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Effects of negation and knowledgeability on pragmatic inferences

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Abstract

Language use can be characterised as transparent, stating facts about the world, or non-transparent, requiring additional meaning to be inferred. The challenge faced by addressees is recognizing when language use is transparent or not. The current study investigates two factors that may influence how readily participants interpret utterances as instances of transparent or non-transparent language use; speaker knowledgeability and utterance form. When utterances involved negation participants were more likely to recognize this as non-transparent language use and infer that the situation is usually different. Whereas speaker knowledge did not influence how utterances were understood.

Keywords: pragmatics; inferences; negation

Transparent language

The main form of information transmission we have as humans is language. Much of what we learn throughout our life comes through language. We can characterise language use as transparent when the intention behind an utterance clearly maps onto the form used and the speaker's goal in producing the utterance is clear. Generics can be considered an example of transparent language since they tend to express broad generalisations about essential qualities of kinds that tend to be consistent across time; how the world usually is (Leslie, 2012). For example, "bananas are yellow" can be interpreted as conveying a fact about the kind *bananas*, that they are typically *yellow* (Gelman, 2004; Gelman, Star, & Flukes, 2002). Much of what we learn about the world is conveyed through generic utterances (Chambers, Graham, & Turner, 2008; Khemlani, Leslie, & Glucksberg, 2012; Moty & Rhodes, 2021). However, generics can also represent instances of non-transparent language and prompt addressees to draw inferences beyond the explicit content of the utterance. Moty and Rhodes (2021) demonstrated that children and adults can make inferences about unmentioned categories from generic utterances such as "boys like football". Rather than extending the property *likes football* to another group, participants inferred the negation was true of another group; *girls do not like football*.

Indeed, language is not only used to state facts about the world. Often language use is non-transparent and addressees are required to go beyond the explicit content of an utterance to infer additional meaning (Grice, 1975; Sperber & Wilson, 1995). One of the challenges we face is distinguishing

between these instances. How do we distinguish between transparent and non-transparent language use? Consider the utterance "The bus driver is female". This can be interpreted transparently as telling you a fact about the world; that the bus driver in the current context is female (Leslie, 2012; Gelman, 2004). However, the speaker's choice to produce the utterance may also convey that the situation being described is unusual and that bus drivers are not usually female (Moty & Rhodes, 2021). In order to learn about the world through language, addressees need to be able to recognise transparent and non-transparent language use. In the present study, we investigate two factors that may influence how readily participants interpret utterances as cases of non-transparent language use: speaker knowledgeability and utterance form.

Expectations of conversations

How utterances are interpreted is shaped by our expectations about speakers' conversational contributions. As competent language users, we have expectations about how communicative interactions should proceed (Grice, 1975; Levinson, 2000). For example, we expect our interlocutors to provide sufficiently informative and relevant conversational contributions. When these contributions are lacking in informativity or relevance, addressees often compute additional meaning, inferences, in order to reconcile their expectations with the contribution. A well-studied example of inferencing is a scalar implicature. Consider the examples, "I ate some of the cookies" which can imply that *I did not eat all of the cookies* and "my soup is warm" which can imply that *my soup is not hot*. In these examples, the speaker has used expressions, which form scales of informativity <some, all> and <warm, hot>. By failing to use the maximally informative term addressees infer that the stronger instance is not the case, thereby permitting an inference that relies on addressees' expectations about how informative they would expect a speaker to be.

Similarly, addressees expect conversational contributions to add something to the discourse (e.g. Bohn, et al., 2019; Frank & Goodman, 2012; Grice, 1975; Rohde, Futrell, & Lucas, 2021; Sperber & Wilson, 2001). When speakers choose to include mundane or easily inferable content, addressees make inferences as to why the speaker made such a choice. For example, if in conversation I offer you a "yellow banana" you may find this peculiar since, typically, bananas are yellow and thus their colour is not usually specified

(Levinson, 2000; Westerbeek et al., 2015). By including “yellow” the utterance becomes overspecified and in order to understand the utterance as cooperative (e.g. being as informative as necessary but no more), additional reasoning is required. One inference that may arise is of there being another non-yellow banana in the current situation that would have made uttering “banana” alone insufficient (Kravtchenko & Demberg, 2015; Sedivy, 2003).

We also expect conversational contributions to be packaged in conventional forms and when utterances fail to conform addressees are prompted to infer (e.g. Levinson, 2000; I-principle, *what is not said is the obvious* and M-principle, *what is said in an abnormal way is not normal*). For example, saying “Bill stopped the car” implies (via I-principle) that the car was stopped in the stereotypical way whereas saying “Bill caused the car to stop” implies (via M-principle) that the car was not stopped in the stereotypical way. By using non-conventional utterance forms speakers are able to add additional meaning to a discourse via implicature. Speakers have a general bias to be interesting or newsworthy in their contributions. For example, speakers often omit typical or inferable content, choosing rather to mention the atypical. For example, participants are more likely to include optional modifiers or instruments if the situation to be described involves an atypical property: stabbed with an *icepick* rather than a knife (Brown & Dell, 1987; Lockeridge & Brennan, 2002); or *pink* banana rather than *yellow* banana (Westerbeek et al., 2015). When such specifications are not made, addressees can and do draw inferences that the reason content was left unsaid was that the content represents typical, unremarkable information about the situation. The omission is unproblematic because the content is recoverable from world knowledge about typical situations of this type.

These inferences rely on sophisticated reasoning on the part of the addressee. Conversational partners engage in a wide range of reasoning about each other which influences not only the choices speakers make about how to formulate their utterances (e.g. Brown-Schmidt & Konopka, 2011; Horton & Gerrig, 2002; Lockeridge & Brennan, 2002; Jara-Ettinger & Rubio-Fernandez, 2021) but also the interpretations and inferences drawn by addressees. For example, inferences are less likely to be drawn from unreliable speakers (Grodner & Sedivy, 2011), from hesitant or disfluent speakers (Loy, Rohde & Corley, 2019; Yoon, Jin, Brown-Schmidt, & Fisher, 2021) or when the situation is face-threatening (Bonnefon & Villejoubert, 2009). Furthermore, speaker knowledgeability affects how readily inferences are derived. In line with expectations of appropriate conversational contributions, the rate at which inferences are derived varies systematically with a speaker’s perceived knowledgeability; violations of informativity trigger greater inferencing when produced by knowledgeable (Bergen & Grodner, 2012; Moty & Rhodes, 2021; Rees, Reksnes, & Rohde, under review).

When knowledgeable speakers produce utterances that violate addressees’ expectations for cooperativity and informativity addressees are licensed to derive what we call

informativity inferences (Rees et al. under review). When presented with utterances that are considered so mundane as to be better left unsaid, such as *the library walls are blue* one way of reconciling a perceived informativity violation is to infer that the situation has changed; *the library walls used to be different*. Mundane utterances such as this do not require an inference; it is acceptable to consider the utterance as an example of transparent language stating a fact about the library walls. However, Rees, et al. demonstrated that when produced by a knowledgeable speaker (i.e. a speaker who is familiar with the library) participants derived informativity inferences more often than when produced by an unknowledgeable speaker. Furthermore, the rate of informativity inferences derived was also influenced by manipulating properties of the speaker (how chatty or reticent they were) which influenced addressees’ expectations of what constitutes and appropriate contribution. An open question is how do addressees determine if an utterance is transparent? Is there a bias for interpreting utterances transparently or are we predisposed to derive inferences, and what factors influence how readily informativity inferences are drawn? The present study aims to replicate the effects of speaker knowledgeability observed by Rees et al. and further consider how the form of an utterance may prompt addressees to compute inferences. Specifically, how does the presence of overt negation influence inferencing?

Inferencing from negation

Along with using language to talk about how the world is, we can also use language to talk about how the world is not. Although talking about the affirmative can be considered the default in language, talking about the negative is also common. For example we can say, “Bears do not fly” or “There is no petrol in the car”. It is suggested that the use of negation emphasises information that is contrary to expectations or deviates from the norm. By uttering, “bears do not fly” this conveys that the speaker believed that the addressees thought that bears can fly (Givón, 1979; Horn, 1989; Wason, 1965). This is thought to occur because it would be infelicitous to talk about the absence of something unless that was relevant to the situation (Bonnefon & Villejoubert, 2007; Nordmeyer & Frank, 2014). Experimental studies tend to focus on the processing of negation rather than any additional meanings that may arise when negation is present. It has been demonstrated that in the absence of appropriate contextual support, negated utterances are more effortful to process than their positive counterparts and that the processing cost of negation is related to the degree to which it violates expectations (Dale & Duran, 2011; Kaup, Ludtke, & Zwaan, 2007; Nieuwland & Kuperberg, 2008; Xiang, Kramer, & Nordmeyer, 2020). Such findings sidestep the issue of what inferences are associated with the use of negation.

The present study asks two questions (1) how do how addressees interpret negation and (2) how does negation interact with speaker knowledgeability. If negation is interpreted as a signal that expectations have been violated,

such a violation should prompt addressees to interpret utterances containing negation as conveying more than transparent facts about the world. Instead, addressees may infer that things are usually *not* in keeping with the uttered fact. Furthermore, the strength with which these interpretations arise should be affected by a speaker's knowledgeability about a topic. When a knowledgeable speaker uses negation, the interpretation that the uttered fact is not usually the case should be stronger than when uttered by an unknowledgeable speaker. For example, consider "There's no snow in Lausbern". This utterance can be interpreted as transparently conveying a fact about how the world is at that moment; however, the presence of negation may do more than that by indicating that the speaker expected there to be snow and that the violation of those expectations renders it newsworthy to talk about the absence of snow. This interpretation is licensed if the speaker knows about how things usually are in Lausbern. Conversely, the positive version of the utterance "There's snow in Lausbern" when uttered by a knowledgeable speaker may convey that usually there is not snow or that the situation has recently changed, as per the results of Rees et al. (under review).

Experiment overview

Participants saw screenshots of text-message conversations about a fictional location (see Fig.1). Each conversation included a statement about the location, the weather, and the food. An utterance established the speaker's familiarity with the location by stating whether or not it was the destination ("we've finally arrived" vs. "we've got an overnight layover"). The expectation was that speakers would be perceived as knowledgeable about the location if it is their destination but less so if, the location is a layover/ passing location. If a speaker is not knowledgeable about a location, then they should have few expectations about what that location is usually like. Consequently, any utterance made about that location is likely to be considered as transparently conveying a fact about that location. For example, stating "There is snow" in a location you are unfamiliar with would not license any additional inference that depends on your knowledge of how things usually are at that location. In contrast, if a speaker is talking about a familiar location and is assumed to be cooperative and informative, then an addressee is in a position to infer additional information, such as *it does not usually snow*. Evidence of this kind of location-dependent and knowledgeability-dependent interpretation would be in keeping with a model of communication in which addressees are on the lookout for cues that indicate the availability and strength of potential inferences. On the other hand, if addressees treat language primarily as a transparent medium by which speakers convey their perceptions of everyday situations (utterances simply convey facts about how the world is), then familiarity or knowledgeability need

not influence inferencing. That latter account of addressee behaviour may be unlikely, given the pervasiveness of pragmatic reasoning.

Utterance form was also manipulated through the presence or absence of negation. If negation conveys a deviation from expectations then we expect negated utterances to increase inferencing. For example, "There is no snow" should prompt addressees to infer that the opposite is usually the case to a greater extent than the positive version "There is snow". To assess participants' interpretation of the utterances, they were asked what they think is usually the case (Does it usually snow in Lausbern?). For a negated utterance ("There's no snow"), the participants' responses can be interpreted as follows: a positive response (yes, it usually snows) indicates that the utterance has been interpreted as conveying additional information; i.e., participants have reasoned that usually the situation is different; conversely, a negative response (no, it does not usually snow) indicates that the utterance has been interpreted transparently. For a positive utterance ("There's snow"), the opposite pattern holds for how participants' responses can be interpreted: Affirmative responses (yes it usually snows) indicate transparent interpretations and negative responses indicated inferences.

If the rate at which addressees draw inferences is sensitive to speaker knowledgeability, then the familiar location is predicted to yield greater rates of non-transparent (inference) interpretations. Furthermore, if the presence of negation is another cue that can support addressee inferencing, then it is predicted that negated utterances will yield greater rates of non-transparent (inference) interpretations

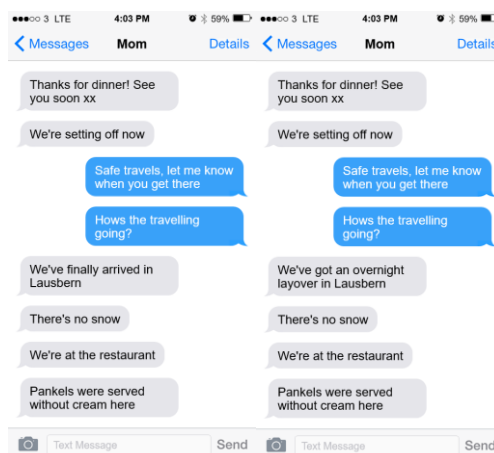


Figure 1. Example text message conversations

Method

In line with open science principles all materials, data, and analysis scripts are available on the Open Science Framework.¹

¹ Anonymous osf link:
https://osf.io/q8t9a/?view_only=d7a65e3e33e14ea188291947468a4679

Participants

A total of 408 fluent English speakers (Age 18-74 years, $M=35.78$ years) were recruited from prolific and received payment at a rate of £8 p/hour.

Design & Materials

Participants saw screenshots of text message conversations between two interlocutors that were constructed using two online text message simulators². There were two different Locations (see table 1 for scenario breakdowns) and participants saw one text message per location (2 in total).

Each conversation included four consecutive utterances from the speaker (grey). The first utterance established the speaker's location and their familiarity with that location. The second utterance referred to the weather in that location. The third utterance mentioned an activity the speaker had done and the fourth utterance mentioned a food. To avoid any influence of participants' real-world knowledge, the locations and food used were fictional.

Speaker knowledgeability was manipulated in the first utterance by establishing if the location was their destination (e.g. "We've finally arrived") or not (e.g. "We've got an overnight layover"). Utterance form was manipulated in the second and fourth utterances through the presence or absence of negation (e.g. "There's [no] snow", "Pankels are served with[out] cream"). Thus there was a 2 x 2 design (knowledgeability x Utterance form) counterbalanced across four random orders.

Table 1. Stimuli scenarios

Location	Weather	Activity	Food
Lausbern	Snow	Restaurant	Pankels
Floetham	Rain	Cafe	Scuntles

Procedure

The study was hosted and administered online through Qualtrics surveys (Qualtrics.com). Item presentation was blocked and counterbalanced to ensure that an equal number of participants saw each location first and only saw a single conversation per location. For each conversation participants were asked what they thought was usually the case for the weather in that location and the food item (e.g. "Does it usually snow in Lausbern?", "Are pankels usually served with cream?") and could respond either "yes" or "no".

Results

We analysed the binary responses (inference/transparent) with a logistic regression in R (Version 4.0.3, R core team, 2020) using lme4 (Version 1.1-23; Bates, Mächler, Bolker, & Walker, 2015). We used the maximal model that allowed for convergence.³

Variables were centred such that, for Speaker Knowledgeability, the familiar location (destination) was coded as 0.5 and the unfamiliar location (passing_through) - 0.5. For utterance form, negation was coded 0.5 and positive

was coded -0.5. Figure 2 shows the proportion of inference responses by location and utterance form.

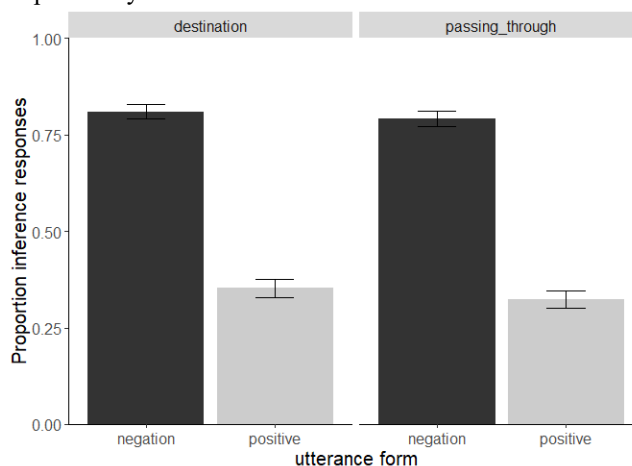


Figure 2. Proportion of inference responses by location (left panel shows familiar and right shows unfamiliar).

The model showed a main effect of utterance form ($\beta = 2.421$, $SE = .152$, $z = 15.962$, $p < .001$) with participants drawing more inferences for negated utterances than positive utterances. There was no effect of familiarity on responses; rates of inferring were equivalent regardless of whether the location was the destination or not ($\beta = .103$, $SE = .132$, $z = .779$, $p = .436$) and there was no interaction between location and utterance form ($\beta = -.028$, $SE = .254$, $z = -.110$, $p = .913$). Compared to positive utterances, utterances that contained negation appear to have encouraged participants to draw more inferences that there was deviation from what was typical. Surprisingly, speaker knowledge had no effect on interpretations; we return to this in the discussion.

General Discussion

How do addressees distinguish between transparent and non-transparent language use? In the present study, we suggested that speaker knowledgeability and utterance form may be factors involved in distinguishing between transparent and non-transparent language. Transparent language can be characterised as language that does not require additional inferences to understand, that conveys facts about how the world typically is (such as generics, Gelman, 2004; Leslie, 2012), whereas non-transparent language prompts addressees to compute additional meaning. Non-transparent language triggers inferencing by failing to meet an addressee's expectations of conversation, for example by being less informative than expected (Grice, 1975; Levinson, 2000; Sperber & Wilson, 1995).

Considering utterance form, negation was hypothesised to affect inferencing by conveying a deviation from expectations. Our findings support this. When utterances contained negation, participants were more likely to infer that

²(<https://ifaketextmessage.com/>; <https://fakedetail.com/fake-android-text-messenger-generator>).

³Response ~ Location * Utterance_form + (1|participant) + (1|question)

the situation is usually different from how it was stated: “there is no snow” was interpreted as conveying that typically there is snow. Conversely, stating “there is snow” was less likely to be interpreted as conveying that typically there is no snow. The affirmative utterance was interpreted as transparently conveying a fact about how the world usually is. This finding suggests that, unless there are explicit cues, addressees are biased to interpret utterances transparently. That is, inferences are only derived when required, which is in line with a large body of literature indicating that pragmatic inferences are costly to derive and are dependent on the context (Bott & Noveck, 2004; Breheny, Katsos, & Williams, 2006; Huang & Snedeker, 2009; Noveck & Posada, 2003). Furthermore, this is consistent with work showing that negation is costly to process and this may be due to pragmatic factors (Dale & Duran, 2011; Kaup, Ludtke, & Zwaan, 2007; Nieuwland & Kuperberg, 2008). Of course, the present study provides no measure of processing and so cannot make any claims to that effect.

Unlike previous work, there was no effect of speaker knowledgeability on rates of inferencing. Rather than concluding that speaker knowledgeability does not have an effect, it is possible that this result reflects a failed manipulation. Typically, there is a clear distinction in knowledge level with one speaker being highly knowledgeable and another speaker being unknowledgeable about a topic (e.g. Bergen & Grodner, 2012). In the present study, we manipulated knowledgeability through location. We posited that when speaking about a location that was the destination, speakers would be thought to be more knowledgeable about that location since you typically plan to go on holiday to a location whose features you know about. In contrast, for a non-destination, i.e. somewhere that you are passing through or have a layover in, you are likely to be less knowledgeable. This distinction between the two types of locations and its predicted effect on the rate of inferencing was not born out in the present study and it may be because the manipulation was too subtle. In similar work by Rees, Reksnes, & Rohde, their familiarity manipulation related to a child talking about school or a field trip to the prime minister’s office where it is generally agreed that children are much more familiar with their school than a field trip location. In terms of a holiday destination versus a layover, the difference in familiarity may have been less pronounced. Future work could try to determine what level of sensitivity addressees have to speaker knowledgeability and what are the limits of this.

The present study begins to tap into the types of reasoning that is undertaken by addressees during communication and broader questions about how and when inferences are computed. Often, context is cited as affecting inferences but context is a broad concept and encompasses a wide range of factors including privileged and common ground, both physically and informationally, models of our interlocutor, and current motivations and goals for communication. Our ongoing line of investigation asks which factors are involved in distinguishing between transparent and non-transparent

language. Furthermore, the work presented here extends on the traditional scope of pragmatic inferences. Much work focuses on a narrow set of linguistic phenomena that gives rise to inferences such as quantifiers, scalar adjectives, and disjunction (Van Tiel, Van Miltenburg, Zevakhina, & Geurts, 2016). However, inferences in communication are not restricted to particular classes of words; the same utterance with differing intonation can give rise to different interpretations (Gotzner, 2017; Keysar, 2007; Tomlinson, Gotzner, & Bott, 2017).

Conclusion

One challenge faced by language users is recognizing whether an utterance is transparently conveying a fact about the world or if it is indicating a deviation from what is usually the case. The results demonstrate that one cue addressee’s use is negation. Negated utterances prompt addressees to infer that what is stated is not usually the case. Although there was no effect of speaker knowledgeability in this instance future work is needed to assess how sensitive addressees are to different levels of speaker knowledgeability.

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