and belonged to parties with different roles in both opposition and government.[6] The sources of the tweets were anonymized in the test to avoid possible effects of partisanship bias. However, politicians mentioned in the tweets, as well as the names of political parties and other public figures were maintained to preserve authenticity.[7]

In total, 42 tweets were selected. Stimuli were subdivided into four groups according to the type of presupposition trigger (or its absence):

(a)   7 political tweets containing a presupposition (PPP) with a definite description (DEF). The definite phrase was made up of a definite determiner and a noun. All definite descriptions had the syntactic functions of subject and occurred in a preverbal position.

(b)   7 political tweets containing a presupposition with a change of state verb (CSV). We selected tweets containing the Italian verb *continuare* ('to continue'). This verb presupposes a process that was already going on; thus, it can be considered as a particular category of change of state verb (Lombardi Vallauri 2019).

(c)   For each presuppositional item, an assertive counterpart was created as a control condition (7 EXP DEF, 7 EXP CSV).

(e)   In addition, 14 filler items (not containing any presuppositional trigger) were added and interspersed among the critical stimuli as distractors.

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[6] Luigi Di Maio, Minister and leader of the party *MoVimento Cinque Stelle* ('Five Star Movement'), and Matteo Salvini, Minister and leader of the *Lega per Salvini Premier* ('League for Salvini Premier') were at the time members of ruling parties. On the contrary, Giorgia Meloni, leader of the party *Fratelli d'Italia,* ('Brothers of Italy'), was serving in opposition. Depending on the specific time window, Matteo Renzi, leader of *Partito Democratico* ('Democratic Party') and subsequently leader of the party *Italia Viva* ('Italy Alive'), was serving in opposition or was part of the government.

[7] With respect to AOIR internet research ethics (https://aoir.org/ethics/), we consider the use and the quotation of political tweets in our research as not problematic since they are publicly available messages produced by public figures.

Regarding definite descriptions, only deverbal nouns were chosen.[8] Unlike non-predicative existential presuppositions, such as the existence of objects and people, these definite descriptions have more potential of bearing relevance and of being accommodated or rejected.

The creation of the assertive counterparts from the presupposition was conducted as follows: a definite description represented by a deverbal noun (e.g., *l'approvazione del superbonus*, 'the approval of the superbonus') in (1) was explicitly paraphrased by means of a verb in the active form (*Il governo ha approvato il superbonus*, 'The government approved the superbonus'), as the minimal pair represented by examples (1 a,b) shows:[9]

(1a)   PPP_DEF: *L'approvazione del superbonus da parte del governo* […]

'The approval of the superbonus by the government [...]'

(1b)   EXP_DEF: *Il governo ha approvato il superbonus* […]

'The government approved the superbonus [...]'

Importantly, we are well aware that (1a, 2a), such as the other minimal pairs in our experiments, may contain other definite descriptions (e.g., *il superbonus*, 'the superbonus', *il governo*, 'the government') as well as other presupposition triggers and/or different types of implicatures. Crucially, though, the pairs *only* differ in that the implicit content attached to a certain presupposition trigger in a sentence is explicitly paraphrased, i.e., asserted, in the other sentence. In other words, our experiment aims to assess participants' response to this difference

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[8] Deverbal or second-order nouns are defined as denoting "events, processes, states of affairs, which are located in time and which are said to occur or take place, rather than to exist" (Lyons 1977: 443).

[9] In these and the following examples, we add underlines to emphasize some specific word or phrase in the tweets. These traits do not belong to the original messages.

between the two sentences in a minimal pair (i.e., the opposition between implicit and explicit encoding of some content).

Regarding change of state verbs, only "continuation verbs" (*continue*) were considered. They represent a subgroup of change of state verbs presupposing that an event is already ongoing (e.g. *Mary continues to speak* presupposes that "Mary was already speaking"). Concerning their explicit paraphrase, the sentences in (2) display how the original form involving a presupposition, (2a), was modified into a periphrastic construction, (2b), in its asserted counterpart.

(2a)   PPP_CSV: […] *la nave della Ong tedesca SeaEye <u>continua a far sbarcare</u> in Italia immigrati senza alcun controllo.*
'[…] the ship of the German NGO SeaEye <u>continues to land</u> immigrants in Italy without any control'

(2b)   EXP_CSV: […] *la nave della Ong tedesca SeaEye <u>ha fatto e fa sbarcare tutt'ora</u> in Italia immigrati senza alcun controllo.*
'[…] the ship of the German NGO SeaEye <u>has made and still makes immigrants land</u> in Italy without any control'

All stimuli were arranged in a Latin Square Design so that each participant was never presented with the same piece of information twice, i.e., in presupposition and in the assertion packaging. The experiment design is summarized in Table 1. Each list of stimuli was assigned to a different group of participants (Group A or Group B).[10] Stimuli have been semi-randomized so that fillers and target items could be properly distributed and two items with the same trigger never followed each other immediately.

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[10] For each participant, anonymized personal data were collected by means of an online questionnaire. The participants were informed about their rights according to the *European General Data Protection Regulation* (EU GDPR 2016/679). Before starting the experiment, they were explicitly asked to give their consent to the use and publication of the data for scientific purposes by checking a box.

Group A			Group B	
Nr.	**Type**		**Nr.**	**Type**
7	EXP_DEF		7	EXP_DEF
7	EXP_CSV		7	EXP_CSV
7	PPP_DEF		7	PPP_DEF
7	PPP_CSV		7	PPP_CSV
14	Fillers		14	Fillers
total 42			total 42	

Table 1. Stimuli design

3.2.2 The experimental procedure

The experiment was conducted online by means of the software *LimeSurvey* (www.limesurvey.org). After a short training phase, each participant was exposed to the 42 items, according to the design summarized in Table 1. After reading each tweet, participants could move to the next page where they saw a question containing the stimulus presented in the tweet in its asserted form, independently of the 'packaging' (presupposition or assertion) used in the previous page. This is shown by the question in (3), referring to example (2) above, in which the presupposition conveyed by the trigger *continuare*, 'continue', is asserted:

(3) Did the tweet that you have just read contain the following information?
  La nave della Ong tedesca SeaEye ha fatto sbarcare in Italia immigrati in passato
  'The German NGO ship SeaEye has landed immigrants in Italy in the past'

The participants were then asked to choose one out of five answers on a Likert scale, ranging from "yes, information X is certainly present in the text" to "no, information X is certainly not present in the text". The expected reply to each question involving the

experimental stimuli, in both their presupposed and asserted versions, was "yes, information X is certainly present in the text". Accuracy and degrees of certainty (e.g., for positive answers, "yes, information X is probably present in the text", "yes, information X is certainly present in the text") were tracked. Unlike the questions referring to the experimental stimuli, those following the distractors were meant to elicit a negative answer to keep participants' level of attention high during the whole experiment.

Table 2 displays the experiment flow as an example: Group A was presented with some presupposed information triggered by the change of state verb (PPP_CSV), whereas Group B received stimuli containing the asserted version (EXP_CSV).

Group	*Stimulus*	*Question*
A	An appeal to 18-year-olds: make your voices heard because this government keeps postponing approval for the culture voucher and wants to exclude concerts from it.	Did the tweet you just read contain the following information? *The government has delayed approval for the culture voucher in the past* Choose one of the following options: o certainly yes o probably yes o probably not o certainly not o no response
B	An appeal to 18-year-olds: make your voices heard because this government has postponed and is postponing approval for the culture voucher and wants to exclude concerts from it.	

Table 2. The experimental design

4. Data Analysis

4.1. The sample

In total, 243 participants took part in the experiment. Most of the participants were university students, PhD students, and academic staff members.

Non-native Italian speakers were excluded as well as bilinguals and participants declaring learning difficulties or dyslexia. Uncompleted surveys were also discarded. Finally, 117 participants were considered for the analysis. The majority of participants are young (min: 19, max: 66; mean: 29.5, sd: 12.58; 80% are under 40; 70% under 30) and female (85 females, which is 73% of the participants). The composition of the two experimental groups (Group A and B) is only homogenous for gender (χ^2= 2.16, df = 1, *p* = .141) but not for age (t = -31.71, df = 2201.5, *p* < .0001) as Group B participants are on average older (mean = 36.28, sd = 13.93) than those belonging to Group A (mean = 23.65, sd = 7.25).

4.2 Statistical analysis

In a recent methodological paper, Endresen & Janda (2016: 219) discussed the challenges that Likert-derived data poses to researchers in the social and human sciences. The main issue is represented by how one chooses to consider this type of data (i.e., as categorical, ordinal, or numerical ordinal variables), which obviously has an impact on the statistical tests deemed more appropriate.

According to Endresen & Janda (2016), *conditional inference trees*, as well as *random forests*, seem to be "the most appropriate, informative, and user-friendly" statistical techniques for the analysis of Likert-derived data. However, such techniques seem also prone to accuracy issues, especially when interaction terms are involved, as highlighted by Gries (2020). For this reason, we decided to triangulate the results of a non-parametric model, i.e., a conditional inference tree (henceforth, CT) with those provided by a parametric model, i.e., an *ordinal mixed-effect regression model*. This choice also resonates with the claim made by Endresen & Janda (2016: 247), according to which "comparison of the outcomes of parametric and non-

parametric statistical models designed for handling different types of data is of key importance and bear implication for similar studies."

Moreover, mixed-effect regression models also have the advantage of considering variance induced by random effects, such as participants and experimental stimuli, which in CT is not immediately accessible. This is important since individual variation is expected in our experiment. Participants may rely, in fact, on different strategies in carrying out the task and they can also express different degrees of certainty concerning their responses. Moreover, by-stimuli variation is also expected: the sentences used in the experiment are quite heterogeneous as they were produced spontaneously on Twitter (as observed in § 3.2.1., the tweets were only partially modified for the sake of the experimental design).

The statistical analyses were conducted with the R programming language (v. 4.2.2.; R Core Team 2022) and the *tidyverse* package (v. 1.3.2; Wickham et al. 2019). More specifically, the analysis of the conditional inference tree model required the *party* package (v. 1.3-11; Hothorn et al. 2006), whereas the analysis of the mixed-effect regression model was carried out with the *ordinal* (v. 2019.12-10; Christensen 2019) and *ggeffects* (v. 1.1.4; Lüdecke 2018) packages.

4.2.1 Conditional inference trees

Conditional inference trees are non-parametric statistical techniques that recursively partition a data set by carrying out a series of binary splits testing the association between each independent variable and the outcome (or dependent variable).

The CT represented in Figure 1 was obtained from a model in which the Likert-scale rating scores were the dependent variable, which was treated as a categorical variable (Rating_num; levels: '1' to '5'). The factors 'information packaging' (INF, levels: explicit paraphrase, EXP, and presupposition, PPP) and 'presupposition triggers' (TRG, levels: definite

descriptions, DEF, and change of state verbs, CSV), as well as their interactions, represented the independent variables. The structure of the model is made explicit by the following formula:

(4)   Rating_num ~ INF+TRG+INF:TRG

The rating scores are represented by values ranging from '1' (the speaker is certain that there is *no* such information in the message) to '5' (the speaker is certain that there *is* such information in the message), with the middle ground value '3' conveying indecision. With respect to our test design (§ 3.2.2.), also notice that the values '1' and '2' correspond to the wrong answers to the experimental stimuli.
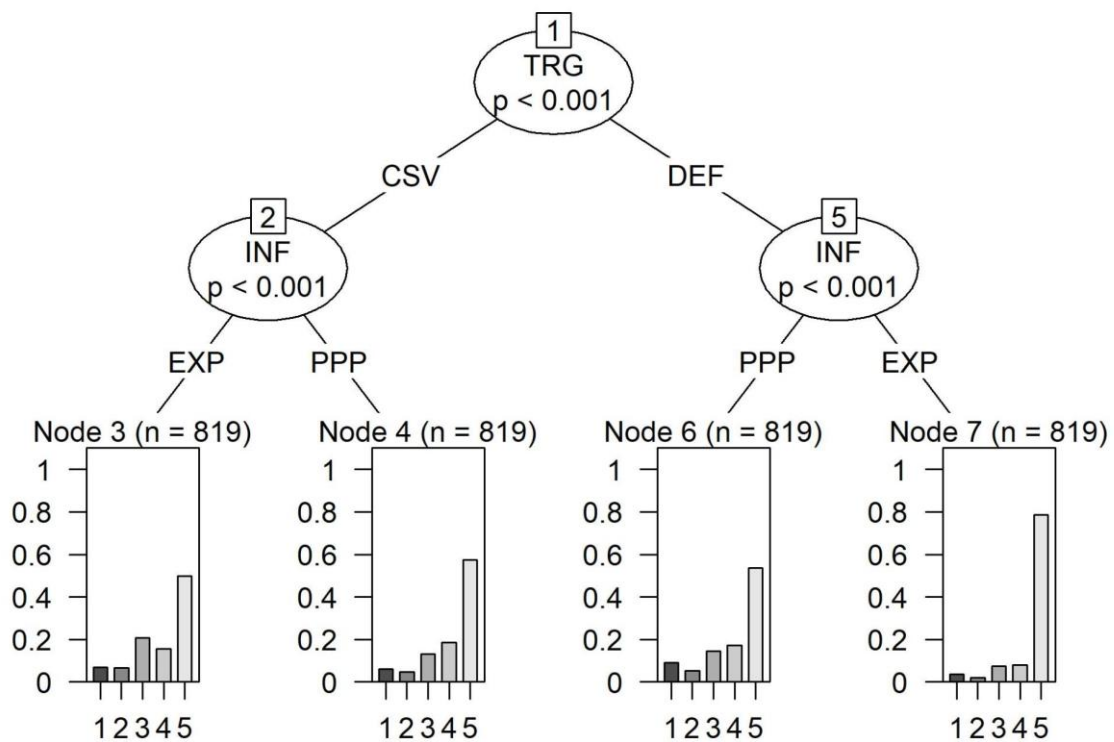

Figure 1. Conditional inference trees (1 = "certainly not" i.e. participants are certain that there is no such information in the message, 3 = "no response", 5= "certainly yes" i.e. participants are certain that there is such information in the message).

According to Figure 1, the most important variable partitioning the dataset is 'trigger' (TRG). Following the right branch, a significant interaction with the variable 'information packaging' (INF) emerges. The explicit paraphrasing of a definite description (EXP) is correctly recalled in over 80% of the cases (summing up the ratings '4' and '5'; see the right-most plot in Node 7).

The content of a definite description presented in presuppositional packaging (PPP) is correctly recalled in over 60% of the cases (summing up '4' and '5'; see Node 6). A glance at the column representing the highest rating score ('5') in the right-most barplot makes it clear that the explicit paraphrasing of a definite description is recalled with more certainty (and possibly more ease) than when the same content is implicit. Moreover, the rating score '3', which is scantily represented in Node 7, rises up to about 15% of the data in Node 6. If the presupposition trigger is represented instead by a change of state verb (on the left branch of the tree), a significant interaction emerges again between the variables 'trigger' and 'information packaging'. If the presuppositional content of a change of state verb is explicitly paraphrased in the message (EXP), less than 50% of the ratings received the highest score, cf. the left-most barplot in Node 3. In the same plot, ratings '3' (indecisive) amount to about 20% of the data. If the presuppositional content of the change of state verb is implicit (PPP), ratings '5' rise up to about 60% of the responses, whereas the percentage of indecisive answers drops under 20% (Node 4). Finally, the percentage of the 'negative' rating scores ('1' and '2') are extremely low overall: since they represent the wrong answers to the questions referring to the experimental stimuli, such a low percentage may be considered a good indicator of the subjects' attention during the test.

4.2.2 Ordinal mixed-effect regression

The model considered for the analysis included rating scores as the dependent variable (Rating_num) and the independent fixed factors 'information packaging' and 'trigger', as well as their interaction. Unlike the conditional inference tree (§ 4.2.1), the dependent variable was treated as an ordered factor, which is justified by the fact that in the rating scores a '5' "is higher than the score '4'" (Endresen & Janda 2016: 234) and so on. In such cases, the use of ordinal mixed-effect regression seems well justified. Following Barr *et al*. (2013) and Brauer & Curtin (2018), the model had "the maximal random effect structure called for by the design of the study" (Brauer & Curtin 2018: 405), which is by-speaker and by-item random intercepts as well as a by-speaker random slope for the interaction term (see the Appendix for more details). The formula is reported in (5):

(5)   Rating_num ~ INF*TRG + (1 + INF*TRG | Speakers) + (1 | Items)

Importantly, the model confirmed the significance of the interaction between 'trigger' and 'information packaging' (INF[PPP] * TRG[CSV], $\beta = 1.98$, SE $= 0.53$, z $= 3.75$, *p* $< .001$), already observed in the CT (Figure 1). This means that the presupposed content of change of state verbs is more likely to receive a higher rating score than when it is explicitly paraphrased, even if the difference between the two 'packaging' strategies seems modest. Such an effect is visualized in Figure 2,[11] in which the predicted probabilities based on the model are plotted: we observe, for instance, that a stimulus containing a change of state verb in the presupposition packaging has a 61% chance of obtaining the highest rate ('5'), whereas chance drops to 53% when its implicit content is explicitly paraphrased. In contrast, the predicted probability for the

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[11] This plot and the R code needed for its creation, is based on the tutorial on ordinal logistic regression in R by Marissa Barlaz (https://marissabarlaz.github.io/portfolio/ols/).

explicit paraphrase of a definite description has an 86% chance of receiving the highest rating, whereas it lowers to 54% when the existential claim of the definite description is presupposed.
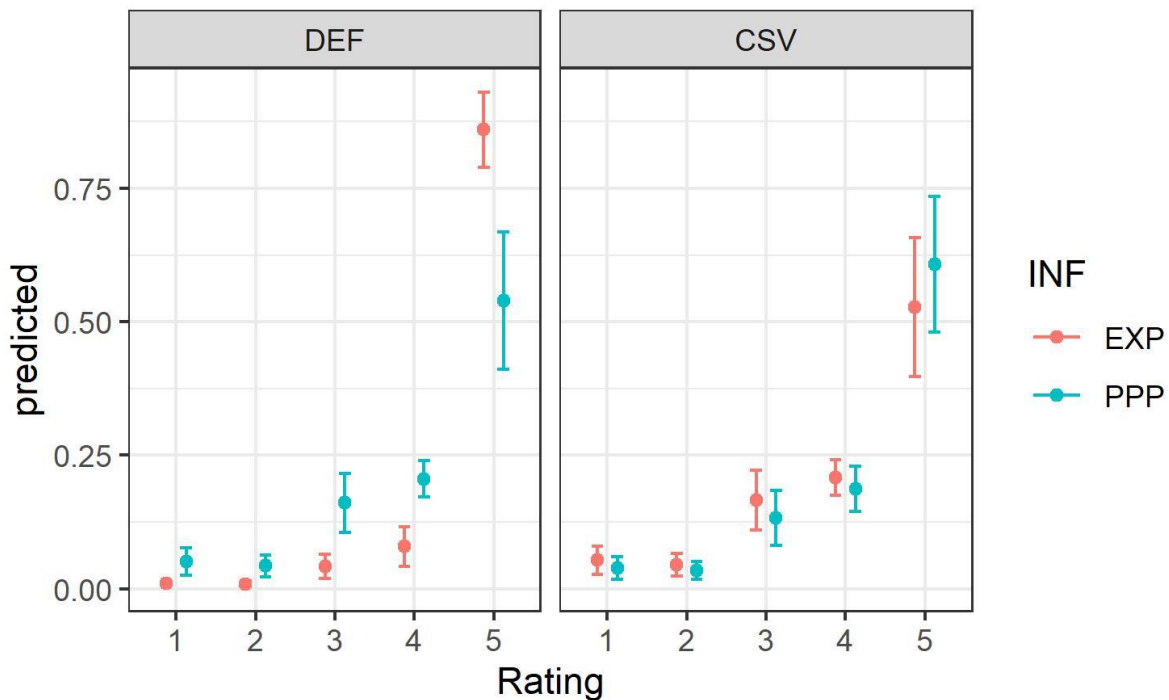

Figure 2. Probabilities of response for each point of the Likert scale with confidence intervals.

In evaluating this model, we also must observe that both by-speaker and by-item intercepts point to variation (see the values of standard deviation in the Appendix). Moreover, a look at the by-subject slope of the interaction term also reveals that the effect shown in Figure 2 is not stable across participants. Its direction (i.e., the sign of the coefficient) shows that 53% of participants assigned lower rating scores to change of state verbs in the presupposition packaging with respect to the fixed slope in Figure 2 (see also the Appendix), whereas 47% of participants assigned higher scores.

4.3 Discussion

4.3.1 Differences between trigger types and shallow processing

We can now come back to our two research questions:

> Q1. Does presupposition vs. its explicit paraphrase differently affect information recalling?

> Q2. Do differences in the form of presupposition triggers - definite descriptions or change of state verbs - interact with differences in information recalling?

The results of the CT and the ordinal mixed-effect regression model reveal that definite descriptions and change of state verbs may have a different effect on memory recall, which appears to be modulated by their explicit or implicit presentation in texts. While information is more easily remembered when it is asserted, change of state verbs show the opposite pattern, their presuppositional content being recalled with more ease when it remains implicit. This trend appears to be partly in line with what, for example, Domaneschi et al. (2018) found in accuracy responses to definite descriptions and change of state verbs. Notably, comparing change of state verbs and definite descriptions in satisfaction and accommodation conditions, Domaneschi et al. (2018) noticed that subjects' responses were more accurate with change of state verbs than with definite descriptions. As expected, accuracy was even higher in the satisfaction condition.

The answer to question (i) and (ii) can thus be that the responses of participants to presupposition and assertion packaging display different patterns, which are modulated by the type of the presupposition trigger. This last observation requires further elaboration in light of recent proposals on the 'shallow processing' of presuppositions. Ferreira & Lowder (2016), for

instance, convincingly argue that given and presupposed content is likely to be processed in a 'good-enough' way, whereas more processing resources tend to be allocated to the elaboration and comprehension of new and focal information (cf. also the observations of Lombardi Vallauri 2016 on a 'dual' processing system and, more generally, Borst et al. 2010, Christiansen & Chater 2016 for the implications of a cognitive bottleneck in language processing).[12] The authors couch this condition in the following terms:

> […] it appears that the part of the sentence that is <u>likely to be misinterpreted is the part that is more likely to be treated as given</u>, even outside a context. (Ferreira & Lowder 2016: 222)

> Given information is processed <u>superficially</u>, with the result that the representation can end up <u>missing key details or even failing to reflect its actual content</u>; this is the effect of good-enough processing on the given portion of the sentence. New information is the target of processing effort, and the mechanism that supports the integration of the new information is the generation of a set of predictions. (Ferreira & Lowder 2016: 240-241, emphasis added)

These claims meet the general assumptions made by de Saussure (2013) that presuppositions are processed superficially (de Saussure, 2013: 178) and that the accommodation of presuppositions is the result of a shallow – i.e., superficial – mental processing that may bypass critical evaluation ('epistemic vigilance') to some degree (de Saussure 2013: 184).

This asymmetry between presupposed and asserted content is reflected in shorter reading times for presupposed information in behavioral experiments and, on the contrary, in

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[12] Within this purview of research, it has been suggested that the informational structuring of sentences reflects a human cognitive constraint, namely that only one chunk of information can be processed with more attention, while the others should go through a shallower processing because the remaining resources are only available for a superficial treatment. In an evolutionary perspective, this could also explain why all utterances are made of an informationally more salient unit (the focus or assertion) and a less salient one (the topic or presupposition), cf. Lombardi Vallauri (2016) and Lombardi Vallauri & Masia (2015).

longer reading times for focal information (cf., among many others, Lowder & Gordon 2015). At the same time and very interestingly, it is also reflected in easier recalling in the case of focused information by contrast with presupposed information. This leads us to some further consideration. If our assumptions on the role of good-enough processing can be assumed to hold (to a greater or lesser extent), the shallow processing possibly induced by definite descriptions might not be merely put down to the presuppositional status of the critical information, but rather to its topical status in the sentence (remember that in our experiment definite descriptions in the presupposition packaging occur as preverbal subject NPs, i.e., in a typical topic position, cf. § 3.2.1.). So, contrary to what Ferreira & Lowder (2016) stated for given *vs*. new information – which they do not properly distinguish from the topic-focus level – we suggest that it is precisely the presentational properties of some information, namely its linguistic packaging as topic or focus, that leads to a more or less shallow processing. As a matter of fact, a presupposition trigger may coincide with the topical or the focal part (typically, VPs) of the sentence, thus inducing different processing mechanisms (*focused presuppositions* are, in any case, perceived as more salient than *topical presuppositions*). Moreover, if the good-enough processing of some information were determined by its presuppositional status only, we could have reasonably expected a similar level of accuracy in responses concerning both definite description-based and change of state verb-based stimuli, which was not the case.

The patterns found in our data seem to (partly) confirm what follows: if we admit that a more shallow processing may result in an increased difficulty in recalling information and that different rating scores in Likert scales are indicative of different degrees of easiness (or difficulty) in information recalling, then our data show that the same information concerning the content of a definite description tends to receive overall lower rating scores when it is presented in a presuppositional (implicit) packaging compared to when it is explicitly asserted.

However, as argued above, this does not seem to be the case for change of state verbs, which instead display the opposite pattern. We can speculate on this result, seemingly contradicting the predictions of a 'good-enough' processing strategy, by putting forward the two following hypotheses:

4.3.2 The role of the topic / comment partition

In our set of stimuli, definite NPs and their asserted counterparts generally occur in sentence-initial position, i.e., a position usually held by thematic, topical, discourse-old items. In light of a 'good-enough' approach, this specific structural position could be used to provide readers/listeners with the instruction of processing that item of information in a shallow manner. As suggested by Lombardi Vallauri (2016: 8), the topic of an utterance already indicates that its content is considered by the speaker as given and inactive, thus not deserving processing effort. On the other hand, change of state verbs tend to occur in a less backgrounded, more focal syntactic position (corresponding with the VP), let alone being more predicative in nature. Moreover, Piciucco et al. (2022) have demonstrated that verbs would be dispreferred as a word class to realize the topic of an utterance. Change of state verbs might appear more salient from a processing perspective, thus calling for greater allocation of processing resources.

4.3.3 Issues with the experimental design

In the questions regarding the asserted version of the change of state triggers, we opted for an explicit paraphrase of the presupposed content associated to *continuare*, 'continue' that included the adverbial phrase 'in the past', as in the following example (presented in its translated version):

(6)   Salvini <u>attacked me and is attacking me</u> while his people say that "Italy would
        do well to leave the Euro". […]

In the text you just read did you find the following information?

Salvini attacked the politician <u>in the past</u>

The idea behind this paraphrase (Salvini attacked the politician in the past) was to be as explicit as possible without leaving any room for ambiguity. However, with hindsight, such formulations might have caused some biases, especially because adverbials such as 'in the past' were not explicitly present in the stimuli. Some speakers may have searched for literal, word-for-word correspondences between the information in the question and the stimulus, thus becoming puzzled in the end. Consequently, they might have opted for the safest choice, i.e. the rating '3' ('I'm not sure') or, in any case, for a less 'certain' rating. Moreover, the formulation we chose might have been perceived as giving more relevance to the notion added (here, 'past') or, in a Gricean framework, a violation of the second maxim of Quantity ('do not make your contribution more informative than is required').

5. Conclusion

What we know about the mental representation of presupposed information is still in development despite the numerous and promising findings available to date. The results from earlier and more recent studies are heterogeneous. In this paper, we have presented the results of a behavioral experiment in which measurements of the accuracy levels in recalling information have been collected in response to political tweets containing presuppositions, as opposed to their (derived) assertive versions.

Comparing definite descriptions and change of state verbs, it emerged that the information conveyed by the assertive counterparts of definite descriptions was recalled more accurately. For the change of state verbs set, information was more accurately recalled when it remained implicit, namely with its presuppositional encoding. We explain this difference by

invoking the role of "shallow mental processes" when dealing with definite descriptions. This is possibly because of their mostly topical status in the stimuli. The different recalling paths traced by the two trigger types suggest that (a) the linguistic anchors of presupposed information are not equally represented in the human mind and may be a source of distinct cognitive dynamics, and (b) that further systematic experimental study – especially with respect to the information status of the presupposition – is called for to better control for biases related to the way recipients deal with the overall informational structuring of the content of discourse.

For this reason, we believe that even though the obtained results are not conclusive, they do epitomize a valid testing ground to appraise both the elaborated working hypotheses and research questions in follow-up investigations on the subject.

Authors contributions

Louis de Saussure is responsible for the theoretical background regarding presuppositions and wrote section § 2.1. Viviana Masia holds responsibility for the refinement of the theoretical background regarding neurolinguistic evidence regarding the processing of implicit content. She wrote sections 2.2, and 3.1 as well as, jointly with Davide Garassino, sections 4.3 and 5. Nicola Brocca is responsible for the Lime Survey questionnaire and for data curation. He wrote sections 2.3 and 3.2. Davide Garassino conducted the statistical analyses and interpreted the results with Viviana Masia; he wrote sections 4.1 and 4.2 and, jointly with Viviana Masia, sections 4.3 and 5. Viviana Masia, Nicola Brocca and Davide Garassino were equally involved in the conceptualization of the experimental design and in the investigation process.

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Appendix

Cumulative Link Mixed Model fitted with the Laplace approximation

Formula: Likert-scale evaluations ~ INF * TRG + (1 + INF * TRG | Speakers) + (1 | Items)

Random effects

Groups	Name	Variance	Std. Deviation	Corr.
Speakers	(Intercept)	1.03	1.01	
	INF[PPP]	0.32	0.57	-0.75
	TRG[CSV]	0.50	0.71	-0.66 0.33
	INF [PPP:CSV]	0.53	0.73	0.85 -0.66 -0.65
Items	(Intercept)	0.84	0.92	

Number of groups: Speaker 117, Item 56

Coefficients:

Predictors	Estimate	Std. Error	Z	p
INF[PPP]	-1.65	0.38	-4.32	< .0001
TRG[ASP]	-1.70	0.38	-4.43	< .0001
INF[PPP] * TRG[ASP]	1.98	0.53	3.75	< .001

Threshold coefficients:

	Estimate	Std. Error	z
1|2	-4.58	0.31	-14.95
2|3	-3.92	0.30	-12.97
3|4	-2.73	0.30	-9.17
4|5	-1.81	0.29	-6.15