

Multimode Conference, Toulouse, France. (2009).

Behavioral Indices of Cognitive Processing in Children

L. Phan, R. Meza, J. Felizardo, G. Littlewort, M. Bartlett, J. Movellan, J. Reilly

How children learn and reason have been topics of long standing interest in Developmental Psychology with Piaget and Vygotsky responsible for some of the earliest studies. Typically such studies focus on children's conceptual development and learning using verbal responses as a window into the child's thought processes. Our study concerns another aspect of reasoning: what are the behavioral indices of cognitive processing in children? What communicative signals are children using and how do they change with development? Finally, how are the signals from the different communicative channels, e.g., face, eye gaze and language integrated in time? To address these questions, we have conducted a battery of experimental tasks designed to elicit specific communicative behaviors. Here we focus on children's identifying hidden objects as a means to elicit what children do when they are solving a problem. Twelve English speaking children (ages 4-8 years old) have participated in the project. In the Hidden Objects task, the child reaches into a closed box and is handed an object which the child is asked to identify. Overall, each child identifies nine objects varying from common place items, e.g., a triangle block, to the more unusual, e.g., a rubber fish. Our goal is to characterize children's behavior, both linguistic (using CHILDES) and non-linguistic: facial expression and eye gaze (using facial Action Coding System, FACS, Ekman and Friesen, 1978), prosody (using PRAAT, Boersma & Weenink, 2008) and head movement. To look at how children are integrating signals across communicative channels, the child's transcribed utterances, and non-linguistic behaviors (facial expression, prosody, eye gaze and head movement) are integrated using the ELAN program.

Our results show that as the child touches the object and grapples with identifying the object, he or she averts gaze from the experimenter, turns or tilts the head and generally looks up. Facial expressions common during this "grappling" phase are Action Units (FACS) 6, (cheek raise), 7 (lower lid tensed) 9 (nose wrinkle) all of which functionally decrease the eye opening and diminish the intake of external information, as does averting gaze from the experimenter. As the child names the object, he turns and looks at the experimenter, however, the utterance begins before eye contact is made. In addition to the microanalytic multi-modal results from ELAN, we conducted an adult judgment study where adults evaluated the children's behaviors on a 7 point Likert scale as 'very certain' to 'very uncertain'. Adults reliably signaled the "grappling phase" as uncertain to very uncertain, thus confirming the results from the ELAN coding. With respect to prosody, in comparing the prosody of the child's response to his or her previous answers to questions where the child was certain of the answer, e.g., 'what is your name?' It was found that adults judged the child's prosody as 'uncertain' when the pitch rose and 'certain' when the child gave an answer where the pitch fell.

The results of this study will inform our understanding of which communicative channels children are using and how they integrate behaviors across channels. Together they will be important in teaching, for teachers learning to be sensitive to children's communicative behaviors outside language, and in designing interventions for children with communicative disorders.