

*Language and Conceptual Development series*

# Conceptual development and conversational understanding

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**Children's understanding of the implications of conversation can influence their responses on tasks designed to measure conceptual development. These responses are in keeping with developmental changes in the ability to recognize and resolve ambiguity in communicative contexts, as shown, for example, in children's ability to compute 'scalar implicatures'. Examining steps children take to overcome difficulties in processing the relevant features of tasks and in correctly interpreting task instructions promise to illuminate mechanisms of conceptual development. We review recent research in this area, focussing on early knowledge of the appearance–reality distinction and knowledge of cosmological concepts.**

Suppose you hear that the Italian judicial system has launched prosecutions against the Prime Minister and his associates. You ask your Italian colleague 'How did the trials end up?' The reply 'the associates were convicted' implies that the Prime Minister was not convicted. An understanding of how such pragmatic implications ('implicatures') are recognized by the listener is at the heart of current investigations in cognitive science of verbal communication processes. When we interpret language, we go well beyond what is said, enriching, and sometimes even reversing, what is encoded linguistically by adding a wealth of implicit information that enables us to retrieve the speaker's intended meaning. This is a special challenge for children who are inexperienced in conversation.

It has been generally acknowledged that any analysis of conversational understanding in both children and adults needs to explain how listeners identify and take communicative context into account in the assignment of reference and the resolution of ambiguity, for example, in humor, irony, metaphors, and sarcasm [1–9]. Of considerable influence to date is the analysis introduced by Grice [10,11] who observed that the expectations of participants in conversation are characterized by various maxims. These enjoin speakers to (i) say no more or no less than is required (maxim of *quantity*); (ii) 'Try to tell the truth and avoid statements for which you have insufficient evidence (maxim of *quality*)'; (iii) 'be relevant (maxim of *relation*)'; and (iv) 'avoid ambiguity and obscurity (maxim of

*manner*).' Violations of these maxims necessarily occur in that to follow one maxim can mean that another is violated. This process creates a 'logic in conversation' that allows listeners to follow the implications contained in natural language. For example, if a person complains that she has a headache, a friend might respond that there is a drugstore around the corner. The implications are that the walk to the drugstore is short, that the drugstore is open at the time, that it sells tablets to alleviate headaches, and that these tablets are publicly available to be sold to the sufferer. To state all this explicitly by following the manner maxim would be to violate the quantity maxim not to say more than is necessary. In most cases the implications are likely to be mutually understood among conversationally experienced speakers. If the speaker appears to violate one or more of these maxims but the hearer has reason to believe that the speaker is cooperative, then the hearer needs to generate inferences to ensure that the speaker's contribution to the conversation is adequate at the level of intended meaning.

Limitations in conversational understanding can mask the nature of conceptual knowledge in several ways. In particular, young children who are unskilled in understanding why, when, and how conversational maxims are violated often fail to interpret speakers' meanings. For example, they might not follow why an adult experimenter departs from the maxim of quantity and seems to say more than is required, using repeated questioning, for the purpose of determining the certainty of what they know. In the face of such questioning, children might inappropriately abandon their original correct answer for a different one in the hope of satisfying the experimenter [12,13]. Nevertheless, despite what children say under these conditions, they can still demonstrate a wealth of conceptual knowledge in tasks that reduce the requirement for them to follow the implications of questions [14,15]. As Gelman *et al.* [16] observed some time ago, children's incorrect answers on tasks designed to examine their conceptual development might reflect the extent of their conceptual competence in a particular domain of knowledge. However, quite separately, their performance on the same tasks might require a type of planning or procedural competence – a motor or linguistic response – that is not yet within the child's grasp. Even if children have both a conceptual and planning competence, they might still not display the depth of their understanding

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owing to difficulties in sharing the speaker's conversational implications necessary to determine the relevant features of the task and correctly interpret instructions [17].

In this article, several new directions in the study of children's conversational understanding are examined that help to illuminate the nature of conceptual development. These concern research on children's knowledge of the distinction between reality and the phenomenal world of appearances, their knowledge of certain cosmological concepts, and their ability to compute the implications of speakers' statements by recognizing scalar implicatures.

### Knowledge of the appearance–reality distinction

One of the most significant areas in which children's limitations in conversational understanding can mask their conceptual development involves the ability to distinguish between reality and the phenomenal world of appearances. Flavell and his colleagues [18] devised tests to determine whether children aged 3 and 4 years can distinguish between the true color of a substance, or the nature of a living kind, and their appearance under, for example, colored filters or masks and costumes. In one such task, children are shown milk in a glass that has a red filter wrapped around it. The children were asked, 'What color is the milk really and truly? Is it really and truly red or really and truly white? Now here is the second question. When you look at the milk with your eyes right now, does it look white or does it look red?' In contrast to most of 4-year-olds who succeed on this task, less than half of 3-year-olds correctly identified the milk to *look* red but to *be* white really. Many 3-year-olds make 'phenomenist' errors: they say the milk is really and truly the way it looks, that is, red.

Although such results have been taken to reveal a conceptual deficit in development, children as young as 2 years do display a grasp of the appearance–reality distinction in a 'show-and-tell' game; they can describe the appearance and show the real function of objects [19,20]. Moreover, children aged 3 years prefer a candle that looks like a crayon to a real crayon when asked 'to draw with something that *looks like* a crayon', and they prefer a real sponge to a sponge that looks like a rock when asked to clean up some spilled water [21]. They often use more than one label for the same object depending on the context of a speaker's request [22,23]; in adapting their terminology to the context of the conversation, they are not limited to a single label that exclusively refers to appearance or reality. Recently, Deák *et al.* [24] have shown that 3-year-olds' lack of success on appearance–reality tasks reflects a difficulty in identifying the point of the conversation initiated by the interviewer. They found that there is a strong relation between answers on the appearance–reality questions and the 'overlapping' control tasks in which children were asked parallel questions about the properties of another item.

According to this analysis, if asked two questions about appearance and reality that involve deciding between choices of appearance and reality, children might be unclear whether each of the two questions requires a newly reasoned answer – one that does not depend on the other. If this is the case, then children often stick with their first answer until provided with feedback or until

asked a new question altogether. In instances where the questions are not readily comprehensible, children's answers might reflect a characteristic response bias (see Box 1). How children interpret task instructions and their attentiveness and flexibility to the range of available alternatives reflects their performance on tasks that require flexibility in meaning [25–27].

Other research suggests that, compared with monolingual children, children who acquire two languages early perform better on appearance–reality tasks, possibly because they are adept at inhibiting incorrect answers and can switch appropriately from one dimension of an object to another [28]. Alternatively, bilingual children might be pragmatically more skilled because they are exposed to a wealth of linguistic information and conversational experience.

### Cosmology

The appearance–reality distinction is fundamental to knowledge in any causal domain, from biology to psychology and from physics to cosmology. For example, children need to learn that, although the earth looks flat, in reality it is spherical. In this respect, Vosniadou and Brewer [29,30] have proposed that young children are constrained to believe that the outward appearance of a flat earth that they see is, at least in part, a genuine reflection of the earth's real shape. They initially have a naïve cosmology founded on the 'entrenched presuppositions' that the earth is a flat plane (the 'flatness' constraint) and that unsupported objects fall 'down' (the 'support' constraint). As children grow older, their naïve theory of the shape of the earth is said to come into contact with the culturally received view – in Western countries the accepted scientific case that the earth is spherical. When children are told that the earth is round, they are said to form 'synthetic' mental models (e.g. representing the earth as a hemisphere topped by a flat surface on which people live) that are an amalgam of the child's naïve theory and the culturally received view, which guide their reasoning about the earth's shape.

#### Box 1. Response bias patterns in young children

Fritzley and Lee [56] investigated whether yes/no questions would lead to a 'yes' bias in young children's answers to questions. They asked 2- to 5-year-olds yes/no questions that were either comprehensible or incomprehensible, and about either familiar or unfamiliar objects. The 2-year-olds displayed a consistent yes bias whereas 4- and 5-year-olds showed no response bias towards comprehensible questions and a negative response bias towards incomprehensible questions. Results for 3-year-olds were mixed, suggesting that the age of 3 years is a period of developmental transition in response tendency towards yes/no questions. Fritzley and Lee conclude that yes/no questions are suitable for older children, providing these are made to be comprehensible (and do not involve meaningless terms), but that such questioning is likely to give biased results when used with younger children and when the questions are incomprehensible. Even so, children of all ages appear reluctant to say that they don't know the answer to closed-ended questions even when they are explicitly told that such a response is acceptable [57]. This might be particularly the case when children are asked yes/no questions in comparison with wh-questions (what, where, why) [58]. For children in Western cultures, there might be a cooperative norm to try to provide an answer to avoid admitting ignorance.

However, there are several reservations concerning how children interpret the task and implications of test questions that prompt a reconsideration of this position. First, the evidence is based largely on children's expertise in drawing and in constructing clay models. As children's art often does not correspond to their choice of representation of objects as these actually are [31,32], their responses might reflect a lack of planning competence that underestimates their conceptual development. Moreover, a Gricean analysis suggests that children might interpret test questions like 'Is there an edge or an end to the earth?' as 'Is there an edge to the circle that you have drawn to represent the earth?' If so, they might offer an apparent flat-earth response to an unintentionally ambiguous question when they actually hold no such belief.

Second, as the children were repeatedly questioned on a theme ('Would you ever reach the edge of the earth? Say we kept on walking and walking and had plenty of food with us? Could you fall off the edge of the earth?'), they might vary their responses simply in an attempt to provide what they think the experimenter believes is the right answer. A third reservation is that children in many cultures initially have no models or beliefs about the shape of the earth and the day–night cycle before scientific instruction. If so, they would not strive for empirical feedback on the accuracy of their beliefs, and their answers therefore reflect post-hoc rationalizations rather than mental models based on entrenched presuppositions. One exception is in Australia where, in contrast to countries such as England, children are given systematic instruction on cosmology and the day–night cycle.

In a recent comparison of Australian and English children's knowledge of the shape of the earth and the day–night cycle [33], Australian children were nearly always significantly in advance of their English counterparts. However, their better performance was not achieved on open-ended questions but on tasks involving explicit questioning, where the children were often provided with a range of alternative answers, sometimes in reference to 3D models. These findings support the notion that the questioning methods used in previous research might have underestimated children's competence [34], and are consistent with recent work indicating that, 'entrenched presuppositions' notwithstanding, children can be easily trained on aspects of cosmology [35]. As even adults can have trouble identifying explanatory cosmological concepts such as gravity [36], the research to date does not attribute to children a sophisticated understanding of cosmology, but points to the existence of a grasp of factual information that serves as a 'placeholder' until such an understanding is achieved – if it is at all – in adolescence and adulthood [37,38].

### Implicatures and the development of conversational understanding

Conversational understanding as shown on tasks designed to examine children's appearance–reality knowledge or their knowledge of certain scientific concepts reflects a broad development in pragmatic competence that continues throughout childhood. Recent work points to strong conversational influences on responses to reasoning tasks

involving numerals (e.g. *two, three*), quantifiers (*some, all*), connectives (*and, or*), and epistemic modals (*might, must*). In particular, several studies have been devoted to children's ability to draw 'scalar implicatures' – scenarios that arise when a speaker uses a weak member of a scale (e.g. *some* or *might*) to implicate that the stronger term of the scale (*all* and *must*) does not hold. For example, the utterance '*Some of the dwarfs loved Snow White*' implies that not every dwarf loved Snow White.

Noveck [39] tested the proposal that the semantic meaning of *some*, as compatible with *all*, appears earlier in development than its pragmatic, '*some, but not all*' meaning. He gave children aged 7 to 9 years and adults sentences such as '*Some giraffes have long necks*'. Children assigned a 'logical' semantic meaning to *some* as compatible with *all* whereas adults often provided a pragmatic interpretation in rejecting this proposition. Similar patterns of results were obtained with a scale involving connectives and epistemic modals, consistent with earlier findings from reasoning tasks [40,41] that showed a 'logical' interpretation of connectives in children. However, when the goal of the task is made more salient, even 5-years-olds can be induced to inhibit the logical meaning and choose the pragmatic interpretation (see Box 2).

According to the neo-Gricean position proposed by Levinson [6], scalar implicatures are often automatically and effortlessly computed whenever a particular form occurs in an utterance. For example, in hearing '*Some students are bright*' we automatically infer that not all of them are bright. By contrast, Relevance Theory [8,9] proposes that all scalar implicatures are effortful as they are derived when the hearer is trying to compute an optimally relevant interpretation of the utterance. The development of scalar implicatures in children would seem to support the effortful interpretation from Relevance Theory, in that, with increasing age, children come to expend the effort required to detect the implications of quantifiers such as *some* apart from their semantic meaning [42]. Research with adults also seems to support this position. For example, Bott and Noveck ([43]; see also [44]), presented adults with underinformative sentences such as '*Some elephants are mammals*'. Those who interpreted the items as a scalar implicature (e.g. '*Some but not all elephants are mammals*') took significantly longer to answer, indicating that those who were interpreting these items pragmatically were engaged in effortful scalar implicatures.

Studies on the development of scalar implicatures are consistent with related work on the development of sentence processing [45]. When shown two toy frogs, one on a napkin and one on a tray, together with a second, blank napkin, the request 'Put the frog on the napkin in the box' is processed far less efficiently by 5-year-olds than by adults. Whereas adults move the frog on the napkin directly into the box, many children move the frog on the tray onto the blank napkin and then into the box. However, although children are easily led 'down the garden path' in their use of context to process sentences, they are capable of acknowledging ambiguity in the meaning of utterances, as shown by their patterns of eye gaze [46]. The nature of the communicative setting can be such that even adults might not avoid distractions that

## Box 2. The development of scalar implicatures

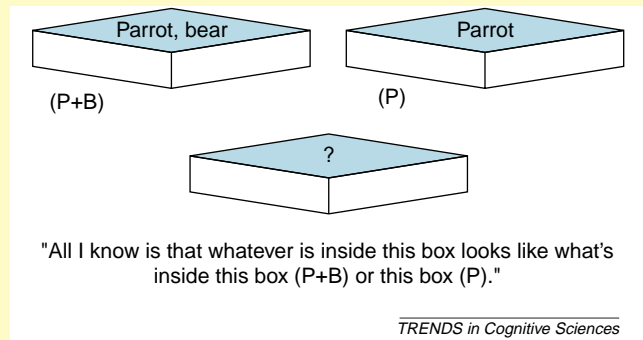
Analysis of scalar implicatures can be traced back to J.S. Mill [59]. He noticed that if we say to someone 'I saw some of your children today' the hearer is induced to infer that I did not see them all, 'not because the words mean it, but because, if I had seen them all, it is most likely that I should have said so...' (p. 501). These implicatures arise when a weaker term of a scale is used in place of a stronger, more informative term that logically entails it. Although they have been studied extensively in linguistic pragmatics, scalar implicatures have only recently been investigated experimentally (see Fig. 1).

Papafragou and Musolino [60] examined how 5-year-olds and adults judged the appropriateness of utterances that included the terms 'start', 'some' or 'two' and that were used in contexts that would have justified the use of stronger terms (i.e. 'finish', 'all' and 'three', respectively). Children, for example, were first shown three toy horses on a table and all of them jumped over a toy fence. Then a puppet said 'Some horses jumped over the fence' and participants were asked to say whether 'the puppet answered well'.

Adults overwhelmingly rejected infelicitous statements, as predicted by pragmatic theories. By contrast, children performed less well in that they often accepted infelicitous utterances, but their response depended on the type of statements and the clarity of the instructions. They performed better with numerals than with the other terms (see also [61]), and their success was enhanced when the instructions and the procedure made it clear that they were expected to evaluate the felicity of utterances, rather than their truth. In a follow-up study, Papafragou and Tantalou [62] gave 5-year-olds situations such as one involving an elephant described as having been told to color a set of four paper stars. When asked about what he had colored, the elephant is said to reply, 'I colored some'. In this situation, 5-year-olds say that the elephant should not be given a prize, choosing the pragmatic interpretation, rather than the semantic one.

Although children at 5–6 years of age are less skilful than adults in detecting violations of conversational maxims and

recognizing conversational implicatures, they are nevertheless able to demonstrate such abilities in certain contexts, particularly when they are aware of the goal of the task and when task demands are reduced [63–65].



**Fig. 1.** Design of a scalar implicature task involving modal reasoning. Children are shown three boxes: one containing a toy parrot and a bear, a second containing a parrot, and a third whose contents are described by an experimenter as the same as either the first or second box. The children's task is to judge whether an experimenter's statements about the presence or absence of a parrot in the third box (given the knowledge of this similarity) are right or wrong. Their responses determine whether children interpret a modal reasoning statement involving 'might' logically or pragmatically. The statements given are: (1) 'There has to be a parrot in the box' (correct response: right); (2) 'There doesn't have to be a parrot in the box' (correct response: wrong); (3) 'There cannot be a parrot in the box' (correct response: wrong); (4) 'There might be a parrot in the box' (correct response: right, although this statement would be judged as right on a semantic or logical interpretation but wrong on a pragmatic interpretation, as it wrongly implies that a parrot does not have to be in the box.) Adapted with permission from [39].

preclude taking account the listener's perspective [47–49], whereas if these distractions are reduced even young children can communicate effectively [50].

## Conclusion

The research surveyed here indicates several ways in which children's conversational understanding influences their responses to tasks designed to evaluate their conceptual development. One perspective on this research suggests that increasing accuracy in the interpretation of utterances is made possible by the acquisition of a conceptual distinction between literal meaning and speaker's

meaning [51,52]. However, given the findings of recent studies, a viable alternative places an emphasis on attentional development rather than conceptual change. The mechanism underlying improvements in conversational understanding can be seen as similar to Leslie's Selection Processor, a mechanism of attention that permits children to base their predictions of a person's searching behavior on his or her beliefs (whether true or false) and to inhibit predictions based on reality [53,54] (see also [55], in this issue). When a mother says to her messy child 'you are really tidy now and your toys are put away nicely' the child – who already knows that messages about an object or action can have more than one interpretation [22–24] – needs to inhibit a literal interpretation of the mother's message to arrive at the intended sarcastic meaning. Systematically taking issues of conversational understanding into account (see Box 3) promises to lead to a richer, more complete account of conceptual development.

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## Box 3. Questions for further research

- What is the relation between the expression of theory-of-mind reasoning involving the knowledge of others' beliefs [55] and the computation of implicatures?
- To what extent is the development of conversational understanding the result of a domain-general improvement in processing speed and working-memory capacity underpinning cognitive effort?
- What is the influence of culture on conversational understanding in relation to conceptual development, particularly for cultures in which children are not typically involved in conversation with adults?
- What are the effects of impaired access to conversation (such as in deaf children with hearing parents who do use a sign language) on conversational understanding, including the processing of scalar implicatures and ambiguous sentences?
- To what extent is there an interaction between pragmatic development and development in other areas of language, such as lexical semantics?

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