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## False-Belief Tasks, 5 December

On December 5, 2013, a workshop on [false-belief tasks](#) was held at the University of Amsterdam's (UvA) Institute for Logic, Language and Computation (ILLC). The organizer and host Dr. Jakub Szymanik managed to bring together a group of researchers from different backgrounds, ranging from logic to computer science and cognitive neuroscience.

False-belief tasks are a range of developmental psychological tasks that test whether children are capable of attributing false beliefs to other agents. This ability is a key-ingredient in the child's 'Theory of Mind' (ToM), i.e., the understanding of other agents' mental states. An often-used version of the false-belief tasks is the 'Sally-Anne'-task. During this task, the child listens to a story about a girl named Sally who places her marble in a basket. When Sally leaves the room, Anne takes the marble and hides it in a box. Now Sally returns to her room and the child is asked "*where will Sally look for her marble?*". Children below the age of 4 tend to respond with the factual state of the world (the box) instead of the state of the world as falsely believed by Sally (the basket).

Rineke Verbrugge, Professor of Logic and Cognition at the University of Groningen (RUG), kick-started the topic during another workshop earlier that week on the [social dynamics of information change](#). Verbrugge presented her work on scrub jays, a specific kind of crow, who hide caches of food and occasionally steal from rival caches. As food is an essential pre-requisite for survival, prevention of thievery is tied to Darwinian fitness. Birds protect themselves against theft by employing several strategies; one of them is to re-locate food when it was cached while another bird was watching. Although this kind of behavior seems to imply a ToM, Verbrugge showed that the same behavior can be generated by a virtual bird that operates on behavioristic rules that react to stress induced by the presence of others rather than actual representation of other agents' beliefs (van der Vaart, Verbrugge, & Hemelrijk, 2012: Corvid re-caching without 'Theory of mind': A model. *PLoS one*, 7(3)).

The first speaker of the current workshop, Burcu Arslan, a PhD candidate specialising in higher order social cognition of children, affiliated with the artificial intelligence group of the RUG, proposed an ACT-R model of second order false belief reasoning. Second order false belief tasks test whether children can reason about the false beliefs of an agent about the false beliefs of another agent. The learning process of the ACT-R model from first to second order reasoning mimics the developmental progress in children. Future plans were mentioned to test the model's predictions with 5–6 yr olds (Arslan, Taatgen, & Verbrugge, 2013: Modeling Developmental Transitions in Reasoning about False Beliefs of Others. In *Proc. of the 12th International Conference on Cognitive Modelling*).

Thomas B olander, associate professor from the Technical University of Denmark (DTU), from the department of applied

mathematics and computer science, gave a formalization of the Sally-Anne task in Dynamic Epistemic Logic in order to allow artificial intelligence to be capable of reasoning about other peoples' beliefs and knowledge as this is an essential prerequisite for the proper functioning of socially sensitive service robots.

Stefan Wierda, post-doctoral researcher at the (RUG) specialized in cognitive neuroscience of visual attention, presented another ACT-R model and proposed the possibility that there could be transfer of skills that are engaged in similar yet different tasks. Wierda proposed an analogy between the Sally-Anne task and the Marble Drop Game in which subjects have to engage in higher order reasoning about the goals of other agents instead of false beliefs. Stefan proposed an underlying capacity for inductive reasoning in which the same basic inference rule is re-used several times. An interesting question that remains open is why humans are limited to roughly 3 orders of reasoning.

Torben Braüner, associate professor of computer science at Roskilde University, specialized in logic and its application in computer science, proposed a similar common cognitive basis for different tasks. Braüner noticed a similarity in the logic behind the Sally-Anne task and the Smarties task. The Smarties task shows that children below the age of 4 have not only difficulties with *attributing* false beliefs to *others* but also with *remembering* their *own* previous false beliefs. Braüner formalized this similarity in the form of a natural deduction system for hybrid modal logic in which satisfaction operators can effect jumps between both different time-points and/or agents (Braüner, 2013: Hybrid-Logical Reasoning in False-Belief Tasks. In *Proceedings of Fourteenth conference on Theoretical Aspects of Rationality and Knowledge (TARK)*).

The workshop was concluded by Nina Gierasimczuk, a post-doc researcher at the ILLC, who gave an unannounced surprise talk in which she summarized the workshop and emphasized the importance of interdisciplinary collaboration. As an example of such collaboration, Gierasimczuk presented her work on reasoning strategies of children playing the Mastermind game in which she collaborated with the psychology department of the UvA. She obtained her data from a massive online educational system in which thousands of school children learn arithmetic and abstract reasoning through online games (Gierasimczuk, van der Maas, & Raijmakers, 2013: An analytic tableaux model for Deductive Mastermind empirically tested with a massively used online learning system. *Journal of Logic, Language and Information*).

In conclusion it can be said that the presentations and the ensuing discussions were a success and a nice example of the interdisciplinary cross-pollination that is becoming more and more characteristic of the diverse field of cognitive science.

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