Book Reviews

Ontogeny of Thought

Intellectual Development. Birth to Adulthood. ROBBIE CASE. Academic Press, Orlando, Fla., 1985. xx, 461 pp., illus. $39.50. Developmental Psychology Series.

For most of the past quarter century, two rival theoretical traditions have guided efforts to understand intellectual development. Jean Piaget described cognitive development as a sequence of qualitatively different stages. Each stage consists of an organized set of logical reasoning skills that underlies all of an individual's cognitive functioning. Alternatives to Piaget's theory have emphasized acquisition of more molecular units. In the 1950's and 1960's, neobehavioristic theorists described cognitive change in terms of the cumulative acquisition of associations between stimuli and responses; in the 1970's and 1980's, information processing theorists described much the same change in terms of children's acquisition of rules and algorithms in specific content domains.

This history is described in detail in the first five chapters of this book. Case claims, quite correctly, that the time is ripe for new theories of intellectual development, theories that encompass the strengths of these traditional adversaries. He describes such a theory, one that draws upon many of the proven features of Piagetian and information processing theories, and, to a lesser extent, upon theories that have emphasized the role of cultural transmission of knowledge.

Case describes children as problem solvers whose goals and strategies for achieving goals change with development. Intellectual development is said to consist of four qualitatively different stages that are differentiated by the control structures that are used to solve problems. During the sensorimotor stage infants learn the relations between objects and actions. During the stage of relational thought, which begins at approximately 18 months, the relations learned in the sensorimotor stage become the units of thought and problem solving. In the dimensional stage, beginning at approximately five years, underlying dimensions are abstracted from specific relations. Finally, in the vectorial stage, which coincides with adolescence and early adulthood, information from two dimensions is integrated to form a vector. Each of these stages consists of three parallel substages in which the basic units are extended to ever broader and more complex domains.

These stages resemble Piaget's stages, an ancestry that Case readily acknowledges. However, the mechanisms of stage transition go considerably beyond traditional Piagetian constructs. Case proposes four general regulatory processes: problem solving, exploration, imitation, and mutual regulation. These processes are thought to produce progressively more powerful levels of thought because each yields novel combinations of problem solving strategies. However, collectively they are insufficient as a transition mechanism because they cannot explain, for example, why cognitive development is so protracted, spanning years instead of days or months. To explain this and other features of intellectual development, Case argues that short-term storage space constrains the amount of problem solving that can occur at a given time. Short-term storage space increases with age, thereby producing developmental change in level of problem solving. In turn, increases in storage space are thought to be due to increases in operating efficiency and to maturational factors such as neural myelinization.

Case's theory is exceptional for its scope. I mean this in three ways. First, unlike many theorists who focus on a particular segment of development, Case aims to provide a continuous account of intellectual development from birth to maturity. Second, whereas some theorists have simplified the analytic task by subdividing intellectual development into more manageable components (for example, development of quantitative or memory skill), Case has insisted that a theory of intellectual development must address both cognitive changes that are domain-specific and those that are not. Finally, unlike many developmental theorists who offer vague promises that their efforts may lead to insights into methods for optimizing intellectual development, Case describes in detail and has evaluated some of the instructional implications of his work.

Throughout, Case first describes with great care the categories of evidence that would test his theory and then presents illustrative findings. For example, if problem solving, exploration, imitation, and mutual regulation drive much of development, then they should (i) be detectable very early in life, (ii) be common throughout development, and (iii) produce cognitive change when manipulated experimentally. In fact, these properties characterize each of the four proposed regulatory processes.

Particularly interesting are the new data Case reports from his research group at the Ontario Institute for Studies in Education. Some of the work he describes will surely be controversial. I, for one, would like converging evidence concerning the executive control structures that mediate task performance and concerning the processing demands of different tasks. However, in these and other instances, Case is suitably circumspect concerning the strength of support that his experimentation provides for his theory.

In sum, this book can be read with many aims: to understand the critical issues that must be addressed by any theory of intellectual development, to understand a new theory that will surely be one of the reference points of the 1980's for cognitive developmental theorists, and to learn the outcomes of an extensive and imaginative program of research. For any of these aims, Case's book is highly recommended reading.

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Developments at MIT

A Century of Electrical Engineering and Computer Science at MIT, 1882–1982. KARL L. WILDES and NILO A. LINDGREN. MIT Press, Cambridge, Mass., 1985. xiv, 423 pp., illus. $15.

This is a history written by engineers, principally by Wildes, assisted in the final stages by Lindgren. They have produced a bifurcated work. The first half is disjointed, its events and figures connected merely by chronology and the story's locus in the Massachusetts Institute of Technology. Its chapters center on individuals, first as department chairmen, then as researchers. This half moves fitfully from the founding of the Institute and its electrical engineering program through the departmental administrations of, primarily, Dugald C. Jackson and Harold L. Hazen, taking their stories to 1952. Several more chap-