Why Evolutionary Psychology Cannot Be True

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Paper Prepared for the Session

Bordering on Fact: When Anthropologists Have to Take Science to Task

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Annual Meetings of the American Anthropological Association

San Francisco, CA, November 15, 2012

Evolutionary Psychology has had quite a run. In popular media, and as a spreading theoretical orientation in fields from economics to political science to psychotherapy to literary criticism, the claim has been staked that it offers a unifying, *scientific* foundation for new understandings of old problems. EP's claim that only evolution–variation and selective retention–can explain the underlying designs they claim to find in human minds, behaviors, and cultures. This talk offers a counter-claim: the core theoretical construct of classical EP cannot possibly be true.

This is not an attack on all efforts to understand the evolution of human cognition, only the theoretical main frame associated with Tooby, Cosmides, Buss, Pinker, and company. In a long sentence, that main frame is: the mind is a mass of modules or domain specific neurological algorithms, expressing information coded in our DNA, which evolved to process specific inputs on specific adaptive problems, producing psychological dispositions and behavioral responses, that were adaptively advantageous in enhancing inclusive fitness, in the ancient Environment of Evolutionary Adaptedness–the EEA–of the African savanna.

I will first discuss recognized problems with the idea of massive modularity, then turn to issues of selection in an imaginary EEA environment. My central point is that although EP may survive direct critiques of Massive Modularity, this complex gene-based structure could not possibly have evolved as EP's claim.

The idea of mental modularity was raised by Fodor's work on computational modularity of the primary visual system. Evolutionary Psychology radically expanded this insight to claim that the entire mind is modular, that humans reliably develop "hundreds or thousands" of

dedicated circuits, which en masse, constitute the human mind.

A classic illustration of modularity is Orians and Heerwagen's evolved responses to landscapes. The idea is that selection has favored emotional responses to terrain features commensurate with their likely fitness contribution, as evidenced by our supposed preferences in landscape paintings. Our artistic sensibilities supposedly reveal, we prefer savannas, as we supposedly should. But we also discriminate between high and low quality savannas. Major positive features includes open views, browsing animals, grassy ground cover, and frequent changes in elevation for spatial orientation. There are also negatives–which must be computed in balance--such as predators, unfriendly conspecifics, parasites and toxic foods. There is much more to this module. The authors discuss a host of transitory, seasonal, and long term cues to productivity, all with their evolved emotional responses. Research with college students indicates that selection has conferred very specific preferences, for instance concerning trees, for canopies that are not too dense or too thin, and trunks that are not too tall and that branch close to the ground. Our evolved responses are not static, they guide us through stages, from initial encounter, to exploration, to settlement. They also vary by individual age. That is *one* module.

EP has it that natural selection inscribed all these preferences on our genes. Evolutionarily, what does that require? Each value of each variable–say tree trunk height or branchiness–must have a distinct chromosomal locus. Selection on each is independent, and in competition: good allele for short trunks, vs. bad allele for canopy shape; good combination of alleles for trees, bad combo for open vistas. Given that this evolved set of preferences includes dozens of variables, each with its own variations, and programmed reactions vary by individual age and phase of exploration, hundreds or more likely thousands of genetic permutations are

possible for this module. And it is not just those allelic variations that need to be selected: so too must the computational algorithm that combines and weights them all. True, some posited modules are simpler than this, such as a fear of snakes. But many others are certainly more complex. Try to imagine how many specifics must be involved in a homicide adaptation module proposed last year by Buss, that includes: sensitivity to adaptive problems solvable by homicide, a catalogue of homicide relevant information, estimates of formidability of victims, forecasts of likely consequences of murder, and cognitive stimulation of killing.

The idea that the human mind is little more than a mass of such modules has been thoroughly critiqued. One is that genomics shows there are not enough genes to produce such numerous and intricate systems. I think that critique fails as recent investigations indicate that upwards of 80% of the noncoding areas of chromosomes are involved in regulating gene expression. Combine that point with emerging regulatory functions of the RNA transcriptome and epigenome, and no one could possibly guess how much complexity the chromosomes can generate. On the other hand, bring in the fact of pleiotropy–one gene codes for many functions–and the *selection process* that is the focus of my critique become far more encumbered. At the genetic level, selection pressure can only be imagined as a currently opaque vector, typically involving not sweeps of single genes, but statistical shifts of quantitative trait loci.

Advances in neurobiology have not been kind to EP. Much work has demonstrated developmental plasticity and functional reuse of brain regions, which continues in adulthood. It seems few but EP's themselves now subscribe to their we-are-Science mantra: only natural selection can account for complex design. No--development can, as with visible neural and

learning changes associated with reading or musical training. Post-genomics and neural imaging–which could have clinched the case for EP–have done anything but. No gene has been discovered for any specific module. Indeed, in all the claims floating around about a 'gene for this or for that,' I know of none for a gene determining anything with the psychological specificity of most any element of any module–for example, snake recognition. No modules have been lit up by fMRIs or PET scans. Sure there are grosser localizations of functions, such as impulse control, which could be 'consistent with' EP, do not need EP. These are invisible modules. Through some radical views of neurobiological plasticity and developmental construction have been knocked back by evidence of substantial genetic functional localization in the brain, this is seen as pre-wiring, not hard-wiring, and subject to great modification by experience. Self-proclaimed "middle-grounders" say that an adult brain may indeed have domain-specific circuitry, but these develop and are shaped through experience, in contrast to the EP view of "normal" unfolding of genetic blueprints.

Other critiques are aimed at the theoretical construct of modularity. Points include: EP modules do not fulfill the criteria of mental modularity. The precise character of hypothesized modules are very underspecified in multiple ways, and often totally vague. There is an "allocation problem"--how do sensory inputs get channeled to the module that is supposed to process them, when some of the defining characteristics–e.g. does this involve a social relationship?–are pretty deductive themselves? How can domain specific modules account for the analogic, comparative reasoning that make up so much human thought? If there is no general-purpose problem solving ability, what is the nature of fluid intelligence as measured in tens of millions of IQ tests? What happens when one module says to do this and another

module says do that? How are all the modules integrated–what is the "me" that emerges from all of them?

Of course these critiques produced rebuttals, some of which recast the basic concept of massive modularity. Yes, it is granted, neural functions may result from development, but the development is guided by the genes to preset outcomes. OK, EP modules do not meet standards of classic modularity, but they are modular-ish. So many are not discrete, enclosed circuits. Elements of one circuit may serve multiple domain-specific modules, and one module may involve several parts of the brain–so don't expect any localization through neuroimaging. Modules may receive input *from* or produce output *to* other modules, and can be nested in hierarchical layers of modules–so don't expect any clear definition of one module vs. another. All such connections also require selection for specific genes–I hasten to stress--adding hugely to the complexity of the proposed evolved massively modular product. There can even be some multiple domain modules, such as "practical reasoning" or even general intelligence. As some critics point out, these reformulations are so broad as to accommodate virtually any neurobiological findings, and are far from the concept of content-specific modularity that has been central to the presentation of EP.

These defensive reformulations mean that EP cannot neurobiologically be declared dead. On the other hand, there is precious little in recent brain science that actually *supports* EP. The evidence for the existence of evolved modules relies almost exclusively on their putative adaptive function. EP's *know* they exist because their psychological experiments show that they exist. But the college students who take these tests are highly atypical as exemplars of pan-human nature; and time after time, when critics examine a specific proposition, such as the

cheater detection module–the crown jewel of EP theory–major challenges have been raised. Of course those are rebutted. But the trump rebuttal of all is that even if any, or many, proposed modules are tossed out, these are just individual hypotheses and so do not falsify the paradigm. Which would seem to leave EP utterly beyond disproval. That's where selection comes in.

The Environment of Evolutionary Adaptedness ain't what it used to be. An assumption that our ancestors passed millions of years on the African savanna, playing out "Man the Hunter" scenarios, pervades EP thinking about selection for massed modules. Recent research on evolutionary environments provides a very different picture of hominins adaptive context. East African grasslands began to expand around the time of the Last Common Ancestor roughly six million years ago. Yet extensive woodlands continued. Ardipithicus ramidus, the Australopithecines, and even Homo habilis of roughly 2.3 million years ago (or later) display adaptations for *woodland* living. The notion that any of these were diminutive savanna hunters, and the foundational EP scenario of *man* bringing home the bacon to wife and children, is rendered totally untenable by several lines of evidence--such as the fact that the Pleistocene savanna was traversed by mega predators, which sometimes came in packs. What the retained morphology of woodland dwellers combined with expanding savannas does suggest is that our ancestors exploited multiple environments. They were intelligent, social, and flexible. They needed to be.

Not only were evolutionary environments mosaics, they fluctuated wildly over time. The Rift Valley and lakes that were the center of east African hominin developments amplified climatic oscillations, leading to massive changes from wet to arid, and from hot to extremely hot. These are known from the time of the LCA all the way up to the emergence of anatomically

modern humans. The periods of greatest fluctuations coincide with major evolutionary changes in hominins, between times of greater stability. This is consistent with punctuated equilibria, rather than the gradualist model of evolutionary change that underlies the EP idea of slow selective fine-tuning of adaptive programs.

Before 2.3 million years ago, there is no reason to conclude that any of the ecological or social circumstances typically attributed to the Environment of Evolutionary Adaptedness were in place. Our ancestors seem like just another great ape–sorry. Many species went extinct through these climate changes. Hominins did not. Some paleobiologists conclude that such complex and changing environments acted as powerful selective force for increasingly open, flexible, behaviors. Adapt*ability* itself was our adaptation.

Only with the emergence of Homo erectus around 1.8 million years ago does the hominin fossil record indicate specialized adaptation to extreme heat of the open savanna, and pronounced meat eating. If EP's savanna EEA has any reality, it starts then. But virtually at the same time, hominin expansion out of Africa begins, perhaps pushed by extreme temperatures and aridity in Eastern Africa. Erectus was in Georgia about as early as the earliest African finds, and spread through all the varied environments of Asia. Once again, flexible adaptability is indicated. Somewhere between 800 and 300,000 years ago, the Neanderthal line spit of from Homo sapiens, with other branches besides, such as Homo antecessor. A few years ago one might dismiss those branches as irrelevant to our evolved brains, as they went extinct. The discovery of both Neanderthal and Denisovan DNA in modern humans, plus the incredibly freaky Homo florensiensis, clearly signals that our recent phylogenetic history is about to be rewritten. And it looks to include at least one extreme bottleneck constriction of our ancestral

population down to a couple of thousand individuals. That may have been the most extreme selection episode in our evolutionary history, and we have no idea what it was.

Well, one might say, even if natural environments were always changing, the *social* environments remained constant. In graduate school, I studied cultural ecology, which demonstrated how human social patterns flexibly respond to major environmental characteristics, including in such prime EP topics as subsistence, marriage, politics, group definition, and social structure. Simple hunter-gatherers have highly variable, and often highly flexible, adaptive patterns. A major nexus of EP theorizing is the combination of patrilineal organization, exclusive territoriality, and intergroup conflict or war. None of these can be substantiated as normative for known hunter-gatherers. No less variation–and probably much much more--should be expected from our ancient ancestors. Consider the Hobbit, a tiny microcephalic in a world of dragons.

One thing we know for sure about hominin evolution is that starting with Homo habilis and continuing through Homo erectus, the brain got larger. Late Homo erectus could top out 1100 cc–not up to anatomically modern humans at 1350 cc, but getting there. The brain is energetically expensive. Selectively, it had to earn its keep. Was brain expansion a matter of neurons piling up to add more domain specific modules, or was this evolving an organ for constructing contextually attuned adaptive minds through prolonged maturation and neurobiological development out of a highly plastic neo-cortex? With Homo erectus we see our ancestors not just adapting, but reconstructing their adaptive niches by the use of fire and cooking, massively altering the effective environment.

Anatomically modern humans appear, rather suddenly, roughly 140,000 years ago, maybe

earlier. Yet signs of fully cultural existence, such as characterize all contemporary humans, do not show up until 70,000 years ago or later. Why the time lag? One recent theory is that the emergence of culture came from a brain mutation. Another, that it required a demographic critical mass. Another that language itself had to culturally evolve, as a communication system that could be exapted as the platform for symbolic cognition. Either way (or any other), culture is a recent *emergent domain*, as irreducible to biology as biology is to physics. As others have pointed out-- I'll mention Ashley Montagu and Leslie White--culture is a new adaptive dimension, capable of rapid innovation and transmission, Lamarkian more than Darwinian. All you have to do is look around to see that cultural adaptation is what enables humans to live in any environment of the world.

Through all this phylogeny, EP would have us believe that differential reproductive success accrued to those with mutations that, for example, exaggerated the nearness of approaching sounds as opposed to receding sounds, and hundreds or thousands of modules more. Natural selection has inescapable rules. Variation is based on random mutations. For EP to be true, every value of every variable of every module, every connection within or between modules, every pathway of processing and algorithmic variation, *each* would have to first, arise from a random mutation, and then be favored by its contribution to relative inclusive fitness. Each had to confer increased reproductive success to individuals who bore it over thousands of generations, in order for the allele to sweep the ancestral human population. Every permutation, within or between or among modules, would *itself* have been in Darwinian competition with every other permutation. I will not recreate my guesswork, but I estimate that a minimum of 10,000 specific DNA loci would be necessary for a relatively simple version of massive

modularity, and probably many times that. And of course, in the EP world of selfish genes striving to reproduce themselves via reproduction of their lumbering hosts, all those permutations in mental structure would also be in competition with all those genes underlying the great *physical* evolution that we know occurred through the fossil record.

Going back to the Last Common Ancestor entails some 300,000 generations. But for more than two thirds of that, there is very little movement toward humanness. The only possibly plausible place to start the process is with Homo erectus, meaning about 90,000 generations. Even if EP ideas of evolutionary processes were realistic, there are not enough generations in hominin evolution to accomplish this prodigious design feat–10 or 10's of thousands of genes, each tugging in different ways to maximize their reproduction. Evolutionary Psychologists are fond of mentioning the liver or heart as examples of design by selection. Fish have livers and hearts. These organs had millions upon millions of generations for design. Go back and take a look at George Gaylord Simpson's presentation of benchmarks in the evolution of eyes. It begins with protozoans.

Other critics have pointed out that Evolutionary Psychology's massive modularity is unsupported by science outside the EP paradigm, unlikely in light of developments in genetics and neurobiology, unnecessary as other scientific approaches are capable of explaining the evolution and development of adaptability, and nearly unfalsifiable in that any critique can be deflected. What makes it impossible, in my estimate, is considering massive modularity as a selection proposition, in a realistic EEA, of diverse ecologies in massive fluctuation, with bursts of rapid change and bottlenecks, where whole organisms–not individual selfish genes, but bundles of 30,000 genes and countless regulatory elements, all developing within systems of

systems which are open to the environment--either survive and reproduce, or don't.

EP's great popular appeal is its seeming *plausibility*–wouldn't it just make sense to evolve an inborn fear of savanna snakes? EP has spread by virtue of its limitless bucket of plausible sounding modules. But when one thinks instead of the selection process that would be necessary to produce that modular system, EP is not the least bit plausible. It can't be true.

EP has spread through popular media and to many fields of study by donning the mantle of Darwin, evolution, and Science. Far too long, anthropologists have just ignored it, wishing it would go away while allowing it to spread. As this panel suggests, better to hold it to account.