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Evolutionary psychology: Neglecting neurobiology in defining the mind

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Abstract

Evolutionary psychology defines the human mind as comprising innate and domain-specific information-processing mechanisms that were designed to solve specific evolutionary problems of our Pleistocene past. Yet it is argued here that evolutionary psychology's assumptions regarding the mind are often inconsistent with the neurobiological evidence; biological constraints may place limits on the kinds of hypotheses that can be made within a theoretical framework that wants to remain true to the known properties and functions of the human nervous system. Evolutionary psychology's assumptions regarding our innate biology also shape their treatment of culture and learning in ways that may inaccurately reflect true experience–neurodevelopmental interactions. It is suggested that the mind can be adequately understood and its activities properly explained without hypothetical appeal to countless genetically pre-specified psychological programs, and in a way that remains consistent with both our neurobiology and neo-Darwinian evolution.

Keywords

criticisms, critique, evolutionary psychology, mind, neurobiology, sociobiology

Evolutionary psychology defines the human mind as comprising innate and domain-specific information-processing mechanisms that were designed to solve specific evolutionary problems of our Pleistocene past. This model of the mind is the underlying blueprint used to engage in the kind of research that characterizes the field: speculating about how these innate mechanisms worked and what kinds of evolutionary problems they solved. But while evolutionary psychologists do engage in research to confirm or disconfirm their hypotheses, the results of even the most rigorous studies have been open to alternative, scientifically valid means of interpretation (e.g., Buller, 2005; Richardson, 2007). What constitutes "evidence" would seem to vary in accordance with the

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theoretical assumptions of those viewing it (Kuhn, 1962). Arguments about, or appeals to, "the evidence" may thus involve little more than theoretical bible-thumping or pleading for others to view the "facts" from their preferred theoretical perspective. When theoretical paradigms are unable to agree on what it is that they are looking at, it reminds us that the data are anything but objective, and gives good reason to question the theoretical blueprints being used. This paper argues that evolutionary psychology's assumptive definitions regarding the mind are often inconsistent with neurobiological evidence and may neglect very real biological constraints that could place limits on the kinds of hypotheses that can be safely posited. If there are problematic assumptions within evolutionary psychology's definition of the mind, then we also have reason to question their special treatment of culture and learning, since both are thought to be influenced by modular assumptions unique to the paradigm. It is finally suggested that the mind can be adequately understood and its activities properly explained without hypothetical appeal to countless genetically pre-specified psychological programs, and in a way that remains consistent with both our neurobiology and neo-Darwinian evolution. While some of these critiques have been previously stated by others, the present paper adds to the discussion by providing a succinct summary of the most devastating arguments while offering new insights and examples that further highlight the key problems that face this field. Importantly, the critiques presented here are argued to be capable of standing their ground, regardless of whether evolutionary psychology claims the mind to be massively or moderately modular in composition. This paper thus serves as a continuation of the debate between evolutionary psychology and its critics. It will be shown how recent attempts to characterize critiques as "misunderstandings" seem to evade or ignore the main problems, while apparent "clarifications" continue to rely on some of the same theoretical assumptions that are being attacked by critics.

Evolutionary psychology: Defining the mind

In defining the mind, evolutionary psychology essentially combines Darwin's notion of adaptation with the assumptions of cognitive psychology:

> Evolutionary psychologists suggest that the human mind is a complex integrated assembly of many functionally specialized psychological adaptations that evolved as solutions to numerous and qualitatively distinct adaptive problems. . . . *Psychological adaptations* are information-processing circuits that take in delimited units of information and transform that information into functional output designed to solve a particular adaptive problem. (Confer et al., 2010, p. 111)

The foundation of evolutionary psychology is based on an argument that the mind works somewhat like a computer—made up of genetically pre-specified and domain-specific mental algorithms, or computational programs, originally designed to solve specific evolutionary problems of the past. These hypothetical mental mechanisms are often referred to in the literature as modules, and the above-mentioned assumptions comprise what is often referred to as the modular theory of mind. It should be noted that there has been considerable debate about whether the mind is massively or moderately modular, or not modular at all. A mind that is *massively modular* (Fodor, 1983) would be comprised almost entirely of pre-specified incompressible[1] mental programs or modules; a *moderately modular* mind (Carruthers, 2003) would be mostly modular in composition; while the *non-modular* mind would be almost entirely domain-general and non-modular in composition. For the purpose of this discussion, I will focus on the prevailing view within evolutionary psychology. Though there is some theoretical variation within the field, this position would appear to lie somewhere between moderately and massively modular assumptions (Pinker, 1997; Tooby & Cosmides, 1992), with modules being, by definition, relatively distinct, though at times proposed as being functionally connected with other modules (Tooby, Cosmides, & Barrett, 2005). Within the literature of modularity, there has also been debate regarding the innateness of modules, though again, for the purpose of this discussion, I will focus on the prevailing position within the field. This view assumes that modules are largely pre-determined or pre-specified in our genes—a qualification accepting that the environment may also play a role in their activation (discussed later). An example of a module may include specific fear-detection mechanisms, which are thought to be sensitive in responding to certain kinds of environmental stimuli (e.g., snakes; Ohman & Mineka, 2003), and are argued to have been beneficial during what evolutionary psychologists call the Environment of Evolutionary Adaptedness (EEA)—presumably, some earlier point in our evolutionary history (e.g., the Pleistocene). And since these hypothetical modules are assumed to be somehow encoded in our DNA, they are presumed to be heritable; organisms that survived would have an increased probability of passing the successful genetic information, and presumably the "mental programs," on to their offspring.

Leda Cosmides and John Tooby (1997) suggest that "the brain is a physical system. It functions as a computer." For evolutionary psychologists, the environment offers a vast array of potential "input" for our countless innately pre-specified biological programs to "compute." Thus, certain environmental stimuli have a priori meaning as "information" or potential "input," since it is assumed that genetically specified and domain-specific mental program(s), designed to solve specific evolutionary problems, must be capable of identifying specific input as meaningful. In this model, *psychological meaning* is largely assumed to be pre-specified in our genes. Modern influences, including culture, environment, and learning, take on a different role for evolutionary psychologists. For them, the environment has already played its biggest part—during the EEA. While modern environmental forces may offer "proximal" influence or input, they are not regarded as the "distal" or "ultimate" sources of influence within the causal chain.

Evolutionary psychologists frequently give examples such as our reflex upon touching a hot stove. The nociceptive circuits in this case trigger a meaningful innate reflex causing us to recoil. All of this happens without our having necessarily had any first-hand or vicarious experience with hot stoves, and without our needing to think about the physiological consequences of burning our hands. The "proximate" cause is the hot stove, while the "distal" cause is a genetic prewiring that prepares our nervous system to recoil in such situations—presumably because organisms that could do this quickly would have had a better chance of survival. Examples such as these show that our nervous system is often capable of innately identifying some internal neurophysiological representation as meaningful. But is that the case for all psychological processes? If so, where is the evidence? If not, how do we know where to draw the line?

Computational brains and biological constraints

Evolutionary psychologists often appeal to evidence of functionally specified neurobiological systems to help justify their innately modular theoretical assumptions. For example, investigators have found support for relatively distinct systems involving visual recognition of human faces and emotional expressions (Adolphs et al., 1999; Allison, Puce, Spencer, & McCarthy, 1999), language (Kolb & Wishaw, 2003; Shalom, 2008), and various emotions (Bremner & Charney, 2010; Rohlfs & Ramirez, 2006). Studies involving brain lesions additionally show that damage to these key areas can often cause predictable functional deficits (Kolb & Wishaw, 2003). Evolutionary psychologists often interpret these studies as evidentiary support for their belief in profuse modularity and innate functional specification (Duchaine, Cosmides, & Tooby, 2001). For evolutionary psychologists, "psychological adaptations are just like other adaptations" (Hagen, 2005, p. 156). They therefore see no problem in giving examples such as withdrawing a hand upon touching a hot stove as evidentiary support to justify their speculating about higher-level socio-cognitive modules, such as one's ability to detect cheaters (Cosmides & Tooby, 1992) or Western men's preference for blonde women (Sorokowski, 2008). In terms of hypothesis testing, the nervous system is given homogeneous treatment—any part of it is implicitly treated as fair game for speculating about innate modularity. But while this view makes for easy hypothesis generation and research production, it may be based on some very problematic assumptions.

The evolutionary psychology definition of the mind, comprised of dedicated information-processing mechanisms, would have been influenced by philosopher Jerry Fodor's (1983) original hypothesis presented in *The Modularity of Mind*. Yet, Fodor himself saw the mind as divided into systems—some made up of modules and some not. This view is consistent with the position of most modern-day neuroscientists, who describe both phylogenetically old special-purpose systems, and later-evolving general-purpose neural systems (e.g., Panksepp, 1998; Rose, 2005). We might briefly conceptualize the more hard-wired lower-level systems as including spinal and cranial reflexes, systems controlling balance or orientating movements, autonomic nervous system responses, basic emotional states, and so on. These systems tend to be specified, reflexive, functionally discrete, yet interconnected, similar to how evolutionary psychologists might envision their hypothetical modules. Ontogenetically, these kinds of systems tend to be fully functional at birth, and are less amenable to change as a result of environmental input. In contrast, higher-level neocortical systems, including those responsible for complex thought and social interaction, appear to involve an integration of numerous systems of varied differentiation. They are hardly at all developed at birth, offer greater neural plasticity, and are therefore extremely amenable to change as a result of environmental input. So while there is abundant evidence for modularity in lower-level systems, it is simply incorrect to suppose that all or even most of the human central nervous system works this way. In the words of Jaak and Jules Panksepp (2000):

> Although the lower reaches of all mammalian brains contain many intrinsic, special-purpose neurodynamic functions (e.g., basic motivational and emotional systems), there is no comparable evidence in support of highly resolved genetically dictated adaptations that produce socio-emotional cognitive strategies within the circuitry of the human neocortex. (p. 111)

It is important to consider that our nervous systems are hierarchically built. Layered like a cake, older "adaptations" are not necessarily rewritten or revised with a more efficient script, but are instead "added-to" and built upon, with the newest layers involving neocortical areas that are highly plastic or flexible and capable of interacting with lower layers in some very complex ways (Koziol & Budding, 2009). The current consensus within the neurobiological sciences seems to support a view where much of the brain is thought to be highly plastic and in which an abundance of neural growth, pruning, and differentiation of networks is directly influenced by environmental experience (Kilgard, 2002; Kolb & Wishaw, 2003). This is especially the case for secondary, tertiary, and associational areas, which make up the majority of the brain's neocortex and are primarily involved in the kinds of complex, higher-order, psychological processes that appear to be of greatest interest to experimental psychologists. These particular areas seemingly lack characteristics indicative of *innate* modularity, though, with experience and use, they may build upon the functional complexity of adjacent primary cortices that perhaps have such characteristics.

For example, when we venture anteriorly from the primary motor strip, we see representational connections in the prefrontal regions that take control of increasingly complex motor behavior and executive motor planning. These non-primary neocortical structures, including tertiary and associational areas, may become functionally specialized by way of Hebbian synapses[2] involving experience-dependent neuronal activation, and the building of functional connections with adjacent primary cortices. The end result in a developed (i.e., adult) brain may therefore reflect circumscribed neural networks that indeed *look* modular, but the environment may often play the greater role in shaping them. For example, we might imagine looking into the brain of an experienced gymnast, where we would undoubtedly see greater differentiation and representation of areas dedicated to motor planning and dexterity of movement. Knowing the kind of training regimen required for a gymnast to reach a high level of skill, we might surmise that this biology was primarily shaped by the environment. However, we could not necessarily say that an individual had a genetic pre-specification or an innate mental module governing his or her acrobatic skill. While the basic components are there in the motor strip (which is to a degree pre-specified or module-like in structure), the complex neuronal integration and differentiation arguably comes by way of later-evolving (and later-developing) associational areas in the prefrontal cortex that make greater use of learning and experience to create new functional networks. Recent neurobiological studies suggest, for example, that the brain can be shaped by various experiential factors, including skill-acquisition (Gobel, Parrish, & Reber, 2011), exercise (Helmich et al., 2010), meditation (Jang et al., 2011), and therapy (Linden, 2006).

For the present purposes, it is important to note that neurobiological findings have been used in various ways to explain a multitude of psychological processes from a neurodevelopmental perspective and without appeal to innate pre-specification. Neurobiological structures underlying reading, for example, may appear module-like in composition, but the requisite areas are obviously not connected by default. Reading has instead been argued to involve associational areas that assist in creating functional connections between the ventral visual stream, which is involved in object recognition, and Wernicke's area, which is involved in phonological processing (Schlaggar & McCandliss, 2007). Investigators argue that it is *the high degree of neural plasticity* which allows these different areas to become functionally connected through experience. Stated differently, the neurodevelopmental challenge involves utilizing ontogenetic experience in a way that will functionally organize the neocortical networks to meet the environmental demands for reading. Research of this kind allows us to question whether the environment might have more of a causative role in creating functional specialization within the nervous system. Up to this point, evolutionary psychologists are unlikely to see this line of reasoning as a threat to their theory, since they can argue that some of the underlying components of reading would likely involve the utilization of modular mechanisms that are in fact innate.[3] In any case, psychological phenomenon such as reading acquisition would be of little interest to them, since reading would have been an unlikely adaptation of the Pleistocene period. However, it does offer an illustrative example of environmentally programmed modularization supported by neurobiological evidence. Neurobiological findings have also been used to make similar kinds of arguments for other psychological functions, including language acquisition—one of the most fiercely guarded psychological constructs within nativist circles. Instead of language being a relatively discrete and innately pre-specified module, it is argued by some to arise from the functional integration of a number of pre-specified sub-components resulting from neurodevelopmental plasticity and experience-dependent activation (Behme & Deacon, 2008; Brauer, Anwander, & Friederici, 2011; Etard et al., 2000; Karmiloff-Smith, 2010). From this neuroconstructivist approach, functional specialization or modularization is thought to arise out of a gradual process involving genetic pre-specification, neural flexibility, and experiential programming. The present discussion is not intended to argue a solid defense for the origins or mechanisms of reading, language, or any other psychological construct. The only point to be made, which has been made more generally by others, is that the identification of module-like organization in an adult brain may tell us little about how that organization came to be. Our biology could conceivably accomplish functional organization by way of very basic, valence-laden neurobiological systems, interacting with our complex environments to dynamically shape the rest of the nervous system. This could conceivably lead to something that looks like a modular circuit—but it may not be *innately* modular. If modularization of the brain can result from learning and experience, then we ought not to use evidence of modularity in the adult brain or findings from lesion studies to justify a belief in innate modularity.

Based on the most accepted view of human neurobiology, it would seem that the "safest" place for evolutionary psychologists to look for specialized domain-specific neural mechanisms would be in the lower brain. Here, one may find older evolutionary mechanisms that offer less neuronal plasticity and would be conceivably shaped far less by environmental input. We might therefore be on safer ground to infer a genetic link, which would at least give us some reason to speculate about its having been selected by nature *for* some adaptive reason. If evolutionary psychologists were careful in making these more "targeted" hypotheses, their claims might be less controversial and more neurobiologically defensible. But the lower reaches of the nervous system are also less likely to hold the interest of evolutionary psychology—it wants to explain higher-level cognition and social processes. It wants to explain our whole human nature. And even in the evolutionarily older parts of the brain, where structures are more likely to be modular and domain-specific, we must concede that rather than being immutable and stable in composition, these circuits may also be influenced by the environment or by higher-level systems. Countless examples can be found through inhibition of many lower-level circuits by executive functions of the prefrontal cortex (Goldberg, 2001). In other words, the trait in question, assumed by evolutionary psychologists to be the result of some adaptive module from our Pleistocene past, may actually be the result of more generalized mechanisms that have been adaptively shaped by one's environment, and are now interacting with lower-level systems in more complex ways. It therefore becomes extremely difficult, if not impossible, to effectively guess what kind of traits are arising from innately modular circuits.

We can see the problem from a different perspective using evolutionary psychology's favored computer analogy. While it is true that humans have some engrained and pre-programmed biological circuits, all evidence would suggest that, unlike modern computers, our environmental experiences can cause these mental circuits to become edited, hi-jacked, intensified or lessened, inhibited, and so on. How else might we explain a person acquiring a phobia of hats, a fetish for shoes, or having an apparent indifference to what might be an evolutionarily relevant danger (e.g., cliff jumping)? If we accept this is true, we must also accept that it becomes difficult to say what might have been there at birth, or instead shaped by common environmental experiences that we all share. Modern computers cannot be re-programmed without a human; they do not function like the human mind. We are the ones who effectively *tell* computers what the binary ones and zeros of their programming language will represent. We give symbolic meaning to the code, which allows us to even say that computers processes *information*. Now let us turn to the human mind. Evolutionary psychologists want to say that *meaning* and *information* are objectively pre-programmed by our inherited biology. However, it would appear that we extract much of our information, and the meaning it contains, from a sociocultural cloud of symbolic representations that belong to a shared human subjectivity, or something Raymond Tallis (2011) refers to as the *community of minds*. Our subjective mental states are thus socioculturally structured and shaped through our reliance on an agreed-upon language and agreed-upon sets of subjective human meanings. The brain is only one part of the picture: it facilitates the mechanistic activities of the mind, but it does not solely cause them (Gergen, 2010). Human meanings, which belong to the collective community of minds, will thus often transcend the underlying mechanisms that represent them.

In this view, the "great programmer" is in part our environment, and many of our "adaptations" can occur within our lifespan. In David Buller's words, "evolution has not designed a brain that consists of numerous prefabricated adaptations, but has designed a brain that is capable of *adapting* to its local environment" (Buller, 2005, p. 136). Thus, at least part of what we have inherited by natural selection is the ability to flexibly shape our biology, within genetic constraints, to suit the demands of our environment and the symbolic realities defined by our cultures. But are our genes even capable of programming "hundreds or thousands" of mental mechanisms with the kind of complexity that evolutionary psychologists envision?

Some critics have argued against profuse modularity based on genetic evidence and the problem of a potential *gene-shortage*. It has been stated that our estimated 25,000 genes do not have enough information to code for all of our complex human behaviors (Ehrlich, 2000). Humans share an enormous amount of genetic information with other mammals. For example, 90% of mouse and human genomes have regions of conserved synteny (Sands, 2003), meaning not only that they share an overwhelming amount of genetic material, but that much of the chromosomal sequencing is identical. The remaining genetic material must therefore account for the dramatic physical and psychological differences seen between humans and other animals. And while a small number of genes can produce dramatic variation, for example developing a larger brain or placement of a leg, it is arguably more genetically taxing to create vast arrays of specialized neural mechanisms not possessed by mice, dogs, or gorillas (Ehrlich, 2003). This could potentially lead to a gene-shortage if we must account for a dizzying array of distinct neurobiological modules unique to humans (Ehrlich, 2000). Others have countered this line of argument by pointing out that the human body is already capable of reaching an astonishing level of complexity without a shortage of genes, since one gene will have an effect on multiple biological mechanisms (Hagen, 2005; Marcus, 2003). But Paul and Anne Ehrlich (2009) point out that this is precisely the *reason* for an argued gene-shortage. If natural selection selected one behavior or trait, then it would likely end up modifying another, owing to the fact that they shared genetic information. The kind of genetic alteration required to produce so many species-specific dedicated psychobiological adaptations would conceivably wreak biological havoc on an animal that has already been so finely tuned by evolution.

If we were to accept that the human genome may put an upper limit on the number of pre-programmed adaptations investigators can comfortably hypothesize without potentially jeopardizing the rest of our genetic endowment, we would need to become more parsimonious with our hypotheses. Complex and numerous psychobiological adaptations would presumably need more genetic information to constitute themselves. So, would it not have been more efficient for the human genome to provide genetic instructions for adaptive modules that can work in a wide range of environmental situations instead of a specified few? Would it not make more intuitive sense, for example, to have acquired biological systems that direct us to "fear and avoid environmental threats" (e.g., things that evoke physical or emotional pain or discomfort), versus having separately acquired systems that direct us to "fear and avoid spiders," "fear and avoid snakes," "fear and avoid being raped," and so on? Evolutionary psychologists argue against general mechanisms, again claiming that our mental programs would have been more specified, since a program that is good at solving one problem tends to do a poor job at solving another (Tooby & Cosmides, 2005). If *all* of our "mental programs" were inherited, and the environment was incapable of significantly shaping our neural complexity, they might have an argument. But based on the previous discussion neither seems to be the case. As Maarten Derksen (2010) points out, evolutionary psychologists seem to want to separate ontogeny from phylogeny, or at least redefine what kind of relationship they ought to have. For them, the "information" (or the ability to identify and process it) must be built into the human machine, since a purely domain-general mind—equivalent to 1.5 kg of neuronal silly-putty—would be unable to extract anything meaningful from the environment; it becomes paralyzed by a kind of "blind search." But this line of reasoning sets up a false dichotomy where the only sensible choice seems to favor a heavily pre-specified system. However, those who reject the evolutionary psychology definition of the mind would not see a problem with a modest number of pre-specified valence-laden systems, since they ought to be "good enough" to get the organism started while the environment plays a larger role in the "programming." Again, there is an abundance of research that demonstrates our nervous systems are able to do this through Hebbian synapses and building functional representational neural networks—this is the basis of learning.

From a computational perspective, we can imagine a system comprising deeply imbedded algorithmic mechanisms—each with specific functions, while other parts of the system remain comparably flexible and domain-general. In this way, domain-general mechanisms are now able to encode information from the environment, since they are no longer paralyzed by blind search, but are instead being loosely directed by simple low-level mechanisms. Note that much of the "information" or potential "input" in this model can be built outside of the system and involves a more guided search toward a restricted range of environmental stimuli that can then be used to inhibit, overwrite, or extensively build upon the complexity of innately modular systems. For example, a series of low-level module-like mechanisms could assist the system in attributing positive or negative valences to environmental input. Utilizing these basic mechanisms, the domain-general or flexible part of the system may further encode information from the environment to create new valence-laden internal representations of the external world based on experience. These learned representations then assist in directing *future* behavior, so that it no longer relies exclusively on innately modular lower-level mechanisms. Importantly, there seems to be no good reason why the mind cannot be conceived as a *mostly* domain-general learning device—it has the advantages of putting much of the "information" outside of the system,[4] yet has just enough simplistic pre-programmed module-like structures to prevent it from being paralyzed by blind search. Our biological reality, informed by the physical sciences, suggests that the human brain is made up of both domain-specific and domain-general mechanisms, along with their complex interactions (e.g., Kolb & Wishaw, 2003; Panksepp, 1998), and that a great many of these sociobiological systems are shaped by our present-day environments and even by our interpersonal experiences (e.g., Schore, 1994; Siegel, 1999). This view is in many ways rejected or minimized by mainstream evolutionary psychology.

Nature, nurture, and culture

Most evolutionary psychologists will concede that a psychological trait might be partially explained by means other than their favored modular mechanisms that were adaptively selected to solve specific evolutionary problems. In theory, most would accept that an observed trait could have arisen from chance genetic inheritance or that it might represent a side-effect or by-product of some other unknown genetic adaptation. Most would also admit that a trait could have been learned by way of individual life experience or shared cultural environments, though even here they would prefer to say that culture and environments are only activating some invisible module that they then go on to explain (see discussion below). So while the marginal role that evolutionary psychology ascribes to the environment, culture, and learning might assist the field in deflecting accusations of genetic determinism, critics argue that evolutionary psychologists make only minimal efforts to entertain them as credible alternative hypotheses. Though it has become fashionable for scholars to declare that "the nature–nurture debate is dead," that "it is neither all biology, nor environment," it would seem that in practice the theoretical biases remain.

One would suspect cultural explanations to be a potential threat to the validity of any evolutionary psychology explanation relying on the assumption of trait universality, as proof of underlying genes at work. A hypothesis should be instantly weakened, for example, when one finds a culture where the trait in question is either absent or operating in contradiction to what would be predicted by an evolutionary psychology claim. But even if the trait in question *is* found to be ubiquitous across cultures, it still does not rule out the impact of culture. In an age of globalization, the universal spread of democratic and capitalistic values threatens the existence of truly independent cultures. As cultures erode and our lived environments become exceedingly similar, it consequently becomes more difficult to measure the direct effects of our shared environments on personality. But rather than this effect lifting the burden of proof from the evolutionary psychologist, I suspect the burden becomes necessarily more onerous, though there are likely few in the field who would see a need to meet this new challenge. Thus, universal traits that might be the result of true cultural or environmental effects risk being interpreted as proof of some adaptive mechanism with a genetic origin.

Interestingly, evolutionary psychologists choose to differentiate between *evoked culture* and *transmitted culture*. Evoked culture is confusingly defined by Jaime Confer et al. (2010) as "differential output elicited by variable between-group circumstances operating as input to a universal human cognitive architecture" (p. 118). They in essence suggest that different environmental circumstances can evoke, or activate, some kind of dormant but pre-programmed information-processing module(s), which would in part explain what we view as culture. This may involve an appeal to genetic pre-specification or epigenetics. Though Confer et al.'s definition of transmitted culture is more in-line with how most non-evolutionary psychologists would define culture (e.g., learned behaviors, values, and beliefs transmitted within a group), they go on to propose that "explaining transmitted culture requires the invocation of *evolved psychological mechanisms* [emphasis added] in both transmitters and receivers" (p. 118). In other words, they seem to suggest that even within cultures, certain kinds of information (e.g., different forms of gossip) are preferentially transmitted between group members in specific ways that served evolutionarily adaptive purposes. They then go on to provide examples that only beg the initial question, and divert attention away from the main problem. They do not address the issue of cross-cultural variability in a way that would satisfy non-evolutionary psychologists, though it would seem they would now like their untested definition of the mind to influence how we even define culture. The concern is thus partly evaded: "We cannot be challenged by cultural variability, because we are claiming culture to be a part of our information-processing modularized paradigm." It would appear that they are trying to explain away the problem, treating an assumption as a fact, and, moreover, relying on the very assumption critics are trying to question.[5] In part, this all makes sense. Evolutionary psychologists *must* downplay culture, because for most of us, cultural influences would support the existence of a domain-general and flexible nervous system that can adapt to environmental experiences. But the core principles of evolutionary psychology are biased in a way to dismiss this view, in defense of a version of the mind comprised of domain-specific information-processing mechanisms—it is a requisite theoretical assumption that validates their methodological approach.

To illustrate how theory pardons method, we need only compare the divergent perspectives regarding the assumed composition of the mind, and see what it would take to test hypotheses within each. Let us first suppose that we accepted a definition of the mind that involves some kind of complex interaction involving a relatively parsimonious amount of lower-level module-like systems, and higher-level systems that are more ontogenetically shaped, domain-general, and plastic. If we wager this version of the mind to be correct, it would seem that we must exercise extreme caution in attributing psychological variables to genetic origins, as we have allowed for other plausible interpretations that would be extremely difficult to disprove. Otherwise, how could we know which "primary cause"[6] (environment vs. genes) or biological system (domain-general vs. domain-specific) is giving rise to the psychological trait of interest? However, the alternative view assumes that the mind is massively or mostly massively modular, involving a composition of pre-specified and domain-specific psychological mechanisms. Assuming the present-day environment to play a comparatively minor role, the evolutionary psychologist can justify its neglect during the investigative process, which, in a way, excuses him or her of the more demanding burden proof required of the non-evolutionary psychologist. The evolutionary psychologist need only be concerned with uncovering the genetically pre-specified psychobiological modules that are presumed to define nearly all of our mental architecture. Since the genetic sciences can do little at the present moment to assist in this task, most of this is done through formulating speculative hypotheses about what they might be. But these hypotheses can be almost impossible to disprove, since nothing else grounds them; they are not constrained by knowledge of our neurobiological composition—only by the supposed EEA (e.g., the Pleistocene period), about which our knowledge is severely limited. The speculations of evolutionary psychology are therefore free to be reverse-engineered and adapted to favored interpretations. This is in part made possible by virtue of the fact that most of the field conducts research supposing innate biological mechanisms, without seeing much need to study these mechanisms first-hand. It would seem that evolutionary psychologists are seldom if ever required to substantiate their claims on a biological level, though they are often deemed good enough to be viewed as empirically supported. It would appear that the real heavy-lifting and hypothesis-testing is then put on the neurobiologists or, worse, researchers of the future.

Computational or modular theories of mind tend to create hypotheses relatively independent of or indifferent to what data we have about how the human nervous system actually works. The hypotheses presented by evolutionary psychologists, for example, are seldom accompanied by: (a) a logical rationale and/or scientific evidence positing the approximate locality and function of requisite neural mechanisms underlying the stated hypotheses, (b) evidence supporting the likelihood of hypothesized mechanisms having arisen from modular neurobiological circuits, and (c) evidence that such mechanisms are likely to have had genetically endowed origins, versus having been indoctrinated by way of experience and learning acquired during ontogenetic development. In addition, popular writers in evolutionary psychology (i.e., Pinker, 1997) interpret the mind to be "what the brain does," but usually go no further in explaining how the central nervous system could possibly create this version of the mind they go on to describe. Most evolutionary psychologists curiously show little discomfort in neglecting the basis upon which the theory supposedly rests. This sidestep is convenient, as they are then able to create a version of the mind free from the requirements and constraints of physical reality. The reasoning is thus circular: the mind is what the brain does … we will spend little time exploring how the brain works … but we will go on to describe the mind … which will be used to deduce brain function. Rather than the theoretical framework offering a way of organizing or describing reality, it instead *becomes* reality. It involves a top-down approach: using observations of apparently universal traits as assumptive evidence of both domain-specific adaptive circuits, and underlying genes at work. There is remarkably little concern about whether the hypotheses fit within the context of current scientific knowledge about genetic inheritance, ontogenetic neurodevelopment, and neurobiological structure and activity. But simplifying or neglecting neurobiological research would be a grave error, as the underlying biological structure may set limits as to what kinds of traits are likely to have arisen from innately modular circuits or genetic influences. Critics have argued, for example, that evolutionary psychologists often hypothesize psychological mechanisms that, in order to work properly, would place biologically unrealistic processing demands on the brain (Bechtel & Mundale, 1996). It is thus ironic that evolutionary psychology would be based on a foundation so detached from our genes and underlying biology. Instead evolutionary psychologists would appear to continue the dualist tradition of keeping the mind and body as separate entities, perhaps not to preserve a notion of a "soul," but to maintain the illusion that we humans have the intelligence to explain ourselves,[7] and that this new field, and its contributing members, have helped to usher in what David Buss (2005) claims to be "a true scientific revolution" and a "profound paradigm shift in the field of psychology" (p. xxiv).

Summary and discussion

Evolutionary psychologists offer adaptive explanations for a wide range of human behavior by way of intriguing stories that have face validity. The term "*evolutionary* psychology" also borrows the name of a theory that few in the scientific community would refute, giving it the appearance of authoritative credibility. Many are drawn to its simplicity and ability to impose an order or structure, which helps us understand what was previously too difficult to comprehend, or otherwise came with great effort and lengthy study. Though often characterized as a field only looking to apply evolutionary principles to the field of psychology, it is more correctly defined as a field with specific assumptions regarding the mind. These theoretical assumptions have arguably led to methodological issues, including what would appear to be an unrestricted "free pass" to neglect the immediate environment in the investigative process while "theorizing" about adaptations that somehow explain themselves.

While most critics would agree that the human central nervous system was almost certainly shaped by natural selection, they take issue with the claim that evolutionary psychologists know *what it was* that nature selected. To repeat again, *evolutionary psychologists claim that nature selected specialized and domain-specific (versus domain-general) mechanisms that process information*. But our biological and social sciences suggest that we have instead inherited both domain-specific and domain-general neurobiological systems, involving innate and environmentally shaped mechanisms; it would be impossible to differentiate between the two without a thorough understanding of how these underlying biological systems work, though evolutionary psychology as typically practiced seldom engages in this kind of deeper investigation. Evolutionary psychologists also have little need for a deep understanding of culture or the present-day environment, since neither is viewed as a causative source of "ultimate" influence. Meaning is not found in the immediate environment, but is instead pre-specified in our genes, or, perhaps more accurately, is believed to be pre-specified in our genes. In this way, meaning and reality are found within the evolutionary psychology paradigm itself. The irony is that in wanting to combat constructionism and relativism, evolutionary psychologists would seem to have created a secular belief system that has constructed their own sets of meanings, including how they would seem to want to redefine culture, the environment, and the inner workings of the human brain. If they were forced to concede that the mind were made up of both domain-specific *and* domain-general mechanisms; if they were forced to concede that they should understand the underlying biology upon which they base their assumptions; if they were forced to concede that they must tease apart environmental learning from genetic influences; any "progress" being made in the field would grind to a halt.

While empirical "findings" are made within the field, many of them only make sense if one accepts the assumptions of evolutionary psychology's definition of the human mind. Criticisms and alternative explanations have been offered for some of evolutionary psychology's most cherished findings, including those related to kin selection (Sigling, Wolterink-Donselaar, & Spruijt, 2009), human mating (Eastwick, 2009), incest aversion (Ingham & Spain, 2005), propensity to rape (Begley & Interlandi, 2009; Gard & Bradley, 2000; Ward & Siegert, 2002), language acquisition (Behme & Deacon, 2008; Brauer et al., 2011; Etard et al., 2000; Karmiloff-Smith, 2010), cheat-detectors (Leiber, 2008), and fear of snakes (Fox, Griggs, & Mouchlianitis, 2007; Lipp, Derakshan, Waters, & Logies, 2004; Purkis & Lipp, 2007). Evolutionary psychologists often respond to their critics by suggesting that they misunderstand their field and that they ought to read the foundational texts of their discipline and the enormity of its research findings. However, this suggestion would appear to be nothing more than theoretical bible-thumping. They want their research to somehow stand on its own—hoping that their critics will excuse or overlook the theoretical assumptions that were made in order for them to conduct it. Evolutionary psychologists appear to be living in the Land of Oz—implicitly suggesting that when our genetic sciences mature, we will someday look behind the Wizard's curtain to find DNA proof supporting their modular hypotheses. However, there is reason to suspect that we will uncover what we should have always guessed—and this is where the computer analogy does ring true—it was not nature that selected these modules, but humans who put them there, crafting stories that were so good, they would even fool themselves of the truth.

The ambitions of evolutionary psychology may cause us to be reminded of a quote often attributed to Einstein: "Make a theory as simple as possible—but no simpler." Any integrative theory of human nature would necessarily consider evolutionary research, though when the science becomes over-extended, it leads into assumptive speculation and illusory truths. It would seem that a large segment of evolutionary psychology has become so invested in its view of the mind that it is assumed to be true. The research takes over, though its theoretical assumptions may have parted ways with reason and are now influencing the methods of investigation and interpretation of data. Theoretical momentum and positivist leanings will seemingly push the field as far as it will go. However, it may not be too late to slow its progress by tenaciously engaging evolutionary psychologists in debate surrounding their theoretical assumptions; this paper offers a small contribution to that ongoing discussion, with the eventual goal of making room for a psychology that may more responsibly apply evolutionary principles to our understanding of the human mind. These viable alternatives would come from a solid understanding of human neuroanatomy and neurobiological function with more rigorous standards of acceptable research that involve ruling out cultural or environmental factors as very serious alternative explanations. Though they lack the theoretical momentum of the old cognitivism or evolutionary psychology, these alternative ways of thinking about human nature are consistent with both neurobiology and evolutionary theory, while explicitly rejecting nativist information-processing and massive modularity assumptions (e.g., Deacon, 1997; Edelman, 1992; Fodor, 2001; Malik, 2002; van Dijk, Kerkhofs, van Rooij, & Haselager, 2008).

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Notes

1. Incompressible means that a module is incapable of, or resistant to, further compression. Modules thus have clear boundaries and functions as discrete units, though evolutionary psychologists claim that they may also be interconnected.
2. These principles are perhaps best summarized by Hebb's axiom: "neurons that fire together, wire together." This is presumably made possible by neurodynamic functions including Long-Term Potentiation and Depression of synapses or growth of new dendrites that influence neuroconnectivity (Kolb & Wishaw, 2003).
3. However, given examples such as these, we might wonder how evolutionary psychologists could know with any confidence what the functional components might be. This amounts to the "grain problem" as stated by Franks (2005).
4. Computational models were fraught with the issue of combinatorial explosion, where hypothetical systems would fail in terms of real-world efficiency or rationality. See Brattico (2008) for a good review.
5. Refer to Derksen (2007) for a detailed discussion of evolutionary psychology's treatment of culture.

6. I am aware of the issues regarding one's trying to separate genes from environment. I only make this distinction here because it would appear that evolutionary psychologists are trying to do just that, or by otherwise stating how our genes and environment ought to interact—with environment offering "proximate" causal influence, while genes offer "ultimate" ones. The present question involves asking how they would methodologically go about testing this relationship.
7. Lugowska (2008) has recently argued that the appeal of evolutionary psychology may lie in its ability to promote culturally relevant myths through its "scientific" view of reality.

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