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Book Review

Missed Connections: Integrating Proximate and Ultimate Explanations in Cognitive Neuroscience

A review of Steven M. Platek, Julian Paul Keenan, and Todd K. Shackelford (Eds.), *Evolutionary Cognitive Neuroscience*. Cambridge, MA: The MIT Press, 2007, 616 pp. US\$65 ISBN: 978-0-262-16241-8 (cloth).¹

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As readers of this journal will happily attest, evolutionary thinking now penetrates and energizes virtually all areas of psychology (Gaulin and McBurney, 2003; Buss, 2005, 2007; Gray, 2006). As readers may also recognize, an exciting recent trend is that scholars are bringing evolutionary thinking to fields that might appear even further from its purview, including law (Jones, 2004), religion (e.g., Boyer, 2001; Atran, 2002; Wilson, 2003), history (Smail, 2007), aesthetics (e.g., Dissanyake, 1994; Miller, 2000), literature (e.g., Carroll, 1994; Gottschall and Wilson, 2005; Barash and Barash, 2005), and morality (e.g., Hauser, 2006; Haidt, 2007). In this new volume, *Evolutionary Cognitive Neuroscience* (hereafter ECN), editors Platek, Keenan and Shackelford go the other way, bringing evolutionary thinking to an area where most people would assume it's already integrated.

In particular, the editors claim that the field of cognitive neuroscience—despite its deep relations with hard-core biological fields such as anatomy, physiology, biochemistry, and genetics—has missed the Darwinian boat by neglecting to harness the power of adaptive thinking. Instead, it has focused on proximate mechanisms without giving proper consideration to the possible function of those mechanisms and their evolutionary history. The editors, who are practicing neuroscientists and evolutionary psychologists, argue that this state of affairs is finally changing (c.f., Webster, 2007) and that it's high time to take stock of what the evolutionary perspective has provided so far. Their stated goal (p. xvi) is, “to present, in an organized overview, the way in which researchers are beginning to wed

¹ All editorial decisions regarding this article were made by David P. Barash.

the disciplines of evolutionary psychology and cognitive neuroscience in order to provide new data on and insights into the evolution and functional modularity of the brain.” In this review, we first discuss the overall goals and organization of ECN before offering remarks on specific sections and chapters.

Overall Organization

Because ECN was not the byproduct of a conference, the editors enjoyed free rein in soliciting chapters. They clearly opted for diversity, as the authors of the 21 chapters, despite their shared incorporation of evolutionary principles, often employ dramatically different methods, species of study, and theoretical frameworks. These diverse approaches present a formidable organizational challenge, which the editors have attempted to meet by organizing sections of the book around different adaptive problems. This seems inspired by Buss’ successful textbook (2007) that includes sections on such topics as food acquisition, long-term mating, short-term mating, and parenting. Although this organization works beautifully for Buss, it is less successful here, owing to the fact many of the contributors apparently do not structure their research programs by initially identifying specific adaptive challenges. Instead, they appear to work from the other direction, identifying a psychological phenomenon of interest and then testing predictions derived from both proximal and functional hypotheses. Such research programs have been patently successful (see below), but the chapters describing them do not form a coherent whole.

For example, Part III, called “Reproduction and Kin Selection,” begins with a superb chapter by Fernald reviewing his research on the reciprocal influences of social interactions, development, and various physiological systems in African cichlid fish. The next chapter, by Platek and Thompson, introduces fascinating recent work on visually-mediated kin discrimination in humans, its potential utility for male parental investment decisions, and its neural correlates. Both chapters deal with visual discrimination, but the adaptive problem they address is quite different: competitor assessment in fish and paternal investment in humans. Other chapters in Part III, by Fisher and Thompson and by Newlin, do not address either of these problems, instead focusing on the psychopharmacology of mating and dopaminergic motivation systems, respectively. Thus, in this section, and others, the reader is often left wondering what neighboring chapters share besides physical proximity. In addition, throughout ECN, authors working on related problems and brain systems almost never make reference to findings and approaches discussed in other chapters.

A major theme that might have effectively tied ECN together is the influence of Tooby and Cosmides’s (1992, 2005) claims on cognitive neuroscience. These claims—the reality of massive modularity, the importance of the environment of evolutionary adaptiveness (EEA), and the universality of human cognitive architecture—are highly influential in evolutionary psychology, especially among the leading thinkers (see Gaulin and McBurney, 2003; Buss, 2005, 2007). In fact, the ECN editors profess commitment to these claims and view them as central to evolutionary psychology’s contribution to cognitive neuroscience (preface, chapter 1; and see Krill, Platek, Goetz, and Shackelford, 2007) stating (p. xiv), for instance, that “all learning is a consequence of carefully crafted

modules dedicated to solving specific evolutionary problems.” Unfortunately, very few of the chapters address such claims head on, and some are completely at odds with them. Take, as one instance, the chapter by Rushton and Ankney, which authoritatively summarizes the mountain of evidence that brain size and IQ are correlated in humans. Naturally, this work supposes the reality of IQ as a measure of domain-general intelligence, and, as Rushton and Ankney note, the evidence for this reality is overwhelming. This finding conflicts with the claim of massive modularity, and ECN should somewhere have addressed such apparent incongruities.

A related shortcoming is that there are no studies presented where Tooby and Cosmides’s massive modularity claim—which ought to be a central issue in cognitive neuroscience—is truly put to the test. Over the past decade, for example, the proposition that there are dedicated, encapsulated modules for face processing has been vigorously probed by neuroscientists of all stripes (e.g., Kanwisher, McDermott, and Chunn, 1997; Gauthier, Skudlarski, Gore, and Anderson, 2000). Closer to home, Cosmides, Tooby and their colleagues have recently extended their seminal investigations of cheater detection by incorporating lesion and neuroimaging data (Stone, Cosmides, Tooby, Kroll, and Knight, 2002; Ermer, Guerin, Cosmides, Tooby, and Miller, 2006). Crucially, both of these research programs have relentlessly sought to characterize precisely how modular the putative mechanisms actually are. ECN would have benefited if a chapter was dedicated to presenting one of these research programs or a similar one.

Another thing that might have brought more coherence to the volume would be a chapter providing a historical overview of the relationship between cognitive neuroscience and evolutionary thinking. Such a chapter might have traced the origins of the cognitive revolution and explored the reluctance of many major players (e.g., Chomsky, Fodor) to fully embrace an evolutionary approach. At the same time, such a chapter could have considered those neuroscience research programs that have been ethologically based (e.g., birdsong) and probed their intellectual origins and influence. Finally, this type of chapter might have presented readers with a few clear examples where an evolutionary approach has been truly necessary to understand cognitive neuroscience phenomena, or conversely, where cognitive neuroscience has strongly informed evolutionary psychology and ethology. Evolutionary psychologists have frequently done this for psychological phenomena (e.g., prepared learning), and it would have been useful to have analogous neuroscience cases brought into relief.

Specific Sections and Chapters

Section 1, “Introduction and Overview” begins with a chapter by Goetz and Shackelford that reviews basic evolutionary principles and how most evolutionary psychologists think they apply to behavior and cognition (i.e., Tooby and Cosmides’s claims). The chapter provides few novel ideas but is written crisply and will serve as useful refresher for many readers. Unfortunately, it provides few thoughts on what challenges must be confronted when evolutionary psychologists bring their ideas to neuroscience.

In Chapter 2, Dunbar presents an updated and detailed review of his and others’ work addressing the evolution of brain size across species and the theory that primate brain

evolution is best accounted for by social demands. The second half of the chapter focuses on theory of mind studies in humans and chimpanzees. It's a nice chapter and stands out as one of the only ones in ECN to explicitly grapple with the possibility of domain-generality.

In Chapter 3, Patel and colleagues provide an introduction to cognitive neuroscience methods and how they may best be employed by evolutionary psychologists. Although the chapter contains a wealth of information, the overall organization is difficult to discern, and there are some inaccuracies (e.g., transcranial stimulation is described as an imaging technique.) We recommend that readers looking for a methodological overview begin with a more traditional cognitive neuroscience text (e.g., Gazzaniga et al., 2002).

Section 2 is titled, "Neuroanatomy: Ontogeny and Phylogeny", and it is a smorgasbord. It begins with a wide-ranging chapter by Stone on the evolution of human life history and its relation to brain development. The chapter culminates with comparative analyses of primate life history and brain size, making it the only one with original analyses in book. Most importantly, Stone attempts to support the long-standing hypothesis of co-evolution between age at maturity and brain size, especially executive brain size (Reader and Laland, 2002). Although the correlation is shown, there are some apparent problems with the methods. For instance, Stone ignores the issue of phylogenetic non-independence, an omission which is no longer excusable given its demonstrated importance and the availability of practical methods to address it (reviewed in Nunn and Barton, 2001). Furthermore, the chapter overlooks several papers that have developed similar hypotheses and shown similar results (Joffe, 1997; Kaplan, Hill, Lancaster, and Hurtado, 2000; Deaner, Barton, and van Schaik, 2002).

Chapter 5 is written by Hopkins and titled, "Hemispheric specialization in chimpanzees: evolution of hand and brain." Hopkins details the accumulating evidence that captive chimpanzees exhibit population-wide asymmetries, both behaviorally and neuroanatomically. The chapter concludes with a review of recent research exploring whether behavioral and neuroanatomical asymmetries might correlate within individuals and whether such individual differences are heritable and/or related to birth order. While the chapter is lucid and will be valued by scientists who work on these topics, non-specialists may be dissatisfied because it barely touches the question of how asymmetries might be related to adaptations or other broader issues.

In Chapter 6, Rushton and Ankney offer an elegant and comprehensive review of the relation between brain size and IQ, showing that the evidence for the linkage is now overwhelming even when body size is controlled. They also do an admirable job of reviewing the politically unpalatable empirical evidence indicating appreciable variation according to age, sex, socioeconomic status, and race. As we stated above, we would have appreciated a discussion of how the phenomena discussed in the chapter relate to Tooby and Cosmides's seminal claims.

Chapter 7 is written by Marino and titled, "The evolution of the brain and cognition in cetaceans." It concisely reviews the evolution of this mammalian order, their peculiar neuroanatomy, how this neuroanatomy relates to their cognition and behavior, and the (often unusual) methods developed to study cetacean brains and cognition. If you've ever wondered how and why dolphins and toothed whales became so big-brained, this outstanding chapter is one of the first things you should read.

Section III, titled, “Reproduction and Kin Selection,” is the first section of ECN that is supposedly organized around an adaptive problem. As we noted above, the chapters in this section actually bear little relation to one another, although they are each valuable in their own right. Fernald’s chapter, titled, “The social control of reproduction: physiological, cellular, and molecular consequences of social status,” provides a wonderful tour of a fully developed research program, describing the mechanisms by which behavioral states and brain physiology interact. Even readers with no interest in fish will be inspired.

Chapter 9, authored by Platak and Thomson, starts by describing some exciting recent experiments showing that humans discriminate visual images morphed to subtly resemble their own face or their kin’s. Moreover, context-dependent preferences and aversions to such morphed faces are explained tidily by various adaptive hypotheses. Platak and Thomson especially focus on results indicating that men may use self-referent visual cues when making parental investment decisions. They conclude by describing their recent neuroimaging studies, which seek to identify a neural signature of males’ heightened sensitivity to a child’s resemblance. Their data indicate that males show increased activation in several brain areas when viewing a self-child morph. Future studies will hopefully replicate these results and extend them by (1) demonstrating that differential activation is unique to kinship recognition and not merely a product of salient or familiar social images (e.g., friend-child morph), (2) verifying that the hypothesized kinship-recognition circuit is anatomically plausible, i.e., that neuroanatomical connections exist between areas in the hypothesized module, and (3) showing that the strength of these anatomical connections or degree of network activation correlates with performance on kin-recognition tasks. In sum, although much work awaits, this emerging research program provides a terrific example of how a rigorous evolutionary perspective can highlight a topic overlooked by traditional cognitive neuroscience.

Chapter 10 is written by Fisher and Thompson and the title aptly summarizes their message: “Lust, romance, attachment: do the side effects of serotonin-enhancing antidepressants jeopardize romantic love, marriage, and fertility?” This fascinating and detailed review drives home why an evolutionary perspective is necessary for both cognitive neuroscientists and practicing clinicians.

Newlin concludes this section by presenting what he calls SPFit (self-perceived survival and reproductive fitness) theory, which seeks to bring an evolutionary framework to substance abuse disorders. SPFit theory essentially holds that the corticomesolimbic dopamine system is not a reward pathway, as some addictions researchers claim, but instead embodies the neural substrate for SPFit, which is, “a basic survival and reproductive motivational system that is activated by drugs of abuse and by perceived threats to survival and reproductive fitness...” (p 286.) Although there are many interesting ideas presented in this chapter, and readers with little knowledge of addictions will learn much in reading it, we remain unconvinced of SPFit’s utility. For one thing, our reading of this literature suggests that, despite the new jargon, Newlin’s interpretation of corticomesolimbic dopamine system is now nearly mainstream. In addition, Newlin’s invocation of a unitary fitness representation appears at odds with Tooby and Cosmides’s (1992, 2005) claim that natural selection has shaped human psychology to execute specific adaptations, not to maximize fitness. Most passages in this chapter appeared in a previously

published review article (Newlin, 2002).

Section IV of ECN is titled, “Spatial Cognition and Language,” and it contains two chapters on sex differences in spatial ability and one on the evolution of language. In the first chapter addressing spatial ability, Puts and colleagues begin by systematically characterizing sex differences in humans and rodents and then turn to various adaptive hypotheses that might account for them. The bulk of the chapter reviews the scores of studies detailing the relevant hormonal, developmental, and brain mechanisms. The chapter is scholarly and thorough, so thorough in fact that non-specialists might easily be overwhelmed by the detail and length (38 pages, almost entirely text). The clear writing and effective use of section headers, however, should allow readers to keep their bearings.

Gur and colleagues wrote Chapter 13, and it is similar to the previous one in that the goal is to characterize sex differences in spatial abilities and review what is known about their mechanistic basis and evolution. It is well-written and, while largely overlapping with the previous chapter, does introduce some different material, such as studies of brown-headed cowbirds, a species in which the demands of brood parasitism have apparently selected for greater spatial abilities in females.

To conclude Section IV, Corballis offers a highly synthetic chapter, titled, “The evolution of language: from hand to mouth.” It first provides an overview of the central challenges in language evolution and puts them in a paleoanthropological and life history context. Corballis then presents an updated distillation of his own theory (Corballis, 2002), which marshals a vast array of data (e.g., anthropological, genetic, neurological) to argue that full-blown human languages were comprised mainly of manual gestures until some time between 100,000 and 50,000 years ago, when vocal language was invented. Although there are reasons to be skeptical of this theory, it seems plausible and certainly succeeds in sensibly organizing the relevant observations and providing an entertaining read.

Section V is titled, “Self-awareness and Social Cognition,” and contains five chapters. Chapter 15 is written by Santos and colleagues and titled, “The evolution of human mindreading: how nonhuman primates can inform social cognitive neuroscience.” The authors first remind us of the methodological advantages of studying nonhumans and then, focusing mainly on their recent work on macaques, argue that there is now compelling evidence that some nonhuman primates possess aspects of a Theory of Mind, although much work still remains in characterizing these abilities. Finally, they review what is known or has been speculated about the neurobiological bases of such abilities and provide examples of how neuroscientific and behavioral methods can complement one another. The chapter is superbly written and will be valuable to many, including monkey neurophysiologists and developmental psychologists.

Chapter 16 is written by Focquaert and Platek, who develop a theory of self-processing, introducing evidence from the nonhuman primate literature as well as their own functional neuroimaging studies. In particular, Focquaert and Platek argue that social cognition relies heavily on simulation and that simulation provides a means not only of understanding the other, but also the self. For these reasons, they hypothesize that in humans, and perhaps other primates, self-awareness is strongly linked to an individual’s ability to attribute mental states to others. The authors survey a broad range of findings while outlining this particular approach to self-awareness and Theory of Mind, struggling

admirably to bring evolutionary perspectives to a philosophically and semantically challenging area. Nonetheless, non-specialists may find the terminology difficult, and, because alternative paradigms mentioned in the chapter (e.g., the “theory theory”) are never described in detail, readers may finish the chapter feeling they’ve not been fully exposed to contemporary neuroscientific views of self-awareness.

Chapter 17 is authored by Baron-Cohen and is titled, “The assortive mating theory of autism.” It presents an updated version of the author’s theory that systemizing and empathizing are fundamentally opposite ways of understanding the world and that a core feature of autistic spectrum disorders is hypersystemizing. The chapter then reviews the evidence implicating genetics in autism, including that individuals with two parents that are high systemizers are at especially heightened risk. The chapter is cogent and should be read by all who have interest in autism or social cognition, even those highly skeptical of Baron-Cohen’s theory. We note, however, that Baron-Cohen’s use of the word “assortive mating” in his title and throughout the paper is confusing since biologists use this word in a different way, meaning that individuals in a population with a particular phenotype have a greater (or lesser) than chance likelihood of mating with one another. Baron-Cohen, despite using the word “assortive,” does not claim that high systemizers are especially likely to mate, only that when they do, the offspring are at heightened risk of autism. This chapter appeared, in virtually identical form, in a previously published article (Baron-Cohen, 2006).

Stevens and colleagues wrote Chapter 18, which is entitled, “Deception, evolution, and the brain.” It speculates on the possible advantages of deception, reviews Trivers’s and Ramachandran’s theories of self-deception, and discusses various neurological disorders and other phenomena related to deception, including misidentification syndromes and memory problems. The chapter’s overall goal is difficult to determine, but it contains several interesting ideas.

Kosslyn provides this section’s finale, presenting his theory of “social prosthetic systems,” which are defined as, “human relationships that extend one’s emotional or cognitive capacities.” The basic claim is that humans are motivated to use the abilities of others to achieve their own interests; conversely, each of us is being employed as a prosthesis by others, so that ultimately we all comprise a social network with multiple goals and abilities, many of which are partly in conflict. The chapter effectively illustrates these points with examples, including an amusing (and enlightening) discussion about the crosswalk featured on the album cover of the Beatles’s *Abbey Road*. Despite the intuitive appeal of the ideas, we suspect that most readers will find themselves ultimately unsatisfied with Kosslyn’s chapter. The problem is that it puts insufficient effort in distinguishing itself from related ideas (a theory of motivation that requires only 16 references?) or developing any specific predictions. Readers are advised to consult Tooby and Cosmides’s (1996) paper on friendship, which develops similar ideas but with clearer directions for empirical research.

Section VI is last and titled, “Theoretical, Ethical, and Future Implications for Evolutionary Cognitive Neuroscience.” In Chapter 20, Kimberly and Wolpe explore the philosophical, ethical, and social questions posed by the kinds of research presented in ECN. They first discuss philosophical implications for issues such as morality and free will

and then turn to the implications of controversial knowledge that such research might generate. The last, and perhaps freshest, part of the chapter is the discussion of how evolutionary psychology and cognitive neuroscience research intersects with society, media, and the criminal justice system. It's a fine chapter, and researchers from all backgrounds will profit by reading it. The final chapter, Chapter 21, is written by Keenan and colleagues, and it offers several helpful remarks on the challenges and rewards of engaging in a truly interdisciplinary field such as evolutionary cognitive neuroscience.

Conclusion

Evolutionary Cognitive Neuroscience's goal is to demonstrate the developing links between cognitive neuroscience and evolutionary psychology, especially Tooby and Cosmides's (1992, 2005) influential version of EP. Although the volume's overall structure does little to illuminate these connections, there are some chapters that certainly succeed. Interestingly, it is often the chapters that appear least beholden to Tooby and Cosmides's stricter claims that do the best job of illustrating how evolutionary perspectives have motivated active neuroscientific research programs. Although readers may initially buy this book because of a specific chapter relevant to their research goals, we suspect they will find it contains many accessible and provocative contributions. In conclusion, we recommend ECN to all psychologists and cognitive neuroscientists with interest in evolution.

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