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The Neuroscience of Choice Behavior

A review of

Neuroeconomics: A Guide to the New Science of Making Choices

by Peter Politser

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Reviewed by
Gordon Pitz

Neuroeconomics? It sounds like a neologism on the order of *politicopharmacology* or *quantum sociology*. But a survey of science news during the last few years confirms that by the end of the Decade of the Brain (1990–1999), research in the neurosciences was driving many important advances in social science. Even economics, the most abstract and mathematical of the social sciences, has not been immune to that influence.

Economics has led something of a split existence recently. Traditionally it has been dominated by theories of rational choice, becoming what some have called the study of *homo economicus*, a.k.a. “Chicago man” (University of Chicago being for many years a major site for the study of this species; see McFadden, 1999). However, in the last 25 years psychologists have shown that the behavior of *homo sapiens* departs in significant ways

from the behavior of *homo economicus*, suggesting that the latter exists only in the world of abstract theory (Thaler & Sunstein, 2008). Behavioral economics, an integration of psychology and economics, has now become a major force in the study of economic decision making. It is appropriate, therefore, that both psychologists and economists turn to the neurosciences for help in finding out how people make decisions. A book that summarizes the current state of knowledge is very welcome.

What precisely can neuroscience add to psychological or economic theories? Surely no one doubts that choice behavior is caused by neurochemical activity in the brain. Finding out where in the brain something happens probably adds little to the explanatory power of theories derived from behavioral studies. On the other hand, every theory makes assumptions about the fundamental constructs that determine behavior, and neurological studies can provide converging validity for the theoretical constructs. Theories in psychology might postulate constructs such as drive and habit strength, short-term and long-term memory, or the five factors of personality. Theories of choice behavior postulate probability, utility, risk, and tradeoffs as core concepts. If one accepts the popular aphorism that a scientific theory seeks to carve nature at its joints (an unfortunate metaphor, perhaps, for a neuroscientist!), then one valuable function of neuroscience is to confirm the existence of the supposed joints.

Politser addresses numerous theories of choice and summarizes the neural and biological research findings that might be relevant to each theory. In this respect *Neuroeconomics: A Guide to the New Science of Making Choices* provides a valuable review of a large, complex body of research. Two summary tables, organized by theory, help the reader to evaluate this information, so we can begin to recognize neurological correlates of the theoretical constructs.

Neurologists use several methods for studying the biological foundations of behavior. The book provides extensive coverage of findings from studies of pathologies, including psychiatric disorders, brain lesions, and drug addictions. Less weight is given to other sources of evidence. Much of the content of the book deals with the impairment of choice behavior observed in pathologies. Unfortunately, it is not always clear to what degree these findings generalize to day-to-day decisions made by the average consumer or investor. Indeed, one topic largely missing from the book is a critical assessment of how different methods used by neurologists might illuminate models of choice behavior.

In recent years the methodology of choice for the neurosciences has become brain imaging, especially functional magnetic resonance imaging (fMRI) techniques, but supplemented by older methods such as electroencephalograph recording and positron emission tomography scans. Politser's review has much less to say about the implications of brain-imaging research than about pathology. This is unfortunate, for recent breakthroughs in neuroeconomics have occurred primarily through the use of technologies such as fMRI (O'Doherty & Bossaerts, 2008).

The Epidemiology of Neuroeconomics

To provide an overall structure for his review, Politser has chosen as an organizing theme a distinction drawn from epidemiology between *efficacy* and *effectiveness*. Roughly, efficacy measures the impact of a medical intervention in a carefully controlled study, while effectiveness measures its impact in real-world situations. Politser asserts that these terms can be used to describe economic theory and behavioral data. Hence the two major sections of the book are devoted to efficacy and effectiveness, respectively.

I found this epidemiological framework to be quite confusing. In epidemiology, efficacy and effectiveness refer to measures of the impact of an intervention. In Politser's usage, *intervention* corresponds to an option that might be available to the decision maker. He contrasts the efficacy of a decision maker's evaluation of the option with the effectiveness of the evaluation. But what exactly is intended by his use of *carefully controlled study* and *real-world situation* in the analogy describing efficacy and effectiveness?

It turns out that the efficacy chapter deals with the theories of rational choice that have been used to describe *homo economicus*. Effectiveness concerns descriptive theories of the choice behavior of *homo sapiens*. But while this distinction might reasonably characterize the difference between normative and descriptive theories of choice, it makes no sense to me from either a behavioral or a neurological point of view. In other words, the distinction does not seem to represent an important natural joint.

To take one example, consider Politser's treatment of expected utility (EU) theory, which has been the bedrock of traditional economics. The theory suggests that a person maximizes the expected utility of the available options. Expected utility is calculated by multiplying the probability of each possible outcome by its utility. According to EU theory, a decision maker's attitudes toward risk can be entirely explained by variations in the form of the utility function. We need to know, then, if the constructs proposed by EU theory are necessary and sufficient to explain choice behavior.

There is indeed neurological evidence that probability (degree of belief) and utility (desirability) are encoded separately in the brain, so here we recognize what may be an important natural joint. But there is both behavioral and neurological evidence that EU theory is inadequate to explain many choice phenomena, and constructs other than probability and utility are required. More accurate descriptive theories (e.g., prospect theory; Kahneman & Tversky, 1979) have been developed that introduce appropriate extensions, but the descriptive theories are not discussed until we reach the effectiveness chapter, and so the adequacy of EU theory is never discussed in detail.

And, of course, the reader is left wondering why EU theory is treated as evaluation under carefully controlled conditions while prospect theory is considered to be evaluation under real-world conditions. Most behavioral economists would conclude that humans do

not calculate expected utilities under any circumstances, and the study of neurology supports that point of view.

This would not be an important issue were there not other natural joints, confirmed by both neuroscience and behavioral research, that are mostly ignored. In fact, there are two distinctions that many theorists would argue are critical to an understanding of decision making (Camerer, Loewenstein, & Prelec, 2005). One is the distinction between deliberate processing and automatic processing, a distinction that appears in one form or another in many dual-process theories of reasoning. The other is the distinction between cognitive and affective determinants of behavior. Each of these dichotomies is recognized by most theorists as being very important, yet they are mentioned only briefly in the final, concluding chapter of the book.

Conclusion

For a psychologist who is interested in contributions that neuroscience can make to the study of decision making, the book contains a great deal of valuable information. Nevertheless, it suffers from its thin coverage of brain-imaging research (especially in normal subjects), its unfortunate choice of efficacy versus effectiveness as the organizing theme, and the consequent minimizing of two essential dichotomies that are recognized in current models of choice behavior.

A reader might do well to supplement the book with other sources. A recent review of neuroeconomics covers similar ground from a very different perspective (Camerer et al., 2005). These authors have much more to say about neuroimaging, and they provide an organizational framework for the material based on the deliberate/automatic and cognitive/affective distinctions. A very brief recent summary devoted specifically to neuroimaging (O'Doherty & Bossaerts, 2008) also provides an alternative framework that addresses issues central to behavioral decision theory.

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