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Leda Cosmides; John Tooby

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Better than Rational: Evolutionary Psychology and the Invisible Hand

By LEDA COSMIDES AND JOHN TOOBY*

Several years ago, we attended an interdisciplinary seminar on what were purported to be “biases” in negotiation behavior. The economists, psychologists, and biologists present were mulling over the data when, suddenly, a prominent economist lit up. “Ah, I see,” he said, “behavior is either rational or it’s psychological.”

This formulation stuck in our minds, because it seemed to succinctly give voice to a tacit assumption held by many economists—one that we think works to the detriment of economics, by isolating it from the relevant parts of biology, psychology, and the rest of the natural sciences. This assumption is that rational behavior is the state of nature, requiring no explanation. Explanations that invoke the cognitive processes that actually generate human choices are required only when behavior *deviates* from this state of nature. In this view, economics is grounded in assumptions of rational behavior, is theoretically constructed out of what logically follows from assuming rational behavior, and gains specificity by plugging in a variety of variables that are kept exogenous to economics, such as preferences. Merchants of the ad hoc and exogenous, psychologists are called in only to provide second-order corrections to economic theory, usually by furnishing a catalog of oddities and quirks in human reasoning (e.g., “biases” and “fallacies”—many of which are turning out to be experimental artifacts or misinterpretations; see G.

Gigerenzer, 1991). And for the many behavioral domains where standards of rationality are unclear or undefined, economics is presently mute.

From a broader scientific perspective, this formulation is decidedly odd. Rational behavior is not, in any sense, the state of nature. Not behaving *at all* is the state of nature in a universe that includes lifeless planets, prebiotic soup, mountains, trees, and tables. All departures from this state of inaction require explanation. Moreover, the behavioral repertoires of various animals differ profoundly from one another, and this must be explained as well: bats cannot speak, and we cannot navigate through echolocation. Humans and other animals reason, decide, and behave by virtue of computational devices embodied in neural tissue. Therefore, a complete causal explanation of any behavior—rational or otherwise—necessarily invokes theories about the architecture of these computational devices. The rationality of a behavior is irrelevant to its cause or explanation.

Every economic model entails theories about these computational devices, but they are usually left implicit, buried in the assumptions of the model. At the moment, most economists rely on the implicit (and somewhat vague) theory that these computational devices somehow embody “rational” decision rules. But developing a more accurate, useful, and well-defined substitute for this black box is now a realistic goal. Results from the newly emerging field of evolutionary psychology suggest that (i) explicit, well-specified models of the human mind can significantly enhance the scope and specificity of economic theory, and (ii) explicit theories of the structure of the human mind can be made endogenous to economic models in a way that preserves and expands their elegance, parsimony, and explanatory power.

*Department of Psychology, University of California, Santa Barbara, CA 93106, and Department of Anthropology, University of California, Santa Barbara, CA 93106, respectively. For enlightening discussions, we warmly thank Gerd Gigerenzer, Robert Nozick, and Paul Romer. For financial support, we are grateful to the McDonnell Foundation and NSF Grant No. BNS9157-449 to Tooby.

At present, economics hovers, scientifically unsupported and isolated in mid-air, theoretically levitating on the assumption of rationality. But this is unnecessary and limiting. There are tight causal and analytic connections between economics, psychology, and evolutionary biology (Tooby and Cosmides, 1992a):

1. Natural selection—an invisible-hand process—is the only component of the evolutionary process that produces complex functional machinery in organisms, such as the vertebrate eye (Richard Dawkins, 1986).
2. Natural selection built the decision-making machinery in human minds.
3. This set of cognitive devices generates all economic behavior.
4. Therefore, theories of economic behavior necessarily include theories about the structure of the cognitive mechanisms that generate that behavior. Moreover, the design features of these devices define and constitute the human universal principles that guide economic decision-making.

In other words, natural selection's invisible hand created the structure of the human mind, and the interaction of these minds is what generates the invisible hand of economics (e.g., Tooby and Cosmides, 1992a): one invisible hand created the other.

I. Evolutionary Psychology

The brain is a complex computational device, a system that takes sensory information as input, transforms it in various ways, stores it, analyzes it, integrates it, applies decision rules to it, and then translates the output of those rules into the muscular contractions that we call "behavior." For the most part, humans have no more conscious access to the structure of these programs and the decision rules they embody than to the processes through which the kidneys select what to excrete. Nevertheless, the structure of these information-processing programs can be mapped in much the same way that a programmer, by studying the web

of relationships that link inputs to outputs, can deduce the structure of a computer program. Hence cognitive scientists can ask: do our brains embody procedures that carry out the rules of logical inference? or calculate Bayesian probabilities? or cause us to avoid incest? or allow us to echolocate?

Of course, the information-processing structure of the mind is fantastically complex, so conducting experiments blindly, without knowing what to look for, has not been an efficient research strategy. This is where the integration of evolutionary biology and cognitive science has proved so useful. The applicability of evolutionary biology is based on a simple but powerful idea. Form follows function: the properties of an evolved mechanism reflect the structure of the task it evolved to solve.

This approach has teeth because there is only one class of problems that evolution produces mechanisms for solving: *adaptive* problems. These are problems that recurred across many generations during a species' evolutionary history, and whose solution statistically promoted reproduction in ancestral environments. By identifying and modeling the adaptive problems humans faced during their evolution, researchers can make educated guesses about the designs of the complex computational devices the human brain embodies, and about many of the specific design features they required to be able to solve these problems. Armed with these models, researchers can then design experiments that can detect and map the features of these complex devices—features that no one would otherwise have thought to test for.

II. A New View of the Mind

The application of these methods is leading to a fundamentally new view of the architecture of the human mind. Previously, the mind was thought to resemble a general-purpose computer: initially free of any content that had not originated in the senses and the social world (the *tabula rasa* assumption), and equipped only with a small number of content-independent rules of inference (e.g., rules drawn from logic, mathe-

matics, and probability theory, or associative rules).

Converging lines of evidence from an array of disciplines are replacing this view with a model in which the human cognitive architecture resembles a large and heterogeneous network of functionally specialized computational devices. Because biological evolution is a slow process, and the modern world has emerged within an evolutionary eye-blink, these devices are inherited from the past and remain functionally specialized to solve the particular distribution of problems that were characteristic of humans' hunter-gatherer past, rather than those of the modern world (e.g., habitat selection; foraging; social exchange; competition from small armed groups; parental care; language acquisition; contagion avoidance; sexual rivalry) (for discussion, see Tooby and Cosmides [1992a]). The fact that these devices are (a) specialized rather than general-purpose and (b) specialized to solve seemingly exotic ancestral problems rather than all problems, or modern problems, leads to markedly different sets of predictions about human behavior and decision-making. In addition, this view implies that cultural differences are vastly overstated, because beneath existing surface variability all humans share the same set of preference-generating and decision-making devices. Finally, the tabula rasa assumption is being discarded: human mental content does not simply originate in the external world. Specialized mental mechanisms inject recurrent content into human thought across cultures (through privileged hypotheses and conceptual primitives, specialized representational formats, privileged preference generators, etc.).

One point is particularly important for economists to appreciate: it can be demonstrated that "rational" decision-making methods (i.e., the usual methods drawn from logic, mathematics, and probability theory) are computationally very weak: incapable of solving the natural adaptive problems our ancestors had to solve reliably in order to reproduce (e.g., Cosmides and Tooby, 1987; Tooby and Cosmides, 1992a; Steven Pinker, 1994). This poor performance on most natu-

ral problems is the primary reason why problem-solving specializations were favored by natural selection over general-purpose problem-solvers. Despite widespread claims to the contrary, the human mind is not worse than rational (e.g., because of processing constraints)—but may often be better than rational. On evolutionarily recurrent computational tasks, such as object recognition, grammar acquisition, or speech comprehension, the human mind greatly outperforms the best artificial problem-solving systems that decades of research have produced, and it solves large classes of problems that even now no human-engineered system can solve at all.

How can this be? General-purpose systems are constrained to apply the same problem-solving methods to every problem and can make no special assumptions about the problem to be solved. Specialized problem-solvers are not handicapped by these limitations. Many facts and relationships relevant to particular types of adaptive problems were stably true of the world during human evolution (e.g., incestuous matings produced a high proportion of birth defects; human grammars were limited to a restricted set of patterns). Natural selection could equip humans' cognitive specializations with design features and problem-solving strategies that exploited the presence of these problem-specific regularities to solve particular classes of recurrent problems in efficient ways appropriate only to that class. Triggered by cues that a particular problem type has been encountered, a network of dedicated computers can selectively deploy from its large repertoire those specialized procedures that are well designed for solving that particular problem. *For the problem domains they are designed to operate on, specialized problem-solving methods perform in a manner that is better than rational*; that is, they can arrive at successful outcomes that canonical general-purpose rational methods can at best not arrive at as efficiently, and more commonly cannot arrive at all. Such evolutionary considerations suggest that traditional normative and descriptive approaches to rationality need to be reexamined (Tooby and Cosmides, 1992a, b;

Robert Nozick, 1994). (Unfortunately, because decision theorists and philosophers have almost equated rational methods with general-purpose analytic tools, the analysis and development of domain-specific methods has been relatively neglected.)

III. Reasoning Instincts

From this perspective, the human mind is powerful and intelligent not because it contains general-purpose rational methods (although it may include some), but primarily because it comes equipped with a large array of what one might call "reasoning instincts." Although instincts are often thought of as the polar opposite of reasoning, a growing body of evidence indicates that humans have many reasoning, learning, and preference circuits that (i) are complexly specialized for solving the specific adaptive problems our hominid ancestors regularly encountered; (ii) reliably develop in all normal human beings; (iii) develop without any conscious effort; (iv) develop without any formal instruction; (v) are applied without any awareness of their underlying logic; and (vi) are distinct from more general abilities to process information or behave intelligently. In other words, these reasoning, learning, and preference circuits have all the hallmarks of what people usually think of as "instincts" (Pinker, 1994). They make certain kinds of inferences just as easy, effortless, and "natural" to humans as spinning a web is to a spider or building a dam is to a beaver.

It is important to identify and map these specialized computational devices, because they powerfully shape economic processes (e.g., by making some social interactions easy for the participants to understand and engage in, and others more difficult to understand or to successfully navigate). For example, humans do not seem to have available on-line circuits that perform many logic operations (e.g., *modus tollens*). However, experimental evidence indicates that humans do have evolved circuits dedicated to a more specialized task of equal (or greater) complexity: detecting cheaters in situations

of exchange. Needless to say, a specialized social exchange logic and associated circuits allows gains in trade to be identified by individuals, trades to be arranged, cheaters to be excluded, and hence markets to emerge spontaneously (Cosmides and Tooby, 1992). Equally important, experimental evidence suggests that humans have specialized circuits for understanding threats, as well as recognizing bluffs and double-crosses. The ability of humans to understand and properly interpret each other's threats also allows and structures the emergence of social predators, coercive coalitions, governments, and other extortive social arrangements.

Moreover, models of bounded rationality and heuristics do not seem to capture accurately the distinctive organization of human reasoning. Such models were based on plausible notions of limited processing capacity (e.g., Herbert Simon, 1956; D. Kahneman et al., 1982) and seemed to make sense of, for example, the experimentally arrived at consensus that humans lacked the ability to do Bayesian reasoning. Recent results from behavioral ecology, however, show that *bumblebees* engage in probabilistic induction that the human brain is considered "too limited" in capacity to perform (see e.g., Leslie Real, 1991). This suggested that the artificial nature of the experiments usually conducted might not be triggering latent competences. As it turns out, although it is true that people are bad at calculating the probability of a single event, when probabilities are expressed as frequencies, the standard "fallacies" and "biases" seem to disappear, and statistically naive subjects behave like good Bayesians (Gigerenzer, 1991; Cosmides and Tooby, 1994). From an evolutionary perspective, this is not surprising. Our hunter-gatherer ancestors were awash in statistical information in the form of the encountered frequencies of real events; in contrast, the probability of a single event was inherently unobservable to them (a single event either happens or it does not). Natural selection can only be expected to have built mechanisms to exploit information in the form that was

regularly available to our ancestors. Such observations have implications about how humans process the various forms of information available to them about their economic environments and supports the view that, instead of bounded rationality, humans have certain nonconscious natural competences that are far better than is presently appreciated.

IV. Universal Preferences and "Rules of the Game"

The most straightforward application of evolutionary psychology to economics involves the likelihood that the two communities collaboratively might be able to create a science of preferences (e.g., the session on "Preferences" at the 1994 Allied Social Science Association meeting featuring papers by Gary Becker and Casey Mulligan, Robert Frank, and Paul Romer). A psychological architecture that simply acquired an arbitrary set of preferences, provided they were present in the social environment, could not have been plausibly produced by the evolutionary process (Tooby and Cosmides, 1992a). Instead, evolutionary psychology should be able to supply a list of human universal preferences, and of the procedures by which additional preferences are acquired or reordered. Models of such mechanisms should be able to address long-standing problems in economics by widening the scope of preferences beyond the usual notion of goods and services (e.g., preferences for participation in coalitions [Tooby and Cosmides, 1988], for risks as a function of sex and age, and even for certain "rules of the game" [Cosmides and Tooby, 1992]).

Indeed, it is frequently assumed that the rules of economic interaction are the outcome of historical processes, created by "society" or by the action of "visible hands"—explicit, conscious, human intentions. However, humans' evolved computational devices may also tacitly supply much of the structure of these "games." Indeed, our evolved psychology may have alternative modes of operation that prompt humans

everywhere to find alternative sets of rules to be reasonable, depending on how closely their particular economic environment mimics various Pleistocene ecological conditions.

For example, humans evolved in small bands who lived by hunting animals and gathering plant foods. Hunting (in many environments) is a high-variance activity, in which luck plays a major role and individuals run a significant chance of coming back empty-handed for several days running. Optimality analyses from evolutionary ecology indicate that under circumstances of high variance for individual foragers, band-wide food-sharing is individually beneficial, a form of risk-pooling that smoothes out what would otherwise be a feast-or-famine cycle for individuals and families. Because foraging and sharing decisions are complex adaptive problems that humans faced for millions of years, humans should have evolved cognitive programs specialized for solving them; and recent evidence from the study of modern hunter-gatherers suggests that they have. These mechanisms monitor local information about factors such as resource variance, using it as a "switch" to turn various alternative sharing programs on or off. These mechanisms should make sharing rules appealing in conditions of high variance, and unappealing when resource accrual is a matter of effort rather than of luck (Cosmides and Tooby, 1992). In other words, different "rules of the game" can be triggered in a lawful way by specific kinds of ecological variables.

Knowing that such computational devices exist could, for example, serve as the basis for deeper and more scientifically satisfying theories of the conditions under which certain ideas and ideologies arise and are maintained (Cosmides and Tooby, 1992). For example, in the modern world, the operation of Pleistocene-forged variance-sensitive sharing programs would probably make cost-sharing for medical care more psychologically appealing than for many other goods, because illness is seen to have a large random component. Less obviously, knowing the structure of such cognitive

devices could help economists understand why certain economies grow so slowly. The savings and investment necessary for economic growth may be difficult to achieve—even when average per capita income is increasing—if there is a substantial amount of effort-independent variance in economic welfare (caused, e.g., by political unrest or frequent natural disasters). In such conditions, an ethic of widespread sharing could be triggered, and resources that might otherwise be saved and invested might instead be consumed.

Lastly, cognitive specializations determine what inferences will be triggered by a situation and what kinds of information will be attention-grabbing, memorable, learnable, communicable. Their structure therefore determines which ideas can be easily replicated from mind to mind, and which cannot (Dan Sperber, 1990). Explicit models of these mechanisms will eventually allow economists to develop well-grounded theories about the Hayekian distribution of knowledge.

In sum, economic theory can increasingly be grounded in the theoretically and empirically derived models of human decision-making machinery that are presently being constructed within evolutionary psychology.

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