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Theories of development: In dialog with Jean Piaget



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ABSTRACT

Piaget's body of work had two major theoretical thrusts: constructivism and stage theory. Both constructivism and stage theories articulate modern work on conceptual development, albeit transformed by developments in cognitive science and cognitive neuroscience. A case study of conceptual change in childhood within a framework theory of intuitive biology illustrates these points.

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Introduction

Jean Piaget was the towering figure in the science of cognitive development throughout much of the 20th century. His work had two complementary thrusts: constructivism and stage theory. The concerns that drove Piaget's work with respect to each of these thrusts, the conclusions he came to, and the evidence he brought to bear on those conclusions are still very relevant in today's discourse. Nevertheless, the conversation has changed in many ways, sometimes fundamentally, thanks to advances in the cognitive sciences and in cognitive neuroscience.

Throughout his illustrious career, Piaget grappled with two different challenges for a theory of cognitive development. The first challenge is explaining the human conceptual repertoire. We are the only animal that can ponder the existence and causes of global warming, the causes and cures for cancer, whether the square root of 2 is irrational, and any of billions of propositions formulated over hundreds of thousands of concepts no other animal represents. Understanding the acquisition of any specific concept (and Piaget studied dozens of specific concepts: *object, cause, number, weight, density, life*, and many others) requires specifying the innate primitives (which Piaget believed to be sensorimotor in nature), and the processes through which they are transformed, through learning, into the adult state.

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Piaget's constructivism concerns the emergence of new conceptual content. The fundamental theoretical commitment of constructivism is that there are qualitative changes within representational systems throughout the course of development. As Piaget repeatedly said, constructivism about any particular conceptual content is in contrast with nativism with respect to the origins of that content and also with empiricism, the view that the relevant content can be acquired by associational processes carried out over already available representations, ultimately grounding out in sensorimotor primitives. Although today's cognitive science no longer endorses the view that innate representational primitives are limited to sensorimotor content (see, Carey, 2009, for a review), here we nonetheless endorse constructivism. Conceptual development includes episodes of change in which new representational resources are constructed, which in turn permit thoughts previously unthinkable.

The second challenge faced by a theory of cognitive development is characterizing the domain-general cognitive resources that make learning, including conceptual construction, possible, and characterizing and explaining developmental changes in this fundamental aspect of cognitive architecture. It was here that Piaget's stage theory came into play. Piaget held that developmental changes in domain general cognitive architecture constrained the conceptual content that could be mastered by children of different ages. His description of those changes changed throughout his long career. For example, he characterized the transition between preoperational and concrete operational thought as a change from egocentric to non-egocentric perspective taking, as an increase in information processing capacity, such as a change from not being able to coordinate two variables in a compensatory fashion to being able to do so, and finally, in his mature theory, as a change in the logical operations available for thought and reasoning. With respect to the 5- to 7-year-old stage change, for example, he held that preoperational children could not represent linear ordering or class inclusion relations, capacities that became available in the transition to concrete operational thought. Below we also endorse the claim that changes in domain-general cognitive resources are important to learning and conceptual change.

Keeping Piaget's two thrusts distinct

Explaining the human conceptual repertoire requires a theory of conceptual content (what makes a given representation have the meaning it has?), a theory of the innate representational primitives, and a theory of the learning mechanisms that transform the initial state into the adult state. A commitment to constructivism requires, in addition, a detailed description of qualitative changes in conceptual content (what kinds of conceptual transitions count as qualitative changes; what makes an acquired representational resource genuinely *new*?). A commitment to constructivism also requires an account of the learning mechanisms that underlie these qualitative changes. Because within-content development sometimes involves qualitative changes, constructivists often refer to "stages" in the acquisition of specific content, for example, stages in the acquisition of the concept *number*, or *matter*. There is nothing wrong with this usage, but it is confusing with respect to Piaget's stage theory, which sought to characterize developmental changes at a very abstract, content neutral, level of description.

Piaget himself did not confuse his two enterprises. For example, in Piaget's and Inhelder's classic study of the conservations, *The Child's Construction of Quantities* (Piaget & Inhelder, 1974), each chapter was devoted to a description of age related changes in children's appreciation of conservation of amount, weight, and volume, as well as the construction of an extensive concept of weight, differentiating it from the intensive concept of density. At the end of each chapter there were *two distinct* theoretical interpretations of the basic descriptive data. First, the content specific changes were characterized in terms of theory changes within children's intuitive theory of matter (see Carey, 2009; Smith, 2007, and Smith, Carey, & Wiser, 1985, for further elaboration). Second, differences in the theories held by 4-year-olds, 8-year-olds, and 15-year-olds were explained in terms of transitions from preoperational to concrete operational to formal operational thought. Piaget kept the two explanatory enterprises conceptually distinct, but he believed that the stage changes at a domain-general level had immediate consequences for constraints on conceptual content. This final hypothesis is not well supported by subsequent work (see Carey, 1985a; Gelman & Baillargeon, 1983), but Piaget's and Inhelder's analyses of conceptual changes within the concepts *weight*, *density*, *volume*, and *matter* in the course of constructing theories of the physical world have stood the test of time (Carey, 2009).

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