Bringing out the Logic in Child Language

When the disjunction operator or appears in adult speech to children, the overwhelming majority of adult utterances carry an implicature of exclusivity. Yet English-speaking children are found to interpret the disjunction operator as inclusive-or in negated disjunctions, adhering to the ‘conjunctive’ reading of disjunction as in De Morgan’s laws: \( \neg [A \vee B] \Rightarrow [\neg A \land \neg B] \) (Gualmini and Crain 2002; 2004). Furthermore, in some languages (Hungarian, Japanese, etc.) disjunction operators do not fall within the scope of local negation, and fail to instantiate De Morgan’s laws in simple negative sentences in adult speech (Szabolcsi 2002). Yet Japanese-speaking children are found to show the same adherence to the conjunctive reading of negated disjunctions as English-speaking children (Goro and Akiba 2004). These results suggest that children assign the meaning of corresponding logical expression to natural language disjunctions, despite highly misleading input.

This paper concerns another Boolean connective governed by De Morgan’s laws: conjunction. In De Morgan’s laws, conjunction is interpreted ‘disjunctively’, meaning ‘not both’: \( \neg [A \land B] \Rightarrow [\neg A \lor \neg B] \). Although English accepts the Boolean ‘not both’ reading in certain contexts, we have found that the ‘neither’ reading of negative definite conjunctions is ubiquitous when the conjunction and does not receive focal stress. In two experiments, adult subjects (N=38) were asked to judge the truth or falsity of sentences like (1) and (2), following a story in which the Smurf had managed to jump over only one of the two obstacles he attempted. The adult subjects rejected the test sentences over two-thirds of the time as descriptions of such contexts. We take the results as indicating that English definite conjunctions can have the same denotation as definite plurals (Szabolcsi and Haddican 2003), and therefore fail to yield the Boolean ‘not both’ reading under negation.

Assuming that the ‘neither’ reading of negated definite conjunctions is characteristic of the input to children, we sought to determine whether or not English-speaking children can nevertheless interpret conjunction as a Boolean connective, using the (quasi) downward entailing operator only. As observed by von Fintel (1999), only does not create a typical downward entailing linguistic environment. For example, only Tigger ate pizza does not entail only Tigger ate pepperoni pizza. Yet semantic decomposition (cf. Horn 1969) reveals a hidden downward entailing meaning component of sentences containing only, as in (3), and the second meaning component, the so-called “assertion”, creates a downward entailing context. In previous research, we demonstrated children’s knowledge of the different meaning components of only in sentences containing conjunction. Twenty-one English-speaking children (average age = 5;0) were presented with sentences like “Only Tigger ate pizza or pasta” in a Truth Value Judgment task. Our subjects accepted the ‘disjunctive’ interpretation of conjunction in the presupposition (Tigger ate pizza OR Tigger ate pasta), accepting the target sentence for 93% of the time when Tigger only ate pizza and nobody else ate anything; but children required the ‘conjunctive’ reading of conjunction in the assertion (nobody else ate pizza or pasta ⇒ nobody else ate pizza AND nobody else ate pasta), and rejected the target sentences 90% of the time, e.g., when Tigger ate pizza and someone else ate pasta.

The same research strategy was applied to conjunction in the present study. That is, we asked how children interpret definite conjunctions within the hidden downward-entailing meaning component of sentences with only. Twenty children (average age = 4;11) witnessed a (computer generated) demonstration of magic by three would-be magicians (Aladdin, Neptune, Genie), who used magic words to attempt to perform several feats, e.g., open boxes, flip over cars, turn a frog into a princess, etc. For example, on one trial children were asked to evaluate sentence (3) in a context in which Aladdin used magic words to open both boxes, but Genie was able to open just one box. If the negated conjunct in the hidden meaning component of (3) were interpreted as meaning that everyone else (other than Aladdin) had failed to open either box (the ‘neither’ reading), then children should have rejected the target sentence, since Genie opened one of the boxes. But the Boolean interpretation of conjunction (in the hidden meaning component) makes the sentence true, since Genie failed to open one box. The finding was that the twenty child subjects accepted sentences like (3) in this kind of context on 38/40 trials (95% of the time), whereas they rejected two other control sentences nearly as often (88%). The findings are interpreted as further evidence that children impart the same meanings to natural language expressions as those that are assigned to the corresponding logical expressions in classical logic.
(1) The Smurf didn’t jump over the tree and the pond.
(2) The Smurf jumped over the bench, but he didn’t jump over the tree and the pond.
(3) Only Tigger ate pizza  
   (i) Presupposition: Tigger ate pizza  
       * Tigger ate pepperoni pizza (non-DE)  
   (ii) Assertion: nobody else ate pizza  
       nobody else ate pepperoni pizza (DE)
(4) Only Aladdin opened the blue box and the black box.

Selected references