Convergence and divergence between word learning and pragmatic inferencing

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Abstract

Word learning by exclusion and pragmatic inferencing of implicature have typically been studied separately. However, there is a growing assumption that they are in fact similar processes, and therefore it can be expected that children might be competent in implicature younger than previously thought. We motivate this assumption with some theoretical observations and by drawing on empirical studies, and suggest that, indeed, pragmatic maxims can be applied by children in word learning contexts. Thus young competence in implicature is to be expected. We moderate this claim with observations of divergence across the word learning and implicature inferences, in how they are modelled by Gricean theory, and finally consider what pragmatic theory would predict for development, proposing that some word learning and implicature inferences may be easier than others and therefore acquired or applied earlier.

Keywords: Implicature; word learning by exclusion; pragmatic inferencing; language acquisition.

Introduction

Until recently the two extensive literatures on word learning and on implicature have remained largely separate. But there is now a dawning realisation, and even growing assumption, that this separation may be an artefact rather than a meaningful distinction (e.g., Barner, Brooks, & Bale, 2011; Katsos, in prep; Katsos & Bishop, 2011; Stiller, Goodman, & Frank, under review).

In the word learning literature, much debate has centered on word learning by exclusion, or 'mutual exclusivity', starting with Markman & Wachtel's (1988) description of the phenomenon. In a typical experiment, the child must disambiguate the referent of a novel word from two potential referents. They are presented with two objects, one familiar and one unfamiliar, and then instructed, for example, 'show me the *blicket*' or questioned 'which one's the *blicket*?'. Many studies have found that young children and babies choose the unfamiliar object for the novel label at above chance levels, which is typically accounted for by reasoning that excludes the familiar object on the basis of constraints or pragmatic inference (e.g., Bion, Borovsky, & Fernald, 2013; Diesendruck, 2005; Diesendruck, Carmel, & Markson, 2010; Diesendruck & Markson, 2001; Jaswal, 2010; Markman & Wachtel, 1988; Markman, Wasow, & Hansen, 2003; Scofield & Behrend, 2007; Zosh, Brinster, & Halberda, 2013).

Experimental pragmaticians, meanwhile, have been concerned with the nature and acquisition of pragmatic inferences, particularly quantity implicature, and its subtype, scalar implicature, as well as manner and relevance implicatures (e.g., Barner et al., 2011; Guasti et al., 2005; Noveck, 2001; Papafragou & Tantalou, 2004; Schulze, 2013; Tribushinina, 2012). In this typical example of a scalar implicature, the hearer reasons that had all the friends been at the party, the speaker would have said so:

A: Were all your friends at the party?

B: Some were.

+>Some but not all of A's friends were at the party.

If we consider how word learning and implicature might be related, there are three options:

1. There is no similarity at all.
2. There is a superficial similarity, but no underlying common process.
3. There is a similarity; they share the same processes.

In this paper we argue that there is indeed an interesting similarity in terms of processes (option 3), though this must be moderated by some observed differences.

Specifically, we make two suggestions. Firstly, word learning by exclusion is just one of the multiple pragmatic strategies available to infants for word learning. If pragmatic word learning and deriving implicatures are similar processes, we would expect to find convergence in their appearance over development. Secondly, there are differences between these types of inference, which suggest differences in acquisition. We use these observations to predict an order of acquisition for different word learning and pragmatic inferences, in the simplest case. This leads to further suggestions and predictions for experimental work to test these hypotheses, with the aim of filling in the picture of early pragmatic development in the transition from non-verbal to verbal communication. We support our theoretical observations with evidence from experimental studies, and throughout assume a Gricean perspective, while also drawing on neo-Gricean theories (e.g., Levinson, 2000).

Convergence and divergence across inferences

Convergence

There are, broadly, two views on the phenomenon of word learning by exclusion: it is explained either in terms of constraints (e.g., Jaswal, 2010; Markman & Wachtel, 1988), or with pragmatic reasoning about the speaker's intended meaning (e.g., Clark, 2009). In principle, the two views are compatible, with both strategies potentially available depending on context or developmental stage (as Lewis & Frank, 2013, suggest from a formal perspective), and there is experimental support for both (e.g., Diesendruck, 2005, and Grassmann, Stracke, & Tomasello, 2009, for the pragmatic view; Jaswal, 2010, for constraints). Here we focus on the pragmatic view, and raise the possibility that word learning converges with other pragmatic processes, like implicature derivation. Three lines of evidence support this claim.

A theoretical motivation Pragmatic formulations of word learning by exclusion are usually based on Clark's (2009) Principles of Contrast & Conventionality: an expectation that for certain meanings, a conventional form is used in the language community (Bloom, 2002; Clark, 2009; Diesendruck, 2005; Diesendruck et al., 2010). 'If the speaker does not use the conventional form for the known referent, they must intend the other, novel referent', it is reasoned. This can equally be understood in Gricean terms. Clark's Principles involve reasoning about form, which suggests that word learning by exclusion is akin to Gricean manner inferences (Grice, 1991), because they also involve reasoning about the form of an expression (as Marchena, Eigsti, Worek, Ono, & Snedeker, 2011, and Brosseau-Liard & Hall, 2011, suggest). In the following example, the hearer contrasts the more complex construction 'made the car stop' with the alternative that could have been said, 'stopped the car', and infers that had the speaker intended to communicate *stopped the car in the normal way*, they would have said so in the normal way:

He made the car stop.

+>He made the car stop *not in the normal way*.

If we take 'obscure', to mean 'non-conventional', then avoiding obscurity is the same as sticking to convention. Word learning by exclusion is an application of the manner maxim to the task of word learning. In the situation with a known and unknown object, in which a novel word would be an obscure way of referring to a known object for the child, the child, assuming the speaker's co-operativity and conventionality, infers that the speaker is referring instead to the novel object in the usual way.

This leads to the idea that word learning by exclusion is not a special case, but just one pragmatic strategy – one that employs the maxim of manner – among several used in word learning. Children could equally learn words by applying quantity and relevance maxims, as Frank & Goodman (under review) and Akhtar (2002), respectively, propose. In Frank & Goodman's study, 3-year-olds were presented with a picture of two dinosaurs, one with one unfamiliar item like a headband, and another with a headband and another unfamiliar item, a bandana. The experimenter pointed to the dinosaur with two items and said "here is a dinosaur with a *dax*". To test their mapping of the novel word, the children were then presented with two more dinosaurs, one with a headband and one with a bandana, and asked, "which is the dinosaur with the *dax*?". Children more often chose the unique item, the bandana, presumably on the basis of informativeness, or the maxim of quantity: to identify this referent (the dinosaur), the speaker should say as much but no more than is necessary; if the speaker intended to refer to the headband, the speaker would have not said enough to be informative because the other dinosaur also has a headband, therefore the speaker must be referring to the bandana. In Akhtar's (2002) study, 2- and 3-year-olds heard a novel object described as 'a *wuggy* one' in one of two conditions: the preceding discourse had concerned either the shapes of novel objects, or their textures. Perhaps unsurprisingly, the children were more likely to infer that the novel adjective, *wuggy* referred to shape than texture in the shape condition, and vice versa. Presumably, they could reason along such lines as: "to say something relevant in this situation, the speaker would say something about shape, so *wuggy* must be about the object's shape". See Table 1 ('word learning – relevance' and 'word learning – quantity') for a more thorough sketch of these inferences.

Following Grassman (2013), the inference for word learning by exclusion can be formulated in terms of a disjunctive syllogism with an embedded modus tollens. A disjunctive syllogism has the form: p or q, not p, therefore q. A modus tollens is an instance of: if p then q, not p, therefore not q. Taking the typical experimental example with two objects, one known, say, a banana, and one unknown, the 'blicket', the inference precedes as follows, with (1, 3b, 4) forming a disjunctive syllogism, and (2, 3) the embedded modus tollens:

The speaker S said 'p'

1. S could be intending to refer to *p*, the banana, or *q*, the unknown object
2. If S meant *q*, S would have said 'q', 'banana'
3. a) S said 'p', 'blicket', b) so S does not mean *q*, the banana
4. Therefore, S intends to refer to *p*, the unknown object
5. Therefore 'blicket' refers to *p*, the unknown object

This is a model of the reasoning only, not a description of conscious, or even unconscious thought, although Halberda (2006) uses eye-tracking to find evidence for a disjunctive syllogism in word learning by exclusion. Strikingly, manner and quantity implicatures, and their corresponding word learning inferences, can be modelled in the same way (we return to relevance implicatures below), as they too involve contrast of what was said with what was not said, and the negation of what was not said, as depicted in Table 1. This is a theoretical indication that the relationship between word learning and implicature deserves further investigation.

Table 1: Word learning and implicature inferences

	WL by exclusion	**Manner**	**WL – quantity**	**Quantity**	**WL – relevance**	**Relevance**
What was said	S said 'p'					
Possible alternatives	S said 'p' instead of more conventional 'q'		S said 'p' instead of more/less informative 'q'		The context is about a topic, *q*	
	with meaning *q* of known object	with meaning *q* similar to *p*				
Alternative action	If S meant *q*, S would have said 'q'				If S meant to communicate something relevant in this situation, S would have said something about *q*	
Assume	co-operativity					
	conventionality		informativeness		relevance	
Negation of alternative	S did not say 'q' therefore does not mean *q* (in a conventional way)		S did not say 'q' therefore does not mean the more/less informative *q*		N/A	
Bridging inference	N/A				'p' must be about *q*	
Intended meaning		Therefore S means *q in a non-conventional way*		Therefore S means *p but not q*		Therefore S means *p about q*
Word learning	Therefore 'p' means *p*		Therefore 'p' means *p*		Therefore 'p' means *p*	

Empirical observations: common prerequisites Word learning and implicature derivation have in common the necessary prerequisites for pragmatic reasoning: children need to be able to share in a joint-attention frame with the speaker; read their intentions; track the common ground and take in contextual cues; and assume that the speaker is co-operative. There is much evidence that these abilities develop around the first birthday (for an overview, see Tomasello, 2003, 2008), and so are available for both word learning and implicature in the early years of language acquisition.

Empirical observations: common behaviour Both word learning and implicature derivation are sensitive to pragmatic manipulations, such as changes in speaker reliability (Diesendruck et al., 2010, and Grodner & Sedivy, 2011, respectively), speaker belief or epistemic state (Carpenter, Call, & Tomasello, 2002; Diesendruck, 2005; Goodman & Stuhlmüller, 2013, for word learning; Breheny, Ferguson, & Katsos, 2013, for implicature), joint attention and common ground (Grassmann et al., 2009, and Tribushinina, 2012), situation or communicative purpose (Grosse, Moll, & Tomasello, 2010; Grosse & Tomasello, 2012; Scrafton, 2009; Verbuk, 2012; and Tomasello, Strosberg, & Akhtar, 1996), and speech-accompanying acts (Grassmann & Tomasello, 2010, for word learning), though see Jaswal (2010) and Brosseau-Liard & Hall (2011) for opposing views.

From these empirical findings and theoretical observations we suggest that just as speakers apply manner, quantity and relevance maxims in implicature derivation, so too are they used by children for word learning.

Divergence

However, this conclusion must be moderated by observations of divergence across these inferences. Firstly, we consider differences between word learning and implicature inferences *per se*, and secondly divergence across manner, quantity and relevance maxims.

Divergence between word learning and implicature We can note some systematic differences between word learning inferences and their corresponding implicature inferences. The end step of word learning reasoning is not an implicature that enriches some literal meaning, but the endpoint is the reference, or meaning, of the novel word form. The difference between word learning by exclusion and manner inferences, in particular, probably rests on the greater knowledge required for manner implicatures for identifying the alternative expression that was not used and its stereotypical implication. Also, Davies & Katsos (2010) and Morisseau, Davies & Matthews (2013) point out that for word learning, the need to make the inference is always obvious when a novel word is heard, while this may not be the case for implicature in-

ferences, and likewise the consequence of not inferring the meaning of a novel word may have a severe consequence for communication, whereas not deriving an implicature does not always fully hinder communication.

Divergence between maxims Firstly, there is divergence in the type of reasoning (see Table 1). Manner and quantity implicatures, and their associated word learning inferences, involve, on the pragmatic account, a disjunctive syllogism with embedded modus tollens – contrast with what was not said and its negation. Relevance inferences, on the other hand, are rather an attempt to bridge the gap between what was said and what was expected, and the implicature incorporates assumptions that are not explicitly said. For example, in this simple case the hearer relates what is said to the question by relying on background assumptions:

A: Would you like some soup?

B: I'm not hungry.

+>No, I would not like some soup.

(based on the assumption, from world knowledge, that people want to eat when they are hungry, and not eat when they are not)

Secondly, the inferences differ in whether the *form* or the *informational content* of what is said and what is not said is contrasted (see Table 1 'possible alternatives' and 'alternative action'). Manner inferences involve comparing, primarily, forms that have the same literal informational content, and word learning by exclusion arguably only involves the forms of the words used (contrasting the novel form with the known form associated with the familiar object). Quantity inferences, meanwhile, involve conceptualisation and contrast of sets of lexical alternatives within the same semantic field, and relevance inferences work at the level of propositions; for both, informational content, rather than form, is key.

Thirdly, there are clearly a number of factors that vary across all the different inferences. World knowledge is essential for relevance inferences, for example:

A: Would you like a cup of coffee / camomile tea?

B: I need to work late tonight.

+>Yes, I would / No, I wouldn't.

Knowing that coffee is a stimulant and camomile soporific is necessary to infer whether the answer here is positive or negative. Similarly, deriving ad hoc scalar implicatures can be dependent on world knowledge:

A: Did you cycle from Cambridge to Brighton?

B: I cycled to London.

+>I did not cycle to Brighton.

(Based on the world knowledge that London is closer to Cambridge than Brighton.)

Of course, world knowledge may play a role to varying degrees for all other types of inferences, too.

The degree or difficulty of conceptual knowledge also varies. For example, contrasting terms in the epistemic domain such as *think–know*, are understood and used at age 3 or 4, after verbs of desire (Perner, Sprung, Zauner, & Haider, 2003), while in the quantificational domain, children may understand *all* in an adult-like way aged 2 (Barner, Chow, & Yang, 2009), allowing an implicature with *some*. Children may be able to make scalar inferences in more tangible domains, such as *warm–hot*, still earlier, though such scales are not typical in experimental studies. Finally, inferences may also be more or less dependent on context, according to how salient the contrasting alternatives are in the common ground and preceding discourse (see e.g., Saylor & Sabbagh, 2004 for the affect of salience on word learning by exclusion).

In sum, there are indeed reasons to suggest convergence of pragmatic word learning and implicature inferencing, as is increasingly assumed, and so we would expect similar behaviour under manipulation of pragmatic conditions in comparable studies. However, there are also theoretical differences across inferences, and between pragmatic inferences and word learning *per se*, which lead us to expect divergence in their use by children.

Acquisitional convergence and divergence

These largely theoretical similarities and differences can be applied to the empirical question of how and when children make these inferences in word learning and conversation over development. The Gricean model does not demand predictive applications to acquisition, but educated guesses can be made about an order of appearance.

Convergence

As we have suggested that pragmatic word learning and implicature derivation are in many ways alike, we would predict a closing of the gap between the ages at which children are observed to learn words pragmatically and derive implicatures. Indeed, while early studies seemed to find that children perform poorly with implicature inferences (e.g., Guasti et al., 2005; Noveck, 2001; Papafragou & Musolino, 2003), with improved, more age-appropriate methodologies which do not require meta-linguistic judgements, the age of above-chance competence, if not adult-like performance, has been significantly revised downwards, to as young as three years (Grosse, Schulze, Noveck, Tomasello, & Katsos, in prep; Schulze, 2013; Scrafton, 2009; Stiller et al., under review; Tribushinina, 2012). Further, comparable inferences are observed in non-verbal responses still earlier, at age 2 or younger (Grosse et al., 2010; Tomasello, Carpenter, & Liszkowski, 2007).

Divergence

The differences across inferences suggest diverging patterns in acquisition, too. To make any suggestions about the order of appearance in acquisition we need to decide: a) for each feature in the inference, which setting is likely to be easier or harder and b) which of the features carry more or less weight, i.e., how conflict between the different settings is resolved.

We suggest that:

- counterfactual reasoning (manner, quantity) is harder than bridging inferences (relevance) because it involves computation of what is not said, contrast with it, and its negation

Table 2: Features of inferences – shading indicates a difficult setting

		WL by exclusion	Manner	WL – quantity	Quantity	WL – relevance	Relevance
Reasoning	with informational content		Y	Y	Y	Y	Y
	with form	Y	Y				
	involves embedded modus tollens	Y	Y	Y	Y		
What is communicated	Negation of what is not said		Y		Y		
	Form-reference association	Y		Y		Y	
	Assumption of what is not said						Y
	Particular world knowledge required				(Y)	Y	Y
	Need for inference not necessarily obvious		Y		Y		
	Communication possible without inference		Y		Y		

- reasoning about contrasting forms and informational content (manner) might be harder than reasoning about informational content alone (quantity and relevance)
- reasoning about informational content is harder than reasoning about form (word learning by exclusion)
- the more world knowledge required, the harder the conceptual knowledge required, and the more context independent the inference, the more difficult the inference

From these speculations a general order of expected acquisition for the easiest case emerges:

> Word learning by exclusion $<$ Word learning through relevance or informativeness / Relevance implicature $<$ Quantity implicature $<$ Manner implicature

This is apparent looking at Table 2, in which the suggested difficult settings of features appear shaded. No judgement is being made as to whether an implicature or mapping of a novel word to a referent is more complex.

While some studies have looked at quantity and relevance implicatures in children as young as 3 years, there are, to our knowledge, no studies that offer comparable results for different word learning and pragmatic inferences at the critical younger age, 2–5 years. If we conducted such a study, we would expect to find the simplest cases of inferencing appearing in the order suggested above, after pragmatic prerequisites and – for all but relevance – the ability to do some form of counterfactual reasoning are in place, along with a large amount of variability depending on context, conceptual and world knowledge, and the need to make an inference.

A few studies point in this direction, however. Bernicot, Laval & Chaminaud (2007) find that relevance inferences are acquired early and sarcastic ones late in 6–10-year-olds. Antoniou, Grohman, Kambanaros & Katsos (2013) use the same complete-the-story picture-matching task with 6–12-year-olds and find that relevance is easiest and irony hardest, with no difference between manner and quantity in the middle. With younger children aged 3, 4 and 5, Eskritt, Whalen & Lee (2008) find best performance in sensitivity to violations of Gricean maxims for relevance, and poor performance for quantity implicature in 3-year-olds. Again, Siegal et al's (2010) study on bilingual 3–6-year-olds and Surian, Baron-Cohen & van der Lely's (1996) study on 6-year-olds find better performance for relevance than quantity. Furthermore, relevance inferences arguably appear even at a pre-verbal stage in pointing (Tomasello et al., 2007), while the earliest reported robust competence with manner implicatures in pointing is at age 3 (Liebal, Carpenter, & Tomasello, 2011).

Conclusion

In sum, we suggest that pragmatic word learning and implicature derivation are similar to a great degree in their prerequisites and inferential processes; indeed, word learning strategies such as reasoning by exclusion may be just particular instantiations of pragmatic maxims in a word learning context. This has implications for pragmatic acquisition, specifically motivating an expectation of younger competence in implicature than initially supposed. There are also differences between inferences, as well as between word learning and implicature per se, from which we suggest an acquisitional ordering. We leave open the possibility that there may be divergence or convergence of word learning and implicature over development: as cognitive abilities, linguistic experience and contexts change, so too might learning strategies. Future research might address questions such as: in comparable conditions, are word learning and implicature inferences affected

in a similar way by manipulation of pragmatic cues? Do manner, quantity and relevance inferences for word learning and implicature appear at different stages of development? How do other factors (e.g., number and salience of alternatives, conceptual and world knowledge) affect performance for word learning and implicature? Our specific conclusions, from the extrapolation of theory to testable hypotheses for acquisition, may be wrong, but we hope that it is nevertheless an interesting proposal as an attempt to spell out what pragmatic theory predicts for acquisition.

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