The development of pragmatic abilities

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1. Introduction

It is widely assumed that human communication in adults relies on a complex species of mind reading that involves inferentially reconstructing the meaning that the speaker had in mind and wanted to convey (Grice, 1975; Sperber & Wilson, 1986/1995). Children's pragmatic abilities, however, present a paradox. Experimental work has shown that remarkable competence in important preconditions for pragmatic reasoning is present from infancy (see Baillargeon, Scott, & Bian, 2016 for a recent review); nevertheless, research on a variety of linguistic phenomena (e.g., reference, implicature, metaphor, irony) has demonstrated that children's pragmatic abilities are fragile and task-dependent even until late in childhood (e.g., Bucciarelli, Colle, & Bara, 2003; Filippova & Astington, 2008; Noveck, 2001; Waggoner & Palermo, 1989; Winner & Leekam, 1991, a.o.).

Sometimes, the paradox surfaces even within the realm of a single phenomenon. For instance, in the domain of referential communication, some experimental evidence shows that even 2-year-old children can successfully integrate another person's perspective in both their comprehension and production of referring expressions (Morisseau, Davies, & Matthews, 2013; Nadig & Sedivy, 2002; Nilsen & Graham, 2009; O'Neill, 1996), yet other evidence shows that children frequently ignore their interlocutor's perspective as late as age 8 or 9 (e.g., Deutsch & Pechmann, 1982; Epley, Morewedge, & Keysar, 2004; Girbau, 2001). For other phenomena, there is debate in the developmental literature about whether they truly rely on rich pragmatic computations about others' intentions or might involve non-pragmatic mechanisms. In word

learning, for instance, some commentators treat mutual exclusivity (i.e., the bias to assume that a label applies only to one object) as the result of a pragmatic process that assesses speaker's referential intentions (Diesendruck & Markson, 2001; Woodward & Markman, 1998) and others consider it a lexical constraint that does not involve intention recognition (de Marchena, Eigsti, Worek, Ono, & Snedeker, 2011; Preissler & Carey, 2005; Regier, 2005). Together these conflicting patterns and perspectives raise two interrelated questions: What accounts for the complex pattern of results in children's pragmatic development? And how do children become adult-like, competent communicators?

In this chapter, we focus on scalar implicature as a paradigmatic case of children's pragmatic development and start sketching a framework for answering these questions. In recent years, scalar implicature has been the topic of very active experimental investigation, mainly because it displays an easily testable division between semantic and pragmatic meanings. After briefly introducing scalar implicature (Section 2), we review experimental evidence that reveals a complex pattern of successes and failures in implicature derivation in children (Section 3). We next examine different accounts that have been put forth to explain children's performance and sketch a proposal that provides a new explanation of the child data (Section 4). Finally, we discuss new directions in the study of scalar implicature that have important implications for theoretical accounts of pragmatics (Section 5) and conclude by connecting the phenomenon of scalar implicature to a broader picture of the nature and scope of children's early pragmatic abilities (Section 6).

2. Scalar implicature

Implicatures are components of speaker meaning that are communicated without being explicitly stated. Scalar implicatures are a type of conversational implicature that arises when the speaker uses a weaker scalar item from a scale of items organized in terms of semantic strength. Such scales can be lexically defined (e.g., <*all*, *most, …*, *some*>, <*and*, *or* >, <n, ..., *three*, *two*, *one*> , <*must*, *should*, *might*>, see Horn, 1972, 1984; Levinson, 1983, for additional examples) or contextually defined (see Hirshberg, 1985, for a discussion on contextual, ad-hoc scales). Sentences (1)-(5) are examples of scalar implicature, where (a) can be used to imply (b); in (1)-(3), the scales are lexically defined but in (4)-(5) they are contextually constructed:

(1) a. The professor graded some of the exams.

b. The professor did not grade all of the exams.

(2) a. We'll order pizza or sushi tonight.

b. We will not order both pizza and sushi tonight.

(3) a. He owns three cars.

b. He does not own more than three cars.

(4) a. Max and Alicia are engaged.

b. Max and Alicia are not married.

(5) a. Mary liked the crust.

b. Mary did not like the filling.

On contextualise accounts, including Grice's (1975) framework and Relevance Theory (Carston, 1995, 1998; Noveck & Sperber, 2007; Sperber & Wilson, 1986/1995; see also Geurts, 2010; Sauerland, 2004, 2012), scalar implicatures (as well as other types of pragmatic inference) arise

as a result of a rich computation which takes into account the speaker's conversational purpose and his/her knowledge of background facts. On a Gricean (1975) account, scalar implicatures in (1b)-(5b) arise because the hearer realizes that the speaker did not use a stronger, more informative term that would have been relevant (thus violating the Maxim of Quantity). On a relevance-theoretic account (Carston, 1995, 1998; Noveck & Sperber, 2007; Sperber & Wilson, 1986/1995), scalar implicatures arise when a weak scalar term fails to satisfy the hearer's expectations of relevance. The scalar inferences (1b)-(5b) are drawn by the hearer in an attempt to make the utterances satisfy this expectation with the least amount of processing effort. On both accounts, the fact that the speaker in (1a)-(4b) opted for a weaker scalar item gives the hearer reason to think that the stronger scalar alternative does not hold.[1]

3. Experimental evidence on scalar implicature

Although adults compute scalar inferences when these are warranted by context (Bott & Noveck, 2004; Breheny, Katsos & Williams, 2006; Degen & Tanenhaus, 2015; Grodner, Klein, Carbary & Tanenhaus, 2010), children often fail to derive scalar implicatures until fairly late in development. In an early demonstration, Noveck (2001) found that French-speaking 5-, 7- and 9-year-old children were very likely to accept sentences like "There might be a parrot in the box" when it was clear from context that there "had to be a parrot in the box", while adults tended to reject them. Similarly, in the same study, 8- and 10-year-old children did not object to logically

[1] On other, grammatical/lexicalist accounts, the scalar implicatures in (1b)-(3b) are mediated by linguistic-level representations and arise by default, and thus differ from the context-driven inferences in (4b)-(5b) (see Chierchia, 2004; Chierchia, Fox, & Spector, 2009; Levinson, 1995, 2000). We will not be discussing these accounts here (but see section 5 below for experimental evidence against these accounts).

true but pragmatically infelicitous sentences like “Some giraffes have long necks”, while adults were equivocal. Relatedly, Chierchia, Crain, Guasti, Gualmini, and Meroni (2001) found that 5-year-old children often accepted pragmatically infelicitous statements with disjunction (e.g., “Every boy chose a skateboard or a bike”, when every boy chose both a skateboard and a bike), while adults readily rejected them. These findings were taken to suggest that although children can calculate logical, semantic meaning, they have difficulties computing pragmatic meanings. Later work further confirmed these early findings (e.g., Foppolo, Guasti, & Chierchia, 2012; Guasti et al., 2005; Huang & Snedeker, 2009; Papafragou, 2006).

Despite children’s difficulties, there is now robust evidence showing that, under certain conditions, children can be sensitive to the pragmatic reasoning required for scalar implicature generation. For instance, Papafragou and Musolino (2003) showed that 5-year-old children failed to reject logically true but pragmatically infelicitous sentences such as “Some of the horses jumped over the fence” in a story in which all of the horses had jumped over the fence; however, children’s performance improved after children received training on how to treat under informative sentences and were presented with supporting context (see also Guasti et al., 2005; Foppolo et al., 2012).

Other studies have shown that the type of response and other task characteristics affects children’s success in scalar implicature tasks. In Katsos and Bishop (2011), 5-year-old children who readily accepted true but infelicitous *some*-statements in a binary judgment task, demonstrated clear signs of sensitivity to implicature when they were asked to use a 3-point scale to evaluate the same statements. Specifically, when children were asked to use one of three strawberries (small, medium, large) to reward a speaker based on how well he answered questions about a story, children–just like adults–rewarded the speaker with a small strawberry

for false responses, a large strawberry for true and felicitous responses and, critically, a medium-size strawberry for true but pragmatically infelicitous *some*-responses. Similarly, in Pouscoulous, Noveck, Politzer, & Bastide (2007), methodological changes improved performance. Specifically, in this study, French-speaking 4-, 5- and 7-year-old children who were asked to perform an action-based task (i.e., remove tokens from boxes or add tokens to boxes to make them conform to statements such as "Some of the turtles are in the boxes") were highly successful in deriving scalar inferences; nevertheless, children as old as 9 who were asked to evaluate the same sentences in a binary judgement task that additionally differed in other design features (e.g., adding distractors in the stimuli, using a less frequent quantifier) largely failed to derive the implicatures.

Even though most of the above studies involved lexical (quantifier) scales, other paradigms have shown similar findings with contextual scales. For example, in Papafragou and Tantalou (2004), Greek-speaking 5-year-olds were shown scenarios in which an animal had to perform an action off-stage (e.g., colour 4 stars). The animal was asked a question about whether it had performed the action (e.g., "Did you colour the stars?"). In critical trials the animal responded with a weak scalar term (e.g., "I coloured some"). Children were asked to give a prize to the animals who had successfully completed the task. Children were remarkably successful in deriving scalar inferences (i.e., withholding the prize from the animals that used *some*). Furthermore, they succeeded with both lexical scales (such as <*all*, *some*>) and contextual scales ("Did you eat the sandwich?" – "I ate the cheese"). A more recent study that used a referential communication paradigm showed successful derivation of scalar implicature from context-based scales in even younger children (Stiller, Goodman, & Frank, 2015). In this study, children were asked to select a target referent from a display of three closely matched

alternatives. For example, the experimenter said "My friend has glasses" when one "friend" did not wear glasses (irrelevant referent), one friend wore glasses only (pragmatically felicitous referent), and one friend wore glasses and a hat (logically compatible but pragmatically infelicitous referent). Children, often younger than 4, correctly picked the pragmatically felicitous referent, thus, showing signs of successful implicature derivation.

In sum, experimental findings from almost two decades of research have demonstrated that children are, in fact, capable of the reasoning processes required for scalar inference, at least from the age of 4 (see also Eiteljoerge, Pouscoulous, & Lieven, 2016, for corpus evidence that children produce utterances with the weak scalar quantifier *some* in ways that suggest an awareness of the contrast between *some* and *all*). Nevertheless, the conditions under which children are more likely to put these reasoning processes to use are very heterogeneous, leaving several possibilities open about the nature of children's difficulties.

4. The nature of children's pragmatic difficulties

Several theoretical possibilities have been proposed in the literature to explain children's mixed performance with scalar implicature. According to a first possibility, children often fail to compute a scalar inference because, unlike adults, they lack the necessary processing resources (Chierchia et al., 2001; Reinhart, 2004, cf. Pouscoulous et al., 2007). This account posits that acceptability judgment tasks (on which children typically fail) have high metalinguistic demands and predicts that, in simpler pragmatic tasks, children will be more successful in deriving scalar implicatures. Although this prediction is reasonable, currently, there is no concrete evidence that children's particular difficulty with scalar inference relates to processing limitations such as working memory or attention deficits.

According to a second possibility, children fail to reject logically true but pragmatically infelicitous statements in binary judgment tasks not because they are insensitive to violations of informativeness but rather because they are more tolerant to such violations than adults (Katsos & Bishop, 2011). According to this view, a mechanism for pragmatic reasoning is in place from an early age but is masked by the typical experimental methods used. This proposal successfully explains children's failures in standard binary acceptability judgement tasks. However, this account cannot explain why children have difficulties with scalar inferences in eye-tracking tasks that simply involved following spoken instructions (e.g., Huang & Snedeker, 2009) or why children successfully derived scalar inferences in certain studies that used binary judgments (e.g., Skordos & Papafragou, 2016).

According to a third possibility, children fail to derive scalar inferences across many different tasks because they have problems generating the stronger scalar alternative (e.g., they cannot access *all* when hearing *some*; Chierchia et al., 2001; Barner & Bachrach, 2010; Barner, Brooks, & Bale, 2011). Evidence for this possibility comes from the fact that, even though children fail to reject pragmatically infelicitous sentences with a weak scalar term in a binary task, they correctly choose the stronger, more felicitous statement if presented with both the strong and the weak alternative (Chierchia et al., 2001; see also Ozturk & Papafragou, 2015). Thus, children are not oblivious to the relative informativeness of the two scalar terms but cannot spontaneously recover the stronger scalar alternative when needed for a scalar inference. Further evidence for this possibility comes from the fact that children have difficulties with generating the stronger alternative from lexical scales (e.g., < *all, some* >) in tasks that do not involve scalar implicature computation but do not have problems deriving alternatives related to contextual scales, presumably because the latter do not rely on establishing a stored relation between lexical

items (Barner et al., 2011). Nevertheless, this explanation fails to account for children's failures to compute scalar implicatures from sentences containing *some* in tasks where the stronger alternative (i.e., *all*) was present in other experimental sentences and was thus, in principle, accessible (e.g., Noveck, 2001).

An alternative, much broader, theoretical possibility is that the main source of children's pragmatic difficulty with scalar implicature lies not so much with recognizing that particular terms are members of a scale or accessing the stronger alternative but rather with spontaneously estimating that stronger scalar terms constitute *relevant* alternatives in a given exchange (Papafragou & Skordos, 2016; Skordos & Papafragou, 2016; cf. Bott & Noveck, 2004; Noveck & Sperber, 2007; Pouscoulous et al., 2007). Recent evidence provides a clear demonstration of how the saliency of alternatives combined with the transparency of relevance expectations contribute to children's successful implicature computation. Skordos and Papafragou (2016) found that 5-year-old children, in a binary judgment task, rejected pragmatically infelicitous sentences with a weak scalar term (*some*) only when the stronger alternative (*all*) was made both accessible and relevant to the goals of the conversation. By contrast, when the stronger alternative was salient but irrelevant to the goal of the task, children were unlikely to compute an implicature. Crucially, scalar implicature computation from the quantifier *some* was also facilitated by the presence of a quantifier such as *none* that did not constitute a stronger alternative and was not even a member of the <*some*,… *all*> scale: as Skordos and Papafragou proposed, *none* could not have given access to the quantifier scale itself but encouraged children to consider the broader domain of relevant alternatives (i.e., quantifiers). These results show that a major problem for children when computing implicatures (and potentially other types of

pragmatic inference) is their inability to spontaneously reconstruct expectations of relevance if these expectations are not sufficiently clear in the context.

This theoretical proposal offers a coherent framework for explaining conflicting results in prior literature. First, it is in accordance with findings showing that children have no difficulty calculating implicatures in tasks that provide a sufficiently supportive context (e.g., Foppolo et al., 2012; Guasti et al., 2005; Papafragou & Musolino, 2003; Papafragou & Tantalou, 2004). Typically, in these tasks, the stronger alternative was made both salient and relevant by the experimental manipulations. Relatedly, this proposal can also explain children's successes with context-based scales, in which the stronger alternative was both (visually) accessible and relevant to the computation of an implicature (e.g., Barner et al., 2011; Papafragou & Tantalou, 2004; Stiller et al., 2015).

Second, this proposal can also account for children's inability to calculate implicatures in tasks where the stronger alternative was present in the experimental stimuli and thus accessible for the purposes of implicature computation (Foppolo et al., 2012; Noveck, 2001). For instance, recall that in Noveck (2001), young children failed to detect underinformative *some*-sentences ("Some giraffes have long necks") when asked to evaluate different types of *all* and *some* statements. Notice that, in this task, the strong and weak scalar statements described completely different states of affairs (an example of a strong statement would be "All elephants have trunks"). Therefore, although the stronger scalar term *all* was present in various statements throughout the task, it was not clear that it was a relevant alternative to the weaker scalar term *some*. Interestingly, this explanation may also account for adults' relatively high rates of non-pragmatic responses in this task.

Finally, a relevance-based account for scalar implicature computation can explain why alternative methods for evaluating pragmatically infelicitous statements (i.e., non-truth value judgment tasks) typically show successful implicature computation in children (e.g., Katsos & Bishop, 2011; Papafragou & Tantalou, 2004; Pouscoulous et al., 2007). For instance, in Katsos and Bishop (2011), children may have been more likely to show signs of implicature computation given a 3-point Likert scale compared to a binary-judgment task because the possibility for a gradient response made children realize that the goal of the task was not to evaluate truth conditions but rather the felicity of pragmatic meanings. Thus the presence of a scale encouraged children to evaluate the "goodness" (and not the truth) of an under-informative statement in relation to other potential alternatives.

5. New directions in the study of scalar implicature

A key component of contextualist approaches is the assumption that the derivation of scalar implicature (in case the literal, semantic meaning does not satisfy expectations of relevance) engages a rich computational process that integrates the speaker's epistemic state (see Carston, 1995, 1998; Geurts, 2010; Grice, 1975; Noveck & Sperber, 2007; Sauerland, 2004, 2012; Sperber & Wilson, 1986/1995; cf. Chierchia 2004; Chierchia, Fox, & Spector, 2009; Levinson, 2000, for an alternative view). On these approaches, the hearer typically reasons that the use of an informationally weaker statement means that the speaker either does not know that the stronger scalar statement is true or knows that the stronger statement is not true (Franke, 2011; Geurts, 2010; Horn, 1972, 1989; Noveck & Sperber, 2007; Sauerland, 2004; Spector, 2006; van Rooij & Schulz, 2004). However, within early experimental work on scalar implicature, the role of speaker knowledge remained unexplored.

Recent experimental evidence from adults provides support to contextualise models of scalar implicature derivation, in which information about speaker knowledge is integrated at early stages of the pragmatic computation (Bergen & Grodner, 2012; Breheny, Ferguson, & Katsos, 2013). For example, Bergen and Grodner (2012) used a reading time paradigm, where participants read scenarios told from a first-person perspective. Introductory sentences established whether the speaker had full or partial knowledge of an issue (e.g., "At my client's request, I meticulously compiled the investment report/At my client's request, I skimmed the investment report"), followed by critical sentences that included the weak quantifier *some* (e.g., "Some of the real estate investments lost money") and continuations that referred to the complement of the set mentioned in the critical sentence ("The rest were successful despite the recent economic downturn"). Results showed that participants took longer to read sentences with *some* when it was established that the speaker had full–compared to partial–knowledge of the issue (presumably because the speaker generated the implicature *not all* in the full knowledge condition). Furthermore, participants in the full knowledge condition were faster to read the continuation sentence compared to participants in the partial knowledge condition (presumably because the generated implicature had already evoked the complement set). Similarly, Breheny et al. (2013) using a visual world paradigm, demonstrated that the speaker's epistemic state (i.e., whether he had witnessed the whole event or parts of an event) affected the derivation of ad-hoc scalar implicatures at early stages of pragmatic processing.

More recent work with children has shown some success in integrating speaker knowledge in scalar implicature computation but also some developmental limitations (Hochstein, Bale, Fox, & Barner, 2014; Papafragou, Cohen & Friedberg, in press). For instance, in Papafragou et al. (in press), 4- and 5-year-old children watched two videos, where two almost

identical agents ("twins") performed the same action (e.g., colour a star). In one video, an observer witnessed the whole event; in the other video, the observer fell asleep halfway through the action and only watched part of the event. At the end, children heard either a strong or a weak statement (e.g., "The girl coloured all/some of the star") and had to attribute it either to the fully knowledgeable or to the partially knowledgeable observer. Results showed that 5-year-olds were able to attribute informationally strong statements to knowledgeable observers and informationally weak statements to partially informed observers, but 4-year-olds could not reliably link the observer's (i.e., speaker's) epistemic state to the informational strength of different statements.

These findings have important implications for theoretical debates about the nature of children's pragmatic abilities more generally. The fact that 5-year-olds at least were able to consult the speaker's epistemic state when computing an implicature provides evidence in favour of the view that children have the ability to integrate information about other people's perspectives in pragmatic reasoning. These results are consistent with a growing body of experimental work on other domains of pragmatics where children were found sensitive to others' mental states from a very young age. These domains include word-learning (e.g., Papafragou, Fairchild, Cohen & Friedberg, in press; Sabbagh & Baldwin, 2001; Southgate, Chevallier, & Csibra, 2010) and perspective-taking (e.g., Morisseau et al., 2013; Nadig & Sedivy, 2002; O'Neill, 1996; O'Neill & Topolovec, 2001).

These findings from Hochstein et al. (2014) and Papafragou et al. (in press) raise the possibility that simpler experimental tasks might reveal that children younger than 5 can reason epistemically when computing implicatures. In direct support of this possibility, a new study using context-based scales and a very simple task inspired by the literature on referential

communication has shown that 4-year-old children are very successful in integrating speaker knowledge when computing scalar implicatures (Kampa & Papafragou, 2017). In this study, participants saw two nearly identical pictures side by side. In the first picture, a girl was sitting across a table facing forward towards the participant. Midway across the table was a tall cardboard box split into two vertical, see-through compartments. Each compartment contained an object and both objects (e.g., a spoon and a bowl) were clearly visible both from the girl's and from the participant's perspective. The second picture was identical to the first but one of the compartments was blocked, such that the girl in the picture could only see one of the two objects in the box (e.g., the spoon but not the bowl). Participants heard either a strong statement (e.g., "I can see a spoon and a bowl") or a weak statement (e.g., "I can see a spoon") and had to pick the box that the girl was talking about. Four-year-old children performed above chance in matching weak statements to displays where the girl had limited knowledge of the contents of the box, although their performance was still not adult-like.

6. Conclusion

In this chapter we examined the development of children's pragmatic abilities with a focus on scalar implicature, a well-studied case of pragmatic-inferential process in children. The current state of the art suggests that children have the ability to compute scalar implicature from a young age but have problems estimating what constitutes a relevant alternative, if relevance expectations are not made sufficiently clear by the experimental context. The present approach goes some way towards resolving a paradox in the domain of pragmatic development, whereby children appear to have underlying pragmatic abilities but may not be able to implement them consistently in all contexts.

It remains an open question how to draw more precise connections between developmental data and specific theoretical proposals about the nature of pragmatic processing. Beyond broad points of agreement, contextualist accounts diverge in their underlying principles. For present purposes, this has implications for terms such as 'relevance'. Within Relevance Theory, relevance is a trade-off between processing costs and expected cognitive gains (Sperber & Wilson, 1986/1995). Under this account, the listener's expectations of relevance determine whether an implicature will be calculated or not; the favoured interpretation is the one that satisfies these expectations with the least cognitive effort. Within the Gricean framework, relevance is defined with respect to the conversational goals, for instance, the ''Question under Discussion" (QUD; Krifka, 1999; Roberts, 1996, 2004; cf. Stalnaker, 1979). Under this view, implicatures are generated only if they are triggered by an answer to the QUD. Existing developmental work has not attempted to adjudicate between contextualist accounts but this remains a ripe opportunity for further research.

A further important direction for future work would be to uncover the mechanisms that underlie pragmatic development across a range of phenomena such as word learning, referential communication, implicature, presupposition, metaphor, etc. At present, connections between these domains have not been explicitly drawn, although it is clear that the same pragmatic considerations underlie many of these phenomena. The computation of different types of implicature is a case in point. Developmental evidence from relevance implicatures coheres with the conclusion from the study of scalar implicatures that children have difficulties evaluating speaker intentions when they have to reconstruct relevance for themselves. There is evidence that children under the age of 6 are generally unable to generate novel, non-conventional relevance inferences (Bucciarelli et al., 2003; de Villiers, de Villiers, Coles-White, & Carpenter,

2009; Loukusa, Leinonen, & Ryder, 2007; Verbuk & Shultz, 2010). For instance, de Villiers et al. (2009) presented children with short dialogues (e.g., "Dad: What happened to the ham?", "Boy: The dog looks happy!") and were asked to explain what a speaker meant (e.g., "What did the boy mean? Why did he say that?"). Children under the age of 6 were unable to offer an explanation that invoked a relevance implicature (e.g., "The dog ate the ham"). In contexts where relevance computations were simpler, however, even 3-year-olds appeared to draw these inferences (Schulze, Grassmann, & Tomasello, 2013; Tribushinina, 2012; see Grigoroglou & Papafragou, in press, for discussion). By integrating findings from a variety of linguistic phenomena, future work can provide a broader account of the developmental trajectory of children's pragmatic abilities.

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