

Neoconstructivism



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THE NEW SCIENCE OF COGNITIVE DEVELOPMENT

Edited by

SCOTT P. JOHNSON

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FOREWORD

What is Neoconstructivism?

Nora S. Newcombe
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Piaget was supposed to have solved the problem of the origins of knowledge, to have bridged the nativist–empiricist split. This goal was one of his aims in beginning to study children’s cognitive development, and, at the end of his life, he regarded this goal as accomplished (Chapman, 1988). Yet, even before his death, criticisms of Piaget were mounting (Gelman & Baillargeon, 1983). They now form a familiar litany: no clear evidence for stages and structuralism, insufficient attention to the gradualisms and localisms of cognitive progress, excessive emphasis on verbal justifications of judgments. Among these limitations, two issues stand out: an overly lean delineation of the starting points for cognitive development, and a description of the mechanism of cognitive change that was little more than a re-naming of the phenomenon as accommodation.

So, how do we characterize starting points and developmental change? These two questions were addressed in a bold way by the resurgence of nativism, which came roaring back on the intellectual scene in the 1950s with Chomsky’s (1959) critique of Skinner and which had become the dominant paradigm for thinking about the origins of knowledge by 1980 or so. Nativism solves the first of Piaget’s problems by definition—by postulating the richest starting points imaginable, ones that encompass all the “core knowledge” required to understand the world. An important addition to this philosophically classic position, appearing in force in Fodor (1983), was the idea that the mind/brain

is organized into *modules* that are not only neurally specialized and present from the beginning but that do not accept information from each other. Indeed, nativists have argued that evolution could not work to create human intelligence without such modular organization—there must be some *thing* for evolution to select or weed out (Cosmides & Tooby, 1994). And nativism solved the second of Piaget’s main problems (one that had shrunk to minuscule size by the hypothesized existence of so much innate knowledge) essentially by fiat—by postulating simple “triggers” that led children to select parameters or fill content into slots. More recently, they have added the hypothesis that change occurs when human language bridges the gap across modules of core knowledge (Spelke, 2003).

None of these postulates of nativism are, however, supported by the evidence. Starting points are strong, but infants are not tiny adults with insufficient control over their arms and legs. There is much more conceptual change than nativists envision and strong evidence that environmental input is integral to cognitive development in complex ways that go far beyond triggering (Newcombe, 2002). There is also good reason to think that language, while helpful to human thought, is not the *sine qua non* of cognitive flexibility (Newcombe & Ratliff, 2007). So, what’s the alternative to nativism? Information-processing theorists of the 1970s and 1980s retained lean starting points and used production system modeling to address the problem of

change (Klahr & Wallace, 1976). However, there seems to be more initial competence than most such modelers were willing to contemplate. In addition, these modeling efforts, like the connectionist modeling that succeeded production systems, have often failed to use empirical information about the kind and sequence of environmental information to constrain the models (Newcombe, 1998). Vygotsky has sometimes been presented as an alternative to Piaget, but his work concentrates too exclusively on social and cultural interaction to seem to provide a satisfying overall framework for many aspects of cognitive development (Newcombe & Huttenlocher, 2000).

The need for new approaches to cognitive development became increasingly evident by 1990, and several books began to fill the need for nonnativist approaches to cognitive development: Elman et al. (1996); Gopnik and Meltzoff (1997); Karmiloff-Smith (1992); Siegler (1996); Thelen and Smith (1994). However, each of these approaches also has some limitations, for example, of scope or specificity. In addition, they competed with each other, so that, for example, connectionism and dynamic systems theorists spent much time debating whether their efforts were similar or different (Spencer, Thomas & McClelland, in press). The end result is that there is not, as yet, a dominant theoretical framework within which to situate the large volume of exciting recent empirical work on cognitive development—research that sometimes seems to define theory better than debate that is self-consciously theoretical (Oakes, Newcombe, & Plumert, in press). Research on cognitive development has gained steadily in interest for several reasons—better techniques and methods, established phenomena with richly detailed data that allow for finely tuned competing explanations to be pitted against each other, and better and better contact with insights and methods from cognitive science, neuroscience, computer science, and comparative psychology. But it is missing an “ism” to define it.

Into this healthy and hopeful intellectual ferment comes this book. It is forthrightly titled *Neoconstructivism*, returning us to

consider Piaget in a new light. Perhaps his life work did after all come close to his goal of reconciling nativism and empiricism. He was wrong about many things—the viability of structuralism, the leanness of starting points, the lack of a need for close study of input and mechanism. He was also living at a time when he could not follow up thoroughly on his nods to social interaction, or to what might have been his fascination with the architecture and processes in the physical substrate (the brain that is the mind). Nevertheless, his fundamental idea seems now to have been absolutely right: that a biologically prepared mind interacts in biologically evolved ways with an expectable environment that nevertheless includes significant variation. The chapters in this book collectively show us the promise of neoconstructivism.

Here are some tenets that I think unite the neoconstructivist approach.

- Everyone is a Darwinist. That is, all theorizing in cognitive development is situated in a context in which we must consider the adaptive value of thinking, and how it developed over evolutionary as well as developmental time. There is no need to cede the Darwinian high ground to the modularity theorists or to the nativists in general.
- Experience expectancy is a key concept. Keeping this valuable concept (delineated by Greenough, Black, & Wallace, 1987) firmly in mind, we can see how nature’s solution to the problem of the construction of knowledge could as easily—arguably more easily—have been the selection of neural abilities that will inevitably learn from their expectable input what needs to be learned. There is no a priori need for specific content to be wired in—although of course some may be.
- The world is richly structured and well equipped with perceptual redundancies and correlations that support experience-expectant learning. This idea is a fundamentally Gibsonian one, although it acquires new resonance in contemporary theorizing, in which we can specify how the information is “picked up” rather than simply asserting that it is.

FOREWORD

- Humans (and perhaps other species as well) bring to the task of learning about their world a rich endowment in computing probabilities, lying at the heart of the work on statistical learning discussed in this book, as well as of Bayesian approaches to cognition and its development. These abilities go a long way to solve the problem of profligate association that nativism is fond of using to attack more balanced approaches that include empiricist elements.
- A richly structured world and a strong capacity for probabilistic reasoning interact, within the experience-expectancy framework, to select among and/or to integrate the multiple cues typically available to draw conclusions about causality, to remember spatial location, and so forth.
- Action plays a key role in learning and development, just as Piaget thought, not only because it creates the occasion for experiment but also because it allows for situations that are more replete with information than observation.
- Development and learning are closely intertwined concepts but not quite the same. Development is learning as the learner changes. For example, the learner acquires a shape bias or the idea that words are reliable cues to categories. As another and different example, perceptual tuning, especially in the first year of life, works by pruning capacities not by adding to capacity, to create a fundamentally altered learner.
- Developmental change can be quantitative, qualitative, or both at the same time, depending on the granularity of observation. The oft-cited dichotomy between quantitative and qualitative change that is supposed to distinguish theories of developments should be consigned to the dustbin of history; see Thelen and Smith's (1994) elegant discussion of the "view from above" and the "view from below."
- Analyses of the causes and mechanisms of developmental change need to proceed on all four of Aristotle's fronts—looking for formal, material, final, and efficient causes. Formal cause is analogous to developmental

description (and "thick" description [see Geertz, 1973] comes close to being a cause); material cause is analogous to the neural substrate; final cause is analogous to putting development in an evolutionary and adaptive context; efficient cause is analogous to an analysis of the interactions of input with the neural substrate and the current cognitive state of the learner.

The chapters in this book cover many domains (although not all) and more important, they agree in many ways, subscribing either explicitly or implicitly to the list of key ideas listed above. But within the species of neoconstructivists, there are also dimensions of variation, just as cats differ in their markings, eye color, or even in the possession versus absence of a tail. The two most important differences among the chapter authors are the following:

- How strongly domain-general is human cognition and cognitive development? Some investigators in the neoconstructivist tradition embrace domain generality while others clearly work within a domain-specific framework. Note, however, that, importantly, domain specificity does not entail either nativism or modularity.
- How bottom-up versus top-down is human cognition and cognitive development? Some chapter authors seem to think that bottom-up approaches are necessary to avoid the extremes of nativism while others are more comfortable with top-down influences—recognizing that those influences may themselves be constructed.

Going back to the issue of a new "ism" to replace nativism as the framework for thinking about cognitive development—is neoconstructivism just one more "ism" that can be added to the list of contenders for a contemporary alternative? Does it vie with connectionism, or dynamic systems thinking, or emergentism, or overlapping wave theory, or small-p piagetianism, or other terms or schools of thought? Very importantly, I think the simple answer is No. The eight tenets listed above establish a neoconstructivist big tent that can cover all of the specific schools

of thought mentioned above and more. What can then ensue is the sorting out of the specific issues in empirical description, theory making and modeling that are the normal business of a mature science. Piaget's biggest idea, if not his many smaller ones, has turned out to be right after all.

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Introduction

The term *neoconstructivism* was generated by combining *neo*, taken from the Greek *neos*, meaning “new,” and *constructivism*, taken from (among other sources) the pioneering theorist and researcher Jean Piaget. Piaget’s constructivist theory holds that cognitive development is a continual process of building knowledge on previous skills (e.g., perception, memory, and action repertoires) and existing knowledge structures, from a foundation at birth consisting largely of reflexes and sensory impressions. It seems to me a first principle of any theory of development that *development happens*—every human being that ever existed or ever will started out as a fertilized egg and grew from there. This is hardly an insightful observation, yet it is rarely mentioned in the literature, and consequently our understanding of the “growth” of cognition is woefully incomplete. Piaget’s constructivism, and now neoconstructivism, represent attempts to address this problem.

The origins of this book are rooted in an idea that came to me in 2003. The idea was motivated by the following observations. Research on cognitive development, particularly in infancy, consists largely of demonstration studies—experiments designed to show some cognitive skill at a particular age, often with little or no consideration of limitations characteristic of young infants’ perceptual skills and cortical immaturity, and often with little or no consideration of development. Demonstration studies can be contrasted with process studies—experiments designed to examine mechanisms underlying performance or development that support the skill in question or bring it about.

Back in 2003, I thought that the balance of the field was weighted heavily toward demonstration studies, which tend to grab attention and headlines (“Infants Are Smarter Than You Think” and such). These studies have an important place in the literature, and my colleagues and I have produced a few ourselves. Yet progress in the field relies also on an understanding of process, in particular developmental mechanisms, because an understanding of development is required for a complete characterization of any psychological phenomenon. My idea in 2003 was to organize a symposium focusing on process studies as a theme for a major developmental conference. I began attending conferences in 1992 (the International Conference on Infant Studies, or ICIS, in Miami), and was not aware of any such symposium having been organized previously. So I asked around, got agreements from four principal researchers in the area (most of whom are represented by chapters in this book), and submitted it to ICIS for the 2004 meeting in Chicago under the title “The Big Questions in Infant Cognition: Trenchant Debate, Tentative Answers.” Talks were presented on object perception, categorization, word learning, and dorsal/ventral visual processing.

The reviewers accepted the symposium, and the reception at the conference itself far exceeded any of our expectations. The room was packed and overflowing; some audience members sat on the floor, stood at the back, and stacked up deep outside the doors. At that time, I thought either

(a) we got lucky in terms of the conference schedule, (b) this is a fluke, or (c) there is pent-up demand for discussion of developmental mechanisms at our conferences. To find out, I tried it a second time, submitting a symposium titled “Origins and Ontogenesis of Human Cognition” (all of whose contributors have chapters in this book) to the 2007 meeting of the Society for Research in Child Development in Boston. This time, the talks centered on memory development, grammar learning, and social cognition. Again, the room, though substantially larger than the 2003 symposium, was full to overflowing.

Finally, I organized a smaller meeting, held in November 2006 in New York City and generously funded by the National Science Foundation, bringing together 12 of the 24 authors who appear in this book. Participants in the meeting and authors in this book are all active researchers in cognitive development whose work, though involving a wide range of methods and approaches, coheres in a common framework: an explicit focus on developmental mechanisms of human cognition. The meeting was productive, enlightening, and encouraging, and suggested to me (and, I think, the other participants) that we are really onto something worthwhile.

I think the fields of developmental and cognitive science need this book and others like it. The range of methods and approaches is not necessarily representative of relevant research as a whole, but it is representative of some of the questions that are being asked and of some of the important findings that have been yielded in the past several decades. I hope you find it useful.

I would like to thank the authors for their hard work; Catharine Carlin at Oxford University Press for her enthusiasm and patience; the National Science Foundation for funding the meeting in 2006; the NSF, National Institute of Child Health and Human Development, Economic and Social Research Council, and Nuffield Foundation for supporting my own work, and my family, in particular Kerri Johnson.

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