CANADIAN JOURNAL OF PHILOSOPHY
Volume 35, Number 2, June 2005, pp. 309-330

Nature, Nurture and Why the Pendulum Still Swings

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I Introduction

In both popular and technical discussion we often find the pairs of opposed terms 'innate/acquired,' 'due to genes/due to environment,' 'nature/nurture,' and so forth. They appear to be used as if they all captured a genuine distinction, and the same distinction at that. A related family of opposed pairs is held to describe the difference between those who attribute a certain trait to 'nature' and those who attribute it to 'nurture': 'nativists' versus 'constructivists' is one such pair. Chomsky and his followers are often described as 'nativists' regarding certain features of language. On a cursory examination, many of the claims of Evolutionary Psychology bear the appearance of 'nativism.' That is, it looks as though Evolutionary Psychologists are making claims to the effect that many features of the mind which are often thought to be due to 'nurture' are in fact due to 'nature.' However, two of the genre's leading practitioners, John Tooby and Leda Cosmides, vigorously deny that this is their position. In fact, they deny that 'nature versus nurture' questions make any sense:

> Evolutionary psychology is not just another swing of the nature/nurture pendulum. A defining characteristic of the field is the explicit rejection of the usual nature/nurture dichotomies — instinct vs. reasoning, innate vs. learned, biological vs. cultural. What effect the environment will have on an organism depends on the details of its evolved cognitive architecture. (Cosmides and Tooby 1997, 16)

But what exactly does rejecting 'the usual nature/nurture dichotomies' entail? As can be seen, they offer a selection of phrasings for the dichotomies. But whichever phrasing we choose, there are still two possible claims that may be being denied here — a stronger one and a weaker one. The stronger claim is that it is possible to attribute a trait *wholly* to the influence of genes or *wholly* to the influence of environment (or some other suitable pair of substitutes for 'nature' and 'nurture'). To deny claims of this type, however, is completely uncontroversial — in fact, it is hard to imagine any claim of this type being coherently asserted. The weaker claim is that it is possible to talk of traits as *more* or *less* under the control of genes or environment. Tooby and Cosmides also explicitly deny this:

> As with all interactions, the product simply cannot be sensibly analyzed into separate genetically determined and environmentally determined components or degrees of influence. For this reason, *everything*, from the most delicate nuance of Richard Strauss's last performance of Beethoven's Fifth Symphony to the presence of calcium salts in his bones at birth, is *totally and to the same extent* genetically and environmentally codetermined. (Tooby and Cosmides 1992, 83-4; emphasis added.)

'[T]otally and to the same extent' — in other words, it makes no sense to talk of a trait as more the product of genes than of environment, or vice versa. So they reject the weaker claim too. One way in which the point they are making here is often put is that the effects of genes and environment are *incommensurable* (e.g. Sober 1994a). Consider the following analogy: a glass of wine goes sour overnight. Is this a result of the chemical composition alone or of the surrounding conditions (air temperature, etc.) alone? Clearly neither makes any sense. Nor does it make sense to say that a *greater proportion* of the effect was due to one or the other factor. That is all very well, but to accuse Evolutionary Psychologists of nativism does not necessarily mean to accuse them of thinking that genes are responsible for a greater proportion of our cognitive makeup than environmental conditions are. This is because there are other ways to construe the nature/nurture dichotomy. On at least one of these other construals, I want to argue, Tooby and Cosmides turn out to be making nativist claims that are both very strong and very general. To spell this out a bit further: the traditional 'folk' distinction between 'innate' and 'acquired' carries a host of connotations, not all of which can be captured by any one genuine distinction. But that does not mean that *none* of them can be captured by genuine distinctions. What I want to argue is that at least one genuine distinction — that between canalized and non-canalized — captures much of what the folk distinction connotes. Further, I will show that Tooby and Cosmides make a very general claim to the effect that all or most of our cognitive architecture is very highly canalized. Thus, despite their protestations to the contrary,

Evolutionary Psychology is another swing of the old nature/nurture pendulum after all.

One might be tempted to say 'so what?' Perhaps the remarks quoted above were only meant to deny *a particular version* of the dichotomy. And if they do turn out to endorse a highly 'nativist' position on one reading of the dichotomy, *and* even if that reading is the correct one, does that make them guilty of anything worse than false advertising? Perhaps the above-quoted remarks should be treated as mere isolated *obiter dicta*. It is more serious than that, however, as the claims they make which I interpret as coming close to old-fashioned nativism, are — I will argue — suspect for reasons above and beyond false advertising.[1] The scepticism of those who find Tooby and Cosmides' views unconvincing because of their nativism is, therefore, well-grounded.

To sum up, then, the aim of this paper is to establish the following three points:

- There is at least one understanding of the innate/acquired (nature/nurture etc.) dichotomy that captures a genuine distinction. Moreover, that distinction in turn captures much of what was traditionally understood by the nature/nurture distinction. (Section II)
- On this understanding, Evolutionary Psychologists are making a host of claims that come close to a traditional 'nativist' position. (Section III)
- There are good grounds for being sceptical of those claims. (Section IV)

Before all that, however, I want to give some background to this discussion. In particular, at the beginning of the next section, I want to indicate why many people (not just Evolutionary Psychologists) think that the innate/acquired dichotomy should be abandoned.

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1 In any event, I think it is unlikely that these remarks are mere *obiter dicta*, as Tooby and Cosmides say similar things number of times in different articles — the two quotes given above are from different articles — suggesting that they consider this point important.

II Canalization as a Partial Substitute For Innateness

Before the twentieth century, there was much debate about what was innate, but little about what innateness was. It seems to have been assumed that the concept was unproblematic. This assumption persists in many quarters today. For example, in the debates among linguists between those who agree with Chomsky that there is an innate 'universal grammar' and the minority who think that there isn't, nobody ever offers more than the most cursory account of innateness. However, the classic innate/acquired (nature/nurture, etc.) distinction was called into question in the 1950s, notably by Daniel Lehrman (1953) in his critique of Konrad Lorenz's view of instincts. Lorenz carried out important research in the field of animal behaviour, much of which involved observing how behaviour developed in conditions of isolation. He reasoned that if a behaviour manifested itself equally whether the animal was raised in its natural habitat or in isolation, then that behaviour was instinctive, or 'innate.' However, Lehrman pointed to the truism that there is no such thing as development in isolation from all environmental conditions — a creature has to get its resources from somewhere in order to develop at all. Further, in actual experimental situations it is often not obvious what the developmental resources are, the deprivation of which will prevent a given organism from developing a given trait. For example, it had been observed that female rats who had just given birth would gather material to build nests and bring food to their young, even if it was their first litter, and they had never had the opportunity to observe other rats doing so. This was widely taken by ethologists at the time as evidence that this behaviour was innate. However, further experimental work showed that if the rats had no experience of picking things up and carrying them, they would not gather material for nests or carry food to their young. In the new experiments, the floor of the rat's cage was made of netting, so that any discarded food or faeces would fall through, leaving the rat with nothing on which to practise carrying things around.

The question that should be asked, according to Lehrman, was not 'does this trait develop in isolation?' but 'what resources are involved in developing this trait?' This goes hand-in-hand with the question of how the trait arises in the development of the individual organism (ontogeny). Lehrman urged that any division of traits into innate and acquired was arbitrary, served no useful purpose, and further had the harmful effect of 'black-boxing' these questions regarding development. It is a truism that no trait arises owing to the actions of genes alone, and according to Lehrman there are no grounds for dividing up the extra-genetic resources such that, if a trait's development requires the presence of *these* resources but not of *those*, then it is innate.

Lehrman's critique was specifically to do with *behavioural* traits, but if his argument is sound it can be extended to morphological traits as well. For they too always have a developmental story involving extra-genetic resources. This line of thought has been taken up by many developmental biologists (see Gottlieb 2001 for a brief history). It has also given rise to a school of thought called Developmental Systems Theory, which rejects the innate/acquired distinction, and emphasises the need to study the specific ontogeny of any trait in any organism (see for example Oyama 1985, Griffiths and Gray 1994).

Paul Griffiths has recently suggested (2002) that the concept of innateness should be discarded as a folk biological concept. He argues that the terms innate and acquired (nature and nurture, etc.) have been used to pick out a number of different distinctions — adaptations *versus* nonadaptations, present at birth *versus* not present at birth, species-typical *versus* non-species-typical, unlearned *versus* learned, reliably developing in different environments *versus* not doing so, and so on. It may have been tacitly assumed that the different distinctions went hand-in-hand, but Griffiths thinks that any such assumption is unjustified. He recommends that instead of calling a trait innate, we should say which (if any) of the properties traditionally associated with that term we are attributing to the trait on this particular occasion:

> Substituting what you actually mean whenever you feel tempted to use the word ''innate'' is an excellent way to resist this slippage of meaning. If a trait is found in all healthy individuals or is pancultural, then say so. If it is developmentally canalized with respect to some set of inputs or is generatively entrenched, then say that it is. If the best explanation of a certain trait difference in a certain population is genetic, then call this a genetic difference. If you mean that the trait is present early in development, what could be simpler than to say so? (Griffiths 2002, 82.)

Note that Griffiths does not deny that there are genuine distinctions to be made here. But there are many different distinctions, not just one.

Despite arguments such as Lehrman's, a number of people have since attempted to capture the concept of innateness in a formulation — for example, Stich (1975, Introduction), Ariew (1999), Wimsatt (1999) and McLaurin (2002). For the most part, especially in the last few years, such formulators have generally admitted that no single formulation can capture all that seems to be entailed by the nebulous traditional (or 'folk') concept. Further, some features which seem to be entailed by that nebulous concept are now generally admitted to be not worth capturing, either because they are incapable of being fulfilled by anything (for example: determined solely by genes, or unaffected by environment) or because they are of no real significance (for example: present at birth). But even leaving those aside, most recent formulators admit that their particular formulation requires some of the implications of the tradi-

tional concept of innateness to be jettisoned. For example, some accounts capture (or at least try to capture) species-typicality and/or being an adaptation, at the expense of developmental fixity (e.g. McLaurin); others vice versa (e.g. Ariew). In defence of the former approach, it might be argued that the significance of innateness in modern biology is in identifying traits as products of evolution, rather than as having a particular type of developmental history in individual organisms. In defence of the latter, it might be argued that the traditional concept of innateness *seems* to apply as much to traits that (*prima facie*, anyway) are not adaptations as to those that are (e.g. genetically inherited susceptibilities to disease) and, for that matter, as much to non-species-typical traits as to species-typical ones (e.g. eye colour, genetically inherited susceptibilities to disease).

Fortunately, for present purposes I do not need to adjudicate regarding the adequacy of these various attempts to formulate innateness. This is because I do not claim that Evolutionary Psychologists are saying that many traits are innate, according to the one true concept of innateness. Rather, I claim that there is no one true concept of innateness, but that they are saying that many cognitive traits possess features that, according to the folk-concept, innateness is held to entail.[2] Hence, I *do* wish to argue that at least one of the formulations successfully captures *some* — in fact, quite a lot — of what innateness is traditionally taken to imply (and also some of what makes people anxious and/or sceptical about 'nativist' psychological claims). Further, unlike some of the traditional (supposed) implications mentioned above, it captures a property which some traits genuinely have and others do not. The account I have in mind is André Ariew's, which makes use of the concept of 'canalization.'

This concept was developed by C.H. Waddington in the mid-twentieth century (see his 1975, chs. 11-13). Waddington was led to develop the concept by experiments that showed that competent ectoderm tissue can be induced to develop neural plates by a large variety of different compounds, both natural and artificial (see Gilbert 2003). The implication is that the development of these plates is not reliant on a narrowly-specified set of environmental circumstances (i.e. the presence of one particular compound); so the trait can be relied on to develop in a wide variety of different environmental conditions. This state of affairs is in

2 Just to clear up a possible misunderstanding here, my claim is not that the Evolutionary Psychologists are saying: 'there are features that the folk-concept is held to entail, and many cognitive traits possess these features.' Rather I am saying that there are features that the folk concept is held to entail, and that the Evolutionary Psychologists are saying that many traits possess these features.

contrast to one in which the trait has to rely on one particular set of resources to develop. Some traits are environmentally sensitive in this latter way; if they nevertheless usually develop in the organism's natural environment, it is because *either* (i) that environment is very stable with regard to the resources needed, *or* (ii) the organism moves around to track the resources, *or* (iii) the organism (or the population to which it belongs) manipulates the environment to ensure the resources are present, and so on. (I do not pretend this list is exhaustive, but hopefully the reader will get the idea.) Thus we have a clear contrast between traits that reliably develop in a wide variety of different environmental circumstances, and ones that do not. A trait that reliably develops in a wide variety of different environments *in virtue of being able to employ a wide variety of different resources in its development*, is said to be *canalized*. Although Waddington developed this concept, it was Ariew who, much more recently, argued that (as the title of his article proclaims) 'Innateness is Canalization.' I do not wish to make that bold claim, however. What I endorse is the milder claim that canalization captures much of what the folk-concept is traditionally held to imply.

Two consequences of this formulation should be noted. First, canalization is a matter of degree. No trait is canalized *simpliciter*, since there will always be some environmental conditions in which it will not develop (even if the organism develops normally up to the point where the trait 'should' appear.) In fact, no matter how many different sets of resources can be employed in the development of a trait, there will still be an infinite number of possible environments where none of them are present. But some traits are more canalized than others. Second, even this canalization-as-a-matter-of-degree can only be ascribed relative to a range of environments. Nonetheless, as Ariew explains, if a trait develops in a wide variety of different environments, there are two ways in which one might explain that fact. (1) However varied that range of environments is in other ways, it does not vary with respect to the resources used in the development of that trait. That is, those resources are present wherever the creature is. (2) A range of different sets of resources can be used in the development of the trait, and at least one of that range is present wherever the creature is. Consider Waddington's findings referred to above. Neural plates develop reliably in a range of different environments, even if those environments vary with respect to the resources used to develop those neural plates. So the explanation for the reliable development of neural plates is (2), not (1). Imagine, however, that instead, one specific compound was needed to induce neural plates out of competent ectoderm tissue. If those plates nonetheless developed in a range of different environments, the explanation would have to be that that one specific compound was present in all those different environments. In this latter type of case, the trait would not be

canalized, whereas in the former type of case it is. Note that, although canalization is only ever relative to a range of environments, the two types of explanation for the reliable development are fundamentally different. Note also that canalization admits of degrees. Imagine that a trait develops only if resource A is present. In this case it is not canalized. Now imagine it develops only if *either* resource A or resource B is present. And now imagine that it develops only if resource A or resource B or resource C is present. In the third scenario, the trait may be said to be more highly canalized than in the second.

Unlike — say — the conception of innateness that sees it as entailing insensitivity to all and any environmental vicissitudes, the concept of canalization captures a feature that some biological traits genuinely have. Further, unlike — say — a conception of innateness as *somehow* influenced by genes, or *somehow* a product of evolution, canalization captures a feature that some biological traits genuinely lack. In other words, even though it is only a matter of degree, and can only be specified relative to a range of environments, the difference between being canalized and not being canalized *is a genuine difference*. It cannot be said that all biological traits are equally canalized. (Contrast this state of affairs with Tooby and Cosmides' claim that '*everything* ... is totally and to the same extent genetically and environmentally codetermined.')

As already pointed out, any concept of innateness which implies that innate traits will *invariably* develop, is far too strong. There is no trait that is insensitive to any environmental influence. It is nonetheless reasonable to expect traits to vary (relative to a given range of environments) in the *degree* to which they are sensitive to environmental influence, which is exactly what canalization captures. So, if we wish to defend a concept of innateness that is a matter of degree, and we wish to capture the distinction 'sensitive-to-environmental-variation *versus* insensitive-to-environmental-variation,' then canalization does the job. As I mentioned earlier, some people see innateness as intimately tied to the further feature of being an adaptation. Canalization does not *entail* this, but the fact of a trait being canalized is *likely to be* a product of adaptation. If a trait is canalized, a likely explanation is that it was important to the organism and needed to be reliably developed in a variety of different environmental circumstances, and the differences involved included differences in the relevant developmental resources. It is reasonable to infer from a trait's being canalized that it is *likely* to be pretty important to the organism, or at least to have been so to many of its ancestors. (Traits that are not adaptations *can* be canalized, however.) Moreover, empirical evidence supports the conclusion that canalization of a trait can be produced by selection for the trait. Experiments — again carried out by Waddington — have shown that artificial selection for traits which were initially not canalized, eventually led to those traits becoming canalized.

However, it is not reasonable to infer from a trait's being important that it is likely to be canalized (a point that will be important in section IV).

As I said earlier, it is not my aim to establish canalization as *the* ideal formulation of innateness. However, it does capture at least some of the connotations of the nebulous folk-concept. In addition, some of (what were traditionally taken to be) the consequences of innateness — e.g., those that cause anxiety when an undesirable trait is said to be innate — are also contained in the concept of canalization, albeit to a lesser extent. On an either/or view of innateness, it seems to follow from a trait's being innate that it cannot be prevented from arising, and from a trait's being 'acquired' that it can. Canalization is not an either/or concept, but it does express the more reasonable by-degrees version of this consequence: a trait that is canalized is more difficult to prevent from arising than one that is not.

Tooby and Cosmides do not claim that innateness is canalization. But, as I will show in the next section, they do make strong canalization claims for a whole range of human psychological traits. In fact, such claims are central to their whole programme. Hence, some of the consequences that, on the nebulous folk view, are often held to follow from innateness, do actually follow from central claims of Tooby and Cosmides. In the final section, I will argue that these strong canalization claims of Tooby and Cosmides are not justified by either argument of evidence.

III Gray's Anatomy of the Mind

It is a central claim of Evolutionary Psychology that underlying all (or nearly all) psychological and cultural activities of humans is a set of evolved cognitive mechanisms that is species-typical and similar in fine detail across a wide range of different cultures and environments. Tooby and Cosmides make an analogy between this alleged state of affairs and our physical anatomy:

> Just as one can now flip open *Gray's Anatomy* to any page and find an intricately detailed depiction of some part of our evolved species-typical morphology, we anticipate that in 50 or 100 years time one will be able to pick up an equivalent reference work for psychology and find in it detailed information-processing descriptions of the multitude of evolved species-typical adaptations of the human mind, including how they are mapped onto the corresponding neuroanatomy and how they are constructed by the developmental programs. (Tooby and Cosmides 1992, 69)

They note that it is possible to observe detailed anatomical similarity across humans from different cultural and environmental backgrounds. We implicitly accept that most people have the same internal organs,

and that this similarity goes down to deep and intricate levels of structure. Tooby and Cosmides suggest that, just as we can open up a copy of *Gray's Anatomy* and confidently expect any randomly-chosen person to possess the intricate machinery described therein, so someday there will be a 'Gray's Anatomy of the Mind,' which will describe in detail a cognitive architecture that we can similarly confidently expect any randomly-chosen person to possess. It would clearly be absurd to expect different human beings to possess different anatomical structures (barring, of course, the differences between the sexes). Similarly, Tooby and Cosmides argue, it would be absurd to expect different human beings to possess different cognitive architectures (once again barring — all Evolutionary Psychologists agree — the differences between the sexes).

That we have a species-typical anatomy is obviously true. But what is it about that anatomy that might lead us to expect an analogous situation regarding cognitive architecture? If one were asked: why would it be absurd to expect major variations in anatomy, one obvious answer would be: because thousands of years of anatomical research have shown that there aren't. However, this can't be why we should expect an analogous situation regarding cognitive architecture, as there has not been a similarly impressive record of discovery there. So the analogy must lie elsewhere. According to Tooby and Cosmides, it is the *reasons* for the in-depth species-typical similarities that are relevant. Presumably it is uncontroversial that the detailed structure of hearts, livers, and so forth, is to be explained by evolution, and hence (largely) by adaptation. But also, they argue, the fact that these organs turn out reliably the same in great detail, *in many different environments*, is to be explained similarly. We *need* hearts to live in a wide variety of different circumstances. So, just as hearts that functioned efficiently were favoured by selection, creatures with the capacity to reliably develop those hearts in many different circumstances, were similarly favoured. A possible explanation — which may appear to be supported by both this adaptationist argument, and by the empirical fact that most people have hearts — is that hearts, with pretty much all their detailed structure, are highly canalized traits. However, it is possible that the ubiquity of hearts is guaranteed by the resources involved in their development being present wherever humans (and other creatures with hearts) are.

Tooby and Cosmides believe that the adaptationist argument is also valid with regard to cognitive architecture, and is sufficient *by itself* to support the conclusion that this cognitive architecture, in fine detail, is common across the species in many different circumstances, just as the details of anatomy are. In other words, they believe that, prior to empirical evidence, we have good reason to believe that there is a species-typical cognitive architecture, and that the details of that architecture are highly canalized. They articulate precisely this view in their manifesto-

like 1992 article (wherein they even cite Waddington, although they do not use his term 'canalization'):

> Because the world is full of potential disruptions, there is the perennial threat that the developmental process may be perturbed away from the narrow targets that define mechanistic workability, producing some different and nonfunctional outcome. Developmental adaptations are, therefore, intensely selected to evolve machinery that defends the developmental process against disruption (Waddington 1962).... More generally, developmental programs are often designed to respond to environmentally or genetically induced disorder through feedback-driven compensation that redirects development back towards the successful construction of adaptations. (Tooby and Cosmides 1992, 80-1)

'[F]eedback-driven compensation that redirects development back towards the successful construction of adaptations' describes what others call 'canalization.' On Tooby and Cosmides' view it is this that ensures the (alleged) reliable development of our species-typical cognitive mechanisms — rather than any of the alternative non-canalized possibilities I suggested in the previous section — such as the range of environments within which the trait reliably develops being stable with respect to the relevant resources. To their credit, they go on to insert a caveat:

> Thus, developmental processes have been selected to defend themselves against the ordinary kinds of environmental and genetic variability that were characteristic of the environment of evolutionary adaptedness, *although not, of course, against evolutionarily novel or unusual manipulations*. (ibid., emphasis added)

Yet their confidence regarding the likelihood of there being a 'Gray's Anatomy of the mind' clearly shows that they do not think that evolutionarily novel or unusual situations are included to any significant extent in actual present, or likely future, scenarios. Further, they insist that cultural diversity is to be explained as different results of the same underlying cognitive mechanisms operating in different environmental conditions, *rather than* as cognitive mechanisms developing differently due to different environmental conditions.

In the same volume as Tooby and Cosmides' manifesto-like article, Donald Symons (1992) contrasts Evolutionary Psychology with a view he labels 'Darwinian Social Science' [DSS]. On this latter view, based on what Symons (rightly in my view) takes to be faulty adaptationist reasoning, it is predicted that humans will exhibit behaviours that are adaptive in the present-day environment, and present-day behaviours are to be explained in terms of their present-day adaptivity. Symons argues that this does not allow for the slowness of evolutionary change. Instead, he urges that proper adaptationist reasoning predicts that humans will possess cognitive mechanisms that produced adaptive behav-

iour in the environment of evolutionary adaptedness (i.e. the Stone Age), and that present-day behaviour is to be explained in terms of the operation of those mechanisms in the different environment of today.[3] Note that this view contrasts not only with DSS, but with an intermediary view which is more plausible than DSS, but still, according to Evolutionary Psychologists, unsatisfactory. On this intermediary view, adaptationist reasoning predicts that humans will behave in ways that *were* adaptive in the environment of evolutionary adaptedness, and present-day behaviour is to be explained as being the same behaviour that would have been adaptive back then. This appears to be the view of Edward O. Wilson (1978) and other sociobiologists, although that is not always entirely clear. On the intermediary view, then, we behave in the same ways as we did in the environment of evolutionary adaptedness, but there is no guarantee that the same behaviour will still be adaptive today. Evolutionary Psychology goes one step further, however, since it holds that there is also no guarantee that the same behaviour will even be *elicited* in the different environment of today.[4] What is predicted, and what does the explanatory work, according to Evolutionary Psychology, is a stable, species-specific and cross-cultural set of cognitive mechanisms. Although they make remarks such as that the future 'Gray's Anatomy of the mind' will include details of how these mechanisms 'are constructed by the developmental programs,' and the caveat about evolutionarily novel or unusual manipulations' — *it is the cognitive mechanisms themselves, and not how they develop*, that are predicted and explained by adaptationist reasoning, and that are called upon to do the work of explaining present-day human behaviour.

Evolutionary Psychologists' strong commitment to this mode of explanation is clearly shown by the Evolutionary Psychology literature devoted to specific problems. For example, it can be seen in their approach to explaining manifest differences between cultures:

> The central premise of *The Adapted Mind* is that there is a universal human nature, but that this universality exists primarily at the level of evolved psychological

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3 It should be noted that not everyone accepts the view that evolution has not produced any new adaptations in humans since the Stone Age. See Badcock (2000), 13-16, for a brief summary of some counterarguments. However, this view is a central pillar of Evolutionary Psychology, and it is not the aim of the present paper to attack all its pillars at once.

4 It might be argued that the notion of 'the same behaviour' is itself problematic — in what sense is the behaviour of today's late-capitalist producer-consumers the *same* as that of Stone Age hunter-gatherers? I will leave this issue aside for the present, however, merely noting that it is one more point against the intermediary view.

> mechanisms, not of expressed cultural behaviours. On this view, cultural variability is not a challenge to claims of universality, but rather data that can give one insight into the structure of the psychological mechanisms that helped generate it. (Cosmides, Tooby, and Barkow 1992, 5)

And furthermore:

> Behavioural descriptions can be illuminating, but manifest behaviour is so variable that descriptions that capture and explain this variability inevitably require an explication of the psychological mechanisms and environmental conditions that generate it. (ibid., 8)

Thus cultural variability is to be explained by a single set of cognitive mechanisms producing different outcomes due to differences in environment. It is not to be explained by those cognitive mechanisms failing to develop, or developing differently, due to differences in environment.

So anyone who thinks that 'nativist' accounts of psychology are those which entail features that are intractable to developmental disruption or redirection, will place Tooby and Cosmides firmly in the nativist camp. This despite their claim that 'Evolutionary Psychology is not just another swing of the nature/nurture pendulum.' Now, as per the other quotation I placed in the introduction to this article, it may be that in saying this, all they are saying is that the respective contributions of genes and environment are incommensurable. That view is articulated by Elliott Sober (1994a). There is no contradiction between this and the claim that many psychological traits are highly canalized. To this we can respond as follows (1) If they are incommensurable, then not only is it meaningless to talk of traits being more due to genes than environment or vice versa; it is equally meaningless to talk of traits being 'totally and to the same extent genetically and environmentally co-determined' as Tooby and Cosmides do. (2) The 'old nature/nurture' pendulum' is a nebulous concept carrying many different connotations, one of which is that things due to 'nature' are more resistant to environmental influence. This connotation is clearly carried by Tooby and Cosmides' canalization claims. Whatever may be the case regarding any pendulum that might swing between being more and less controlled by genes, there is clearly a pendulum that swings between being more and less resistant to environmental influence. Tooby and Cosmides' view marks a strong swing of this particular pendulum.

Still, one might defend them by saying that, even if their higher-order statements about the status of their theory vis-à-vis old-fashioned nature and nurture, are misleading, their canalization claims may nonetheless be correct. In the final section I will argue that there are grounds for scepticism regarding this.

IV Why the Pendulum Still Swings.

I will divide the arguments that allegedly support Tooby and Cosmides' canalization claim regarding cognitive mechanisms into three headings:

(1) The adaptationist argument.

(2) The analogy with physical anatomy.

(3) Empirical evidence of cross-cultural invariance.

(1) The adaptationist argument is that traits which are important enough will not only be selected for, but will also be selected to be canalized within a broad range of different environments. That Tooby and Cosmides have this argument in mind can be seen in a passage which I have already quoted:

> Because the world is full of potential disruptions, there is the perennial threat that the developmental process may be perturbed away from the narrow targets that define mechanistic workability, producing some different and nonfunctional outcome. Developmental adaptations are, therefore, intensely selected to evolve machinery that defends the developmental process against disruption.... (Tooby and Cosmides 1992, 80)

This requires not only that the traits in question be beneficial, but that they be beneficial in that range of different environments. Let us assume (for present purposes) that there is a range of cognitive traits of which that is true. Does that mean they are likely to be canalized? There are two reasons why I think it does not. First, even if adaptation has safeguarded the development of a trait against environmental vicissitudes, it can only have done so against vicissitudes that the creature's ancestors actually encountered. If the environment of evolutionary adaptedness was stable with regard to the resources employed in the development of that particular trait, adaptation could not be expected to produce canalization. Second, canalization is not the only possible adaptive response to environmental variation. Polyphenism is another. I will explain these two points further in what follows.

First, one problem with the step from 'is beneficial in many environments' to 'reliably develops in many environments' is that it assumes too much about what adaptation is capable of producing. As is well known, adaptation cannot prepare an organism for contingencies with which its ancestors have not actually (and fairly regularly) met. An organism *may* turn out to be able to cope with evolutionarily novel situations, but if it does that is not adaptation, but good fortune. Like any case of good fortune, we can have no prior reason to expect it. And certainly adapta-

tionist reasoning cannot give us any reason to expect it. So, for example, we cannot expect a creature to possess traits that will help it out in circumstances which its ancestors never encountered. That we should not impute any such features to an organism is a direct consequence of the 'evolvability criterion' on which Tooby and Cosmides quite rightly insist. They point out that adaptation can only prepare an organism for environmental vicissitudes which its ancestors actually met. But they do not acknowledge that this applies to whatever canalization is produced by adaptation as well. Their conviction that the species-typical cognitive architecture reliably develops today excludes the possibility that, for any given trait, the environmental conditions relevant to the development of that trait, may have changed since the Stone Age so as to fall outside the range of vicissitudes for which canalization has prepared it. Adaptive reasoning does not justify ruling out that possibility.

The adaptationist reasoning that leads us to expect a trait to be canalized, is perfectly analogous to the adaptationist reasoning that leads us to expect a trait to be there at all: it's canalized because it is (or was) useful for it to be. This means that we cannot expect a creature to be prepared for circumstances which its ancestors never encountered, by being buffered against environmental vicissitudes to development, which its ancestors never encountered. The vicissitudes we should expect development to be buffered against are *only* those its ancestors encountered. To predict on adaptationist grounds that a trait's development is likely to be buffered against such-and-such a contingency, we would need to know that the creature's ancestors actually encountered that contingency. Canalization of traits is relative to a range of environments, but adaptation cannot make that range broader than the range actually encountered by a creature's ancestors. (Although good fortune *might*.)

As I suggested earlier, it is possible for an organism to be assured of the reliable development of the trait because it lives in an environment that is very stable with regard to the resources it needs to develop that particular trait. If this is the case with the environment of evolutionary adaptedness for the organism, then we cannot expect the trait to be canalized in that organism. This is true even if that environment of evolutionary adaptedness encompasses a diversity of varying conditions — as long as it is stable with respect to the relevant developmental resources. Other features of the environment, if they are not relevant to the development of the trait, can't affect whether or not it comes to be canalized. So any arguments to the effect that the environment of early humans was generally variable, so cognitive traits must be canalized, is question-begging. It needs to be established, if this is the argumentative strategy we wish to adopt, that the environment was variable *with respect to the relevant developmental resources*.

Note also that environmental variability, even with regard to the relevant resources, is less assuring of canalization the further back in an organism's evolutionary history you have to go to find that variability. Evolution can 'roll back' on traits that are no longer useful — e.g., deep-sea fish lose the use of their eyes. So perhaps it can roll back on canalization of traits as well.

Second, a further point arising from considerations of developmental biology weakens the Evolutionary Psychologists' adaptationist argument even further. Recall that their claim is that we should expect a set of cognitive traits without significant variation throughout the great majority of humans. But this rules out the possibility of adaptation producing *polyphenic* traits. That is, it often happens that organisms with the same genetic makeup develop different traits in response to different environmental conditions, and this is (apparently) a product of adaptation. For example, in many species, sex is not determined by genes but by environmental conditions. The sex of the echiuroid worm *Bonellia* is determined by whether the larva lands on the seabed, in which case it becomes a female, or on the proboscis of a female, in which case it becomes a (much smaller and proboscis-less) male. The larva can also be 'fooled' by an experimenter introducing fragments of proboscis into its environment, in which case it becomes male (Gilbert 2003, 52). In other species, including most turtles and all crocodilians, sex is determined by the temperature of the eggs at a specific period of development (ibid., 567-8).

The general adaptationist rationale for polyphenism is obvious enough: in two different environment-types, two different morphologies may be beneficial. But why couldn't the same rationale apply to cognitive mechanisms?[5] Is it not perfectly conceivable that people could develop radically different — say — cognitive mechanisms for dealing with mating, depending on the environment in which they grow up? Note that, in the event of something like this being the case, both cognitive mechanisms would be adaptations — they would just be adaptations to different circumstances. This, of course, does not mean that they would be adaptive in any present-day conditions. But it would be distinct from a situation in which a mechanism simply failed to develop due to the absence, or abnormality, of some developmental resource. In the case of polyphenic traits, we would expect both forms to display the complex functional organization that Tooby and Cosmides

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5 Sober (1994b) argues that there are specifiable circumstances where it is adaptive to be cognitively flexible, and others where it is not. In my view, Tooby and Cosmides prejudge this issue.

(rightly, in my view) see as the mark of adaptation. We would not expect to find this in the case of mere failures of development.

A priori adaptationist considerations do not rule out that some human cognitive architecture may be polyphenic — and hence sensitive to environmental variation in its development. Indeed, we know that adaptation produces polyphenic traits in other species. Further, even if we have good reason to believe that some cognitive traits are not polyphenic (sense perception does not appear to be) that would not give us any reason to generalize to others. Perhaps in response to one set of environmental cues, a person might develop cognitive mechanisms appropriate for hunting; in another, for some other way of making a living. And who knows what those cues might be? All that matters, although it is crucial, is that the cues be something that the development of a person *in the Stone Age* could have responded to, and that in a stone-age environment those cues reliably indicated the appropriate environmental conditions. Tooby and Cosmides make much of the evident fact that the environment of humans in the Stone Age was a very changeable one (it included the Ice Ages, and early humans apparently moved around a lot). Let's assume this is true. *One* of the ways adaptation can respond to this is by canalizing traits. But another way, which may be a better way for some traits, is by making them polyphenic.

(2) What about the alleged analogy with physical anatomy? Tooby and Cosmides are right to point out that it would be absurd to expect humans from different cultures to have different physical organs. But one reason why this is less strong than they think as an argument for expecting a similar degree of invariance for cognitive traits has already been given: the thousands of years of anatomical research that have shown that we all have pretty much the same anatomy, have not been matched in psychology by analogous findings on anything near the same scale.

But there is a second reason for casting doubt on this argument from analogy. Many of our physical organs were already in place long before humans evolved, and exist in a much broader range of organisms than just humans. This means they also exist in a much broader range of environmental conditions than any traits that are specific to humans. So, whatever their adaptive history, they *reliably develop* in a much broader range of environmental conditions than any traits that are specific to humans. So, by simple maths, the conditions in which they reliably develop are more likely to vary with respect to developmentally relevant resources for those traits (and to vary more widely at that). Thus whatever the evidence from the mere fact of reliable development in varied circumstances for canalization of anatomical traits, it is by definition weaker for traits that are specific to one species, than for traits that are common to many species. And Evolutionary Psychologists have not made a convincing case (or as far as I know, tried to) against the *prima*

facie well-founded view that much of human cognitive architecture is specific to us. The mechanisms involved in acquiring language are an obvious case. Further, Evolutionary Psychologists stress the claim that the cognitive mechanisms they posit are extremely fine-tuned to problems faced by humans in the environment of evolutionary adaptedness. This does not sit well with the idea that those cognitive mechanisms are inherited from distant pre-human ancestors.

This may appear to be contradicted by my earlier point about canalization being 'rolled back.' However, rolling back of no longer useful traits only happens sometimes, so rolling back of canalization can be assumed to likewise only happen sometimes. A trait is still more likely to able to develop against some environmental vicissitude that its distant ancestors faced, even if it no longer faces it now, than if none of its ancestors ever faced it. We could call this, I suppose, 'vestigial canalization.' In any event, presumably a great deal of our cognitive architecture is not shared by other species. That is not to say that a species-specific trait cannot be as highly canalized as one that many species share. But, once again, it is only by looking at the developmental process(es) for that trait that we can know.

Further, it could be that the great reliability of development of our 'Gray's Anatomy' of physical organs should not be explained simply as a result of canalization, in turn due to their high adaptive value. Some of it might alternatively be explained by *generative entrenchment*—i.e., perhaps those traits are so deeply embedded in a basic structure that they pretty much have to develop if the creature is to develop at all (see Wimsatt 1999). Or to put it another way, a lot of other things depend on them, so that if they fail to develop the creature will not be viable. Any creature of that type that makes it through the early stages of the developmental process can only have done so if that trait developed as it was supposed to. So, while it *may* be the case that hearts and so on reliably develop because adaptation has produced canalization, an alternative explanation is that a viable creature would not develop at all if it did not develop a heart. But this is once again connected to the fact that hearts have been around a lot longer than we have. A likely explanation for a trait being generatively entrenched is that it has been around for a long time.[6] Having designed

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6 Despite this connection, generative entrenchment should not be confused with *phylogenetic inertia*. This latter term refers to a situation where a trait which has been around for a long period of evolutionary time stays around even when it is past its adaptative sell-by date. Vestigial organs are clear examples. A trait may be phylogenetically inert even if other traits do not depend on its being there, i.e. even if it is not generatively entrenched.

creatures with hearts as a central feature, upon which so much else depends, for so long, evolution was extremely unlikely — except over the extremely long term — to produce new creatures without hearts from the same lineage. That would involve undoing a lot of other structure, and cannot be compared to, for example, a nocturnal creature losing the use of its eyes or a land-dwelling bird losing the use of its wings. It is not clear which, if any, of the cognitive adaptations posited by Evolutionarily Psychologists are generatively entrenched to anything like the same degree. So once again, we have less reason to believe that their development is as universally reliable as that of, at least a great deal of, physical anatomy

(3) What about the empirical evidence, such as it is, that Evolutionary Psychologists have gathered to show that there are cognitive traits that are invariant across cultures? Let us assume for the sake of argument that this evidence is better than critics of Evolutionary Psychology think it is. As I have already argued, Evolutionary Psychologists are correct to point out the dangers of 'black-boxing' cognitive mechanisms by focussing instead on behaviour. But as I have also argued, considerations of developmental biology would urge us to go a step further back again: there are dangers in black-boxing development as well. Evolution's legacy to us is not simply a set of behaviours, but neither is it simply a set of cognitive mechanisms. It is closer to the truth to say that evolution's legacy to us is a set of developmental processes that reliably gave rise to those cognitive mechanisms in the environment of evolutionary adaptedness.[7] Tooby and Cosmides rightly point out that behaviour is a product of evolved cognitive mechanisms interacting with an environment, and that different environments may evoke different behaviours from the same cognitive mechanisms. So the fact that such-and-such behaviour is reliably produced in a variety of different environments does not tell us that it will be produced in any other environment. By the same token, however, we can take a step further back and ask: what are the developmental processes and resources that are involved in constructing those cognitive mechanisms? Only the answer to this question would enable us to answer questions about what types of environmental conditions these mechanisms will develop in, and what types will they not. It may be that the traits are canalized, but evidence that they develop in lots of different circumstances does not *by itself* establish this. We would need evidence that they develop in circumstances that vary with respect to the relevant developmental resources. By black-boxing devel-

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7 There are doubtedless further steps back we could take here — it depends on how deeply one is prepared to get entangled in the complexities of Developmental Systems Theory.

opment, Tooby and Cosmides avoid facing the empirical questions that, alone, would tell us whether their canalization claims are true.

V Conclusion

Finally, I want to point out some of the consequences that might follow if we re-open the question of how cognitive traits develop. As it stands, Evolutionary Psychology is capable of giving us insights into why our evolved minds often lead us to do things that are neither adaptive nor conducive to our happiness. See, for example, David Buss's account of how evolved cognitive mechanisms for mate-choice and mate-attraction lead to such present-day malaises as marital dissatisfaction in men and obsessive dieting in women (Buss 1999, 154-5). In this regard Evolutionary Psychology is somewhat better placed than the intermediary view I outlined above, since the former can make sense of behaviour that would not have been adaptive even in the environment of evolutionary adaptedness. However, Evolutionary Psychology confines itself to stories in which a mechanism already in place produces a new result in a new environment. There may also be stories wherein a mechanism fails to develop, or develops abnormally, in a new environment. And because of polyphenism, there may also be stories to be told wherein a mechanism develops one way or another because of a cue which would have indicated that that was the right way to go in the environment of evolutionary adaptedness. But because of new environmental conditions, such a cue may no longer be linked to the conditions it would have reliably indicated in the environment of evolutionary adaptedness. Think of the *Bonellia* worms whose developmental programmes are 'fooled' by experimenters into behaving as if it was a good idea to grow up one sex rather than the other.

Advocates of 'Darwinian Medicine' — such as George Williams and Randolph Nesse (1991) sometimes use the term 'diseases of civilization' to describe syndromes where evolved mechanisms act in ways harmful to the organism because they weren't designed for the modern environment. But such 'diseases of civilization' may include developmental disorders as well as inappropriate functioning of already developed mechanisms. And it may include psychological developmental disorders as well as physiological ones. Taking cognitive development out of the black box in which Evolutionary Psychologists have placed it could open up a fruitful source of clues to explaining, and perhaps preventing, psychological disorders. Such an approach might bear some similarity to psychoanalytic explanation, which emphasises the fragility of psychological development at various points.

Further, although many people may be uncomfortable with the idea, we may be interested in potential ways of getting rid of traits that we see as undesirable. Certainly Evolutionary Psychology tends to see such things as war and male chauvinist attitudes as rooted in 'human nature.' Conversely, we may be interested in ensuring the preservation of desirable traits in new circumstances. As technology advances, the world we live in becomes progressively less and less like our environment of evolutionary adaptedness. So we may be tampering with environmental conditions that are needed to develop human traits we cherish. Recall that even the strongest canalization is only relative to a range of environmental conditions. To tackle these problems, we will need knowledge not just of species-typical cognitive mechanisms, but of the processes and resources that are involved in their construction.

Received: September 2003
Revised: July 2004

Acknowledgments

This paper was written while its author was a Government of Ireland Research Fellow in the Department of Philosophy, Trinity College Dublin; I thank the Irish Research Council for Humanities and Social Sciences for their generous support. An earlier version of this paper was presented at a Visiting Speaker Seminar in the Department of Philosophy at University College Dublin; I thank Jim O'Shea for the invitation, and I thank that department and all who participated in the seminar. Thanks are also due to Richard Gray for his helpful comments on the penultimate draft. Finally, I thank this journal's two referees (necessarily anonymous) whose comments helped to clarify a number of points.

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