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Think Again

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As part of an effort to introduce an evolutionarily rigorous research framework into psychology and the other behavioral sciences (and to strengthen it within biology itself, where it is surprisingly rarely understood), we and a few others have introduced and used the term *evolutionary psychology*. Despite a widespread traditional conviction in many fields that behavior, social relations, culture, or mental phenomena are somehow outside of the scope of Darwinian analysis (see, for discussion, Tooby and Cosmides 1992), the principles of core Darwinism constitute an organism design theory whose engineering principles apply with as much force to the computational and neural machinery that produces behavior as to any other set of organs or tissues in the body (Cosmides and Tooby 1987). Indeed, increasingly accurate characterizations of the designs of these computational devices must eventually form the centerpiece of any meaningful theory of behavior, for any species, in any discipline (e.g., economics; see Cosmides and Tooby 1994).

In this sense, theories of behavior and theories of the structure of psychological mechanisms are simply two sides of the same coin. Observing patterns in behavior is one source of information that helps to reverse engineer the computational designs of the mechanisms that generate those patterns. Reciprocally, accurate knowledge of these designs yields precise theories of the behaviors that these designs generate. Evolution is logically linked to behavior only through its engineering impact on the psychological mechanisms that regulate behavior, and so evolutionary theories of behavior are, inevitably, psychological theories, whether their proponents explicitly recognize it or not. This is why behavioral measures and field studies are a regular part of evolutionary psychological research, along with a broad array of other methods, such as the study of focal brain damage, electromyography, hormone assays, psychophysics, cross-cultural comparison, experimental economic studies, neuroimaging, cognitive experimentation, psychopharmacological dissociations, the analysis of incidence rates from archive-derived data, and so on. Indeed, this is why evolutionary psychology and behavioral ecology are, in reality, essentially the same discipline. The only difference is that the term *evolutionary psychology* was adopted to identify a research program within modern evolutionary biology and behavioral ecology that adheres strictly to the logical structure of Darwinism and that is committed to characterizing the phenotypic designs of mechanisms, which are (usually complex) adaptations. Many researchers who identify themselves as behavioral ecologists share this program, but many do not.

By adaptations we mean inherited arrangements of elements in organisms that have been brought into their specific mutual relationship because that configuration, over evolutionary time, promoted the frequency of that inherited arrangement. In other words, adaptations are systems of functional machinery that assumed their improbably well-ordered functional relationships because, in the ancestral lineage's environment of evolutionary adaptedness, these relationships successfully accomplished tasks that increased the frequency of the alleles coding for those traits. Most phenotypic design consists of adaptations that are complex, that is, consisting of many components that depend for their existence on alleles at multiple loci. Because of sexual recombination and the combinatorics of alleles, most complex adaptations in humans and similar species will necessarily be species-typical and will depend on alleles at many loci being at or near fixation (for analysis, and appropriate qualifications, see Tooby and Cosmides 1990a).

With the foregoing as background, one can define the *environment of evolutionary adaptedness* for an adaptation as that set of selection pressures (i.e., properties of the ancestral world) that endured long enough to push each allele underlying the adaptation from its initial appearance to near fixation, and to maintain them there while other necessary alleles at related loci were similarly brought approximately to fixation. Because moving mutations from low initial frequencies to fixation takes substantial time, and sequential fixations must usually have been necessary to construct complex adaptations, almost all complex functional design in organisms owes its detailed organization to the complex and enduring structure of each species' past. Each design feature present in a modern organism is there because of a large and structured population of events in the past, and these event populations must be characterized if the design features are to be understood. It is a surprising lapse in many excellent evolutionary researchers' thought (see, e.g., Reeve and Sherman 1993) that they are not adaptationists in this strict Darwinian sense but focus instead on the present fitness consequences of a trait, which cannot logically play any role in explaining its existence (Tooby and Cosmides 1990b; Symons 1992).

Because selection is an antientropic process that operates across generations to build functional order into an organism's design, pushing upstream against entropy, the standards required to establish that a set of traits are an adaptation are probabilistic in nature (as they are in any good science). More specifically, one can use a knowledge of selection pressures, ancestral conditions, and computational principles to formulate hypotheses about the likely existence of various cognitive adaptations. To evaluate whether there is evidence for a particular adaptation, the question to be asked is: How improbably well ordered are the elements of the proposed adaptation, of one assumes its function was to reliably solve an adaptive problem or achieve an adaptive outcome in the organism's EEA? The metric is not optimality but rather, how much better than random is the adaptation at achieving biologically functional outcomes? In Williams's language, what is the evidence of special design (Williams 1966a)? That is, what is the evidence that the problem is solved with efficiency, reliability, economy, precision, and so on?

As one part of our research, we have been investigating the hypothesis that the human mind contains specialized information-processing adaptations designed to guide individuals successfully through social exchange. To provide a prototype of what an adaptationist psychological research paper might look like, we wrote "Cognitive Adaptations for Social Exchange," discussing selection pressures, ancestral conditions, predicted design features, and experimental evidence of special design, as well as the by-product counterhypotheses that had been eliminated experimentally. Since this paper, we and others have now produced a much larger body of evidence supporting the hypothesis that humans have specialized cognitive devices for this purpose (e.g., Gigerenzer and Hug 1995; Hoffman, McCabe, and Smith 1996a; Cosmides and Tooby, in prep.c; Fiddick, Cosmides, and Tooby, in prep.). One task is to show that any proposed complex psychological adaptation is effectively human universal, and not limited to some cultures but not others. Toward that end, these results have been replicated not only in a number of literate populations around the world but also using nonliterate subjects drawn from the Achuar, a hunter-horticulturalist population in the Amazonian region of Ecuador (Sugiyama, Tooby, and Cosmides, in prep.).

A second approach is to demonstrate that this specialized reasoning ability is a discrete, independent computational ability distinct from other abilities to reason, with its own unique properties and principles of activation. Toward this end, we have also accumulated a significant body of evidence supporting the existence of, and allowing us to separately characterize, three other reasoning adaptations (out of what we expect to be hundreds) with sharply differentiated functions and properties. These three include one for detecting lapses in taking precautions to avoid danger; one for detecting bluffs when one is threatened; and one for detecting double crosses when one is threatened. The most common counterhypothesis is that human reasoning is general-purpose and does not contain multiple reasoning specializations that operate according to domain-specific principles. If this were true, and there was only one psychological mechanism involved, then neither neurological impairments nor experimental manipulations should lead to dissociations in performance on tasks that differ only in whether they concern social contracts or precautions. To the human mind, these would all be instances of the same task, solved by the same mechanism, embodied in the same neural circuitry. However, subjects do experience experimentally induced dissociations that break down along the predicted lines—indicating that social exchange mechanisms and precaution mechanisms are cognitively real and separate mechanisms in humans (Fiddick, Cosmides, and Tooby, in prep.). We are presently collaborating on a study to identify the neural basis of these mechanisms, by identifying individuals who suffer selective impairments to one or another of these mechanisms, as the result of neurological damage. Indeed, Maljkovic (1987) has found that the ability to detect cheaters is maintained in schizophrenics, while other, more general deliberative reasoning abilities are impaired. This dissociation between social contract algorithms and general problem-solving ability constitutes another line of evidence suggesting that the social exchange mechanisms are a distinct and specialized competence. We are also collaborating on another study into the precaution and social exchange competences of individuals with autism. Autism is now believed to be a disorder caused by damage to part of an evolved faculty of social cognition—specifically, to the "theory of mind" module, a mechanism that causes people to infer that the actions of others are caused by unobservable mental attributes, such as beliefs and desires. Social exchange circuits are a part of social cognition, while precaution circuits need involve no social dimension. One intriguing possibility is that individuals with autism will be able to reason correctly about precautions, since they are nonsocial, but not about social exchanges. Another facet of this research program involves expanding the theoretical analysis from dyadic cooperation or social exchange to *n*-person cooperation, and mapping the set of computational devices that allow humans to form, participate in, manipulate, and abandon coalitions. The existence of a set of specialized cognitive devices that make sophisticated coalitional action possible is one central way in which human sociality differs from that of virtually all other species. Preliminary evidence suggests that at least some of the predicted coalitional mechanisms do exist.

In summary, a number of researchers have gone a long way toward establishing the existence of complex adaptive computational designs in the mind, designed to reason about social exchange. The weight of evidence now indicates that such mechanisms are species-typical. We anticipate that in the foreseeable future, we will be able to identify the neural basis of these mechanisms and their relationship to other related subsystems in human social cognition. What remains distant is the elucidation of the genetic bases and developmental biology of these adaptations.