

Counterfactual Syllogistic Reasoning in Normal 4-Year-Olds, Children with Learning Disabilities, and Children with Autism

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Instruction encouraging imagery improves logical reasoning with counterfactual premises by normal preschool children. In contrast, children with autism have been reported to reason accurately with counterfactual premises in the absence of such instruction (F. J. Scott, S. Baron-Cohen, & A. M. Leslie, 1999). To investigate this pattern of findings, we compared the performance of children with autism, children with learning disabilities, and normally developing 4-year-olds, who were given reasoning problems both with and without instruction in two separate testing sessions 2 to 3 weeks apart. Overall, instruction to use imagery led to persistent logical performance. However, children with autism displayed a distinctive pattern of responding, performing around chance levels, showing a simple response bias, and rarely justifying their responses by elaborating on the premises. We propose that instruction boosts logical performance by clarifying the experimenter's intention that a false proposition be accepted as a basis for reasoning and that children with autism have difficulty grasping this intention. © 2000 Academic Press

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Many investigators have claimed that young preschool children are unable to consider the logical implication of a proposition independent of its truth in the real world (Braine, 1990; Braine & Rumin, 1983; Inhelder & Piaget, 1958, 1964; Piaget, 1970, 1972). Instead, they display an "empirical bias" (Scribner, 1977), drawing conclusions on the basis of real-world knowledge. For example, given a syllogistic problem with a counterfactual major premise, "All cats bark. Rex is a cat. Does Rex bark?," young children with no formal schooling typically answer from their empirical knowledge, stating that Rex does not bark because Rex is a cat and cats do not bark, rather than basing their responses on the information in the premises. Nevertheless, recent research has shown that young children can be prompted to set aside their empirical bias. For instance, Dias and Harris (1988, 1990) report that when 4-year-olds are instructed to "make a picture in their heads" of the major premise of each problem, they are more likely to give logical answers to problems with counterfactual premises. Consistent with that logical strategy, instructed children are also more likely to justify their replies by referring to the premises as stated rather than by referring to their empirical knowledge.

In fact, a variety of prompts have successfully elicited logical responding from young children, including 2-year-olds: the use of invented content (Hawkins, Pea, Glick, & Scribner, 1984); presentation of the material in a fantasy context, such as a distant planet (Dias & Harris, 1988, 1990; Dias & Roazzi, 1996; Markovits & Vachon, 1989; Richards & Sanderson, 1999); presentation of the premises in a dramatic make-believe intonation (Dias & Harris, 1990); and instructions to use imagery (Dias & Harris, 1990; Dias & Roazzi, 1996; Markovits & Vachon, 1989; Richards & Sanderson, 1999). A plausible interpretation of the effect of these various prompts is that they encourage children to enter into a temporary make-believe mode of processing within which real-world considerations do not apply (Dias & Harris, 1988, 1990). Markovits (1993, 1995) proposes a related explanation, arguing that when children are presented with a counterfactual premise in a make-believe context, they construct a "cognitive filter." This filter prevents the retrieval from semantic memory of contradictory empirical knowledge that might otherwise be incorporated into their representation of the premises. Hence, accurate logical responding is more likely.

However, the underlying mechanism by which performance is improved may be more general than is implied by either of these two proposals. Manipulations that improve logical responding may do so by clarifying the experimenter's intention that the premises be accepted and used as a basis for reasoning, irrespective of their real-world status (Harris & Leever, 2000; Leever & Harris, 1999). When the major premise is false, the experimenter's intention that it be accepted is difficult to grasp because he or she violates the conventions of conversation. Normally, when a speaker asserts a proposition that is false, the speaker is either genuinely mistaken or uses a linguistic marker to explicitly indicate that the proposition is relevant despite its falsity (e.g., "If . . .," "Sup-

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