Learning as Perspective Taking: Conceptual Alignment in the Classroom

James G. Greeno, University of Pittsburgh, LRDC, jimgrno@pitt.edu
Brian MacWhinney, Carnegie-Mellon University, Dept. of Psychology, macw@mac.com

Abstract: This poster presents an extension of the psycholinguistic theory of perspective taking to the analysis of reasoning and problem solving in discursive interaction. This extension amends and generalizes schema theory. We present illustrations of perspectival alignments achieved when constructing causal explanations or solving problems, including ways that perspectives shifted during the interactions. We hypothesize that successful learning arises in classrooms when students realign their perspectives with new models**.**

Following Rommetveit (1987), Tomasello (1999), Fauconnier (2000), and others, we hold that conveying perspectives is a fundamental function of language. Like earlier proposition-based theories of understanding (e.g., Kintsch, 1998), perspective theory assumes that understanding a sentence corresponds to cognizing an information structure with entities, properties, and relations. However, perspective theory adds an assumption that meaning structures have a point of view. The viewer may be enmeshed in the perspective (enactive/projective) or the viewer may be viewing from outside, representing and operating on the entities in the perspective (depictive/descriptive). When the viewer cognizes the scene from outside, her or his perspective includes foregrounding and a focus of attention. At the level of single sentences, perspective theory analyses can account for psycholinguistic phenomena such as constraints on anaphoric reference, garden-pathing, structural ambiguity, and the relative processing difficulty for embedded relative clauses (MacWhinney, 2005).

We have extended perspective theory to analyze episodes of interaction in which participants generate understanding of systems they interact with or of problems they are assigned to solve. Our empirical material includes videotaped episodes of teacher-student or student-student interaction in a mathematics classroom, parent-child or staff-visitor interaction in a science museum, and a discussion by a group of secondary-school science teachers. In some episodes participants achieve impressive mutual understanding, in spite of initial discrepancies between their perspectives. We show how these new understandings can be expressed constituents of perspectival constructions that emerged in interaction. We interpret these cases of successful communication as collaborative generation of perspectival constructions and we offer a model of that process, which includes effortful constructive listening. In other episodes one of the participants gives a monologue that represents a perspectival construction and the other participant(s) give little or no evidence of adopting that perspective. One of our goals is to develop and evaluate hypotheses about social practices that support the arduous activities of achieving mutual understanding through alignment of perspectival constructions.

We propose specific amendments to standard schema theory to represent the effects of perspective taking. As in standard theory, we annotate constructions in terms of embedded propositional trees. At the top of these trees are propositions that express the goals of participants as active agents. For example, they may involve enactive statements such as "I turn the crank" or assignment statements such as "I treat the distance between the perimeters of two rectangles as a variable." Embedded under these high-level enactive statements are subtrees of statements that represent the mechanical operations of equations, derivations, and known causal relations. These embedded trees also involve tracing of perspective through the embedded devices. Shifts in perspectival constructions arise primarily from attentional shifts on the higher levels, since the embedded device constructions are usually fully solidified.

We propose that the dynamics of perspectival constructions can explain how learners shift from vague patterns of understanding to clearer causal models. For some of the episodes we have analyzed, it is implausible to hypothesize a previously known pattern that accounts for the understanding that the participants achieve. In these cases, we hypothesize that processes of exploratory construction of perspectival understanding can account for what is accomplished. These processes include use of schemata for constituents of understanding and constraint satisfaction for combining those constituents into a coherent overall perspectival construction. We also propose that hypotheses of constructive constraint satisfaction for generating perspectival understandings are consistent with

hypotheses about reasoning by analogy and with mental models and with classical Gestalt concepts of recentering and other quasi-perceptual processes.

We have begun to develop a taxonomy of perspectival constructions, related to cognitive functions of activities in which they occur. The episodes we have analyzed thus far are of two kinds: constructing causal explanations and solving problems—we expect to find others, such as resolving differences, in future work.

The form of our representations of perspectival constructions (to be illustrated in our poster) is a set of interconnected labeled tree structures that correspond both to a sentential form and to a component of activity (when the perspective is enactive) or a component of the situation (when the perspective is depictive). Location of an element as the sentential subject corresponds to its being the primary focus when the component of that tree is in the foreground. A shift of perspective usually changes the foregrounded component with one of the other elements promoted to the subject position (i.e., it becomes the main focus of attention).

Our analyses of causal explanations include shifts between focus on performing an operation to focus on a causal consequence of the operation, and shifts from a system function (such as physically connecting two systems components) to an enablement. We account for construction of perspectival understandings by hypothesizing knowledge of schemata that include domain-specific requirements of causal systems. The information that we represent in these analyses includes potential answers to many "why" questions, which would be appropriate in different contexts, reminiscent of previous extensive analyses of question answering.

The problem-solving episodes we have analyzed, which come from mathematics classrooms, include actions of writing components of symbolic representations and performing calculations. Constituents of perspectival understanding include recognizing the kinds of components of representations that are constructed (variables, expressions, equations) and semantic relations between the symbols and quantities they refer to. Differences between initial perspectival understandings of different participants provide accounts of difficulty in their communication.

Our perspectival approach provides a convenient way to represent differences of agency between different activities in problem solving. Specifically, we distinguish what Pickering (1995) called conceptual agency and disciplinary agency. We hypothesize conceptual agency when the problem solver chooses to represent some aspect of the problem by identifying a variable or forming an expression or an equation, and we hypothesize disciplinary agency when the problem solver carries out a calculation or solves an already-formed equation.

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