

Shadow Playing with Romanian 5-Year-Olds. Epistemic Adverbs Are a Kind of Magic!

Aim: The current paper draws light on the acquisition of the semantics and pragmatics of epistemic adverbs in Romanian by means of a novel *shadow play paradigm* tested on 36 Romanian adults and 35 TD 5-year-old children. It argues that children as young as 5-year-old are adult-like in their ability to draw implicatures with epistemic adverbs expressing possibility in underinformative contexts (i.e. contexts requiring adverbs expressing certainty), but differ from adults in accepting sentences with epistemic adverbs expressing certainty in overinformative contexts (i.e. contexts where a 'strong' *certain* statement is made instead of a *possible* one).

Background: Previous studies on the acquisition of epistemic modality (Hirst & Weil 1982, Noveck, Ho & Sera 1996, Noveck, Ho & Sera 1996, Noveck 2001, Ozturk & Papafragou 2015 a.o.) have shown that children are sensitive to the relative strength of modals from very early on, being aware of the existence of a modal scale. However, 5-year-olds still have difficulties understanding logical modals, rejecting true sentences and accepting false sentences in rather surprising ways. One possible explanation for this has been *premature closure* (dubbed as such by Acredolo & Horobin 1987), children's tendency to reduce uncertainty to certainty in 'uncertain' contexts, a hypothesis supported by an on-line processing experiment monitoring eye-movement conducted by Moscati, Zhan & Zhou (2017). Similar results have been obtained experimentally for epistemic lexical items such as (*un*)*sure*: 4 to 6-year-old French children attribute certainty more easily than 8-year-olds (Bassano a.o. 1992, Bassano 1996). Apart from Bassano's work and Cournane's (2015) corpus study of epistemic adverbs (showing that children produce epistemic adverbs (but not modals) before age 3), most of the previous work on epistemic modality has focused on epistemic modals. From a methodological point of view, the experiments previously conducted rely on some version of the *hidden object paradigm*, and, more specifically, *the boxes paradigm* developed initially by Noveck (1996, 2001), either in its more complex form, or in a simplified/ adapted version (Ozturk & Papafragou 2014, Moscati, Zhan & Zhou 2017), where subjects have to infer the location of a certain object/ animal in a box based on current evidence and evaluate the truth value of various statements. However, in all experiments, the object/ animal is totally hidden, which caused some speakers to reject any sentence with *certain* even when appropriate.

The Current experiment: The experiment we designed aims to test the mastery of the semantics and pragmatics of modal adverbs *sigur* ('certainly'), *poate* ('possibly') by 5-year-olds. In order to avoid subjects from being too cautious, but, at the same time, keep the object of inquiry inaccessible so as to justify the use of modal adverbs, we developed a novel *shadow play* paradigm where animals hide behind a curtain. Instead of just speculating upon the presence of an unseen animal in a box, subjects can now see the shadow of the animal(s), and, moreover, they can hear the specific sound it produces (a woof-woof representing a dog, for instance).

Participants: are 36 Romanian adults and 35 5-year-olds (17F&18M, Age range: 5-6;6, Mean: 5;6).

Methodology & Materials: The experiment (implemented in PennController) employs a *shadow play paradigm* where subjects have to reward baby dragons depending on whether their statements are the best description of the situation. The experiment consisted of a pretest and a main part. **Superlative Pretest:** Before the actual experiment, children take a superlative pretest, where they are tested with respect to their understanding of superlatives and their negation in deictic contexts ('Show me the tallest giraffe.', 'Show me a peach which is big, but not the biggest'), as well as in pragmatic contexts ('Which is the best description of the image?' 'This is a bear'/'This is an animal'/'This is a frog'). Subjects who do not pass the superlative pretest (<3/6 answers per context) are eliminated. **Shadow Play Test:** Subjects are told there is a wizard who likes to play a shadow game with two baby dragons, Flurry and Bindy. In this game, various animals go and hide behind the curtain-but some of them come in front of the curtain later on. The baby dragons take turns to say who they think the shadow belongs to. The subjects are told that they are supposed to reward the baby dragons with a big apple if what they say is the best description of the situation and with a small apple otherwise (Katsos & Bishop 2011). The choice of making optimality rather than truth value (right/ wrong) a criterion for the reward task was motivated by the higher number of scalar answers obtained previously, when testing subjects with both methods (see X 2020). In the game, there are various groups of animals: a control/ training

group of two bunnies, and 4 testing groups of three animals of the same category (of different colors) each: dogs, frogs, cats, cows. In the main part, after a short training using true and false affirmative sentences with no modal adverbs, the actual testing begins, employing two scenarios per group. We will now exemplify by reference to the group of dogs: see Figures 1 and 2, showing each a picture with the main silhouette, a small image with the animals in front of the curtain, and a small image with all the animals in the game. The small image on the left (ALL ANIMALS) is always present for subjects to easily access the initial situation and in order to prevent processing difficulties because of memory load (Crain & Thornton 1998). *Scenario 1*, where one animal comes back in front of the curtain (in this case, the yellow dog), tests the subjects' understanding of alternatives, their ability to reason that the situation has two possible outcomes: either the silhouette belongs to the red dog or it belongs to the blue dog. *Scenario 2* tests whether subjects are able to reason that the silhouette can only belong to the blue dog, given the fact that there are two animals in front of the curtain now. At the end of Scenario 2, the identity of the shadow is disclosed.



Figure 1. Scenario 1



Figure 2. Scenario 2

There are 31 sentences (3 training Ss, 7x4=28 test & control Ss containing *poate* ('possible') or *sigur* ('certain')) presented in a randomized manner (see 1), with 1 key exception: the optimal S with *certain* (uttered by a dragon) is always followed by the underinformative S (uttered by the other dragon). The contrast is maintained throughout to activate the modal scale and trigger scalar implicatures.

(1) a. It is possible that it is the red/ blue dog. (OPTIMAL)// It is certain that it is the red dog. (OVERINFO) b. It is certain that it is the blue dog. (OPTIMAL)// It is possible that it is the blue dog. (UNDERINFO)// It is certain that it is the yellow dog. (FALSE)// It is possible that it is the red dog. (FALSE)

SCENARIO 1 (1a)			SCENARIO 2 (1b)			
S ^{POSSIBLE1} OPTIMAL	S ^{POSSIBLE2} OPTIMAL	S ^{CERTAIN1} OVERINFO	S ^{CERTAIN2} OPTIMAL	S ^{POSSIBLE3} UNDERINFO	S ^{CERTAIN3} FALSE	S ^{POSSIBLE4} FALSE

Results: 1 adult was excluded from further analyses for errors in control trials. All children were included in the final analysis. 65.71% adults produced scalar implicatures with epistemic adverbs: 22 adults were consistently rejected underinformative statements (3 or 4 answers out of 4). In the case of children, 49.29% of the answers were strict (pragmatic): 15 children consistently produced implicatures, while 49.29% were 'overgenerous' (logical): 14 were consistent. We ran a mixed effect model with Scalar Implicature as variable, Group as fixed effect and Item and Participant as random effects, and obtained no significant difference between children and adults ($\beta = -1.45$, $SE = 0.9$, $Z = -1.615$, $p > 0.05$). However, this does not mean there were no differences among the groups. Though sensitive to the type of scenario, children seem to be less so than adults, choosing the same reward for the same sentence more. Also, children tend to reward overinformative statements with big apples to a much higher degree than adults (59.29% > 23.52%), reflected in a significant difference among groups ($p < 0.01$). 7 children consistently treated OI Ss as the best and the corresponding optimal Ss as not the best, possibly drawing implicatures.

Discussion: Children seem to be adult-like in deriving scalar implicatures with epistemic adverbs, but not adult-like in the evaluation of overinformativeness. In situations where there are several outcomes for a situation, children tend to pick one alternative only and reduce uncertainty to certainty. Given children's general correct assessment of optimal and false control sentences, and also previous results from a coloring task showing children's sensitivity to the difference between weak and strong epistemics (X 2019), it is unlikely that this is because children fail to grasp the meaning of epistemic adverbs. Rather, this fact can be explained by means of the premature closure hypothesis, a strategy to offer a single solution to any problem which logically permits more (Moscati, Zhan & Zhou 2017).