Back in the days when vegetarianism was less fashionable, you could see ads for tofu where a glowing child, her mouth full, exclaimed: "*I can't believe it's tofu!*" One should hope this book will have the same effect on scholars not used to putting Evolutionary Psychology on the dinner table. Clark Barrett's *The Shape of Thought* makes a novel case for adaptationism in the study of the mind, one that addresses almost all of the usual concerns of its opponents. If you think that natural selection could only shape the human mind by building rigid and innate modules—modules that were optimally adapted in the Pleistocene, but can no longer help us act flexibly—, you will discover a discipline that is richer than you thought. If you already know better about the field, this book is much more than an up-to-date introduction to evolutionary psychology. It is a complete rethink of some of its most fundamental notions (chiefly massive modularity, adaptation, and social cognition). In short, I find very few things not to like with the book, except perhaps the picture on the cover (a cross between the monolith in *2001* and an Ikea lamp).

Read this book if you think you already agree with it; read it if you're unconvinced; buy it for your unconvinced friends. They won't believe it's tofu.

While I loved the book, I believe that Barrett's revamped evolutionary psychology reveals problems for that theory. Because it is more nuanced, sophisticated and prudent than some earlier accounts, it lays bare some areas where evolutionary psychology's capacity to come up with novel and surprising predictions can be doubted. This review will focus on two of them: Barrett's views on the proper domain of mental adaptations, and his model of massive modularity.

Adaptations in mind

The first part of *The Shape Of Thought* is devoted to a substantial *aggiornamento* of evolutionary psychology: replace its neo-Darwinian core with an updated evolutionary biology. The field is often seen as wedded to a narrow-minded form of adaptationism. That adaptationism is the bogeyman Barrett wants to exorcise. The adaptationist bogey man gives little thought to the many ways in which development influences evolution. The generation of variation is a black box. So are learning and development. Mental adaptations are innate. Preformationism rules. Barrett dispels this view and sets the record straight in a way no evolutionary psychologist had done. (Though some of these points had been made before—here for instance.) Barrett also corrects the view that adaptation consists in bringing passive organisms to take the shape of an unchanging environment. Friends of Developmental Systems Theory, Evo-Devo, Complex Systems theory, niche construction, or dialectical biology *à la* Lewontin will no doubt find Barrett's brand of adaptationism much more appealing than earlier versions.

The core idea of evolutionary psychology, Barrett-style, is that cognitive structures develop in a way that reflects the adaptive challenges previously faced by the lineage we come from. As a result, today's minds contain information about yesterday's selection pressures. This does not mean we need to represent that information. Our minds work in ways that reflect our evolutionary past, exactly like plants or bacteria, and for the same reasons. Any organism, for Barrett, embodies a series of "inductive bets" that its ancestors placed against nature. A cactus' ancestors had "bet" that their environment would be arid; the cacti that bet differently did not become ancestors. These are metaphorical bets, of course: the product of (more or less) random variation, not conscious decisions. Some of them have been made relatively recently and only by humans, others have been standing for much longer. Barrett claims these bets can be used to make predictions about human psychology, just like they can be used to study cactus physiology. When doing so, we need to keep in mind that our ancestors did not bequeath us ready-made cognitive structures, but flexible developmental programs. The targets of adaptation by natural selection are processes, not structures, and these processes can handle environmental novelties in a highly open-ended fashion. Adaptations need not be innate (and even "innate" adaptations must develop). Cognition develops in

a way that uses the information left in the genome (and elsewhere) from previous inductive bets, in a way that permits us to behave flexibly. Evolutionary psychologists study dynamic systems that spawn thoughts, concepts and modules as the need emerges, that is to say, constantly from birth to death. Cognitive fossils is not what Barrett is after.

How do we use evolutionary theory to make predictions on how the mind works? This is a downside of Barrett's *aggiornamento*: he needs to make the answer to that question a great deal more complicated than it used to be. In standard evolutionary psychology, the way to go would be to identify a selection pressure (avoid predators, for instance); to figure out an adaptive way to meet it (spot animated things and select an immediate flight-or-fight response); to identify what instantiated the selection pressure in the past (snakes and spiders, not cars or drones). That set of adaptively relevant events constitutes the adaptation's environment of evolutionary adaptiveness (EEA), which in Barrett's account is not really an environment at all (even less so a time and a place; certainly not the Pleistocene savannah). Barrett insists, quite sensibly (like his predecessors did before him), that the EEA is something more abstract, "a long smear of events" (p. 168). Environments, in fact, do not exist independently of the animals that inhabit them. They are, in part, shaped by the animals' own behaviours and cognition. In Barrett's framework, the organisms themselves shape the adaptive challenges they have to face. This makes EEAs even more elusive than they usually were.

What are mental adaptations adapted to?

The inductive bets that our ancestors made against nature were not, as we saw, real bets in any sense. They lacked intentionality. They became bets a posteriori, after selection had removed the bets that were less fit. So it could seem weird to ask what these bets were "about," as though they were anticipations of events, like those you might find inside a trader's head. A purist would say that the EEA is just a dead list of causal factors with no bearing on the future. Yet the task of evolutionary psychology requires that we find a way beyond this limit—some method that can allow us to predict whether a new thing or event will resemble the EEA or not. This means finding coherent shapes in the "long smear of event" that was human evolution. This proves to be a tricky task.

The problem of defining an EEA brings us close to a notion developed by Dan Sperber and developed at length in Barrett's book: the proper and actual domains of mental adaptations (p. 27 and passim). Evolutionary psychologists know of two ways to define a cognitive mechanism: by the kind of input that it is capable of processing (its "actual domain"), and by the kind of input that the mechanism got through the filter of natural selection by treating: its "proper domain." The actual domain is easy to investigate in the lab, by toying with cognitive mechanisms and seeing what makes them tick. Not so the proper domain. It belongs in the EEA: it is the set of things and events that the organism reacted adaptively to, thanks to that particular cognitive device. The proper domain is where we can find the "inductive bet" that the particular device we're studying has placed against nature, and has been winning (so far).

Take face perception. According to some, our brains contain specialised areas that become active when we are exposed to human faces, but also to photographs, masks, make-up, cartoon faces, etc. Suppose this is indeed the area's actual domain. What is its proper domain? To answer this, we would need to determine when approximately the cognitive device stopped evolving (before or after the appearance of face paint? of masks?); what adaptive challenges it faced (was it only dealing with humans, or do we include dogs as well? or even other animals? if so, which ones?); what this could tell us about its architecture (does it include a specialised eye-detecting device? Did we need face recognition to be included in face detection, or should the two be separate?). To make a genuinely new contribution to psychology, adaptationist theorists would need to settle these issues with evolutionary theories and data: no looking over our shoulder at lab results (at least at first).

How is this done? Barrett adamantly refuses to provide his readers with any kind of general guidance. His answer, one of the book's leitmotiv, is "It depends". "It depends" is "the First Law of adaptationism", the book's first and last word on how to come up with adaptationist hypotheses. Some readers will no doubt find the First Law liberating; but it will feed others' suspicions.

One such suspicion is that proper domains are simply inferred from the actual domain; that we learn what make mental mechanisms tick by reading the experimental literature, then project this knowledge into the past. Nothing really wrong with this, but we were told that evolutionary psychology would change psychology, and provide it with new, testable hypotheses. This it cannot do if it is merely projecting experimental findings backward in time. Although I disagree with Daniel Burnston's bleak view of the field (see his review here), I share his impression that Barrett often comes close to biting the bullet of unfalsifiability. Face perception is a case in point. There are brain areas that seem to respond selectively to faces. How selectively? This is debated. You might think that evolutionary psychology could help orient the debate: after all, perceiving faces is an evolutionarily relevant task, and mental adaptations should have evolved around it. Surely, we can determine their proper domain, and explain it to other researchers? Well, no; at least not according to Barrett. We must wait for the neuroscientists' answer (p. 118–119). Perhaps they will conclude that there is a specific face perception area; perhaps they will conclude that it is, in fact, much more general. The area's proper domain will be whatever these specialists (who study the mechanism's *actual* domain) decide. "It depends."

One part of the book that somewhat gives this game away is its treatment of culture (chap. 8–10). Barrett claims that a wide range of psychological mechanism imitation (p. 45) to communication (p. 240) to Theory of Mind (p. 211)—are adaptations to culture. They evolved in an EEA that contained culture, and the adaptive problems that they solved had to do with acquiring it; but what is culture? Well, "it depends." In chapters 8 and 9 it consists of socially transmitted information that is "highly variable and constantly changing" to keep pace with an environment that is itself variable (p. 211). In chapter 10 it is made of long-standing traditions that allow good ideas to accumulate. The prototypical cultural obejct is language in chapter 8; in chapter 9 it is fads and fashions (lead by the rich and prestigious, whose deplorable habits we naively copy, p. 230); in chapter 10 it is technology. In fact, forget about those examples. The real answer is much simpler than that:

> "Culture acquisition mechanisms evolve because their products—culturally transmitted behaviors—increase fitness. Culture, in this case, is just a word for the knowledge and behaviors these mechanisms acquire and transmit (…)." (p. 226)

Culture, here, is whatever culture-acquisition mechanisms take as input today. There goes the distinction between proper and actual domains.

I do not subscribe to the view that adaptationist hypotheses are all untestable, post hoc or circular speculations (the evolutionary study of human family ties, for instance, shows how fruitful adaptationism can be—Chapais, 2010; Hrdy, 2011). Yet it is true that Barrett does not seem to be aiming at a bold, novel and testable theory of how the mind works. What he builds instead is an elegant, coherent framework that can accommodate work from a wide variety of fields and perspectives (in itself not a small achievement). This becomes evident when the book tackles the "massive modularity" debate, in its much expected last chapters.

In and out of the igloo—and back in again?

As this blog's readers no doubt know, the debate started from Fodor's proposal that some parts of

the mind—the modules—were domain-specific processors, rapidly and automatically treating a narrow range of inputs. Some parts only: Fodor takes the mind's core to work in a completely different fashion, integrating a limitless array of information in a way that defied mechanistic understanding. This Barrett calls "the 'igloo' model of the mind: a crunchy outside composed of rigid innate modules and a soft center composed of general-purpose cognition" (p. 265; Barrett's knack for metaphors is a delight for readers). Dual-processes models of the mind (like Keith Stanovich's) are also pinned down as variants of the "igloo model." Apparently any theory where a central processing unit flexibly organises a broad array of information sent by a multiplicity of more specialised units, is a theory that belongs in the igloo (p. 266). Barrett makes his ambition clear: Let's tear down the igloo! Does he succeed?

Massive modularity started out as the contention that Fodor's modular model might apply to the human mind as a whole, not just to some of its parts; but many massive-modularists in fact reject the whole Fodorian deal, including its description of modules. Barrett is one of them. He takes none of the Fodorian premises on board. The distinction between domain-general and domain-specific mechanisms is rejected (every mental activity is necessarily domain-specific, writes Barrett, p. 27—in another passage that avoids circularity by a hair's breadth). So is encapsulation (p. 269–270). Mental adaptations are not particularly fast or automatic (p. 272, 276). As for the impression that mental adaptations must be innate, or that evolutionary constraints must restrict cognitive flexibility, the book does an admirable job of dispelling it.

In fact, saying that modules are not innate would massively understate Barrett's point. The book draws on the lessons of "modularisation" theorists (like Annette Karmiloff-Smith) to argue that our mind constantly spawns new mental adaptations, pretty much as needed (p. 304, p. 318, p. 329): modules for reading, modules to ride a bicycle or to play a videogame. Each of these modules can freely interact with almost any other. Each can "choose" (Barrett's word) what input to process, flexibly, in a way that is sensitive to a broad range of information. How so? Well, the assembly of modules is synchronised, through a "central pool of information, like a bulletin board" (p. 93) where information is shared and tagged. The tags allow other modules to know which information is worth processing at any given time. This central bulletin board is also the place where attention emerges. Attentional processes direct the activity of modules, sending them input to process in priority, and thus helping the organism react flexibly to novel events. This central bulletin board (it is clear from these chapters that there is one big central pool where most of the information is gathered) is implemented by long-distance neural hubs connecting a wide variety of areas, as suggested by Bars' "global workspace" theory.

Here (and in no other place in the book), I couldn't believe it was tofu because I suspected that, in fact, it wasn't. I need to squint hard to tell Barrett's "bulletin board" from the "System-2" of dual-process theories. Here is a central hub "where information from many parallel processes comes together and is integrated" (p. 295); here is where attention originates and sends information to modules, controlling and constraining them to process it (p. 271); here is where consciousness and the sense of will emerge. It is hard to see how the many devices feeding the controlling, information-integrating central hub could avoid being, in comparison, less central, less conscious, less in control, and condemned to process a narrower range of input. Barrett sees his model as the opposite of the igloo model— the oposite of "a two-layer model of mind, with a general-purpose homunculus sitting on top" (p. 286); but where exactly is the difference? As an answer, Barrett accuses his opponents (the denizens of the igloo) of anthropomorphising the central processing unit, and treating the brain as "one undifferentiated blob" (p. 287). Is he being quite fair, though?

Tellingly, the book occasionally slips back into old-school modulespeak. We are warned that mental adaptations should not be considered particularly fast, unconscious, or domain-specific (cognition is domain-specific through and through). Yet, in a discussion of pop-out effects in perception (p. 113),

we are told that such fast, unconscious reactions are “a good sign that a specialised detector is at work.” That is a small and harmless inconsistency, but one wonders whether we ever came out of the igloo.

Another worry that Barrett’s account does not dissipate has to do with the “spawning” of modules (what Dan Sperber calls “teeming modularity”). Barrett’s view relaxes the classic definition of modularity to the point that anything, it seems, could become a module. Modules can be formed in response to entirely novel situations, like learning to bike, to write, or to play a video game. Where, then, does modularisation stops? One answer is that it never really does. (I am tempted to attribute this answer to Sperber.) At a limit, one might say that your mind spawns a module when you learn to play *Candy Crush*; another when you learn somebody’s name; and so on. Indeed, if you buy into teeming modularity, it is hard to resist the view that there is a module for *this sentence that you are reading now*. There would be, in this view, a module for every thought. Barrett, it seems, won’t bite that particular bullet. He might be right: after all, teeming modularity raises difficulties of its own. (For instance, what is the proper domain of the thought that “this software needs updating”, as opposed to its actual domain?) The deeper problem is that the book provides no general way of identifying mental adaptations or telling them apart. We are constantly brought back to the “First Law of adaptationism”: “It depends.”

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These reservations concern not so much Barrett’s excellent book as what it reveals about the current state of evolutionary psychology as a theory. *The Shape of Thought* is the best introduction to it that I know of; certainly the most nuanced and sophisticated; also the only one that might appeal to some of the discipline’s usual opponents. Barrett knows to avoid the sore spots, and sidesteps all the traps. This achievement comes at a price: his outlook is prudent to a fault, and he suggests few untrodden research paths where refutable predictions could be made and tested. There are novel insights in the book (the analysis of social ontology as a set of short-cuts for causal reasoning, in chapter 4, is superb), but overall, it reads like a conclusion to evolutionary psychology, more than an introduction.

Full disclosure statement: Olivier Morin’s new book, *How Traditions Live and Die*, is also published by Oxford University Press.