

Scalar implicature : Theory, processing and acquisition

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Résumé

The collaboration of theoretical pragmatists and psychologists of language has been of benefit to all parties. Linguistic phenomena have been a fruitful domain for psychological study, and the empirical data gathered in connection with these phenomena have provided theory-critical evidence beyond the reach of reflective intuition. In this review, we focus in particular on questions concerning the locus of scalar implicatures and their intrusion into the truth-conditions of the utterance, and on the use of generalised and ad hoc scales in drawing scalar inferences. We aim to demonstrate the utility of experimental approaches to these questions.

1. Introduction

Interest in experimental pragmatics has intensified in recent years, as indicated by the burgeoning literature in linguistic and psychological journals, and the growing interest in international collaborations, as exemplified by the Euro-Xprag European Science Foundation network grant (see www.euro-xprag.org, Noveck, Geurts & Sauerland 2009).

Numerous topics have recently been approached from this interdisciplinary perspective: these include reference, speech act, metaphor and figurative language. Recent studies on these aspects of language, initially motivated by theoretical linguistic considerations, have generated plentiful psycholinguistic data. In many cases, these data have enabled researchers not only to settle linguistic debates but also contribute to more general models of human cognition.

One particularly promising line of investigation concerns scalar implicature. As discussed by Katsos and Cummins (2010), this phenomenon is especially amenable to empirical study. There is widespread agreement among theoretical accounts of the interpretation of scalar terms, and consequently the predictions that discriminate between these accounts are subtle and fine-grained. Chierchia (2004), Levinson (2000) and Sperber & Wilson (1986/1995) concur that this renders empirical investigation a more appropriate means of evaluating these predictions than using the traditional tools of the theoretical linguist, introspection and intuition. Their

theoretical accounts of implicature are consequently tailored to this form of investigation, exhibiting a conceptual clarity and precision which makes it possible to draw testable predictions from the theories. Furthermore, the proliferation of research on scalar implicatures reflects the importance of this topic to key questions in psycholinguistics. Theories of scalar implicature typically make claims about the locus of implicature, the role of context and time-course of integrating contextual information, and the relation between contextually-recovered and grammatically-encoded meaning. These claims have implications for the organisation of the entire semantic-pragmatic system.

This paper focuses on two aspects of scalar implicature. One of these is the distinction between generalised and non-generalised scales, and the implications of this for SI generation. The other is the locus of generation of scalar implicatures (whether they are drawn globally or locally), and their interaction with the truth-conditions of the utterance. The general issue of whether scalar implicatures are defaults is pursued in Katsos & Cummins (2010). Again, we hope to draw wider conclusions about the methodological basis for associating linguistic claims with experimental findings. First, however, we briefly review the linguistic phenomena.

2. Implicatures drawn from generalised and *ad hoc* scales

Accounts of scalar implicature differ in the extent to which they posit a difference between generalised and particularised conversational implicatures (GCIs and PCIs respectively). GCIs rely on the existence of a lexical scale of informativeness, such as *<like, love, adore>*, consisting of terms that are equally lexicalised but convey different strengths of information. The use of one term on such a scale conveys the implicature that the stronger terms of the scale do not hold.

By contrast, PCIs effectively rely on a context-specific *ad hoc* scale of informativeness which is typically not lexicalised in the same way. For instance, if you are asked whether you have been to America and Canada, and reply "I've been to America", you convey the implicature that you have not been to Canada, as otherwise you would have said "I've been to America and Canada". This can be analysed as a PCI arising from the *ad hoc* scale *<{America}, {America and Canada}>*. Unlike the lexical informativeness scale discussed in the preceding paragraph, this is a temporary, non-lexically-encoded, context-specific scale, permitting an inference to be drawn only in this specific conversational setting.

According to default accounts, this means that GCIs are available for default computation in the absence of contextual information,

while PCIs are not. These accounts tend to predict that GCIs are rapidly and automatically calculated, and may require extra effort for cancellation: for instance, Levinson (2000) proposes that GCIs are derived by special pragmatic processes developed to maximise the speed of communication, while Chierchia (2004) calls for these inferences to be added in as soon as possible and without contextual interference. PCIs are only generated when contextually necessary, and this is generally considered to be an effortful process.

By contrast, other accounts collapse the distinction between GCIs and PCIs, and propose that the same pragmatic principles are responsible for the derivation of both kinds of implicature. Hirschberg (1991) argues for the existence of a range of scales encoding various types of relation (including part/whole, instance-of, etc.), and consequently holds the lexical scales underpinning GCIs to be salient but unexceptional. Relevance Theory (Sperber & Wilson, 1986/1995, Carston 1998, 2002) holds that all implicatures are derived by the same comprehension strategy, and contextual assumptions are equally fundamental to any type of pragmatic inference process.

As discussed by Katsos and Cummins (2010), experimental evidence appears to disfavour the strong default position: there are indications that scalar implicatures are generally effortful to recover, and are not generated at all in cases where they are contextually irrelevant. However, to demonstrate that GCIs are not default inferences is not the same as demonstrating that GCIs and PCIs are generated by the same mechanism. Here we ask the further question whether GCIs and PCIs are obtained in the same way, or, to put it another way, whether generalised and ad hoc scales are processed in the same way as potential sources of implicature.

3. Scalar implicature and the localist-globalist distinction

Another point of contention between competing theories of SIs concerns the locus of the inference. Grice's original proposal held that implicatures are conveyed by the speaker's failure to make a more informative statement than they actually made. This permits the hearer to draw the inference that the more informative statement could not be made, because the speaker is not in a position to make it while remaining cooperative. Hence, the inference is drawn post-propositionally.

However, in widely-discussed examples such as (1a) and (2a), cited here from Russell (2006), implicatures seem to arise locally – that is, at a sub-propositional level. The corresponding (b) and (c) items are the candidate implicatures in each case.

- (1) a. George believes that some of his advisors are crooks.
b. George believes that not all of his advisors are crooks.
c. George does not believe that all of his advisors are crooks.
- (2) a. Every student passed some of the tests.
b. Every student passed some but not all of the tests.
c. Not every student passed all of the tests.

In each case, the standard Gricean process can derive the (c) implicature: these statements are simply the negations of the stronger alternatives to (a), “George believes that all of his advisors are crooks” and “Every student passed all of the tests” respectively. However, it has been argued that it is also possible to interpret these utterances as conveying the (b) implicatures, which appear to require local derivation. Furthermore, these implicatures are stronger than their (c) counterparts, which they asymmetrically entail.

On the strength of these and similar data, some accounts of scalar implicature take a localist stance, and predict that (1a) and (2a) should be interpreted with the local implicature, as expressed by (1b) and (2b) respectively. Such accounts typically also commit to a default view of scalar implicature, although these are in principle independent considerations.

In a similar vein, it has been observed (by Levinson and others) that implicatures appear in some cases to enter into the truth-conditions of the proposition which gives rise to them. This is also impossible on the traditional Gricean account. Establishing the presence of these aspects of meaning in the truth-conditions of the proposition is a sensitive issue: however, one commonly accepted criterion is passing the Scope Test, according to which only aspects of meaning that can be part of what is denied or supposed, or generally fall within the scope of logical operators, are truth-conditional. Carston (2004) discusses the history of this approach. Under this criterion, widely cited examples such as (3a-c) have convinced Levinson (2000: 198ff), Green (1998) and others that scalar implicatures can intrude into truth conditions.

- (3) a. It is better to eat some of the cake than it is to eat all of it.
b. You shouldn't be too upset about failing some of your exams; it's much better than failing the whole lot.
c. Because the police have recovered some of the gold, they will no doubt recover the lot.

According to these analyses, the scalar implicature (that “some” signifies “some but not all”) must fall within the scope of logical operators in the above examples in order for the constructions to be felicitous. Since this is not compatible with the classical Gricean account, it appears that some kind of encapsulated default-pragmatic

system must be involved in generating these inferences that are neither semantic nor fully pragmatic.

However, Chierchia (2004) and Horn (2004), among others, doubt that these examples show intrusion into truth-conditions *per se*. They argue that what is involved is post-propositional accommodation of the inference, which is triggered retrospectively once the sentences following the scalar terms are processed in order to avoid a contradiction. Horn (2004) further suggests that the extraordinary nature of this process is indicated by the requirement for focus intonation on the scalar term (an observation which is also part of King and Stanley's (2006) account; see also Geurts (2009)).

Localism does not necessarily take a position on whether SIs can intrude upon truth conditions: it only makes predictions with regard to the domain (sub- or post-propositional) in which pragmatic principles may operate. It is also conceivable to detach localism from defaultism: a local but non-default theory, in which SIs are generated locally but are context-dependent, is in principle coherent. However, these two claims have tended to go hand-in-hand in the literature (notably for Levinson, and perhaps even for Chierchia).

4. Experimental investigations

Carston, Levinson, Chierchia and Sperber and Wilson all consider that their accounts of scalar implicature should enjoy psycholinguistic validity, and Levinson and Sperber and Wilson's accounts are explicitly motivated by cognitive considerations. Hence their predictions about the nature of SI generation should be empirically (dis)confirmable (Levinson 2000: 5, 81, 162ff, 370; Chierchia 2004: 51, 68, 93; Carston & Powell 2006 for the Relevance Theory perspective). Here, following the pattern of Katsos and Cummins (2010), we review the empirical evidence which has been brought to bear on the questions under discussion in this paper: generalised versus ad hoc scales, and localism versus globalism in the generation of SIs.

4.1. *SI generation from generalised and ad hoc scales*

The comparison between generalised and ad hoc scales as a source of scalar implicature was studied by Papafragou & Tantalou (2004). They examined whether Greek participants reject under-informative utterances with three types of scale: the generalised lexical quantifier scale *<some, all>*, scales that rely on encyclopaedic world-knowledge such as *<cheese, sandwich>*, and ad hoc scales that are evoked only in specific contexts (e.g. *<{parrot}, {doll}, {parrot and doll}>*). The critical utterances in these cases are those which are 'strictly speaking' true but which have the potential to give rise to false implicatures to the effect that the stronger term of the scale does not hold. The task was

oriented towards young children, addressing in particular the claim (typical of default accounts) that children acquire the implicatures of context-independent generalised scales sooner than the truly Gricean particularised implicatures of context-dependent scales.

In their experiment, adults and 5-year-old children were presented with act-out scenarios in which a puppet would receive a reward if (s)he performed a task which involved achieving the stronger term of the scale, e.g. if (s)he managed to colour all of the stars, to eat the sandwich, or to wrap up the presents (the parrot and the doll). The puppet went away and performed the action hidden from the participant's view, and then came back to report that (s)he had achieved something less than the goal that was set, by saying e.g. "I coloured some of the stars", "I ate the cheese", "I wrapped the parrot". The participants were then asked to decide whether or not the puppet should receive the reward.

For each critical under-informative condition, the adults always withheld the reward. The children withheld the reward in over 70% of the trials, and they were able to justify their response on the grounds that the puppet did not complete the task. Numerically, children were more sensitive to violations with ad hoc scales than with logical or encyclopaedic scales (withholding the reward in 90%, 77.5% and 70% of cases respectively), but this difference did not reach statistical significance. The authors interpreted their data as supportive of context-driven models of pragmatics, in that the reward is withheld at comparable levels regardless of whether or not the contrast scale was generalised.

However, in interpreting these findings, it is necessary to sound notes of caution. The experimental design is atypical within the literature. In a typical task involving under-informative utterances, participants who do not detect that an utterance is under-informative should be able straightforwardly to accept the utterance, while participants who detect the under-informativeness should be able to reject the utterance. In Papafragou and Tantalou's task, the picture is less clear. If the puppet is taken to be informative, participants should withhold the reward, because they can infer that the task has not been completed. However, if the puppet is understood to be under-informative (e.g. "I wrapped the parrot" is interpreted as "I wrapped the parrot, and it is possible that I also wrapped the doll"), then participants are again entitled to withhold reward, as they have no way of knowing with certainty whether the task actually has been completed. Therefore the grounds for withholding reward are potentially ambiguous, which undermines the results of the study, although it must be noted that the justifications given by participants

are consistent with the informative interpretation of the utterances, which suggests that the findings are indicative.

Based on this study, Katsos & Bishop (2011) investigated the same question using the standard paradigm for sentence evaluation tasks. In this paradigm, participants watch the situation unfold, and can therefore tell whether or not an utterance is under-informative for the actual situation. Katsos & Bishop looked at 5-, 7-, 9- and 11-year-old English-speaking children as well as adults. Corroborating the findings of Papafragou & Tantalou (2004), they demonstrated no advantage for generalised scales in the child groups. Indeed, the numerical tendency of Papafragou & Tantalou's study attained significance in this study: under-informative utterances with ad hoc scales were rejected at higher rates than under-informative utterances with generalised scales. This result is clearly not predicted by default accounts, but nor is it supported by context-dependent accounts, which predict a uniform pattern of development for all scales.

A further challenging finding of Katsos & Bishop (2011) concerned the adult group. While adults always objected to under-informative utterances with generalised and ad hoc scales at ceiling rates, an indirect, qualitative advantage for generalised expressions over ad hoc ones was obtained. That is, rejections of under-informative utterances were of two different types: first, straightforward rejections, and second, indirect rejections, phrased as revisions, hedging remarks, ambivalent judgments or metalinguistic comments ("Yes, but he painted the heart as well"; "This was half right, half wrong"; "It's not false, but he missed something", "This one is tricky!", "This is technically correct"). While 15% of the adult objections to under-informative utterances with ad hoc scales were indirect, over 40% of the adult objections to under-informative utterances with ad hoc scales were indirect. If we were to take the straightforwardness of the response (ranging from straightforward rejection to a metalinguistic remark such as "technically correct") as an index of how participants treat underinformativeness, we could interpret this as evidence that adults treat violations of informativeness with generalised scales as graver than violations with ad hoc scales.

To recap, Katsos & Bishop (2011) obtained differences between context-independent generalised expressions on the one hand and context-dependent ad hoc expressions on the other, with children's performance on ad hoc expressions proving better than that with generalised expressions. These findings stand against default accounts that consider inferences which involve generalised scales to be linguistically and psycholinguistically privileged. However, the

findings cannot readily be explained by context-driven accounts either, as these predict no difference between expressions. Moreover, Katsos & Bishop demonstrated a qualitative advantage for generalised expressions over ad hoc ones in the adult data. Thus, they arrived at a picture that is not predicted by any of the existing theories.

One suggestion for explaining the child data is to focus on the kind of violations that were evoked for the specific generalised and ad hoc scales tested. In this methodology, when a speaker is under-informative with regard to the generalised quantifier scale, they are correct about the type of object acted upon (e.g. carrots rather than pumpkins), but miss out information on the quantity of objects (some rather than all). Thus, the speaker has met some of the informativity requirements (kind of objects) but failed others (quantity of objects). However, when a speaker is under-informative with regard to the ad hoc scale, they miss out information both on how many objects were acted upon and on the identity of one of the objects. A child who considers it important to give information first and foremost about the kind of objects that were acted upon might plausibly tolerate the former kind of underinformativeness while rejecting the latter. The difference between scales that was obtained may be due to the fact that younger children seem first and foremost to be focused on avoiding and objecting to violations about the kind of objects.

A related suggestion is that young children may have been interpreting the wh-questions asked in this experimental paradigm as pertaining to general situations rather than specific events. A generic reading of the question may bias young children towards the acceptance of specific indefinite phrases such as “some of the carrots”, since it has been shown that young children do not have adult-like competence in mapping bare and modified noun phrases to generic and specific readings in English (Gelman & Raman, 2003; Pérez-Leroux, Munn, Schmitt & DeIrish, 2004).

Turning to the adult group, we note that the pattern of privileged treatment is reversed. The indirect privilege of the generalised scale can be interpreted in two ways: either this reflects the special status of generalised scales in the linguistic system (as per default accounts), or this is due to some other factor. As default accounts were not upheld for the child groups, we would need to postulate some non-obvious reason why these accounts should in any case apply for adults. Other factors might include an effect of frequency of contrast: in actual language use, “some” is clearly far more often contrasted with “all” than, for instance, “the triangle” is contrasted with “the triangle and the heart”. This may explain why the privileged status of generalised

scales is manifest only in the adults, this being the group with the greatest exposure to language.

Horn's (1984; see also 2004) non-default account of implicature and informativeness might be compatible with this explanation. He proposes that the contexts in which terms of a generalised scale are contrasted with one another are quantitatively more numerous than the contexts in which the terms of an ad hoc scale are contrasted. Thus, context-independent generalised scales are associated not with default implicatures, but with default contexts of occurrence. This account is compatible with the data presented here, if we assume that the adults' far richer experience with language and contexts of use makes them, unlike the children, sensitive to this special property that the terms of a generalised scale possess.

Another suggestion, with regard to the effect of expression, is that we should focus our attention on how the sets that are relevant for the evaluation of informativeness are composed. Generalised scales consist of natural sets, in the sense that they comprise a collection of one kind of items (e.g. carrots). Ad hoc scales, by contrast, rely on sets that comprise different kinds of items, which do not form natural collections. While care was taken by Katsos & Bishop (2011) not to create odd collections for ad hoc scales (e.g. using a computer and a desk – both office items – or a triangle and a square, both shapes), there is an intuitive sense in which these collections of items are still looser than a collection of same-type items, e.g. five carrots. If this is indeed the case, one way to account for the difference between child and adult data is to attribute it to differences in the way children and adults treat set membership, a matter which is outside the purview of linguistic theory. It is possible to test whether the composition of sets interacts with adult and child informativeness: for example, one could investigate the behavior of 'in-between' types of scales, relying on widely held encyclopaedic knowledge (e.g. *<roof, house>*, *<chapter, book>*). These scales do not exhibit the logical properties of the quantifier scale, but their members are more strongly associated than are the members of the ad hoc scales. Thus, it may be predicted that adults, who may be more sensitive to the naturalness of set composition, will treat these scales like the quantifier scales, while children will treat these scales like the ad hoc scales.

In summary, the differences between generalised and ad hoc expressions are not simply a matter of the degree of context-dependence or independence of the contrast that is evoked. The literature on underinformativeness has not, thus far, considered the other factors that may come into play, such as the potential effects arising from the degree of naturalness of the sets involved, a

preference for kind-readings, or difficulty with mapping indefinite or bare noun phrases to generic situations. It is not impossible that further investigations will reveal that the observed differences in child and adult performance with generalised and ad hoc expressions is in fact attributable to factors orthogonal to the question of whether the scale is or is not available in context-dependent fashion.

4.2. *The locus of SI generation*

Recall from examples (1) and (2) above that, when scalar expressions are embedded under belief operators or the universal quantifier, global post-propositional and localist sub-propositional accounts derive different implicatures, with the localist implicatures being stronger than the global ones.

Localist accounts such as Chierchia's (2004, 2006) argue that the occurrence of local implicatures is a grave challenge for global accounts. Globalists have addressed this challenge in three ways. According to Russell (2006) and Geurts (2009), one can consider the instances brought forward by the localists one by one, and argue in each case whether these involve true implicature generation or some other process. (This is similar to Chierchia's and Horn's responses to cases cited in Levinson such as (3) above.) For instance, the global account can derive local SIs if some non-arbitrary assumptions are taken into account. In the case of examples such as (1), repeated below, Russell (2006) provides an account of the derivation of the "local" implicature (1b).

- (1) a. George believes that some of his advisors are crooks.
- b. George believes that not all of his advisors are crooks.
- c. George does not believe that all of his advisors are crooks.

According to Russell, the local SI could be derived by the addition of the assumption that George is epistemically adept, or at least biased towards his beliefs. That is, George could be supposed to take a stance and either believe that something is the case or believe that it is not the case; that is, we exclude the possibility that he simply does not believe it to be the case. With regard to the proposition that all George's advisors are crooks, the global implicature (1c) is compatible with two situations, one in which George does not believe that all his advisors are crooks and one where he believes that it is not the case that all his advisors are crooks (this latter equating to the situation in (1b)). The addition of the assumption that George is opinionated about his beliefs rules out the situation in which George does not believe that all his advisors are crooks, and allows only the situation in which George believes it is not the case that all his advisors are crooks. Ergo, a global implicature augmented with assumptions about the interlocutor's epistemic stance can generate what looks like

a local implicature. The process that generates the SI, however, is fully Gricean.

However, besides these responses, it is possible to cast doubt upon the very foundations of the localist challenge. Geurts and Pouscoulous (2009a, b) have been asking whether local implicatures are actually as readily available as has been assumed. To investigate this, they presented participants with embedded and un-embedded instances of propositions with the existential quantifier, as in (4a) and (4b). They then asked participants to respond to the corresponding questions (4a') and (4b').

- (4)
 - a. Fred heard some of the Verdi operas.
 - b. Betty thinks that Fred heard some of the Verdi operas.
 - a'. Would you infer from this that Fred didn't hear all the Verdi operas?
 - b'. Would you infer from this that Betty thinks that Fred didn't hear all the Verdi operas?

While the localist account predicts equal rates of acceptance for (4a') and (4b'), the global account predicts that participants will be much more prone to accept (4a') than (4b'). This is indeed documented by Geurts and Pouscoulous, for whom participants show evidence of unembedded SIs at rates of 93% but embedded SIs only at 50%. Moreover, they found that the rates of local implicatures vary substantially between conditions: while the rates of generation are as high as 50% for embedding under "think", they are as low as 3% for embedding under the universal quantifier.

These findings seem clearly to indicate that local implicatures are not derived with the consistency expected by local accounts. In fact, bearing in mind that the local implicature under "think" can be derived using a global process of inference, as proposed by Russell (2006), the evidence from embedding under "every" suggests that there may be no truly local SIs, as predicted by global accounts.

Of course, it should further be remarked that these investigations are disconfirming the local account without necessarily providing positive evidence for the global one. They do not investigate whether participants are generating the global implicature (which is also predicted by the global account, just as much as it is predicted that there should not be local implicatures), nor do they show that the apparent instances of local implicature do not arise through authentic scalar implicatures. While the former can easily be tested with the existing paradigm, simply by asking participants whether the global SI follows from (4b), addressing the latter question is perhaps less straightforward.

5. Overview and outlook

In the previous sections we reviewed empirical investigations of aspects of scalar implicature that have been motivated by debates in the theoretical literature. With respect to the question of how speakers and hearers use generalised and ad hoc scales to draw scalar inferences, we observe a confusing pattern of experimental findings: children reject more under-informative utterances with ad hoc scales, while adults seem to consider informativity violations with generalised scales more serious. As discussed in section 3, this is a finding that is hard to accommodate on any account of scalar implicature, and some of the factors contributing to the findings may not relate to the debate on scale types that the investigations set out to address. With respect to the locus of SI generation, we discussed empirical evidence that the ‘local’ embedded SIs are inferred with much less frequency than the ‘global’ non-embedded SIs, and that in many cases the former are apparently not available to participants at all.

It is worth reiterating that not all context-driven or default accounts take (or need to take) a position with regard to these issues. It is possible to have a local account without assuming defaultness (in the sense of independence from discourse context), or vice versa. Similarly, it is evident that neither default nor context-driven accounts can encompass the experimental findings on the use of generalised versus ad hoc scales, at least not without making additional claims about the nature of adult and child processing of set membership, the participants’ understanding of the experimental tasks in question, or some other matters. Although we have seen how various different methodologies may be gainfully employed when we come to operationalise competing theoretical proposals, we must remain vigilant that the responses of participants are in fact conditioned by the variables that we wish to test.

Notwithstanding these difficulties, we see that the relationship between concept and experiment is a productive one, as far as scalar implicature is concerned. Clear predictions at a theoretical level motivate empirical study, and the drive towards empirical investigation motivates clarity at a theoretical level. Moreover, critical evaluation of the nature of responses to experimental stimuli can broaden our theoretical base by suggesting the relevance of additional factors in actual linguistic contexts, and thus rendering these additional factors amenable to theoretical formalisation. For scalar implicature, as for many topics in semantics and pragmatics, the collaboration of theorist and experimentalist appears set to pave the way for future progress at both levels.

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