Discovery and Confirmation in Evolutionary Psychology

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> "In the distant future I see open fields for more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity for gradation."
>
> Charles Darwin 1959, 527

The defining insight of evolutionary psychology consists of bringing considerations drawn from evolutionary biology to bear on the study of human psychology. So characterized, evolutionary psychology encompasses a large range of views about the nature and evolution of human psychology as well as diverging opinions about the proper method for studying them.[1] In this article, I propose to clarify and evaluate various aspects of evolutionary psychologists' methodology, with a special focus on their heuristics of discovery—i.e., their methods for developing plausible hypotheses—and their strategies of confirmation—i.e., their methods for providing empirical support for these hypotheses.[2] I will also evaluate several well-known objections raised against evolutionary psychology. Note that because views about psychology and evolution differ among evolutionary psychologists, I do not pretend to cover every method used in evolutionary psychology.[3]

Here is how I will proceed. In the first section, I analyze evolutionary psychologists' main heuristic for the discovery of psychological traits. In the second section, I examine two heuristics for developing hypotheses about psychological

[1] Evolutionary psychology does not include all the evolutionary approaches to human behavior. For example, by contrast to evolutionary psychologists, human behavioral ecologists overlook human psychology and focus primarily on human behavior (e.g., Winterhalden and Smith 2000; for a survey of the different approaches, see Laland and Brown 2002). Whether and how these different approaches can be integrated is an important question (e.g., Downes 2005). For the sake of space, I will not deal with it here.

[2] See also Holcomb 1998; Daly and Wilson 1999; Ketelaar and Ellis 2000; Conway and Shaller 2002; Simpson and Campbell 2005.

[3] Philosophers have typically focused on a narrow segment of evolutionary psychology, primarily, the work of David Buss, Leda Cosmides, John Tooby, Martin Daily, Margo Wilson, and Steve Pinker. This narrow focus does not do justice to the diversity of views and methods among those researchers that explicitly call themselves evolutionary psychologists (Machery and Barrett in press).

processes. In the third section, I consider what kinds of evidence evolutionary psychologists bring to bear on their psychological and evolutionary hypotheses.

1. Discovery in Evolutionary Psychology: Identifying Psychological Traits

1.1 The Forward-Looking Heuristic

To properly appreciate evolutionary psychologists' discovery heuristics, it is useful to view them against the background of the methods used in psychology. Psychologists attempt to identify and characterize human psychological traits, such as human preferences, emotions or personality dimensions. So, how do psychologists come to entertain hypotheses about these traits? For instance, how do they come to entertain the hypothesis that identifying faces is a psychological capacity underwritten by a dedicated set of processes or the hypothesis that neuroticism is a dimension of human personality? Unfortunately, psychologists have not developed a principled methodology for formulating hypotheses about psychological traits. Typically, psychologists' hypotheses are inspired by folk psychology—and sometimes, but not always, for good purpose. Psychological traits are also hypothesized on the basis of psychologists' theoretical commitments. For instance, psychoanalysis inspired proponents of terror management theory to propose that awareness of mortality results in intense negative emotions, such as anxiety (Greenberg et al. 1986). To extinguish these emotions, they hypothesized that people cling to their cultural worldviews, resulting in various forms of ethnocentrism and outgroup discrimination. Thus, they hypothesize the existence of a process—viz. clinging to our cultural worldviews—characterized by a specific function—viz. extinguishing the anxiety caused by the awareness of our mortality.

Evolutionary psychologists' most important contribution to psychology is perhaps their attempt to offer a method for discovering human psychological traits. They hypothesize that numerous traits evolved to solve information-processing problems that regularly bore on the fitness of our ancestors (e.g., Tooby and Cosmides 1992). A problem that bears on the fitness of the members of a species—*an adaptive problem*—is a situation (produced by the physical or social environment or by the other traits of the organism) such that different variants of a trait contribute differently to fitness. If these variants are heritable, an adaptive problem results in the selection of some variant over

others. For instance, when the ancestor of the primates (strepsirhines and haplorhines) moved into the fine-branch ecological niche 85 millions years ago, the new physical environment selected for, among other things, front-facing eyes, which enabled binocular vision, thus improving depth perception and, as a result, movement among the smaller parts of the branches (Allman 2000).[4] Adaptive problems are always relative to specific organisms. To take a trivial example, improving depth perception is an adaptive problem only for animals with eyes. *Information-processing adaptive problems* are situations such that different variants of a psychological trait contribute differently to fitness. Kin recognition was such a problem for many species, e.g., for Belding's Ground Squirrels (Sherman et al. 1997; but see Mateo 2002). Moreover, evolutionary psychologists highlight the information-processing adaptive problems *for our ancestors*, by contrast to contemporary information-processing adaptive problems. For, only past information-processing adaptive problems could have led to the evolution of processes dedicated to solving these problems.

Based on this hypothesis, evolutionary psychologists rely on the *forward-looking heuristic* for discovering human psychological traits. Evolutionary psychologists attempt to identify the adaptive problems regularly encountered by our ancestors. On this basis, they develop hypotheses about which psychological traits might have evolved. Whence the name "forward-looking": Evolutionary psychologists hypothesize a past adaptive problem and predict either that modern humans should possess a yet unknown psychological trait or that a known psychological trait of modern humans should possess yet unknown properties. For example, based on the hypothesis that low mood is an adaptive response to situations where efforts would not pay off, Keller and Nesse (2005) hypothesized the existence of different subtypes of low mood, corresponding to the different kinds of situation our ancestors might have met.

Three points are worth stressing. Evolutionary psychologists contend that the forward-looking heuristic is *useful* for discovering our psychological traits. They need not endorse the stronger claim that it is *necessary* for this purpose. One reason is that typically, evolutionary psychologists do not claim that all psychological traits are the

[4] Even though front-facing eyes are not necessary for binocular vision (Allman 2000, 127-128 on squirrels' laterally-oriented eyes), they strongly facilitate it.

product of evolution or that all evolved psychological traits are adaptations (e.g., Kurzban et al. 2001 on racialism). Second, this heuristic typically inspires evolutionary psychologists to propose *several* competing hypotheses about a specific aspect of human psychology. For instance, evolutionary psychologists have put forward several competing hypotheses about which traits might have evolved in the domain of mate choice.[5] Finally, developing psychological hypotheses about the mind of modern humans on the basis of the forward-looking heuristic is not evolutionary psychologists' only method. Sometimes, in a backward-looking manner, they start with a known psychological trait and try to identify the pressures that might have selected for it.

1.2 Constraining Hypotheses about Psychological Capacities

Gould and Lewontin (1979) have convincingly argued that unconstrained speculations about adaptive traits are so easy to come by as to be of little epistemic value. Thus, for the forward-looking heuristic to be useful, constraints need to be imposed on the hypotheses developed by evolutionary psychologists. These constraints should warrant some degree of confidence that an adaptive problem regularly encountered during the evolution of humans and their ancestor species has been identified.

Evolutionary psychologists have used at least four bodies of knowledge to constrain their hypotheses about psychological traits—middle-range evolutionary theories, cross-species comparisons, hunter-gatherer studies, and paleoanthropology. I consider them in turn.

Middle-range evolutionary theories specify particular forms of selective pressures that are assumed to have borne on the evolution of a wide range of taxa (Buss 1995). Trivers' theory of parental investment and life history theory are good illustrations (Trivers 1972; Kaplan and Gangestad 2005). There are two main issues with using middle-range evolutionary theories to discover humans' psychological traits. First, these theories might not apply to the evolution of humans. Consider Trivers' (1972) theory of parental investment. In substance, Trivers argues that the sex—typically females, but, in a few species, males—that invests more resources in offspring should have evolved to be more choosy—that is, it should have evolved to base its mating decisions on potential

[5] See, e.g., Buss and Schmitt 1993; Gangestad and Simpson 2000; Miller 2000.

mates displaying traits that are likely to increase the likelihood of survival and reproduction of its offspring. By contrast, the sex that invests fewer resources in offspring should have evolved to be less choosy. Additionally, it should have been the object of sexual selection—leading to the evolution of traits that might influence the choice of the more choosy sex. Several evolutionary psychologists have used Trivers' theory to develop hypotheses about various aspects of human mating psychology (e.g., Buss 1989; Kenrick et al. 1990). However, this theory is relevant to the evolution of human mating psychology only if during human evolution, males' and females' parental investment was regularly unbalanced in a given direction. Since among apes, human paternal investment is abnormally high, one might question the application of Trivers' theory to humans. At the very least, additional information is needed to ensure that it does plausibly apply.

Moreover, middle-level theories are by design unspecific. Because they are supposed to apply to the evolution of numerous taxa, they say very little about what traits might have been selected by the selective pressures they specify. Consider, again, Trivers' theory of parental investment. The choosy sex bases its mating decisions on traits that are likely to increase the likelihood of survival and reproduction of its offspring. These traits are left entirely unspecified by Trivers, obviously because they vary from taxon to taxon. Thus, one cannot determine from these middle-level theories alone which psychological capacities might have been selected during the evolution of humans. Again, additional information is needed.

To constrain their hypotheses, evolutionary psychologists also often *compare humans to other species*. By doing so, evolutionary psychologists attempt to identify what adaptive problems organisms with specific characteristics would face and what traits might have been selected. That is, evolutionary psychologists look for generalizations linking the possession of specific characteristics to specific adaptive problems and to the evolution of specific traits. For instance, like humans, other mammals are omnivores. Psychologists working on disgust have looked at the adaptive problems faced by other omnivores, particularly by rats, and the traits these problems selected for.

Evolutionary psychologists' cross-species comparisons are too often unsystematic and qualitative. Evolutionary psychologists often illustrate the hypothesized

generalizations with a few cherry-picked examples drawn from different phylogenetic taxa. Worse, too often, evolutionary psychologists merely identify a single taxon, sometimes phylogenetically distant from humans, in order to argue that organisms with specific characteristics would face specific adaptive problems. A more systematic comparison would give more weight to evolutionary psychologists' cross-species comparisons.

The large literature in primatology occupies a central place in evolutionary psychologists' cross-species comparison. Pace some critics (e.g., Buller 2005), the point is not to assimilate our ancestors to one of the remnant ape species. Rather, a few evolutionary psychologists have used this literature to reconstruct, admittedly speculatively, the evolution of some known psychological traits (e.g., Fessler 1999 on the evolution of shame). More typically, evolutionary psychologists turn to the literature in primatology to provide evidence that some putative adaptive problem, typically hypothesized on other grounds (e.g., middle-level theories), might have indeed been faced by the ancestor species of humans and chimpanzees. Thereby, they rely, in an unsystematic way, on the method used by paleoanthropologists to reconstruct the traits of humans' ancestors (e.g., Fleagle 1998).

Third, evolutionary psychologists often rely on *hunter-gatherer studies* to identify past adaptive problems (e.g., Barrett 2005 on predation). Clearly, contemporary hunter-gatherers are not relics of our ancestors. They are fully modern humans. Moreover, their conditions of life—typically, harsh environments such as the Kalahari desert where the !Kung live—might not be representative of our ancestors'. Hunter-gatherers might have been pushed into extreme environments by the development and growth of agricultural and, later, industrial societies. Therefore, we can't merely assume that the lifestyles of our ancestors, and thus the adaptive problems they faced, are identical to the lifestyles of modern hunter-gatherers. Still, as textbooks in paleoanthropology typically argue, the study of many (if not all) hunter-gatherer societies provides some useful information about the lifestyles of our ancestors, because it illustrates how a foraging lifestyle constrains the structure of societies, families, etc.

Critics of evolutionary psychology have often argued that the diversity of hunter-gatherers' lifestyles renders knowledge about their lifestyles useless to constrain the

hypotheses about past information-processing adaptive problems (Foley 1996; Buller 2005). The diversity of hunter-gatherers' lifestyles is real, but it does not justify the conclusion drawn by these critics. For, it is often possible to identify clear trends. For instance, men's contribution to a couple's food consumption varies across hunter-gatherer societies. However, using a sample of 10 hunter-gatherer societies, Kaplan et al. (2000; Table 2, p. 162) have shown that in 8 of them, men produced more than 60% of the daily amount of calories available to a couple. Trends might become particularly obvious when hunter-gatherers' lifestyles are compared to the lifestyles of our closest relatives—viz. chimpanzees'. For example, although the importance of meat in hunter-gatherers' diet varies across societies, Kaplan et al. (2000; Table 3, p. 166) have shown that in all societies in their sample, the daily consumption of meat by hunter-gatherers is at least one order of magnitude larger than the daily consumption of meat by chimpanzees.

Finally, *paleoanthropological knowledge about the evolution of humans* might be brought to bear on the hypotheses about past information-processing adaptive problems. For instance, a substantial body of evidence shows that during the evolution of hominoids, meat consumption became an important component of human diet. Together with some data about hunting in contemporary hunter-gatherers, this suggests that male hominoids provided an essential component of females' and children's diet during human evolution (Kaplan et al. 2000; but see Hawkes 1991). Because males provide a necessary component of a family's diet, it is reasonable to apply Trivers' theory of paternal investment to human evolution.

Critics of evolutionary psychology have emphasized the incompleteness of our knowledge about the evolution of humans and have concluded that this knowledge could not be used to constrain evolutionary psychologists' hypotheses (e.g., Richardson 1996; Kaplan 2002). Our knowledge is certainly incomplete. To illustrate, the phylogenetic tree leading to *Homo sapiens*, the date of the last common ancestor to humans and chimpanzees and the nature of our ancestors' immigration out of Africa are controversial.

But, this uncertainty should not obfuscate the fact that paleoanthropologists have now developed well-supported theories about the lifestyle of hominoids. [6]

As we have seen, each of the four ways of constraining hypotheses about past information-processing adaptive problems is imperfect. But, it would be a mistake to conclude that the forward-looking heuristic should be rejected, as some critics of evolutionary psychology have done (e.g., Kaplan 2002; Buller 2005). For, *taken together*, they can appropriately constrain a fair number of hypotheses. Particularly, paleoanthropology and hunter-gatherer studies might justify the appeal to middle-level evolutionary theories.

Moreover, the forward-looking heuristic is often complemented by a *bootstrap strategy*. Evolutionary psychologists often use the knowledge accumulated by psychologists about the structure of known psychological traits to infer what past selective pressures might have been (backward-looking reasoning).[7] These hypotheses about past selective pressures are then used to develop novel hypotheses about some properties of these known psychological traits or to attempt to discover new psychological traits (forward-looking reasoning).

1.3 The Grain Problem

In this section, I briefly consider an important objection against the forward-looking heuristic—*the grain problem*.[8] Sterelny and Griffiths (1999) notice that an adaptive problem might be described at a finer or coarser grain. Consider the adaptive problem of avoiding dangerous situations. Evolutionary psychologists often contend that fear evolved to motivate animals to avoid such situations and to enable them to deal with such situations, when they occur. But, one might wonder whether avoiding dangerous situations is a single adaptive problem. Rather, avoiding dangerous animals and avoiding dangerous places might be two different adaptive problems that have resulted in the selection of two different mechanisms. Of course, the grain problem reiterates for these

[6] See, for instance, two excellent textbooks in paleoanthropology: Lewin and Foley 2003; Silk and Boyd 2005.
[7] The four sources of information used to constrain the forward-looking heuristic have also a role to play in backward-looking reasoning.
[8] Other objections have been raised against the forward-looking heuristic (e.g., Stotz and Griffiths 2002; Buller 2005). Particularly, Foley 1996 and Smith et al. 2000 criticize the focus on past adaptive problems.

two possible adaptive problems. Maybe avoiding spiders, avoiding snakes, avoiding strangers, and so on, are different adaptive problems that might have selected for different psychological traits, for instance different kinds of fear. Now, if evolutionary psychologists are unable to individuate on a principled basis the information-processing adaptive problems encountered by our ancestors, they will be unable to develop hypotheses about psychological traits.

This is a serious problem for evolutionary psychologists.[9] But, note first that the grain problem plagues non-evolutionary approaches to psychology as much as evolutionary psychology. Psychologists of all stripes attempt to discover psychological traits. Psychological traits are often characterized functionally. But, exactly as adaptive problems, functions can be described at a finer or coarser grain. For example, recognizing faces might not be a single function. Rather, recognizing male faces and recognizing female faces might be two different functions.

Furthermore, evolutionary psychologists' bootstrap strategy enables them to reduce the arbitrariness of the grain of description of past adaptive problems. By looking at the organization of known psychological traits, evolutionary psychologists formulate hypotheses about past adaptive problems, on the basis of which they develop novel psychological hypotheses. The inference from the organization of known traits to past adaptive problems provides some ground for preferring some grains of description to others.

2. Discovery in Evolutionary Psychology: Characterizing Processes

2.1 The Modularity Heuristic

Psychologists, particularly cognitive psychologists, often attempt to characterize the nature of our psychological processes. For instance, they are interested in understanding the processes that underlie our capacity to recognize faces. Some leading evolutionary psychologists, such as Tooby and Cosmides, have emphasized the importance of developing process models of the psychological traits considered by evolutionary psychologists. However, many evolutionary psychologists show little interest in process models (Miller and Todd 1998). Rather, in a characteristic Brunswikian manner, they

[9] For discussion, see also Atkinson and Wheeler 2004.

focus on the cues used by our psychological processes (e.g., youth and status for the processes underlying mate choice) and on the correlation between these cues and some properties of the environment (e.g., the correlation between youth and fertility) without developing models of the relevant processes (e.g., a process model of mate choice). Still, some evolutionary psychologists do develop hypotheses about processes. For this purpose, they principally use two heuristics—*the modularity heuristic* and *the design heuristic*. I consider them in turn.

In substance, the modularity heuristic states that *a distinct, dedicated process underlies each hypothesized, evolved psychological capacity*. Thus, when evolutionary psychologists have good reason to believe in the selection of a psychological capacity, they should assume that a distinct process has evolved to underlie this capacity.[10] There is much confusion among philosophers and psychologists about evolutionary psychologists' notion of module (Barrett and Kurzban 2006; Machery forthcoming b). Because the term "module" is used in many different ways in psychology and in neuropsychology, evolutionary psychologists' modules—Darwinian modules—have often been identified to other kinds of modules, in particular to Fodor's (1983) modules. This has led to spurious controversies about whether a mind could really be exclusively made of Fodorian modules. To clarify, Darwinian modules are processes designed to fulfill a specific function. That is, first, Darwinian modules are *adaptations*—the products of evolution by natural selection. Second, they fulfill *a specific function*: They evolved to underlie a specific cognitive capacity.

Of course, the modularity heuristic will inevitably lead to some erroneous hypotheses. After all, many physiological organs have several evolved functions. For instance, the human mouth seems to be designed, among other things, to ingest food, get some perceptual information about the nature of the ingested food, speak and contribute to the facial expression of emotions. Similarly, it is likely that sometimes, several psychological capacities are underwritten by a single cognitive process.

Still, many known traits—including many physiological traits—primarily evolved for bringing about a specific function. This is the case of many parts of the mammalian

[10] For a different take on the notion of modularity in evolutionary psychology, see Samuels 1998, 2000; Shapiro and Epstein 1998; Fodor 2000a; Carruthers 2005.

eye as well as of many evolved behaviors, such as the freezing reaction in the presence of danger. There is thus little reason to doubt that many evolved psychological capacities will be underwritten by distinct, dedicated processes.

2.2 The Design Heuristic

The design heuristic builds on the modularity heuristic. The modularity heuristic assumes that a single process underwrites an identified evolved psychological capacity. *The design heuristic proposes that this process is well-designed for fulfilling its function.* By appealing to engineering considerations, one can develop hypotheses about what design would be appropriate to bring about the relevant function.

The design heuristic has been under attack. It has been argued that even if we were able to identify some past adaptive problems, this knowledge might be useless for developing hypotheses about the nature of the mechanisms that underwrite the capacities that might have been selected (Griffiths 1996; Buller 2005). Four main reasons are supposed to support this claim. It is often correctly noted that adaptations are never created de novo. Rather, they are modifications of existing traits. For this reason, they have typically numerous features that can neither be explained nor, a fortiori, be predicted by considering the selective pressures that caused their evolution. Second, because adaptations are almost always modifications of anterior adaptations, it is impossible to determine what process might be selected by an adaptive problem in a given species without having some extensive knowledge of the phylogeny of this species. For instance, many species have faced the adaptive problem of mate guarding, but, depending on their phylogeny, different species evolved different strategies for mate guarding. Third, it also correctly noted that an adaptive problem might not have a single optimal solution. For this reason, once an information-processing adaptive problem has been identified, it remains unclear what psychological process has been selected for solving this problem. Finally, even when an adaptive problem has a single optimal solution, many traits might solve the problem in a satisfying manner, if not optimally. Since, for various reasons, evolution often does not reach optimal solutions, but only satisfying ones, the nature of the processes selected for solving an identified adaptive problem might remain unclear.

It is worth emphasizing that even if the design heuristic were of little use to develop reasonable hypotheses about the cognitive processes underwriting our cognitive capacities, having identified these capacities by considering past information-processing adaptive problems would already be a substantial progress for psychology. Traditional methods of cognitive psychology and of neuropsychology might then be used to determine the nature of the processes underlying these capacities.

Moreover, the strength of the four arguments summarized above should not be overestimated. They *do* establish that the design heuristic might lead to erroneous hypotheses. But, they do *not* establish that it will systematically mislead. The design heuristic might reduce the class of possible hypotheses about the processes underlying our cognitive capacities. It might also allow psychologists to identify some features of cognitive processes, because these features are shared by all the processes that could solve an adaptive problem.

3. Confirmation in Evolutionary Psychology

3.1 The Structure of Hypotheses in Evolutionary Psychology

To properly understand confirmation in evolutionary psychology, one needs to distinguish three levels of hypotheses (Conway and Schaller 2002; see Figure 1). Typically, evolutionary psychologists put forward *a psychological hypothesis*—viz. a hypothesis about the existence or the nature of some psychological trait (level 2). From this hypothesis, they infer some *empirical predictions* about the effects to be found in experimental and non-experimental studies (level 1). The originality of evolutionary psychologists is that they also develop *hypotheses about the origins of the psychological trait* under consideration (level 3).

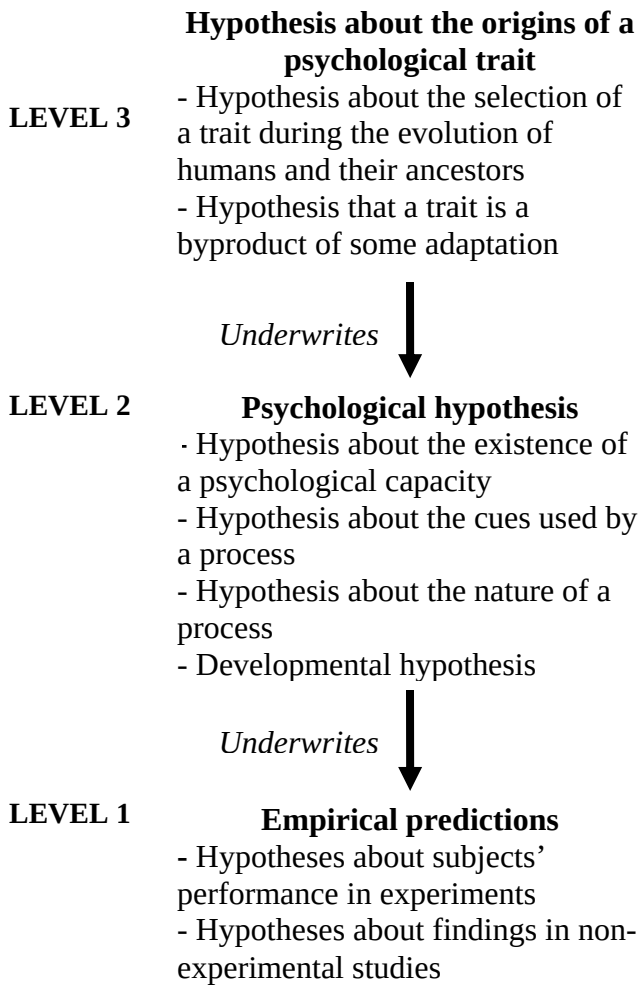

Figure 1: The Structure of Theories in Evolutionary Psychology

Like other psychologists, evolutionary psychologists develop various types of hypotheses about the human mind (level 2). First, evolutionary psychologists often develop hypotheses about *the existence of a specific cognitive capacity underwritten by a dedicated process*. For instance, Cosmides and Tooby have famously argued that people are endowed with a dedicated process whose function is to identify cheaters—i.e., individuals who fail to honor contracts and promises (Cosmides 1989). A second kind of psychological hypothesis asserts that *some specific cue is used in the process(es)* bringing about some function. To illustrate, Buss has developed and tested numerous hypotheses about the cues used by males and females—attractiveness, status, youth, etc.—to choose

a mate (for review, see Buss 2004). More rarely, evolutionary psychologists develop hypotheses about the *nature of the processes* underlying specific cognitive capacities. Consider again mate choice. Because potential mates have different values along the properties that are relevant for mate choice (e.g., a potential mate might be highly attractive, but have a low social status), males and females need to weigh these different values. Li et al. (2002) have studied how males and females weigh the properties of potential mates. Finally, evolutionary psychologists put forward *developmental hypotheses*. For instance, Barrett (2005) hypothesized the early development of a system dedicated to reasoning about predators and prey.

From these psychological hypotheses, evolutionary psychologists—like other psychologists—infer some predictions about specific effects in experiments or in non-experimental (observational, correlational, etc.) studies (level 1). Several empirical predictions are typically derived from the same psychological hypothesis. It is noteworthy that evolutionary psychologists often consider a larger range of empirical predictions derived from psychological hypotheses than non-evolutionary psychologists. In addition to laboratory (experimental or observational) studies, evolutionary psychologists have looked at archives (e.g., Daly and Wilson 1988 on police reports of infanticide), at law codes (e.g., Wilson and Daly 1992 on marriage and divorce laws), at published ads (e.g., Waynforth and Dunbar 1995 on "lonely hearts" ads), and so on. Although such studies should not replace laboratory studies, they usefully complement them, for they ensure the external validity of the findings based on laboratory studies.

Psychologists of all stripes develop hypotheses at levels 1 and 2. Indeed, evolutionary psychologists' hypotheses at these levels often compete with hypotheses developed by non-evolutionary psychologists as well as with alternative hypotheses developed by other evolutionary psychologists. Cosmides' (1989) hypothesis that humans possess a cognitive system dedicated to identifying cheaters competes with various theories of human reasoning, including Cheng and Holoyak's (1985) theory of pragmatic reasoning schemas (level 2). According to Cosmides, people are adept at reasoning when this involves identifying people who break norms specifying benefits to be taken and costs to be paid, while, according to Cheng and Holoyak, people are adept at reasoning for any kind of norm. From these two competing hypotheses, Cosmides infered different

empirical predictions (level 1). For this purpose, she relied on the Wason Selection Task, an experimental design that had already been extensively used to study human reasoning.[11]

So far, there is no difference between evolutionary psychologists' hypotheses and the hypotheses developed by other psychologists. What distinguishes the structure of evolutionary psychologists' theories is a third, distinctive level of hypothesis: *Evolutionary psychologists attempt to identify the origins of the psychological traits under consideration*. In some cases, they hypothesize that a trait under consideration is a by-product of an adaptation. For instance, Kurzban et al. (2001) have hypothesized that racialism is a by-product of a cognitive system dedicated to identifying cooperative groups. In other cases, evolutionary psychologists contend that a psychological trait under consideration is an adaptation. In both cases, evolutionary psychologists claim that some traits are psychological adaptations. Now, characterizing a trait—be it physiological, psychological or behavioral—as an adaptation is to make an assertion about the process by which some organisms came to possess it. One asserts that some organisms possess this trait because their ancestors possessed this trait and that in specific past environments, this trait increased their likelihood of surviving and reproducing more than the traits possessed by other organisms.

By contrast, non-evolutionary psychologists often overlook the origins of the psychological traits they are investigating. For example, experimental psychologists working on categorization are typically silent about the origins of the categorization processes. Of course, evolutionary psychologists are not the only psychologists to develop hypotheses about the origins of psychological traits. Cultural psychologists often argue that specific psychological traits are the outcome of some cultural and historical processes. For instance, Nisbett and colleagues have argued that East-Asians' holistic cognition results from various aspects of East-Asian culture, itself the product a specific historical trajectory (e.g., Nisbett 2003). Evolutionary psychologists' hypotheses about the origins of psychological traits sometimes compete with these alternative hypotheses. Sometimes, evolutionary psychologists develop several alternative hypotheses about the

[11] For a review of the literature, see Tooby and Cosmides 2005; for further discussion, see Gigerenzer and Hug 1992; Sperber et al. 1995; Fodor 2000b; Fiddick et al. 2000; Sperber and Girotto 2002.

origins of known traits or about what kind of traits might have evolved in a given domain. For instance, there are several competing hypotheses about the origins of racialism—a known trait (Machery and Faucher 2005).

3.2 Evidence in Evolutionary psychology

The kind of evidence needed to support evolutionary psychologists' hypotheses at levels 1 and 2 is identical to the kind of evidence needed to support psychological hypotheses in general. From their psychological hypotheses, evolutionary psychologists infer some empirical hypotheses or predictions, which are tested in laboratory and non-laboratory studies against the predictions derived from other psychological hypotheses (developed either by other evolutionary psychologists or by non-evolutionary psychologists). A psychological hypothesis developed by an evolutionary psychologist is empirically supported to the extent that the empirical predictions that are derived from it are confirmed and to the extent that this empirical prediction cannot (or, at least, not so naturally) be inferred from an alternative psychological hypothesis.

Depending on the nature of the psychological hypothesis developed by evolutionary psychologists, different kinds of evidence are needed. To illustrate, hypotheses that a cognitive capacity is underwritten by a dedicated cognitive process require the kind of evidence that psychologists use to support claims about dedicated processes. In psychology and in neuropsychology, functional and neuropsychological dissociations are typically used for this purpose.[12] Thus, to support the hypothesis of a dedicated process underlying cheater-detection, Tooby, Cosmides and their colleagues have looked for functional (e.g., Cosmides 1989) and neuropsychological (e.g., Stone et al. 2002) dissociations between the capacity to identify cheaters and the capacity to identify violators of other norms, such as prudential rules.

Now, suppose that a psychological hypothesis about a specific trait endorsed by some evolutionary psychologist is correct. What support does this confer to the hypothesis from which it is inferred—viz. the hypothesis about the origins of this trait? A hypothesis about the origins of a psychological trait is supported to the extent that the inferred psychological hypothesis cannot be inferred (or, at least, not so naturally) from

[12] The logic of dissociation remains controversial (Machery forthcoming a, chap. 5).

alternative hypotheses about the origins of the trait under consideration, for instance from a cultural hypothesis. A hypothesis about the origins of a trait fails to be supported even if a psychological hypothesis that has been inferred from it is supported, when this psychological hypothesis can be equally well inferred from alternative hypotheses. For instance, Eagly and Wood (1999) recognize that cues, such as status and youth, are used differently by males and females in mate choice. But, against Buss and his colleagues, they contend that these differences are not gender-specific adaptations. Rather, they are the product of the division of labor between genders and of the resulting socialization of males and females.

Thus, evolutionary psychologists' hypotheses about the origins of specific traits must underwrite hypotheses about the properties possessed by these traits that cannot be derived from alternative non-evolutionary hypotheses. Although space lacks to investigate this issue in much detail, we might profitably look at how evolutionary biologists support hypotheses about the origins of traits, particularly about what kind of evidence supports the hypothesis that a given trait is an adaptation (see, particularly, Williams 1966; Rose and Lauder 1996). Biologists use a large range of evidence for this purpose. When available, historical evidence can be used to study the spread of a trait in populations. Biologists also often use the comparative method to study whether traits are adaptations: When a trait is present in many species, one can test whether this trait is an adaptation to a specific adaptive problem by determining whether, independently of their phylogeny, the presence of this trait is correlated with the presence of the relevant adaptive problem. Traits can be experimentally manipulated in order to compare the contribution to fitness of these traits and their variants. In some populations, one can study longitudinally how environmental changes affect the frequency of traits in a population. Biologists study hypothesized adaptations to local environments by transplanting organisms to different environments. Optimization models are also regularly used to argue that a trait is optimally or quasi-optimally designed for some purpose. Finally, evolutionary geneticists have recently developed sophisticated techniques to study whether alleles have been under selection.

Evolutionary psychologists do not rely on the whole gamut of evidence used by biologists to support hypotheses about the origins of a trait, particularly about whether it

is an adaptation. Some types of evidence are often not available (Kaplan 2002). There is often little historical evidence about the spread of a psychological trait. The origins of psychological traits that are not shared by other species cannot be studied by the comparative method. When a trait is universal, the hypothesis that it is an adaptation cannot be studied by correlating variants and reproductive success. For obvious ethical reasons, experimental manipulations of the relevant traits are impossible. And since we have so far very little knowledge of the genetic bases of most psychological traits, evolutionary genetics is currently of little help.

So, how do evolutionary psychologists support the hypotheses about the origins of psychological traits? In what follows, I focus on the evidence most commonly used by evolutionary psychologists to support the hypothesis that a psychological trait is an *adaptation*.[13] (But, remember, evolutionary psychologists have developed numerous hypotheses that some traits, such as female orgasm and racialism, are by-products of adaptations.) For this purpose, they mostly rely on three types of evidence—*design*, *cross-cultural data*, and *developmental data*.[14] First and foremost, evolutionary psychologists follow Williams (1966) in contending that the *design* of a trait is evidence that this trait is an adaptation for a specific function. That is, evolutionary psychologists take the fact that a trait is so organized as to produce economically, reliably, and efficiently a specific outcome that was arguably fitness-conducive in some specifiable past environment, as evidence that this trait is an adaptation. For instance, Fessler et al. (2005) have argued that disgust is an adaptation designed to prevent contamination from pathogens-carrying substances. According to them, a key aspect of the design of disgust is the adjustment of disgust-sensitivity to changes in immune functioning: The threshold for feeling disgust is lowered when immune functioning is weakened. Notice that evolutionary psychologists typically do not claim that adaptations have to be optimally designed (e.g., Simpson and Campbell 2005): Because adaptations typically evolve from previous adaptations and because they involve trade-offs between diverging selective pressures, their design is rarely optimal.

[13] See also Andrews et al. 2003; Simpson and Campbell 2005.
[14] Some evolutionary psychologists have also used simulations and evolutionary game-theoretic models to support their hypotheses about the origins of the traits investigated (e.g., Todd 1997; Kameda et al. 2002).

There are two main problems with the inference from design to adaptation: Many traits studied by evolutionary psychologists do not show clear evidence of design and the design of a trait can be produced by other processes than natural selection.[15] I consider these serious worries in turn. One might grant that design is evidence for adaptation, but doubt that the psychological traits considered by some evolutionary psychologists are designed for bringing about some outcome that would have been fitness-conducive in past environments. Consider, for instance, Buss and colleagues' claim that the processes underlying males' and females' mate choice are gender-specific adaptations designed to choose mates that are likely to contribute most to reproductive success. According to Buss, a key aspect of the design of these processes is the fact that males and females weigh differently cues such as status and youth in mate choice. Buss and his colleagues reasoned that because of the differences between males' and females' social roles in hominoids, status would have been a more important property of potential mates for the reproductive success of females than for the reproductive success of males. Moreover, they argued that because females' fertility decreases faster than males', youth would have been a more important property of potential mates for the reproductive success of males than for the reproductive success of females. A skeptic might worry that a gender difference in the weights of status and youth in mate choice is flimsy evidence of design. Among other things, we'd like to know whether besides status and youth, males and females use other cues to choose a mate and whether the use of these cues makes any evolutionary sense.

The answer to this first worry about design is to build a stronger case for the design of putative psychological traits. One way to do this is to focus on how a given trait produces different outcomes in different environments. That is, evolutionary psychologists might profitably focus on how this trait interacts with different environments rather than on its average manifestation across environments (Kaplan and Gangestad 2005; Simpson and Campbell 2005). If the varying manifestations of a trait across environments could have been fitness-conducive in ancestor populations, then the trait arguably has a complex design.

[15] For further discussion of the use of design in evolutionary biology, see Gould and Lewontin 1979.

The second critique challenges the status of design as evidence for adaptation. One might grant that some psychological traits are clearly designed for producing an outcome that would have been fitness-conducive in past environments, but contend that numerous processes besides selection can produce such a design. Domain-general learning might be the most relevant process for psychology. In a nutshell, it is the process by which organisms, including humans, acquire psychological traits for which there was no selection in the past. Some psychological traits that are designed to produce an outcome, such as the process (or the set of processes) that underlies reading, clearly result from some form of domain-general learning. Domain-general learning contrasts with other forms of development such as maturation and domain-specific learning. A process of learning is domain-specific if it has been selected for the development of a specific psychological trait.

Evolutionary psychologists often attempt to explain away domain-general learning by relying on two additional sources of evidence—*cross-cultural data* and *developmental data*. I consider them in turn. Evolutionary psychologists often investigate whether the candidate psychological adaptations are present *in numerous and diverse cultures*. For instance, Sugiyama et al. (2002) have replicated Cosmides' findings in the Shiwiar of Ecuadorian Amazonia and Schmitt (2005) has studied various aspects of mating preferences in 48 nations. Domain-general learning is an input-sensitive process: Its outcome varies depending on its inputs. Because what children are taught varies across cultures and because across cultures, children live in very different physical and social environments, a trait designed by domain-general learning would probably not be present in numerous and diverse cultures or, at the very least, it would be designed differently across cultures. Showing that a psychological trait is present in many diverse cultures and is similarly designed provides evidence that its development is canalized—that is, its development results in the same outcome in a large range of environments. This constitutes evidence that the trait is not acquired by domain-general learning.

Evolutionary psychologists also focus on various aspects of the development of candidate adaptations—particularly, whether they are acquired *early*, whether or not the process of acquisition is *fast and automatic*, whether the traits are acquired *in spite of degraded and variable inputs* (poverty of stimulus) and whether their acquisition depends

on *critical periods*.[16] Thus, using a simplified version of the Wason Selection Task, Cummins (1996) has presented some evidence that 3- and 4-year old children are able to identify cheaters, too early for domain-general learning to explain the possession of this capacity. Öhman and Mineka's (2001) literature review shows that the acquisition of fear reactions to some stimuli (e.g., snakes) is automatic and cognitively impenetrable. Research on the Westermarck effect suggests that sexual desire between two individuals strongly decreases when co-rearing occurred during early childhood (Wolf 1995). These properties of the development of the candidate adaptations are evidence against their acquisition by some domain-general learning.

3.3 Can Empirical Evidence Support Evolutionary Psychologists' Hypotheses?

Some philosophers have criticized the evidential support of specific hypotheses (e.g., Lloyd 1999; Buller 2005). The correctness of these criticisms is an empirical question and there is no place here to sort the wheat from the chaff among these objections (see Machery and Barrett in press). More radically, some philosophers have expressed skepticism about whether evolutionary psychologists' hypotheses, more specifically their hypotheses about the origins of the psychological traits under consideration, can in principle be empirically supported (e.g., Panskepp and Panskepp 2000; Dupré 2001; Kaplan 2002; Lloyd and Feldman 2002). They emphasize that evolutionary psychologists do not use the large gamut of evidence typically used by biologists (sometimes because they can't) and they criticize the reliance on design, cross-cultural data and developmental data.

No doubt, evolutionary psychologists have sometimes dealt too casually with the evidence needed to support claims about the origins of the psychological traits under consideration. However, there is little reason to endorse a *principled* skepticism about the evidential value of evolutionary psychology. Standard psychological methods can provide evidence for evolutionary psychologists' psychological hypotheses. Moreover, detailed description of the design of psychological traits, cross-cultural results, developmental findings and, when available, phylogenetic and comparative data can provide strong evidence for evolutionary psychologists' hypotheses about the origins of

[16] Of course, it is not the case that the development of adaptations necessarily possesses these properties.

the psychological traits under consideration. In fact, because the methods of developmental psychology are well developed and because it might be easier to study human children than the offspring of other species, developmental data can afford a unique source of evidence to bear on evolutionary psychologists' hypotheses about the origins of psychological traits.

Conclusion

Evolutionary psychology remains a very controversial approach in psychology, maybe because skeptics sometimes have little first-hand knowledge of this field, maybe because the research done by evolutionary psychologists is of uneven quality. However, there is little reason to endorse a principled skepticism toward evolutionary psychology: Although clearly fallible, the discovery heuristics and the strategies of confirmation used by evolutionary psychologists are on a firm grounding.[17]

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