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Inhibition and cognitive development: object, number, categorization, and reasoning

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Abstract

In the early 1990s, the concept of inhibition sparked a new surge of interest in cognitive psychology, both in North America and in Europe. In the framework of that research trend, it is proposed here that cognitive development cannot be reduced to the coordination–activation of structural units (as in Jean Piaget's structuralist theory and in the neo-structuralist models), but that development also often involves inhibiting a competing structure or scheme. This approach, which views the processes of selection–inhibition as age- and domain-specific, is illustrated by four experimental examples (from infancy to adulthood): object construction, number, categorization, and reasoning. © 2000 Elsevier Science Inc. All rights reserved.

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The concept of inhibition has a long and diverse history (Smith, 1992; Macmillan, 1996), and seems to be benefiting from a new thrust of energy in cognitive psychology. This renewed interest in the classical question of inhibition, which began in the early 1990s both in North America (Tipper et al., 1989; Bjorklund & Harnishfeger, 1990; Dagenbach & Carr, 1994; Dempster & Brainerd, 1995) and in Europe (Houdé, 1995b), is an outgrowth of the study of developmental and inter-individual differences, the ever-increasing impact of cognitive neuroscience and connectionist models, research on selective attention, and newly discovered relationships between psychopathology and cognitive science. In neurofunctional imaging studies, for example, it is now hypothe-

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sized that, in certain cases, decreased neuronal activity in a specific brain area reflects top-down inhibitory modulation of irrelevant processing (Ghatan et al., 1998).

In the study of developmental and inter-individual differences in cognitive psychology, today's experimental research is aimed at analyzing the microgenetic functioning of the mechanisms of activation and inhibition (programmed by the executive component of working memory; Baddeley, 1986, 1992; Pascual-Leone, 1988), which select an appropriate problem-solving strategy. The research thus focuses on cognitive competition in information processing, and resistance to interference. The underlying assumption is that development cannot be reduced to the mere coordination–activation of structural units (as in Jean Piaget's structuralist theory and in the neo-structuralist models of the eighties), but that developing also means learning to inhibit a competing structure or scheme (Houdé, 1995b, 1999a). To illustrate this theoretical approach, which emphasizes selection–inhibition processes, four experimental examples (from infancy to adulthood) are given below, in the areas of object construction, number, categorization, and reasoning.

1. Object construction

The question of the relationship between cognitive development and inhibition becomes a relevant one as soon as the basic unit of reality, the permanent object, is in place in the infant. Research on infant oculomotor activity (the study of visual fixation time), which uses the violation-of-expectancy paradigm, has shown that early object permanence already exists at the age of 4 or 5 months (Baillargeon, 1987; Baillargeon et al., 1985). How, then, can one explain the well-known A-not-B error, observed by Piaget (1954) at 8 months and present until the age of 1 year? Remember that to demonstrate this error, the experimenter puts the infant in front of two covers that are equally easy to reach (A and B), and then puts an object under cover A. The infant has no trouble finding it. After a few repetitions (A-A-A-. . .), the object is conspicuously moved under cover B. The infant who continues to search under A makes the A-not-B error. According to Piaget, this error is a testimony to the lack of object permanence, in the sense that infants should know that the object continues to exist under cover B because that is where they lost sight of it. But this explanation is no longer tenable today. New (post-Piagetian) research has shown that the object permanence scheme (acquired by the early age of 4 or 5 months) clearly precedes the A-not-B error! (Certain authors (Smith et al., 1999) even indicate that there are circumstances in which older children and adults make a similar error.) An inhibition-based analysis is better able to resolve this first "paradox of development."

Situations like Baillargeon's, where oculomotor reactions to unexpected events are observed (events where object permanence is violated), can indeed be considered as optimal contexts in which the "simple" activation of object