Temperaments:
A critique of evolutionary psychology.

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Abstract. This thesis is devoted to examining Leda Cosmides and John Tooby's use of evolutionary psychology as a heuristic framework for explaining human social behavior. Cosmides and Tooby are among the most vocal advocates of a now popular version of evolutionary psychology. They argue that the functional complexity of human reasoning can be best explained within the framework of adaptationism and that knowledge of the evolutionary environment of adaptiveness is essential to a scientifically satisfying explanation for why humans behave as they do. I first discuss the design logic of evolutionary psychology, and the methodology Cosmides and Tooby use. I then discuss the consequences of not adhering to standard scientific practice and whether Cosmides and Tooby's adhere to standard scientific practice in developing and testing their models.

To the memory of
Nicholas Robert Lyle
1922—1999
Papa

Contents:

1. Introduction: explaining human social behaviors.

> [I]t is now possible to … understand for the first time what humankind is and why we have the characteristics that we do (Tooby and Cosmides, pp. 20, 1992).

Why do people behave as they do? There is a glut of answers for the question asking, why do people behave as they do? Many of the proposed answers are inconsistent with one another. Given the complexity of the subject and the current disparity among the intellectual community, it is inevitable that such a state of affairs would arise. Sorting through the bog of candidates for answers comprises an important part of the attempt to develop scientific explanations for human behavior.

One intuitive answer to the question is that people behave as they do because people are altruistic. By altruistic I mean that people promote the well being of others even at their own peril. This explanation is contentious because any one of a number of atrocious acts individuals have committed against humanity may be invoked to counter the claim. Still, one might offer in defense, as heinous as those acts are they are not sufficient to demonstrate that people do not sometimes promote the well being of others. And this is at least needed for altruism to be possible. Many people promote the well being of others even if sometimes some people act selfishly. Plato argues that people never intend evil because evil behavior is irrational and people cannot intentionally be irrational. So, for Plato, explaining potential counter examples to the claim that people are always altruistic requires saying why people sometimes act irrationally. This requires Plato to explain that humans act irrationally only out of ignorance. The point is made when Socrates defends himself against Meletus' charge that he is guilty of corrupting the youth of Athens. Socrates argues that no rational person knowingly corrupts their fellows because it is better to live among good rather than wicked fellow citizens. Socrates points out to Meletus that the wicked harm those who are closest to them whereas good people benefit those closest to them. Since no rational person desires to be harmed, if one does corrupt ones' fellows, it is unwillingly and out of ignorance (Cohen, Curd, and Reed, pp. 114, 2000). Plato argues people are by nature rational and rational people promote the well being of other people.

Hobbes' answer to "Why do people behave as they do?" is inconsistent with philosophical arguments like Plato's. But, Hobbes' answer also can be said to be equally intuitive. One might think that people behave as they do because people are basically self-interested. One might think that promoting one's own interest is the only intrinsic desire, and that there is nothing inherently valuable in privileging other humans above one's self. Hobbes argued that without the constraint of the Sovereign's sword, people are brutish. Hobbes believed that only the fear of death keeps humans from tearing each other apart. When Hobbes looked around he found that people were by nature egoists. Granting that the preservation of one's own life is the only intrinsic desire, rational people will value their own lives above all else. On Hobbes' conception of rationality people are rational in that they value their own well being above all else. For one possessed of Hobbesian reasoning processes it is irrational to pursue any interests that do not promote one's own well being, exclusively.

Arguments like Plato's and Hobbes' funnel scholars to a particular conceptual analysis of rationality and the philosophical intuitions driving each particular conceptual analyses clash. Some scholars argue that people are naturally altruistic while other scholars claim that people are naturally self-interested. Yet, scholars agree that in some sense rational people are thoughtful people, so it becomes important to say how people think. So, whether one is inclined to think that people are altruistic or self-interested, one needs to know how people think to know why people behave as they do. But, from Plato (4^{th} century BCE) to Nozick (1993), the a priori attempts to state necessary and sufficient conditions for being thoughtful all fail. What remains is to evaluate other attempts.

A natural alternative is to treat human behavior scientifically by carefully observing how human's actual behaviors vary within the many environments they are found in. But, with exceptions such as Aristotle, it was not until relatively recently that scholars took up the projects of carefully observing and cataloging human behaviors just for the sake of understanding how humans actually behave.

David Hume (1777) and Gustav Fechner (1860) are among a handful of scholars to develop and encourage other scholars to adopt new methodologies for investigating human behavior. Hume and Fechner were interested in understanding how people actually behave. Hume laid the foundations for scientific psychology by persuading scholars to model human behavior analogously to Isaac Newton's models for the behavior of inanimate bodies in motion. Hume rejected appeals to authority and Cartesian analysis as sufficient conditions for inquiring about the real world, including human behavior. Newton's work was praiseworthy, thought Hume, because Newton's general laws for the behavior of physical bodies were rooted in empirical data. Fechner contributed to the scientific investigation of sensation and perception. Fechner's contributions made it possible to say with mathematical precision which cues would result in lawful regularities in human behavioral responses. Fechner and his mentor Weber demonstrated that is indeed possible to use quantitative analysis in the investigation of human behavior. Human behaviors can be measured with scalars just as other natural physical phenomena can be measured (Dember and Warm, 1979).

Likewise, Charles Darwin (1871) turned to nature for direction. It was the careful observation of organism's actual behavior that led Darwin to develop his radical ideas. Unlike the neo-Thomists and others practicing the methodology of the "Schoolmen," Darwin went out into the field and collected data prior to developing an explanatory framework. In December of 1831 as the naturalist to the survey ship HMS Beagle Darwin set out on a five-year voyage of scientific discovery. As naturalist on the HMS Beagle Darwin visited Tenerife, the Cape Verde Islands, Brazil, Tierra del Fuego, the Galapagos Islands, New Zealand, Tasmania, and the coral reefs of Keeling Islands. During his five-years as ship naturalist Darwin observed and collected various life forms. The observations Darwin made as ship naturalist resulted in a vast knowledge base from which he began to seriously question Creationist explanations for variation among living beings (Gregory, 1987). Hume, Fechner and Darwin are pivotal figures in shifting the mainstream's interest away from philosophical enquires to scientific enquires.

It is possible to locate evolutionary psychology within the history of philosophy and the life sciences. The life sciences developed as a result of changes in the mainstream's attitudes about what methods are appropriate for generating new knowledge. The life sciences can be viewed as a turning away from philosophical method toward an empirical method. As the sciences at large developed, scholars in increasing numbers turned to scientific methodology to address specific questions. Darwin's questions encouraged the development of evolutionary biology. In turn, as evolutionary biology developed, evolutionary minded scientists began to focus on specific questions within evolutionary biology. Evolutionary minded scientists like Leda Cosmides and John Tooby developed evolutionary psychology because they wanted a tool to investigate how natural selection effected the development of human social behaviors. Evolutionary psychology is a discipline that focuses specifically on understanding the relationship between evolutionary processes and human social behaviors.

Evolutionary psychology as a heuristic framework for explaining human social behaviors comes with a history and it is important to understand that evolutionary psychology needs to be viewed as a period within a historical climate. Historically speaking, there are various competing explanations for the causes of human social behaviors. In the pages that follow I argue that like the philosophers who failed, the scientists will fail when relying upon appeals to authority or conceptual analysis alone. Explanations for why humans behave as they do must be rooted in careful observation of actual human behaviors, nothing less will be satisfying.

2. The Value Of Evolutionary Psychology: modeling human social behavior

> [A]n understanding of the principles that govern evolution is an indispensable ally in the enterprise of understanding human nature and an invaluable tool in the discovery and mapping of the species-typical collection of information-processing mechanisms that together comprise the human mind (Tooby and Cosmides, pp. 50, 1992).

Every scientific discipline and sub-discipline exists because it has something to offer to the scientific community. As soon as the scientific community recognizes that a discipline has nothing to offer, scientists will suspend work on that discipline's projects. In time the discipline withers and perhaps dies. On the other hand, as soon as the scientific community recognizes that a discipline has something to offer, additional scientists begin to work on that discipline's projects and the discipline flourishes. The key to a discipline's survival lies in generating information. The more valuable the information to the scientific community, the more attractive the discipline is to developing scientists. When the information being offered is little valued, then there is little motivation to pay attention to the discipline offering the information.

The ideal discipline for attracting scientists is a discipline that can provide information that no other discipline can offer. Evolutionary psychology, argue its advocates, is in a position to offer explanations for human social behavior that no other discipline can offer, social science or otherwise. Evolutionary psychology's advocates claim evolutionary psychology can provide information that no other discipline can offer.

Evolutionary psychology's advocates claim evolutionary psychology is in position to offer explanations for human social behaviors that no other discipline can offer because of the heuristic utility of evolutionary psychology. According to Cosmides and Tooby (1992, 1994, 1997) the value of evolutionary psychology lies in the discipline's heuristic utility. Cosmides and Tooby believe that "knowing what [a mechanism] was designed to do—what its functions is—has enormous heuristic value because it suggests what design features it is likely to have. It allows you to pinpoint the kinds of problems a [mechanism] should be very good at solving" (Cosmides and Tooby, pp. 530, 1994). The unique heuristic utility of evolutionary psychology lies in the design logic developed and utilized by evolutionary psychologists. The design logic evolutionary psychologists utilize enables them to formulate sharply focused predictions and formulating sharply focused predictions is essential to the scientific process. In developing particular design logic implicit in the principles of evolutionary biology and cognitive science, evolutionary psychologists are able to model the developmental processes that enable human social behaviors. By modeling the developmental processes that enable human social behaviors, evolutionary psychologists offer a unique way of investigating social behaviors.

Evolutionary psychologists intend their way of investigating human social behaviors to replace traditional empiricist influences on research projects investigating human social behavior. Cosmides and Tooby see empiricist influences driving wedges between disciplines that ought to be unified with the sciences at large. Traditionally, empiricist arguments conclude that social behaviors are learned. Empiricist explanations for social behaviors tend to focus solely on individuals' ability to make associations and to formulate and follow rules inferred from the associations. Empiricists, generally, argue that it is within the social environment that the associations are given and through processes of enculturation that rules are learned. Locke (1706), a British Empiricist, argued that the mind comes into the world a blank slate. Thus, for Locke and other empiricists one's ability to be social must be learned. An important implication of empiricist arguments is that an individual's social behavior is best explained as a product of the culture the individual is immersed in.

The suggestion that social behavior is best explained by explaining how one becomes enculturated impelled many empiricist minded social scientists to go looking for general purpose reasoning mechanisms. Cosmides and Tooby dub those social scientists that go looking for general purpose reasoning mechanisms the standard social scientists. The standard social scientists are the modern heirs of empiricism (Cosmides and Tooby, 1992). Like their empiricist predecessors, standard social scientists focus on enculturation and learned rule following as the most important variables in explaining human social behavior. Cosmides and Tooby complain that the standard social scientist in their quest to find general purpose reasoning mechanisms have developed a heuristic framework which factions the sciences. So evolutionary psychologists in addition to offering a unique approach to investigating human social behaviors is valued also because it provides a framework to unite research projects investigating human social behaviors. Cosmides and Tooby argue their "framework makes progress possible by accepting and exploiting the natural connections that exist among all the branches of science" (Tooby and Cosmides, pp. 23, 1992).

Evolutionary psychologists, contra the empiricist minded standard social scientists, think that the mechanisms enabling social behaviors are presently in place because of a process of natural selection. Evolutionary psychologists argue that identifying and investigating problem domains stable throughout human history is essential to discovering how adaptive mechanisms function to enable human social behavior. Evolutionary psychology is valuable because evolutionary psychology alone is committed to the design logic of adaptationism.

Cosmides and Tooby argue that identifying a problem domain stable throughout the evolutionary environment of adaptiveness is a likely way to discover naturally selected mechanisms that each function to mediate problems inhibiting reproductive success. Advocates of evolutionary psychology argue that due to the processes of natural selection many non-trivial human social behaviors are candidates for being enabled by mechanisms dedicated to solving long-standing problems.

Utilizing principles foundational to evolutionary biology and cognitive psychology evolutionary psychologists developed a heuristic framework to explain the developmental association between a mechanism and the reproductive problem the mechanism functions to solve. Cosmides and Tooby argue that because evolutionary psychology alone is willing to model problem domains stable through the evolutionary history of the human species, evolutionary psychology alone lies in position to house fruitful research projects offering valuable information to the sciences at large.

Evolutionary psychology claims to be positioned to explain the link between humans' engagement in many different social behaviors and the reproductive success of humans. Reproductive success contributes directly to many social behaviors. Sexual selection, for example, determines our ability to find a mate, which is surely critical to fitness. Behaving sociably mediates problems inhibiting reproductive success; so mechanisms enabling social behaviors were selected. Advocates of evolutionary psychology believe that mechanisms enabling social behaviors are the consequence of human developmental history. Advocates of evolutionary psychology argue that evolutionary psychology is valuable because its heuristic framework guides scientists in their quest for satisfying explanations of human social behavior and evolutionary psychology unlike the empiricist minded standard social scientist, unifies the sciences.

Like any useful heuristic scientific framework evolutionary psychology should be valued to the extent to which it aids researchers in choosing sharply focused predictions that can be confirmed by experimental findings. Cosmides and Tooby claim evolutionary psychology is a heuristic framework from which sharply focused predictions can be formulated and many scientists believe them (Alcock, 1998). Additionally, Cosmides and

Tooby (1992) claim that evolutionary psychology is valuable because it provides essential logic for deriving specific predictions about human social behavior that must necessarily be overlooked by other disciplines. Cosmides and Tooby attribute to Popper (1972) the point that conceptual systems function as organs of perception; as such "they allow new kinds of evidence and new relationships to be perceived" (Popper, 1972, as reported in Tooby and Cosmides, pp. 67, 1992). Cosmides and Tooby appeal to Popper in arguing that "the tools of evolutionary functional analysis function as an organ of perception, bringing the blurry world of human psychological and behavioral phenomena into sharp focus and allowing one to discern the formerly obscured level of our richly organized species typical functional architecture" (Tooby and Cosmides, pp. 67, 1992). The implication is that all other heuristic frameworks fail to make sense of human psychology, including human social behavior. If evolutionary psychology can provide information that no other discipline can provide, as Cosmides and Tooby think evolutionary psychology can, then evolutionary psychologies advocates' promise that evolutionary psychology is valuable will be vindicated.

Characterizing Evolutionary Psychology: explaining human psychology

Evolutionary psychology is a discipline that incorporates into its heuristic framework principles fundamental to evolutionary biology. So, to properly understand evolutionary psychology it is essential to begin by examining principles fundamental to evolutionary biology. Evolutionary biology as a discipline intends to account for the morphological and genetic variation among the different biological kinds. The two major classes of phenomena that evolutionary biologists want to account for are speciation and adaptation. The manifest differences between groups like hominids, which have bilateral symmetry, and starfish, which have radial symmetry, have long captured biologists' attention. Creationism and common decent were early and popular ways of explaining between group differences. Accounting for between group differences is the problem of speciation. Perhaps less evident and more difficult to explain are the within group differences. The within group differences among the various Finches of the Galapagos Islands captured Darwin's attention. Among his other interests Darwin wanted to know what accounted for the variation in the size and shape of Finch's beaks. Accounting for within group differences is the problem of adaptation.

Darwin in setting out to explain morphological variation between groups and within groups introduced the intellectual community to natural selection. Darwin (1871) adopted the principle that natural selection accounts for the morphological variation in life on earth. Darwin's contribution to natural selection theory was five fold. First, Darwin pointed out that some organisms are more able to raise their offspring. Second, Darwin observed that anatomy, physiology, and behavior vary among members of a species. Third, Darwin postulated that given the conditions of the environment, some variants within a group are more likely to survive and reproduce. Fourth, Darwin noted that offspring tend to resemble their parents. And fifth, Darwin surmised that all groups are linked by a shared history (Michel and Moore, 1995). Evolutionary biologists since Darwin have done much to develop natural selection theory.

Currently natural selection theory can be thought of as a set of models that evolutionary biologists use to account for the variation in life on earth. Evolutionary psychology weaves natural selection theory into their explanation for human social behaviors. The account of natural selection theory that evolutionary psychology is familiar with argues that selection works on the phenotype. Selection preserves mechanisms that contribute to reproductive success. I begin by explaining how nature selects among variations. Nature, evolutionary psychologists believe, selects among variations in the genetic makeup of particular individuals. Another way of expressing the point is to say that natural selection chooses among the variations occurring in the gene pool. The gene pool is the aggregate of all the genes and the relative frequency of their allele forms in a population. An allele form of a gene is one of the various forms that a gene may express. Brown hair is the phenotypic consequence of an allele of the gene that expresses hair color and green eyes is the phenotypic consequence an allele of the gene that expresses eye color. Genes get transmitted as a package from one generation to the next.

Genes transmitted as packages from one generation to the next contribute to the variation in phenotypic expressions of individuals. Evolutionary psychologists think of the phenotype of an individual as the anatomical, physiological and cognitive characteristics that the individual consists in. Since there are developmental sequences that relate genotypes to phenotypes, phenotypic variation often can be accounted for by explaining variation in the genotype. Discussion of variation requires noting several interesting features of genes. Genes each have a place on the chromosome like beads have a place on a bracelet; multiple genes may replace each other at a particular locus on a chromosome; a gene may be associated with the occurrence of several different phenotypes (pleiotropism); genes at one locus are found to affect the action of genes at another locus (epistasis); genes may enhance or suppress the action of other genes; and pleiotropic and epistastic processes have graded effects. Any perturbation that results in the rearrangement or displacement of a gene may result in variations in phenotypic expression, just as can changes in the genes themselves.

An individual's genome consists of chromosomes. The human genome for instance has twenty-three homologous chromosome pairs for a total of forty-six chromosomes. All chromosomes consist primarily of Deoxyribonucleic acid (DNA). The portion of DNA that codes for proteins is a very long molecule that can be thought of as a string of genes. Each gene of a DNA molecule has a place on the chromosome like a bead has a place on a bracelet. Yet, since variation occurs in the gene pool of a population, it is not appropriate to think of DNA as a string of genes where the combinations and positions of the individual genes are absolutely static. While it is true that each chromosome consists of a particular arrangement of genes there are two sources that allow for some flexibility in the genetic make up of each individual's DNA molecule. Understanding natural selection theory requires one to become acquainted with both the mechanisms contributing to variation in the gene pool.

There are at least two important sources of variation that naturally occur in the genome. Shuffling and crossing over occur during meiosis, which is the process during which gametes are formed. Sperm and ova are both gametes. Each gamete is a daughter cell that has only half the chromosome complement of the parent cell. During meiosis each chromosome pair divides independently of other non-homologous chromosome pairs. This independent process is an important source of variation in the arrangement of genotypes and it is referred to as genetic shuffling. Because each chromosome division is independent of all the other divisions, there will be variation in the assortment of genes among the various gametes. Independent division of the gametes ensures that the gametes will not be exact replicates of the parent cell. This is commonly referred to as "independent assortment," following Mendel. The particular arrangements of genes on the chromosome factor into to the phenotypes expressed in an individual.

Crossing over is a second important source of variation in the genome. Crossing over transpires when each member of a homologous pair of chromosomes join together and interchange a part of their length. Crossing over can be thought of analogously to the splicing together of two ropes. When crossing over transpires the new chromosome has a block of maternal and paternal genes on the same molecule. Crossing over is an important source of variation in the combinations of allelic forms of genes. The variation in the combinations of allelic forms of genes generated during crossing over will be transmitted as a package to the next generation.

While understanding that selection works on variation occurring in the gene pool is important, providing an answer to what selection works on is only a piece of evolutionary psychology's project. Another piece of evolutionary psychology's project provides an answer to why particular phenotypes are selected. Evolutionary psychologists argue that nature selects only those genetic combinations that work to solve problems that promote or inhibit reproductive success. Because nature selects for only those genetic combinations that affect fitness, natural selection as the process driving evolution produces the universal and species typical complex functional design one finds in life on earth.

Natural selection works to ensure that variation in an individual's genome will be extinguished or infused into the gene pool of the population at large. The variations will be infused into the population when the variations result in phenotypes that enable the individual in possession of the phenotypes to better acquire resources necessary to reproduce. The variations will be extinguished when the phenotypes that result from the variations inhibit reproductive success. The insight offered is that complex phenotypic design results from the functional integration of many mechanisms that together promote the individuals ability to meet the demands of reproduction. Evolutionary psychologists use natural selection theory to explain the complex phenotypic design expressed in the human brain.

Adaptationism is the project of using natural selection theory to explain complex phenotypic design. Adaptationist projects, like evolutionary psychology, focus on the fit between the phenotypes expressed in an individual and the environment the individual occupies. One may think of the environment as a set of definable niches. In turn a niche can be thought of as an aggregate of adaptive problems. Adaptive problems are the pressures in the niche that the individual must mediate in order to reproduce. Because each niche is uniquely composed of adaptive problems, each niche will require niche-differentiated problem solving abilities (Michel and Moore, 1995). Selection is the process whereby individuals come to fit with their niches. Adaptationist programs investigate the complex design (adaptations) that results from selection for niche-differentiated problem solving abilities.

Adaptations are variations in an individual's morphology that enable the individual to mediate the adaptive problems the individual encounters in its niche.

Cosmides and Tooby (1992) refer to adaptations as problem solving machines, machines that solve adaptive problems. Adaptive problems have two distinct features. First, to count as an adaptive problem, the problem must have been sufficiently stable through the history of the species to allow enough time for individual members of the species to acquire mechanisms to mediate the problem. Second, to count as an adaptive problem, acquiring mechanisms to mediate the problem resulted in reproductive differentials. Positive differentials in rates of reproductive success act to preserve and propagate the mechanisms mediating adaptive problems. Solutions to adaptive problems must enhance reproductive success. The result is that variations in an individual's genome that contributed to reproductive success are transmitted as packages to the next generation. Evolutionary psychologists are united in the belief that as the process of selection continued, variations mediating adaptive problems that could be functionally integrated into complex adaptations were propagated within the population until the complex adaptations became universal and species typical.

George Williams (1966) contributed to natural selection theory by arguing that complex functional design is the hallmark of an adaptation. Williams (1966) developed criteria that enable evolutionary psychologists to identify candidate adaptations. Williams (1966) argued that an adaptation must be a universal and species typical characteristic, the solution to an adaptive problem fits the problem too well to have arisen by chance; further an adaptation can be identified by the exhibited specialization in economy, efficiency, complexity, precision, and reliability. Williams' (1966) criteria are important to evolutionary psychology. Evolutionary psychologists point out that the human ability to behave socially meets the criteria for being an adaptation. So, evolutionary psychologists postulate that the mechanisms enabling humans to behave socially are adapted.

Evolutionary psychology utilizes natural selection theory to explain the developmental history of human cognitive capacities. However, the models for natural selection that evolutionary psychology adopts are not only explanatory. Evolutionary psychologists use the models to derive predictions about the kinds of mechanisms that would function to solve adaptive problems. Cosmides and Tooby (1992) join other evolutionary psychologists in predicting that humans possess cognitive adaptations for social exchange. Cosmides and Tooby argue that the mechanisms enabling social exchange are universal and species typical characteristics of humans and human cognitive capacities for social exchange exhibit specialization in economy, efficiency, complexity, precision, and reliability. Further the mechanisms enabling social exchange fit the adaptive problems so well that it is improbable they could have arisen by chance.

Evolutionary psychologists argue that many adaptive problems can be solved through reciprocal altruism, i.e., social exchange. Reciprocal altruism refers to mutually beneficial social exchanges that transpire between genetically unrelated individuals (Trivers, 1971). For example, two individuals may agree that if one of them stays and looks after the garden while the other goes hunting, and that when the other returns with meat, the meat will be shared between them. So long as an individual could obtain more resources than the individual could consume, social exchange agreements similar to the agreement in the above example enabled humans to overcome the limits of obtaining resources serially. Individuals no longer had to wait until the garden was tended before going hunting; both gardening and meat gathering could be carried out concurrently. So, evolutionary psychologists conclude that since nature selects among those available variations in the gene pool that most successfully contribute to solving adaptive problems, and because reciprocal altruism is an avenue through which adaptive problems can be solved, the mechanisms enabling reciprocal altruism must be adaptive. Humans must therefore possess adaptations for social exchange.

In summary, then, evolutionary biology is the branch of biology that studies the processes that give rise to evolution. Cognitive psychology is the branch of biology that studies brains, information processing and how information processing affects behavior. Evolutionary psychology combines natural selection theory with the information processing approach of cognitive psychology. The result of synthesizing principles of evolutionary biology with principles of cognitive psychology is a heuristic framework that enables scientists to investigate the adaptive mechanisms enabling human social behavior. By understanding how brains evolved to process information, scientists can explain how evolved information processing mechanisms enable human social behaviors. Scientists agree that human social behaviors, including learning, need an explanation. Adaptationism leads evolutionary psychologists to think the there is a link between the Pleistocene niches our ancestors inhabited and the modern social behaviors people engage in. In modeling the adaptive problems humans' Pleistocene ancestors encountered evolutionary psychologists are able to derive predictions about the functional attributes of the information processing mechanisms that could efficiently and reliably solve adaptive problems. Evolutionary psychologists are not satisfied with providing a priori accounts. The models evolutionary psychologists build and the predictions derived from those models are only the initial stages of their investigations. Evolutionary psychologists are in the business of providing empirical evidence to test the predictions derived from adaptationist logic.

4. The Argument: identifying evolutionary psychology's commitments

From the aforementioned characterization of evolutionary psychology the following argument can be formulated. The thesis of the argument states that disciplines failing to take Pleistocene environments, especially social environments, into account cannot yield the fruitful research projects that those disciplines like evolutionary psychology, which do take ancestral environments into account, will yield. The key premise is that many of the social behaviors that humans now employ have an ultimate cause reaching back to the Pleistocene epoch; and because possession of mechanisms that enable social behavior resulted in positive reproductive differentials, humans inherited many mechanisms enabling non-trivial social behaviors. The conclusion to be drawn from the key premise is that knowledge of Pleistocene environments aids the project of discovering the design and function of the human brain. Once the mechanisms the human brain consists in are understood, then human behavior can be satisfactorily explained.

Evolutionary psychologists agree that nature selects among the available variations to the extent that the mechanisms arising from the variations contribute to reproductive success. The process of natural selection results in adapted mechanisms that function to solve adaptive problems. Evolutionary psychologists argue that knowledge of the evolutionary environment of adaptiveness affords scientists the opportunity to identify problem domains stable through human evolutionary history. Once a stable problem domain has been identified, the domain can be modeled. From the model of the domain scientists can derive predictions about how a mechanism, efficiently and reliably solving the problem on that domain, should function. After utilizing a model to derive predictions, scientists devise experiments to test the derived predictions. The process of identifying adaptive problems, modeling adaptive problem domains and deriving predictions from the models and testing the predictions is scientifically fruitful. A prediction need not turn out confirmed to be considered scientifically fruitful. Being scientifically fruitful requires only identifying unexplored domains and extracting new knowledge from those domains. This is the sense in which adaptationism is heuristic.

Advocates of evolutionary psychology draw from the above arguments the conclusion that evolutionary psychology can generate knowledge that standard social scientist cannot provide because evolutionary psychology alone utilizes adaptationist logic to derive testable predictions. The soundness of the argument supporting the position that knowledge of Pleistocene environments affords scientists the opportunity to discover the design and function of the human brain is absolutely essential to defending the heuristic value of evolutionary psychology to the sciences at large. The unique understanding of Pleistocene environments is what affords evolutionary psychologists the opportunity to provide unique knowledge about human social behaviors. Evolutionary psychology is valued to the extent that it can provide knowledge no other discipline can provide. If adaptationism were false evolutionary psychology would suffer an irreversible loss of creditability.

Advocates of evolutionary psychology offer arguments designed to demonstrate that evolutionary psychology is uniquely situated to provide new, non-trivial explanations for human social behavior. Their arguments are corollaries of adaptationist logic and are designed to refute the standard social science model for human social behavior. The "Standard Social Science Model" is Cosmides and Tooby's characterization for how empiricist minded social scientists typically practice science. Cosmides and Tooby think standard social scientists are united by their defense of the following claims. First, everywhere children are born the same. Second, adult social behaviors often vary drastically from culture to culture. So, third, to understand the drastic variation in social behaviors, social scientists must investigate how processes of enculturation affect brains (Cosmides and Tooby, 1992).

The prediction that follows straightaway from the Standard Social Science Model is that the brain consists primarily of general purpose reasoning mechanisms, and that general-purpose reasoning mechanisms are the vehicle through which processes of enculturation affects brains. Advocates of evolutionary psychology are agreed that standard social scientists either assume the brain consists of general purpose reasoning mechanisms and goes on to do other work or the standard social scientist works to demonstrate that the brain consists of generalized reasoning mechanisms. In either case the standard social scientists ignores the logic of adaptationism. Cosmides and Tooby, as well as other advocates of evolutionary psychology, point out that by ignoring the logic of adaptationism, standard social scientist has no method for investigating the evolutionary development of the mechanisms enabling social behaviors. Cosmides and Tooby argue that the human ability to learn to behave socially is itself a phenomenon in want on an explanation.

To compel scientists to choose evolutionary psychology over the standard social science model, evolutionary psychology will have to demonstrate that the models evolutionary psychology confirm are incompatible with the models the standard social scientist formulates.

The best evolutionary psychology can do to compel scientists to abandon the standard social science model is to produce the unique knowledge it promises. The delivery of some promised fruit would begin to compel scientists to join the ranks of evolutionary psychology. Cosmides and Tooby advertise evolutionary psychology as a heuristic framework from which one may derive sharply focused predictions. But lacking substantial evidence confirming the predictions derived from the design logic of evolutionary psychology, scientists have only the force of conceptual argument to compel them to abandon their belief that general purpose reasoning mechanisms can explain human social behaviors.

5. Scientific Modeling: a principled way to choose among alternatives

> [Models] of the computational requirements of specific adaptive problems provides a principled way of identifying likely new modules, mental organs, or cognitive adaptations, and thereby opens the way for extensive empirical progress (Tooby and Cosmides, pp. 20, 1992).

The following types of questions need scientific answers. How does being a member of a particular culture affect the brain? Which, if any of these effects are interesting and why? To what extent do social practices shape the way people think and behave? Does the brain we are born with ever change form as a result of being (or not) social? If so, what is the importance of those structural changes? What is the relationship between the intentional content of social exchange and various features of our brains? How does the structure of the brain influence what can be learned? How does the inborn structure of the brain influence social behavior?

The purpose of this section is to account for how scientific modeling may be used to answer questions like the above stated questions. Scientific modeling from which rigorous scientific explanations are formulated can be thought of as a multi component algorithm. The basic components are a specifiable environment (i.e., a real world), a set of related descriptions of the world, predictions derived from the set of related descriptions, tests for fit between the related descriptions and the real world, and a determination of the likelihood that the prediction will be confirmed (Giere, 1997).

I assume that the account of scientific modeling presented here is a reasonable standard to which any enterprise purporting to be scientific can be held accountable. The value of scientifically rigorous explanations to scientists restrains scientists from endorsing any explanation that is not the result of a proper modeling procedure. The process of scientific modeling comes with restraints for those who value scientific explanation above speculation. The process of modeling offers scientists a principled way to check the veracity of an explanation. Since scientists are in the business of generating truthful explanations, scientists constrain themselves to endorse explanations formulated from only well confirmed models. An enterprise is scientific to the extent that the enterprise adheres to standard scientific modeling practices and an enterprise is functioning properly to the extent that the enterprise restrains itself from formulating explanations from poorly confirmed models.

By restraining the kinds of explanations scientists are willing to endorse, scientists free themselves to exchange metaphysical ontology for scientific epistemology. Scientific epistemology begins with the requirement that scientific explanations be more rigorous than other explanations. An explanation is rigorous in the scientific sense if it is an explanation rooted in a well-confirmed model of an object, event or process. The practice of scientific modeling is the process whereby statements about objects, events or processes get confirmed, rejected or retested. Any object, event or process is a candidate for scientific explanation and scientific explanation always begins with the process of modeling. Models of the kind scientists usually utilize can be characterized as a set of related descriptions.

But modeling is not merely the process of generating sets of related descriptions. Modeling, also, includes the process of determining how well each of the related descriptions fit with one another and how well statements derived from the descriptions fit with the real world. To say that a model fits the world well is to say that the model proves to be a reliable guide to the world. For example a model of how the human brain developed fits with real world brains when the model proves to be a reliable guide to the developmental process of real world brains encountered. In the initial stages of scientific modeling it is almost certain that many of the related descriptions the model consists in will not fit very well with the real world. It is the business of science to check the fit of each of the descriptions the model consists in. When the fit between a model and the world is not perfect, the model can be refined to improve the fit. The result is, ideally, an improved fit that is not merely ad hoc. As the set of descriptions the model consists in get tested and refined, the model becomes a more reliable guide to the real world or the model is rejected in favor of an alternative model that is a more reliable guide to the real world.

Recall that a scientifically satisfying explanation begins with a first approximation of some aspect of the real world. The first approximation can be thought of as a set of related descriptions that constitutes a model. However, first approximations result in models that are unreliable guides to the real world. Since the business of science is to formulate reliable models, a scientifically satisfying explanation may not be formulated from a first approximation of some aspect of the real world. A scientifically satisfying explanation for some aspect of the real world requires scientists must check to see how well any particular model fits with the real world the model is intended to be a reliable guide to. Explanations formulated from unreliable models are of no use in the scientific quest for new knowledge concerning the real world.

The standard way of checking to see how well a model fits with the real world is to derive predictions from the set of descriptions the model consists in and to test the predictions. Predictions are statements about how as yet to be observed circumstances in the real world are as a matter of fact. Since statements are either true or false, testing, observing that the real world matters of fact are as predicted by the model, give scientists a principled way to decide on the reliability of the model. When a prediction derived from a model is confirmed by test results, then the model proved to be a useful guide to the real world. As the model continues to produce truthful predictions, then the model gains creditability as a reliable guide to the real world. Likewise, if predictions derived from a model are disconfirmed, then the model is not a reliable guide to the real world. So, scientists test predictions to determine the reliability of a model. Since the reliability of a model of some aspect of the real world is not given a priori, the soundness of explanations formulated from a poorly confirmed model is unknown. Since scientists seek sound explanations, scientists refrain from endorsing explanations formulated from poorly confirmed models.

At work scientists find themselves explaining phenomena by modeling the phenomenal environment as best they can, and deriving predictions from their models. Once a prediction has been derived, the next step is to test to see how well those predictions fare when tested. In testing predictions the scientist experiment to see if the real world matters of fact are as predicted. Testing to see whether the real world matters of fact are as predicted will either confirm or disconfirm the derived prediction. Testing predictions is essential to determining the fit between the model and the real world. A model with none or very few confirmed predictions is not thought of as a scientifically rigorous model. The problem with models whose predictions go untested is that it is hard to trust that the model is a reliable guide to the real world.

Yet, even after confirming a prediction there remains an additional set of questions to be addressed by scientists before scientists are willing to conclude that there is a good fit between the model and the real world. Those questions revolve around saying with a specifiable degree of certainty what the likelihood was that the derived prediction would fit with the real world. For good reason, scientists privilege the confirmation of highly unlikely predictions above predictions that lie around chance. Consider an example. Consider a model of American Halloween night behaviors. The model consists of the following set of related descriptions: one night each year, in October, folks dress up their children in costumes, and take their children to gather candy from their surrounding neighborhoods. When children arrive at the door of neighbors participating in the holiday activities, the children greet their neighbor with "trick or treat?" After being greeted the participating neighbor gives candy to the children.

Now suppose the modeler is being queried about the given model of American Halloween night behaviors. The modeler says, "I can provide reason to think that the given model fits real world American Halloween night behaviors. Since tonight is Halloween, I predict that there will be a knock on the door within the next few minutes." As predicted there is a knock on the door. Thus, there is a definite sense in which the prediction derived from the given model was confirmed. However, confirming a prediction without determining the likelihood for confirmation does little to eliminate alternative models.

Following the algorithm thus far developed, because the person querying the modeler has no knowledge of American Halloween night behaviors, given that the prediction was confirmed, the confirmation of the prediction should be evidence to accept that the model fits with the real world. So, the person querying the modeler should have reason to believe that the given model is a reliable guide to the real world. However, a way to become worried about the model not being a reliable guide to the real world is to wonder if the prediction was too general. A prediction is too general when the prediction can be derived from alternative models of the real world. A prediction that is too general does little to test the reliability of the model as a guide to the real world.

Consider an alternative model of American Halloween night behaviors. The model consists of the following set of related descriptions: one night each year, in October, folks go on a mission to collect funds to be donated to medical research. The folks take their children to gather funds from their surrounding neighborhoods. When the folks' children arrive at the door of neighbors participating in the holiday activities, the children greet their neighbor with "can you help save humanity?" After being greeted the participating neighbors give funds to the children.

Now suppose the modeler is being queried about the given model of American Halloween night behaviors. The modeler says, "I can provide reason to think that the given model fits real world American Halloween night behaviors. Since tonight is Halloween, I predict that there will be a knock on the door within the next few minutes." As predicted there is a knock on the door. Thus, once again, there is a definite sense in which the prediction derived from the given model was confirmed.

However, because the prediction is derivable from alternative models, confirming the prediction that there will be a knock on the door within the next few minutes does not enable the person querying the modeler to adjudicate between alternative models. So confirming a general prediction without determining the likelihood for confirmation does little to eliminate alternative models. If alternative models are not eliminated, then confirmation of the prediction should provide little by way of conviction to believe that the model from which the prediction was derived is a reliable guide to the real world. Since the two models given above describe very different matters of fact, and there will be a knock on the door within the next few minuets can be derived from both models, confirming that there will be a knock on the door within the next few minutes should not convince anyone that the model is a reliable guide to the real world.

Considering the likelihood that an event would be confirmed provides a principled way to regulate one's confidence in the model being a reliable guide to the real world. The more confident scientists are in the likelihood that the confirmed prediction can be derived from only one model, the more confidence scientists place in their belief that the model is a reliable guide to the real world. This captures the common idea that a rigorous test is more significant than a less rigorous test. Consider another example. Suppose instead of predicting that within the next few minuets someone will knock on the door, the modeler predicts that when a child knocks on the door Halloween night, the child will greet the neighbor with "trick or treat?" The likelihood that the child will greet the neighbor with "trick or treat?" given the child is there to collect funds for medical research is minimal. It is hard to see how one could logically derive the prediction that the child will greet the neighbor with "trick or treat?" from the model that American Halloween night behaviors are initiated by the desire to raise funds for medical research. So, the prediction that the child will greet the neighbor with "trick or treat?" is not too general. Thus, because the likelihood of the confirmation of the prediction the child will greet the neighbor with "trick or treat?" is minimal, one's confidence that the model fits the real world is inversely proportional to the likelihood of confirmation. So, under circumstances in which the likelihood that a prediction will turn out confirmed is minimal and the prediction does indeed turn out confirmed, scientists are reasonable to place a high degree of confidence in the fit between the model and the real world.

The principle operating here is that crucial predictions can be derived only from rigorously developed models; the more crucial the prediction is to the coherence of the model, the less likely it is that the prediction will turn out confirmed, unless the model fits the real world. So, scientists cherish models whose confirmed predictions were highly unlikely. The process of scientific explanation offers a principled way to check the fit between any model of human social behaviors and the real world matters of fact the model intends to be a reliable guide to. Further, the processes of scientific explanation come with restraints for those who value scientific explanation above speculation. The value of scientific practice to scientists restrain scientists from promoting explanations formulated from poorly confirmed models.

6. Cosmides and Tooby: modeling and deriving predictions

Incorporated within the heuristic framework of evolutionary psychology is the principle that natural selection theory together with knowledge of the adaptive problems human ancestors encountered in Pleistocene environments is essential to explain why human brains have followed the particular developmental trajectory that resulted in humans engaging in social exchanges. Because evolutionary psychologists are convinced that nature selects among those available variations in the gene pool that most successfully contribute to solving adaptive problems, problems that inhibit reproductive success, evolutionary psychologists are in the business of modeling Pleistocene environments with the intent of predicting which developmental trajectories would be optimal for solving the particular adaptive problems humans encountered.

Developmental trajectories that most successfully mediate adaptive problems can be thought of as optimal developmental trajectories. Evolutionary psychologists model the link between optimal developmental trajectories and optimization strategies to derive predictions about what universal and species typical phenotypes developed within human brains. Evolutionary psychologists predict that humans have followed a developmental course that enables humans to engage in social exchange because social exchange is an optimization strategy. Optimization strategies are algorithms that maximize benefit to individuals. Evolutionary psychologists are united in their belief that individuals' phenotypes enable individuals to develop and pursue optimization strategies. Natural selection theory assures evolutionary psychologists that the phenotypes enabling individuals to develop and pursue optimization strategies were selected and propagated until the phenotypes enabling the optimization strategies became universal and species typical features.

Because selection works on the phenotype and selection preserves and propagates phenotypes that contribute to reproductive success, natural selection theory together with knowledge of the adaptive problems human ancestors encountered in Pleistocene environments are essential elements in an explanation for why human brains followed the particular developmental trajectory resulting in humans engaging in social behaviors.

Cosmides and Tooby are examples of evolutionary psychologists, as scientists, engaged in modeling the Pleistocene environments human ancestors inhabited to derive testable predictions about what universal and species typical phenotypes developed in humans. Cosmides and Tooby use game theory to model possible optimal developmental trajectories available to human ancestors. Cosmides and Tooby "predicted that reasoning about social contracts would exhibit a number of specific design features" (Cosmides and Tooby, pp. 184, 1992). Because social exchange is an optimal strategy only when cheaters can be detected, Cosmides and Tooby predicted that there are content specific reasoning mechanisms (adaptations) enabling humans to detect cheaters. Since The prediction that there are content specific reasoning mechanisms (adaptations) enabling humans to detect cheaters is crucial to the coherence of the model they constructed, Cosmides and Tooby set the goal of their experiments to "be twofold: (a) to show that the reasoning procedures involved [in detecting violations of social imperatives] show the features of special design that one would expect if they were adaptations for social exchange, and (b) to show that the results cannot be explained as by-products of other, more general-purpose reasoning procedures" (Cosmides and Tooby, pp. 184, 1992). The experimental data they collected from a series of tests confirmed that there are "features of special design" and that the results are best explained by adaptationism. After their initial findings confirmed their prediction, Cosmides and Tooby retested their prediction to eliminate alternative models. About the completed series of experiments Cosmides and Tooby ran, they make the following report.

> Virtually all the experiments reviewed above asked subjects to detect violations of a conditional rule. Sometimes these violations corresponded to detecting cheaters on social contracts, other times they did not. The results showed that we do not have general-purpose ability to detect violations of conditional rules. But human reasoning is well designed for detecting violations of conditional rules when these can be interpreted as cheating on a social contract (Cosmides and Tooby, pp. 205, 1992).

Cosmides and Tooby after finding their initial prediction confirmed went back to the lab to check for the likelihood that their derived prediction would be confirmed given that their model was not a reliable guide to the real world. Cosmides and Tooby after eliminating several alternative models concluded that the likelihood was minimal that their derived prediction would be confirmed by experimental findings given that their model was not a reliable guide to the real world (Cosmides and Tooby, 1992).

The design logic of evolutionary psychology enabled Cosmides and Tooby to model developmental processes and to derive sharply focused predictions that could be tested. The specifiable part of the real world Cosmides and Tooby modeled was the development of the brain that enables reciprocal altruism. Reciprocal altruism (i.e., social exchange) can be modeled using the axioms of game theory. The axioms of game theory are utilized by evolutionary psychologists because game theory allows scientists to model optimization strategies. Recall that evolutionary psychologists model the link between optimization strategies and optimal developmental trajectories to derive predictions about what universal and species typical phenotypes developed within human brains. In modeling optimization strategies Cosmides and Tooby (1992) were able to predict that phenotypes enabling social exchange are among the universal and species typical characteristics humans developed.

The prisoners' dilemma is an example of how game theory can be used to model optimization strategies. The prisoners' dilemma is scenario where two partners in crime have been apprehended by the authorities. Each prisoner is put into a separate interrogation room. Both prisoners are given the opportunity to cooperate with the authorities by testifying against their partner. As the case stands, if neither of the prisoners cooperates with the authorities, then both prisoners will be sentenced to two years in prison. But, if one prisoner cooperates with the authorities, the cooperative prisoner will be sentenced to one year and the other prisoner will be sentenced to five years in prison. If, however, both prisoners cooperate with the authorities, then both prisoners will be sentenced to three years in prison. The prisoners' problem is to decide weather to cooperate with the authorities.

Game theory can be used to decide on the optimal strategy that the prisoners should pursue. The prisoners' dilemma can be formalized with a two by two payoff matrix. When there is only one move in the game, it is always in the interest of each prisoner to cooperate with the authorities. Despite the fact that they both are worse off than they would be if neither cooperated. However, when a population of prisoners is run in a tournament with repeated encounters, it is in the interest of the prisoners to cooperate by agreeing not to testify against each other (Axelrod and Hamilton, 1981).

In the prisoners' dilemma the costs and benefits to each prisoner were measured in years in prison. Costs and benefits can in theory be measured with any scalar. The scalar that is important to many evolutionary psychologists' models is fitness. The more fitness points an individual is able to accrue, the more fit the individual is. Likewise, the more fitness points an individual loses, the more unfit the individual is. By constructing a payoff matrix and axiomizing the costs and benefits, scientists can run tournaments to determine optimal fitness strategies. Models of optimal fitness strategies are important to evolutionary psychologists because of the link between optimization strategies and the developmental trajectories nature selects. Natural selection theory assures evolutionary psychologists that the phenotypes enabling individuals to develop and pursue optimization strategies were selected and propagated until the phenotypes enabling the optimization strategies became universal, species typical features. By identifying optimization strategies, evolutionary psychologists can predict what universal and species typical phenotypes humans developed.

Trivers (1971, as reported in Michel and Moore, 1995) used game theory to investigate the possibility that reciprocal altruism is an optimal strategy for an individual to employ. Trivers found three requirements are necessary for reciprocal altruism to be an optimal strategy for individuals to employ. He found that the costs to the individual helping must be low and the benefits to the recipient must be high; it must be highly likely that the positions of the helper and the recipient will be reversed in the future; and, he found, that those who do not reciprocate would be detected.

Cosmides and Tooby (1992) use game theory to model optimization strategies for social exchange. Cosmides and Tooby's model for social exchange asserts that there is a link between developmental trajectories and optimization strategies. Social exchange is optimal only when cheaters can be detected; selection ensures that phenotypes enabling social exchange develop to become universal and species typical features of humans. The prediction that follows from Cosmides and Tooby's model for social exchange is that humans have phenotypes that enable them to detect cheaters. The prediction that humans have phenotypes that enable them to detect cheaters is crucial to the coherence of Cosmides and Tooby's model for social exchange. Further disconfirmation of the prediction would demonstrate that Cosmides and Tooby's model for social exchange is not a reliable guide to the real world. It is arguable that disconfirmation of Cosmides and Tooby's prediction would cast doubt on the link between developmental trajectories and optimization strategies.

However, when Cosmides and Tooby used the Wason selection task to test their prediction, the test results confirmed their prediction. Cosmides and Tooby found that people are much better at detecting violations of social exchange imperatives than they are at detecting violations of any other kind of imperatives. After a number of tests approximately seventy-five percent of subjects tested were able to detect violations of social exchange imperatives but only less than twenty-five percent of subjects tested were able to detect violations of non-social exchange imperatives (Cosmides and Tooby, 1992).

As significant as the findings were, Cosmides and Tooby's model as a reliable guide to the real world was not ensured by the initial test results confirming their prediction. An important question remained to be answered. Cosmides and Tooby needed to determine the likelihood that the prediction would be confirmed given their model was not a reliable guide to the real world. If familiarity effects could account for the test results, general purpose reasoning mechanisms might explain their findings. Cosmides and Tooby needed to demonstrate that it is highly unlikely that humans' familiarity with social exchanges would account for earlier test results. So Cosmides and Tooby went back to the lab to test to see if general purpose reasoning mechanisms could account for the content effects in human reasoning that they earlier detected. With their next series of tests Cosmides and Tooby incorporated both familiar and unfamiliar social exchange imperatives into the Wason selection task. Of the series testing for familiarity effects Cosmides and Tooby (1992) report that the results clearly favor their model. They report,

> In fact, both we and Gigerenzer and Hug (1992) found that the performance level for unfamiliar social contracts is just as high as it usually is for familiar social contracts … around 75% … Familiarity, therefore, cannot account for the pattern of reasoning … performance is not a by-product of familiarity (Cosmides and Tooby, 1992).

Thus, it seems that Cosmides and Tooby found confirmation for a highly unlikely prediction. Because scientists take content specific reasoning mechanisms and general purpose reasoning mechanisms to be exclusive and exhaustive, by treating the prediction that the brain consists solely of general-purpose reasoning mechanisms as the null hypothesis and the prediction that the brain developed content specific reasoning mechanisms as the alternative hypothesis, then it is highly unlikely that the alternative hypothesis would be confirmed if the model from which the null hypothesis was derived were a reliable guide to the real world. It is highly unlikely that cheater detectors would have been discovered if the model from which the null hypothesis was derived were a reliable guide to the real world.

7. Conclusion

I stated at the end of section two that if evolutionary psychology can provide information that no other discipline can provide, then evolutionary psychologies advocates' promise that evolutionary psychology is valuable as a heuristic framework will be vindicated. It seems that evolutionary psychologies advocate's promise has been vindicated. Evolutionary psychology, it turned out, at least in this case, is a valuable heuristic from which a sharply focused and testable prediction was derived. While it is clear that Cosmides and Tooby are practicing science in accord with standard scientific practice (Giere, 1997), still I worry that we will never have the kind of historical evidence necessary "to construct a reliable evolutionary explanation for an adaptation [for human reasoning]" (c.f., Richardson, (1996). It may be that evolutionary psychology's heuristic value is limited to enabling functional explanations and the value of functional explanations is questionable. Further, Cosmides and Tooby found that general-purpose reasoning mechanisms could not account for the context effects in human reasoning about human social behaviors. So, it seems, there is reason to abandon the Standard Social Science Model that factions the sciences at large and ipso facto there is reason to embrace evolutionary psychology as a valuable heuristic framework unifying the sciences at large.

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