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Review: Brains Top Down: Is Top-Down Causation Challenging Neuroscience? edited by Gennaro Auletta, Ivan Colagè, and Marc Jeannerod

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ents a host of ideas and hypotheses about the development of imagination that provide ample fodder for scholars in this domain.

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GROUNDING SOCIAL SCIENCES IN COGNITIVE SCIENCES.

Edited by Ron Sun. Cambridge (Massachusetts): MIT Press. \$50.00. ix + 455 p.; ill.; index. ISBN: 978-0-262-01754-1. 2012.

The publication of a book on integration of the social sciences is timely. The importance of interdisciplinary research was recently emphasized in the 2011 report *Rebuilding the Mosaic: Fostering Research in the Social, Behavioral, and Economic Sciences at the National Science Foundation in the Next Decade* (Arlington (VA): National Science Foundation; available at http://www.nsf.gov/sbe/sbe_2020/). The report stated that future research will be interdisciplinary, data-intensive, and collaborative.

Grounding Social Sciences in Cognitive Sciences includes three chapters on each of four social sciences: culture, politics, religion, and economics. Religion is perhaps an atypical choice for a social science because none of the 214 writers who contributed white papers to *Rebuilding the Mosaic* came from a Department of Religion. However, the three chapters on religion emphasize culture and therefore can be read as an extension of the chapters on culture.

Cultural psychologists study the mutual interactions of individuals with social systems. The challenge for cognitive psychologists is to understand how cultural context influences the developing mind, and the challenge for anthropologists is to understand how culture is influenced by the developing mind (Thagard). Social coordination is supported by allocentric models that provide the basis for joint cognition; personal coordination is supported by egocentric models that provide internal coherence and personal meaning (Shore). Category-based induction provides a mechanism for producing new shared cultural knowledge because social knowledge evolves (Ross).

Religion can be classified into the broader category of rituals, which influence the scale, structure, and cohesiveness of cultural groups (Whitehouse). One value of religion is that it provides a set of moral norms for large-scale cooperative societies (Atran). These norms can be studied both at a cognitive level and at a coevolutionary level that models behavioral traits in populations (Pyysiäinen).

The possibility of a greater integration of the social sciences raises the question of whether a theory of moral choice in times of international political tension can be grounded in scientific knowledge rather than in philosophy and religion (Monroe). Exam-

ples of scientific knowledge that are relevant to political discourse are the social skills model, theories of preserving positive face, equivocation theory, and the use of metaphors (Bull and Feldman). Political behavior is also influenced by emotions, particularly anger and anxiety (Feldman et al.).

Integration in some cases may be difficult because of differences among the social sciences. More productive interdisciplinary collaboration between cognitive science and economics will require multiagent models of social interaction driven by institutional structures (Ross). Although the study of institutional structures is important, neuroeconomics can supplement other approaches as part of a coordinated investigation of decisions at multiple levels of analysis (Kable). Another approach is to study decisions by using psychometric models to integrate human-capital theory with a theory of fluid and crystallized intelligence (McArdle and Willis).

A helpful introductory chapter by the editor (Sun) provides both motivation for the book and an overview of the chapters. The final two chapters present unifying principles. The first of these discusses tools for rebuilding the social sciences (McCubbins and Turner). Readers may benefit by reading this chapter after the introduction to provide another overview before tackling the individual chapters. The final chapter proposes five principles that can provide a framework for unifying the behavioral sciences: gene-culture coevolution, the sociopsychological theory of norms, game theory, the rational actor model, and complexity theory (Gintis).

Grounding the Social Sciences in Cognitive Sciences is an important book that should be consulted by anyone interested in rebuilding the mosaic. The only item missing from my wish list is a critique of the ideas presented in the book. I recommend two special-edition journal issues for those interested in a debate. The first contains multiple reactions to a framework for the unification of the behavioral sciences (H. Gintis. 2007. *Behavioral and Brain Sciences* 30:1-16). The second contains reactions to an article on the socially extended mind (S. Gallagher. 2013. *Cognitive Systems Research* 25-26:4-12).

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BRAINS TOP DOWN: IS TOP-DOWN CAUSATION CHALLENGING NEUROSCIENCE?

Edited by Gennaro Auletta, Ivan Colagè, and Marc Jeannerod. Hackensack (New Jersey): World Scientific Publishing. \$99.00. x + 365 p.; ill.; author and subject indexes. ISBN: 978-981-4412-45-2. 2013.

This book collects contributions and discussions from a workshop held at the Vatican to explore top-down causation in neuroscience, as part of an effort to foster dialogue among philosophers, theo-

logians, and neuroscientists. Most of the contributors are well-known neuroscientists.

The editors pose the question “whether the mind . . . can be considered as a cause . . . in a way that does not violate physical-chemical principles,” and in this connection define top-down causation in the brain to refer to “endogenous cognitive processes” constraining behavior in a way that “occur[s] without any input, that is, without being a consequence of a process triggered (caused) by some input (coming from either the environment or some internal physiological state)” (p. 352). This antireductionist formulation poses a challenge for the neuroscientists, who study the physical brain and generally expect it to be governed by physical law, and they by no means accept the editors’ proffered notion of top-down causation uncritically.

The book is entertaining to read and often instructive, as participants marshal specific experimental data to address compelling questions centered around the nature of consciousness and the possibility of “emergence” of properties that are not implicit in the constituents of a system. It thus offers a glimpse into what leading neuroscientists really think about perplexing issues that are rarely discussed by neuroscientists in any sustained way. Lively debate among the participants follows each chapter.

At times, conceptual looseness mars the discussion and hinders progress toward answering the question of whether top-down causation actually occurs in the brain. In cognitive science, “top-down” refers to influences on stimulus recognition that are not caused by the external stimulus alone, but might also rely on prior expectations, for example. It is not at all obvious that the explanation of top-down psychological phenomena in this sense requires invocation of antireductionist top-down causation as conjectured by the editors. Similarly, in neuroscience “top-down” can be used to refer to anatomical projections from a brain region considered to be “higher” in a processing hierarchy, down to a “lower” brain region. These distinct senses of top-down are used without adequately distinguishing them, and some speakers seem to take the existence of top-down phenomena in psychology or top-down anatomical projections in the brain as establishing that top-down *causation* of the nonreductionist sort occurs in people.

There is a further irony in repeated examples of reductionism-defying quantum phenomena cited by Auletta. Irreducibly holistic phenomena such as superconductivity and nonlocal entanglement, in which larger-scale dynamics supersede the rules for the smaller-scale parts, might be taken as showing the plausibility of irreducible top-down causation in the brain. However, in a classical model of the brain—as explicitly taken for granted by Auletta on behalf of all the participants (p. 159)—

irreducible holism is ruled out (even as “global constraints”) since the system’s dynamics are maximally determined by local interactions among neighboring parts. Nevertheless, this point does not detract from the value of the discussion in the book of multiple detailed examples of apparently holistic principles at work in the brain, including notions of “self,” “schemas,” and potential mechanisms for binding conscious experiences into unified wholes.

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MICROBIOLOGY

POLAR MICROBIOLOGY: LIFE IN A DEEP FREEZE.

Edited by Robert V. Miller and Lyle G. Whyte. Washington (DC): ASM Press. \$159.95. xiii + 312 p. + 11 pl.; ill.; index. ISBN: 978-1-55581-604-9. 2012.

This is one of the first books where a detailed view into microbial ecology (archaea, bacteria, and fungi) of polar habitats is introduced. Great attention is paid to the microbial diversity, physiological adaptations to cold, and biochemical cycling of polar microbial communities.

The first part deals with microbial diversity in polar environments. Molecular and morphological diversity in most of geographical regions across the Antarctic and the Arctic, and in most of polar habitat types—soil, lithic, permafrost, lakes, shallow wetlands (including extremes), glacial and sea ice, snow, marine (including seafloor)—is summarized. The second part shows how microorganisms adapt to cold, including genomic and metagenomic analyses together with potential biotechnology use. The ecology and biochemical cycling of polar microbial communities is introduced in the third part. This part covers the three most important habitat types: microbial carbon cycling in permafrost; polar marine microbiology; and cryospheric environment in polar regions. The most challenging last part contains three chapters: low-temperature limit of microbial growth and metabolism; climate change, ozone depletion, and life at the poles; and life in ice on other worlds. This part discusses if the origin of life could be related with low-temperature or icy environment. This very provocative topic is discussed in detail with respect of physical and chemical properties of all types of ice, including adaptations and metabolic characteristics of ice microbes. One of the most important topics describes the exchange of microbial genome between ice, marine, and terrestrial environments and possible microbial genome exchanges between solar system planets.