Symbolic behavior and perspective-taking are forms of derived relational responding and can be learned

Simon Dymond[a] and Louise McHugh[b]

[a]*Department of Psychology, APU, Cambridge CB1 1PT, United Kingdom; and* [b]*Department of Psychology, University of Wales, Swansea, Singleton Park, Swansea SA2 8PP, United Kingdom.* **s.dymond@apu.ac.uk**
l.mchugh@swansea.ac.uk
url: http://web.apu.ac.uk/appsci/psychol/staff/sdymond.htm
url: http://psy.swan.ac.uk/about_dept/dept_cv.asp?MembersID=85

Abstract: Numerous questions remain unanswered concerning the functional determinants of symbolic behavior and perspective-taking, particularly regarding the capabilities of children with autism. An alternative approach that considers these behaviors to be forms of derived relational responding allows for the design of functional intervention programs to establish such repertoires in individuals for whom they are absent.

Tomasello et al. argue that children with autism exhibit deficits in shared intentionality and that the use of symbols is considered to be a particular problem area for this population. However, they fail to elaborate on the extent to which these deficits might be ameliorated, and what implications this might have for their account. Many questions remain unanswered concerning the functional determinants of these behaviors and how they can be added to an individual's behavioral repertoire once they are found to be lacking. We will address these issues within the context of modern behavioral approaches to symbolic behavior and perspective-taking that consider these behaviors to be forms of derived relational responding.

Conflicting definitions of symbols abound in the developmental literature, yet research conducted over the past 30 years within the behavior-analytic tradition on derived relational responding offers a functional account of the kinds of symbolic behaviors that constitute the very core of human language and cognition (Hayes & Hayes 1992; Hayes et al., 2001; Horne & Lowe 1996). The research has shown a remarkable propensity, given appropriate training conditions, for children with autism and other developmental disorders to produce novel behavior indicative of the efficient use of symbols. Derived relational responding, which at the moment appears to be a uniquely human ability (see Dymond et al., 2003), may in fact be a fundamental process involved in language because of its similarity with the bidirectionality of word-referent relations. In the course of early language training, children learn perhaps one of the most important forms of derived relational responding, which is to name and point to objects and events and to derive relations among these events with increasing complexity as the child develops (Lipkens et al., 1993). For instance, on hearing the spoken word "car," pointing to an actual toy car may be taught. This training episode may be described as "hear name, see and point to object." Next, when presented with a picture of a toy car, a child may be taught to point to the actual toy car ("see picture, point to object"). Following such a training history, emergent relations among the stimuli can then be tested; that is, a child may produce the spoken word "car" and point to a picture when shown the actual toy car (called symmetry or mutual entailment), without further training. Similarly, a child may point to a picture on hearing the spoken word, and vice versa (called equivalence or combinatorial entailment), all without additional training.

These derived performances are, we would argue, symbolic because the child spontaneously derives relations among all stimuli after learning only a subset of baseline relations. Children with autism, including those lacking vocal naming abilities, can derive stimulus relations such as equivalence and exclusion but may occasionally require specialized instructional training protocols before they do so (see Carr 2003; Carr et al., 2000; Eikeseth & Smith 1992; O'Donnell & Saunders 2003; Stromer et al., 1996; Wilkinson & McIlvane 2001). Thus, there are no grounds for claiming that symbolic behavior, or derived relational responding, is either problematic or beyond the behavioral capabilities of children with autism and other developmental disorders. Furthermore, an approach that emphasizes the functional components of symbolic behavior also permits inclusion of symbolic responses other than vocal responses (e.g., manual signing) in the communicative repertoires of children with autism. Reference to such alternative repertoires is notably absent from Tomasello et al.'s account.

Perspective-taking skills, when considered to be a form of derived relational responding, may emerge in a similar manner following a history of explicit reinforcement for answering questions that require the child to shift perspectives between *I–You*, *Now–Then*, and *Here–There*, such as "What am I doing here?" and "What are you doing now?" (Barnes-Holmes et al., 2001; Dymond & Barnes 1994, 1997; McHugh et al., 2004). Although the form of these questions may often be identical, the physical environment is altered each time a question is asked or answered. What remains constant across these events are the relational properties of the deictic terms. Across the course of development and throughout daily discourse, a child learns that *I* is always from this perspective *here*, but not from another's perspective *there*. In this way, the perspective-taking functions of answering questions may be present even if the actual deictic terms are absent as alternative words serve the same contextual function and enable a child to learn to respond appropriately as if the actual terms had been used. We contend that it is contextually controlled ontogenetic histories such as these that Tomasello et al. are referring to when they mention the contribution of "specific experiences" and "forms of perspective-shifting discourse" on the emergence of joint attentional activities.

Approaching perspective-taking as a form of derived relational responding allows for the design of intervention programs to establish such skills in individuals for whom they are absent. Directly training perspective-taking skills of varying complexity across multiple exemplars and then testing for generalized responding with novel question sets is, in our view, a more pragmatically useful approach than "theory-of-mind" alternatives that attempt to teach children with autism about informational states. While considerable applied research remains to be done, functional intervention-based approaches have already been shown to be effective in overcoming joint attention deficits in autism (see Dube et al., 2004; Jones & Carr 2004; Whalen & Schriebman 2003). We contend that approaches such as these will be of more practical use than accounts that either fail to specify the conditions under which deficits can be overcome or completely disregard this as a pragmatic goal at all.

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Interaction synchrony and neural circuits contribute to shared intentionality

Ruth Feldman,[a,b] Linda C. Mayes[b], and James E. Swain[b]

[a]*Department of Psychology and the Gonda Brain Sciences Center, Bar Illan University, Ramat-Gan 52900, Israel; and* [b]*Child Study Center, Yale University School of Medicine, New Haven, CT 06520.*
feldman@mail.biu.ac.il **james.swain@yale.edu**
linda.mayes@yale.edu

Abstract: In the dyadic and triadic sharing of emotions, intentions, and behaviors in families, interactive synchrony is important to the early life experiences that contribute to the development of cultural cognition. This synchrony likely depends on neurobiological circuits, currently under study with brain imaging, that involve attention, stress response, and memory.

If shared intentionality is the apex of evolutionary cognition, as suggested by Tomasello et al. interaction synchrony is among its

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