Why the Economic Conception of Human Behaviour Might Lack a Biological Basis*

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ABSTRACT: In several recent papers Arthur Robson sketches evolutionary scenarios in order to explain why we humans evolved hard-wired utility functions and the capacity to choose flexibly on the basis of them. These scenarios are scrutinized minutely in the paper. It is pointed out that Robson ignores several relevant insightful ideas and distinctions that have surfaced in other contemporary evolutionary theorizing. A somewhat different picture of human behavior emerges once these ideas and distinctions are taken seriously.

Keywords: biological evolution, human behavior, hard-wired utility functions, evolved psychological mechanisms, modules, fast and frugal heuristics.

1. Introduction

In "The biological basis of economic behavior" (Robson 2001a) and several other related papers (Robson 1996, 2001b, 2002) Arthur J. Robson embarks on an intriguing project. The title of the paper might suggest that what Robson wants to show is that economic behaviour is genetically determined to a considerable degree. Or, alternatively, the title might suggest that what Robson wants to point out is that we can learn a lot about economic behaviour by looking at neurophysiological studies of the human brain. These are not the things Robson is after, however. Robson's evolutionary project is a different one. Although he has a few things to say about genetic determinism and neurophysiology, the main thrust of Robson's project is to find out whether an evolutionary rationale can be given for standard behavioural assumptions in economic theory. The question preoccupying Robson is whether there are sound evolutionary reasons for believing that people have the behavioural features that economic theory assumes they have. The sort of answer that Robson seeks does not refer to some underlying genetic make-up or to some underlying brain architecture, but to the efficiency advantages some attempt to solve some ancient evolutionary problem has had over others. One of the intriguing things about Robson's project is that economic theory itself is extensively used to find out whether or not a rationale can be given for specific behavioural assumptions. Economic theory is applied to find out whether or not specific behavioural features assumed in economic theory could have evolved.

In one respect the scope of the present paper is very limited. Most of the paper is devoted to an extensive discussion and minute scrutiny of Robson's ideas and arguments. What is not directly relevant for assessing Robson´s ideas and arguments, but what might be very relevant for the study of the type of issues he addresses, is deliberately left out in the paper. Thus, since it is conspicuously lacking in Robson´s arguments, almost no attention is paid in the paper to the role of culture and of cultural evolution in inducing changes in preferences and beliefs. Several weaknesses, short-

* Comments made by Geoff Hodgson and by the participants of the seminar of the Max Planck Institute, Jena, 11 February 2003 (especially by Christian Cordes and Ulrich Witt) on an earlier version of the paper are gratefully acknowledged.

comings and flaws in Robson´s ideas and arguments will be identified. The purpose of the paper is not to point out that Robson got it all wrong, however.[1] Its purpose is rather to show the relevance of other current evolutionary theorising for the type of project Robson embarks on. Robson mostly ignores, to his own peril, what other evolutionary theorists have to say about the topics he is writing about. Robson's writings are used here as a peg to hang on a more elaborate discussion of the evolutionary origins of human behaviour. A detailed discussion of Robson's work gives me the opportunity to illustrate the significance of several insights and distinctions made in current evolutionary theory.

The discussion of Robson's work will be structured as follows. First some further remarks are made about the specific sort of evolutionary project Robson embarks on. Robson's evolutionary project briefly is positioned among other evolutionary projects in economics. Next some distinctions are introduced that are useful to disentangle different aspects of the evolutionary scenarios that Robson sketches. The *evolutionary problem* allegedly to be solved is distinguished from the *evolutionary process* that it supposedly sets in motion (allegedly leading to certain solutions). Important elements in the evolutionary process are *alternatives* and *capacities*. What are the alternatives available at the start of the evolutionary process and what capacities (cognitive capacities, in particular) do they have? If we know the evolutionary problem and the alternatives and capabilities in the ensuing evolutionary process, we still do not know what outcomes will come about. What is still missing in the scenario are the *selection criteria*. In Sober's (1984) felicitous phrase, what is selected for? It will turn out that all these aspects – evolutionary problems, alternatives, capacities and selection criteria – are treated by Robson in a dubious if not misguided way. Robson does not make any attempt to enhance the credibility of his own identification and discussion of these aspects. He does not take the trouble to gather empirical evidence that could support his scenarios. And he does not seriously connect with other relevant evolutionary theorising either. Worse, it will be pointed out that most of his arguments are sloppy and some of them are even downright flawed.

2. Some peculiarities of Robson's evolutionary project

Robson's work on the 'biological basis' of human economic behaviour is quite unlike other attempts to relate evolutionary theory to economic theory. One such attempt has led to various developments in *evolutionary game theory* (Maynard Smith 1982, Weibull 1995, Vega-Redondo 1996, Samuelson 1998, Young 1998). Evolutionary game theory deals with problems of social interaction in strategic situations. By contrast, Robson concentrates on decision-theoretic problems that are ancestors were allegedly faced with, such as finding nutritious food. Furthermore, while evolutionary game theory analyses ongoing evolutionary processes and their outcomes, Robson discusses evolutionary processes that took place long ago but that still left their traces in the cu-

[1] Indeed, it is even possible that Robson has got it all right. That is to say, at the end of the day Robson's conclusions may all turn out to be vindicated (although I am pretty sure that his arguments for them will be found lacking).

rrent internal decision-making machinery of humans. Moreover, evolutionary game theory deliberately replaces the standard behavioural assumptions of perfect rationality and common knowledge by non-standard ones, such as bounded rationality and non-Bayesian types of learning.[2] In contrast, Robson examines whether an evolutionary rationale can be given for economic theory's standard behavioural assumptions. It seems Robson wants to retain as much as possible in standard economic theory.[3]

Another attempt to relate evolutionary theory to economic theory has resulted in Nelson and Winter-type *evolutionary economics* (Nelson and Winter 1982, 2002; but see also Dosi *et al.* 1988, Hodgson 1999, Metcalfe 1998, Loasby 1999, Witt 2003). This type of evolutionary economics is even more unlike Robson's evolutionary project than evolutionary game theory, if only for the reason that evolutionary economists want to break more radically with standard economic theory than evolutionary game theorists. Evolutionary economists not only eschew standard economic theory's behavioural assumptions, they also want to evade equilibrium analysis. What is more, they also have a research agenda that is different from that of standard economic theory.

This does not mean that Robson's evolutionary project is unprecedented in economics. As Robson himself indicates (Robson 2001b, p. 900), what perhaps come closest to his own evolutionary project are studies such as Becker (1976) and Hirshleifer (1977). Like Robson, Becker and Hirshleifer turn to evolutionary theory to help us understand better what preferences we have and why we have the preferences that we have (instead of others). More recently, Werner Güth and other proponents of the so-called 'Indirect Evolutionary Approach' launched a similar project (Güth and Yaari 1991, Güth and Kliemt 1998). They too believe that the evolutionary past of our species provides the key to an informed and non-arbitrary identification of our preferences. What is more, their project resembles that of Robson in that they, like Robson and unlike many evolutionary game theorists, hold that next to our fixed basic preferences we also avail of an evolved capacity to act flexibly and rationally upon them.

What also warrants some attention, however, is that Becker, Hirshleifer and proponents of the Indirect Evolutionary Approach do not believe that our evolutionary past can shed light on our preferences about alternative packages of consumption goods. Our evolutionary past, they believe, can shed light only on our *basic* preferences (or on our 'commodities', as Stigler and Becker 1977 called them). They believe that looking at our evolutionary past may be helpful, for example, for finding out to what extent we are genuinely inclined to act altruistically (see als Frank 1988 and Field 2001). By contrast, Robson seems to have the kind of preferences in mind that economists usually speak of. He defines preferences over consumption bundles. Robson apparently believes that looking at our biological evolutionary past helps us in identifying our current preferences over consumption bundles.

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[2] For a more elaborate discussion of differences between standard economic theory on the one hand, and evolutionary game theory and evolutionary economics on the other - with a focus on ontological presuppositions - see Vromen (2001b).

[3] See, for example, "Biological evolution seems the best hope for justifying the usual view in economics that an individual's preferences are immutable" (Robson 2001b, p. 900).

The picture that gradually emerges here may be one of Robson trying to justify everything in economic theory that can be justified on the basis of evolutionary theory. But this picture is a bit lop-sided. Robson is prepared to reject standard assumptions in economic theory if these are clearly contradicted by evolutionary theory. Robson argues for example that contrary to the standard assumption that preferences of different individuals are independent, evolutionary theory strongly suggests that at least sometimes preferences are interdependent (such as is the case when individuals are concerned about their status). He also argues that in random environments non-expected utility is likely to have evolved (Robson 1996).

What Robson seems to take for granted, however, is the correctness of what henceforth will be called *economic theory's basic analytical framework*. Economic theory's basic analytical framework identifies three key characteristics of human beings as determinants of their behaviour: preferences, beliefs and rationality (Robson 2002, p. 89). 'Rational behaviour' is understood here not in a formal sense as observable behaviour meeting certain consistency requirements (as it is done in revealed preference theory, for example),[4] but in a substantive sense as behaviour that is deliberately directed by the agents in question at attaining certain ends. Rationality, in other words, stands here for ´Weberian´ means-ends, or ´Humean´ instrumental rationality. The only thing that is really fixed in human behaviour, Robson argues, are our preferences. They are fixed because evolutionary processes in a distant past have endowed us with these. For the remainder human behaviour is flexible: "… Nature may have encoded consumption outcomes in the brain as varying intensities of pleasure, but allowed beliefs to be shaped by local information, and left ultimate decisions to be made flexibly and rationally by the individual" (Robson 2002, p. 91). Our beliefs can and do adjust to prevailing local conditions and so can and does our behaviour.

Thus Robson believes that evolutionary theory can and should alter the *specific* assumptions that economists make about preferences, beliefs and rationality. But Robson does not believe that evolutionary theory undermines the *general* outlines of how economists conceive of individual decision-making. Preferences may have somewhat different properties as economists normally hold, beliefs may be updated in a less-than-fully-rational (non-Bayesian) way and rationality may be less than perfect, Robson argues, but evolutionary theory does not call into doubt that individual agents act flexibly and (approximately) rationally upon their preferences and beliefs. Robson seems to be convinced that the typical economic conception of individual decision-making as individuals acting rationally upon their preferences and beliefs is not jeopardised by the recognition that we humans are evolved creatures.[5]

3. Using economic theory to find out what can be retained of economic theory

When looking more closely into how Robson wants to flesh out the implications of us being evolved creatures, one is immediately struck by the fact that he deploys standard

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[4] Note that 'rational behaviour' in this formal sense can be fully genetically or memetically determined, as Binmore (1994) emphasises. See the last section for a further discussion of this.

[5] At the end of the paper I will return to this.

economic models and theories.[6] Robson (2001b) introduces for example a biological utility function and sets out to demonstrate that individuals that have a particular biological utility function respond evolutionarily optimally to novelty. In Robson (2001a) it is complained that 'utility' is not a popular concept in evolutionary theory. Robson argues that "… Not only can foraging theory be formulated in terms of an implicit utility function, but such problems could explain the evolutionary origin of a hedonic utility function" (Robson 2001a, p. 15). This gives rise to an obvious objection. Can we really explain the existence of a hedonic utility function by referring to an implicit utility function? Is this not question begging? Does this not amount to assuming the correctness of what is to be justified?[7]

The objection does not hold water, I think. Applying economic theory to check the validity of elements of that very same economic theory is not necessarily self-vindicating. An application of economic theory might point out, for example, that individuals do not act flexibly and rationally upon their preferences. This would be pointed out if it were shown that individuals with a different internal decision-making mechanism had greater reproductive success than individuals who act flexibly and rationally upon their preferences. Robson uses economic theory here not to analyse what individuals who act rationally upon their preferences would choose, but to analyse *outcomes* of evolutionary processes. In this respect, Robson clearly differs from Becker's recent applications of economic theory to explain why we have the basic preferences that we have (Becker 1996). In this work economic theory is meant to analyse what individuals choose that act rationally upon their preferences. Becker's attempt at explanation seems to get caught in an infinite regress. In order to apply rational choice theory in Becker's way preferences must be antecedently specified. But where do these preferences come from? We can try to give a rational choice explanation of these preferences too. But of course this only pushes the problem one stage further. For in this explanation we must antecedently specify yet other preferences. Again we have to ask: where do these preferences come from? And so on, *ad infinitum*.

Robson's evolutionary project does not get caught in such an infinite regress. For his use of economic theory does not demand that preferences should be antecedently specified. The predictions of economic theory here are supposed to stand for outcomes of evolutionary processes, not for consequences of rational choices made by individuals. This, however, gives rise to another objection. The objection is that economic theory does not accurately predict outcomes of evolutionary processes. There is a long-standing debate about this. Some argue that under a wide array of conditions and assumptions evolutionary processes tend to converge on the equilibria that economic theory predicts. Demonstrations that convergence of evolutionary processes on Nash equilibria is bound to happen under various different specifications of dynamics is a case in point (see, for example, Mailath 1998 for an instructive overview). Others ar-

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[6] This points at another clear difference with both evolutionary game theory and evolutionary economics. Both evolutionary game theorists and evolutionary economists engage in explicit dynamic process analyses. By contrast, Robson engages in static analysis.

[7] This is similar to the issue of reflexivity manifested in for example the economics of economics. See for example Hands (2001) for an instructive discussion of this issue.

gue that results like these only obtain under a very restricted set of conditions and that it is unlikely that such conditions are actually met in the real world (see, for example, Winter 1964). I will not go into this debate here. For the sake of argument, I will give Robson the benefit of the doubt on this point. I shall simply assume that there is nothing wrong *per se* in assuming that economic theory correctly predicts outcomes of evolutionary processes. In particular, I shall accept Robson's assumption that in evolutionary processes the relatively best performing alternative will be selected.

Even when we grant this, however, Robson's arguments leave a lot wanting. It is one thing to argue that there may be nothing wrong *per se* with Robson's assumption that in the end the relatively best performing alternative wins out. It is quite another thing to argue that the way in which Robson *de facto* proceeds with this assumption is convincing. In order to put the assumption to work, in order to flesh out implications of it, that is, the assumption has to be embedded in some sort of *evolutionary scenario.* This is indeed what Robson does. Robson sketches several evolutionary scenarios to make his points. An evolutionary scenario comprises several aspects, such as the depiction of the *evolutionary problem* to be solved, the *alternatives* available for selection, the *capacities* that they have and the *selection* or *performance criteria.* When it comes to assessing whether or not a convincing evolutionary rationale is provided for something much hinges on how plausibly and coherently these aspects of the evolutionary scenario are sketched. I argue that Robson's project is lacking in this respect. Not only does Robson not succeed in sketching plausible scenarios, his scenarios are also incoherent.

4. Evolutionary problems

Robson argues that problems related to novelty and complexity led to the evolution of preferences and utility functions, and to the particular types of preferences and utility functions that we, modern human beings, still have. To some extent this resembles a well-known argument about the evolution of intelligent behaviour (see, for example, Plotkin 1994). In the literature this line of argument often goes under the name of the 'Ecological Intelligence' hypothesis (Wynne 1988).[8] Here too specific and perhaps even unique features of decision-making in members of the species *homo sapiens* are related to evolutionary problems of novelty and complexity. But here problems of novelty and complexity are referred to in order to account for the existence of intelligence and rationality (or of intelligent and rational behaviour) in humans, not for the existence of utility functions (as Robson does). Unlike Robson does, no presumption is made that intelligent or rational behaviour equals the maximisation of some utility function under constraints. It is telling that in his overview (Robson 2001a) Robson sharply separates a discussion of the evolution of utility functions from a discussion of the evolution of intelligence and rationality. Robson wants everything related to evolution to belong neatly to one of the pre-established key elements in economic theory´s basic analytical framework: utility (and preferences), beliefs and rationality.

More important for our present purposes is that Robson devices specific, well-specified and mathematically tractable problems that are supposed to stand for the

[8] Robson himself contributed to the further development of this thesis (Kaplan and Robson 2000).

general problems of novelty and complexity to make his point. Devising mathematically tractable problems enables Robson to engage in rigorous analysis. This arguably speaks in favour of Robson. But the flip side of the coin here is that it hard to believe that our ancestors faced problems that are even remotely similar to the ones Robson devices. Robson does not really help us out here. He makes no attempt whatever to make it plausible that these specific, well-specified problems ever actually presented themselves to our ancestors.

Let us have a closer look at two specific and well-specified problems that Robson discusses. Robson presents a two-armed bandit problem as a natural setting in which evolutionary responses to problems of novelty may have evolved (Robson 2001b, p. 901).[9] Keep in mind that this problem is supposed to be situated in a time when our preferences did not yet get their definitive shape. As Robson endorses a hedonic interpretation of utility and tends to link preferences to emotions,[10] this allegedly is also the problem-setting in which our emotions have their evolutionary origin. This means that we are probably talking here about an era more than twenty thousand years ago. Arguing that he problem of repeated gambles, in which occasionally new optimal gambles become available, provides an appropriate model for studying problems of novelty in that era strains credulity. Robson characteristically does not attempt to provide evidence to support his claim that the problem depicted ever was a pressing evolutionary problem that our ancestors faced.

In Robson (2002) the envisaged problem is one stemming from an increase in available consumption bundles. The problem is whether to choose a new consumption bundle or to stick to the previously chosen one when a bundle is added to an already large set of available consumption bundles. Again it can be asked whether this problem ever actually exerted a tight evolutionary pressure on our ancestors. Robson seems to think so, because he argues that the appearance of a new bundle created the need to encode either new utilities or new behavioural patterns in our ancestors.[11] If the appearance of a new bundle had not exerted a tight evolutionary pressure, no such need would arise. What makes Robson believe that it was this particular evolutionary problem rather than another that gave rise to the evolution of utility functions? Robson does not provide us with an answer. The particular problem depicted here presumably is supposed to stand for the more general problem of how our ancestors were able to solve the problems of novelty and complexity. But are the specific types of the problems of novelty and complexity that our ancestors were confronted with aptly

[9] The bandit problem is invoked to show that having utility functions permits an evolutionarily optimal rapid response to novelty. When Robson first introduces novelty, he talks of a new optimal gamble suddenly and unexpectedly becoming available. As far as I can see, there is nothing of this kind going on in the bandit problem. What we have instead in the bandit problem, I think, is complexity. The bandit problem represents a complex choice situation in the sense that it is hard for individuals to tell which arm produces most offspring.

[10] Robson suggests that preferences and utility are seated in the limbic system in the human brain (Robson 2001, p. 12).

[11] It is to be noted that the appearance of the new bundle must have presented a pressing and enduring evolutionary pressure for natural selection to be able to do this.

described as an increase in the number of consumption bundles? I find this hard to believe.

5. Pre-existing capacities

Robson contends that preferences evolved prior to rationality. He argues that there is some neurological evidence for this,

> "… since reward centers can be found in evolutionarily ancient brain structures – the "limbic system", for example – but cognitive decision making occurs in brain structures that were more recently exaggerated in human beings – the frontal lobes" (Robson 2001a, p. 12).

Apparently, Robson believes that the historical order in which different parts of our brain grew out into their present shape and size supports the view that our ancestors were not yet capable of rational, cognitive decision making when our preferences first evolved. Furthermore, Robson seems to believe that different parts in our brain are responsible for different parts in our present decision-making. Ancient brain structures like the limbic system are responsible for the affective part, our preferences and utility functions, whereas our more recently evolved frontal lobes are responsible for the cognitive part, the process of finding out what option to choose on the basis of our preferences. What this passage also once again makes clear is that Robson believes that we have evolved *hedonic* utility functions. We prefer options that are most rewarding in the sense that they give us the most pleasurable or pleasing sensations. In this way Robson also forges a link between preferences and *emotions*. Contrary to folk wisdom, Robson follows Damasio (1994) and others in assuming that emotions do not inhibit rational decision-making, but are rather conducive and intrinsic to it (Robson 2001a, p. 15).

Although it is thus contended by Robson that preferences evolved prior to rationality, when analysing the evolution of preferences his working hypothesis is that the simple choices involved are made rationally (ibid., 14). Robson suggests that proceeding on the basis of this working hypothesis is not optional but compulsory: "... a *vestige* of rationality is needed to model how preferences first evolved" (ibid., 12, emphasis added). One wonders: if rationality is assumed to evolve only after preferences already evolved, how can there be vestiges of rationality in the first place? It seems that if Robson is right that in the process in which preferences got their shape rationality did not yet appear on the scene, then when analysing the evolution of preferences we may at most assume building blocks or rudimentary beginnings of rationality, and certainly not vestiges of rationality. Upon closer inspection it becomes clear, however, that Robson indeed does assume the pre-existence of quite sophisticated cognitive capacities on the part of our ancestors when analysing the evolution of preferences.

In Robson (2001b) it is argued that having a particular utility function, based on the production of expected offspring, together with processing a simple rule of thumb, is sufficient and necessary for evolutionary success. The 'simple rule of thumb' depicted involves two stages. In the first stage individuals are engaged in experimentation. They try each of the two options (the two arms of the bandit, in this case) in alternating periods. Individuals are assumed to keep track of the cumulative difference for the utility payoffs. Stage two is entered if the difference exceeds some pre-set critical value. If

option 1 outperformed option 2, then the individual option 1 is chosen thereafter. Option 2 is chosen if option 2 outperformed option 1 in the experimentation stage.[12] Robson is right that the rule is simple in the sense that it is computationally straightforward, uses no internal randomisation, and involves no beliefs about probabilities. But the crucial question is not whether or not the rule is simple in this respect. The crucial question is whether or not processing the rule demands only very limited cognitive capacities and powers. This does not seem to be the case. Keeping track of cumulative differences between the utilities of the two options can be quite demanding in terms of memory and recall, especially if the experimentation stage lasts long and if in this time period the experiment is not the only thing individuals have to pay attention to. It is not even clear that we, with our supposedly superior cognitive powers, would maintain the running cumulative difference faultlessly.

If we assume, for the sake of argument, that Robson's two-armed bandit problem is a fair representation of the evolutionary problem that our ancestors (lacking our sophisticated cognitive powers) were confronted with, then a much more plausible rule of thumb to be ascribed to them, I submit, is the following one. The *immediate* experience with some arm determines what arm is chosen next. If the satisfaction felt is above some critical threshold value, the same arm is chosen again; if the satisfaction felt is below the value, the other arm will be chosen. This rule of thumb is cognitively far less demanding than the one Robson (2001b) describes. For it does not require that individuals keep track of a longer sequence of experiences. The difference with Robson's rule of thumb is that here individuals are assumed to have no cognitive capacity for recall. It is clear that this ´no recall rule of thumb´ does not ensure evolutionarily optimal behaviour. In fact, individuals following this rule may continue to switch (in a non-optimal way) between the two arms indefinitely. Therefore having the particular utility function that Robson depicts, together with following *this* simpler rule of thought, is *not* sufficient for evolutionary success. It seems that for that utility function to ensure evolutionary success, quite sophisticated cognitive powers have to be assumed on the part of our ancestors.

Note that in the foregoing discussion of the two types of rules it is tacitly assumed that individuals are already equipped with the capacity to experience utilities. It remains to be seen whether we are justified in making this assumption. For recall that we are supposedly dealing here with the evolution of preferences and utilities. If this is what we are dealing with, it seems that we have to assume that preferences and utilities do not yet exist. Or, as a minimum, we may not assume that *all* preferences and utilities are already in place. Given what we now know about emotions, it seems plausible to assume that the evolution of emotions was a cumulative affair (Griffiths 1997). That is to say, it is not likely that the full panoply of our emotions and preferences suddenly and simultaneously appeared on the scene. They rather appeared one at a time, building upon other, already evolved emotions. This is not at all how the evolution of utility functions is conceived of in Robson (2001b). Robson does not in-

[12] Another problem is that, strictly speaking, Robson cannot assume that the utility function is already in place when analysing, as he says he does, the evolution of utility functions.

vestigate how utilities gradually and cumulatively evolve. Robson rather investigates whether having the particular utility function depicted is a sufficient and necessary condition for having reproductive success. In particular, when investigating whether having the utility function is a sufficient condition for evolutionary success, he ascertains that his 'simple rule of thumb' suffices. What this means is that he assumes rather than explains the evolution of the utility function. Robson simply assumes that the utility function is already there!

This is different in Robson (2002). Here Robson assumes that for each new consumption bundle a new utility has to be encoded. It can be argued that here it is acknowledged that the evolution of emotions, preferences and utilities is a gradual and cumulative affair. But the cognitive capacities that Robson attributes to individuals are even more sophisticated than those attributed in Robson (2001b). Robson assumes that individuals are endowed with the cognitive capacity to compare utilities and to choose the appropriate consumption bundle (Robson 2002, p. 93). This is quite something, given that the alleged problem to be solved is one of novelty and complexity. The main line of argument in Robson's paper is that when confronted with such problems, having utility functions enables individuals to choose flexibly. This suggests that individuals endowed with utility functions are assumed to be able to choose (on the basis of one and the same utility function) differently in different situations. Given some utility function an individual may choose the one bundle in the one situation and another in another situation, for example because relative costs of obtaining the bundles may differ in the two situations. Furthermore, Robson tacitly assumes that the individuals at stake do not make mistakes. Note that they are supposed to pick out the *appropriate* bundle. All in all this seems to require quite some cognitive sophistication on the part of the individuals. It seems that a high level of rationality is assumed to pre-exist here. Not only does this run counter to what Robson himself believes about the historical order in which preferences and rationality evolved. It also seems implausible to ascribe such a high level of rationality to our ancestors, either human or prehuman, at a time long ago in which not even all of their emotions were in place.

One gets the impression that if there is something that Robson explains it is not the evolution of preferences and utility functions, but the evolution of rationality or intelligence.[13] What is really shown in Robson (2001b) is that having the utility function is sufficient for evolutionary success *if* individuals are endowed with relatively sophisticated cognitive capacities. If individuals are endowed with weaker cognitive capacities, having the same utility function does no longer guarantee evolutionary success. What is really shown in Robson (2002) is that having an extra cognitive capacity can have evolutionary advantages. This impression is reinforced if the alternative that Robson sketches is looked at carefully. The alternative consists of individuals for which Nature dictates the better bundle directly. Robson argues that these individuals are lacking in that they do not have recourse to utility. But it seems that what they rea-

[13] Recall that I noted earlier that there are evolutionary theorists, proponents of the so-called 'Ecological Intelligence' hypothesis, who attribute the evolution of intelligence to evolutionary problems of novelty.

lly miss is the cognitive capacity to act flexibly and rationally upon their utilities.[14] If Robson were really trying to explain the evolution of utilities, he should have assumed the same limited cognitive capacities for both alternatives. This is clearly not what he does. In fact, the individuals of the alternative in Robson (2002) resemble the individuals with the limited cognitive capacities (following the 'really' simple rule) that I just contrasted with the individuals with the utility function discussed in Robson (2001b). They too act upon utilities, but do so with only weak cognitive capacities. All this suggests that it is not the evolution of utility functions that Robson explains, but the evolution of rationality. What Robson really explains, it seems, is that having sophisticated rather than primitive cognitive powers is evolutionary advantageous (*ceteris paribus*).

6. What are the alternatives to be selected from?

Except from the remark that Robson depicts them as being endowed with limited cognitive powers, not much was said thus far about the alleged competitors (or the alternative type) of our ancestors in the evolutionary scenario sketched. What further properties does Robson ascribe to the competitors and what makes Robson believe that the competitors had these properties? Robson asserts that for the competitors the choice of the gamble is genetically determined (Robson 2001b, p. 901), and that Nature dictates the better consumption bundle directly (Robson 2002, p. 930). The latter parlance is in line with Robson's interpretation of the evolutionary problem to be solved in terms of a principal-agent problem, where Nature is the principal and the individual is the agent (Robson 2002, p. 91). The problem, as Robson sees it, is what the principal, Nature, should keep in her own hands and what can and should be left to the discretion of the agents, the individuals. According to Robson the solution is how we, members of *homo sapiens*, make our decisions: the assignment of utilities to consumption bundles Nature keeps in her own hands. But for the remainder we are free to adjust our beliefs and to act flexibly and rationally. Apparently Robson believes that the 'choice' to be made was one between ancestors of us, who already made decisions in pretty much the same way as we do, and other creatures in which no allowance for learning and flexible and rational decision making was made. These creatures, it is assumed, were simply incapable of making flexible choices or of learning. They were creatures in which Nature encoded consumption 'choices' directly for any given set of consumption bundles. Robson's remarks about choices being genetically determined clearly suggest that the encoding is assumed to be implemented at the genetic level. The problem with this depiction of the alternative is that Robson fails to give any evidence that our ancestors ever actually competed with such simple automata. Robson seems to rest content with showing that there are sound reasons for believing that we did not evolve into creatures for which Nature dictates behaviour directly and fully. Robson seems to think that it is sufficient to point out that creatures for which Nature only dictates utility functions directly and fully and that for the rest choose

[14] Of course, Robson himself holds that the alternative has no utilities. But it is hard to see how else 'Nature' can implement automatic responses to consumption bundles in individuals than via 'likings and dislikings'.

flexibly and rationally on the basis of these do better than these mindless and emotionless creatures. But it is not. Unless it is made plausible that these two types of creatures ever existed and were actually competing with one another, such a comparison is left hanging in the air. It is still entirely possible that neither our ancestors nor we even remotely look like any of these two types of creatures.

Robson also seems to confuse two different meanings of phrases such as 'Nature dictates the better bundle'. This is remarkable, because Robson himself explicitly tries to avoid confusion. Robson makes clear that the phrase should not be taken literally. "Thus, when we say that "Nature wishes" the individual to maximise biological fitness, this is shorthand for claiming that individuals who maximize fitness will ultimately dominate the population" (Robson 2002, p. 91). What Robson wants to disclose here is the truism that what ultimately counts in (biological) evolution is actual relative reproductive success. Robson is right that it is quite cumbersome and tiresome to discuss things in these terms. The shorthand 'Nature dictates what creatures do' is meant to be a much more convenient way of expressing the same ideas. So far so good. But Robson also invokes the phrase 'Nature dictates what creatures do' in the sense that what these creatures do is fully and directly genetically determined. Apparently without noticing it, Robson lets the first use of the phrase slip over into the latter.

Contrary to what many seem to think, this equivocation is not at all self-evident. In fact, it is mistaken. It is a bit of irony that Robson himself in effect shows that the equivocation is mistaken. After all, the whole point of Robson's arguments is to demonstrate that not the creatures whose behaviour is fully and directly genetically determined are reproductively most successful, but creatures with the capacity to act flexibly and rationally. Furthermore, 'genetic determinism' understood in the way Robson does testifies to ignorance about the possible role genes could play in affecting behaviour. Genes can never determine behaviour directly. Genes can at most determine behaviour indirectly. What genes can affect directly are processes of *ontogenetic development*. From the fertilised egg to the mature individual genes channel or canalise the development of all kinds of traits, amongst them traits of the brain and behavioural traits. Sometimes the channelling is tight, which means that some traits emerge even when environmental circumstances are unfavourable; sometimes the channelling is loose, which means that it depends largely on prevailing environmental circumstances what traits will emerge. If there were a doctrine of 'genetic determinism' that biologists would be willing to endorse, it would be this: in a process of maturation some traits develop, no matter what environmental circumstances prevail.[15]

It is important to acknowledge that the type of 'genetic determinism' and the belief that people are capable of acting flexibly and rationally do not mutually exclude each other.[16] Acting flexibly and rationally requires certain cognitive capacities, the ontogenetic development of which may be or may not be fully genetically determined. Genes

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[15] 'Genetic determinism' in Robson's sense arguably is a straw man (see, e.g., Dennett 2003). Not even Dawkins (1976), with his famous notion of the selfish gene, holds that we are puppets held on a string by our genes. Dawkins denounces genetic determinism as "… pernicious rubbish on an almost astrological scale" (Dawkins 1982, p. 13).

[16] See Vromen (2001a) for a further discussion of agency and evolutionary theory.

can not be put on a par with preferences, beliefs and rationality as two mutually excluding sets of determinants of behaviour. Genes are not *proximate causes* of behaviour, as some biologists would put it (Mayr 1961). Certain brain processes can be called proximate causes of behaviour. At the level of the mind, psychological mechanisms to act and to learn are also called proximate causes. Some biologists would also be willing to call mental ('folk psychological') states like preferences and beliefs proximate causes (Sober and Wilson 1998). But no one would be prepared to call genes proximate causes, for the simple reason that genes can only be indirect or remote causes of behaviour of behaviour.

7. A third alternative

Perhaps we should give Robson the benefit of the doubt by not taking his assertions literally. Perhaps all he means is that the behaviour of the alternative individuals is fully prescribed *somehow* by some proximate causes. In particular, the alternative individuals are assumed not to have the cognitive capacity to learn and to choose flexibly and rationally. By contrast, individuals endowed with utility functions are assumed to avail of such a capacity. The crucial issue is what difference for decision making it makes for individuals to have such a capacity. What exactly is this capacity according to Robson and how does it figure in learning and decision-making? Robson assumes that once the capacity has developed, its deployment does not bear any trace from the developmental process. That is, it is assumed that learning and decision-making are not indirectly constrained, biased or guided by the genes that were involved in the capacity's development. Robson thus introduces a *dualism* between two components in rational decision-making. Utilities are assumed to be somehow fully prescribed genetically. On the other hand, although the cognitive capacity to learn and act flexibly and rationally is prescribed genetically (at least to some extent), learning and making rational choices themselves fully transcend any genetic prescription.

Robson's depiction of learning and decision-making falls squarely into the category of what nowadays are called *blank slate* theories (Pinker 2002). Blank slate theories hold that in processes of ontogenetic development the human mind gets its mature shape exclusively from the experiences with the environment that the developing child accumulates. What blank slate theories emphatically deny is that at birth the human mind is already prefigured in certain ways and that this affects the ways in which the developing child processes its experiences with the environment. Likewise, Robson denies that human learning and decision-making are innately prefigured or prepared. It seems that for Robson the relation between genes and behaviour is an all-or-nothing affair. Either some constitutive part of behaviour is assumed to be completely genetically determined (such as a utility function), or it is assumed not to be affected by genes at all (such as learning and rationality). Current evolutionary theory suggests that next to the two alternatives Robson discusses there is a third alternative. What is more, there is some evidence that this third alternative is the one that is more likely to have evolved in *homo sapiens* than the two alternatives Robson discusses.

The third alternative is put forward forcefully both by proponents of evolutionary psychology and by Gigerenzer and his associates of the so-called ABC-group.[17] Proponents of evolutionary psychology argue that in their learning efforts and reasoning people are led (most of the time unconsciously) by *domain-specific modules*.[18] Gigerenzer and his associates of the ABC-group prefer to talk of *fast and frugal heuristics*. But, some minor disagreements notwithstanding, what they both have in mind is that people are equipped with evolved psychological mechanisms (or cognitive systems) that guide or channel their learning and decision-making processes.[19] These mechanisms are regarded as proximate causes of human behaviour. Psychological mechanisms enable people to learn certain things in a relatively effortless, quick and reliable way. But they sometimes also impede learning: there are things that we can learn only after having made laborious and time and energy-consuming efforts (if at all).[20] It is similar with our ability to engage in flawless reasoning. Experimental results suggest that people have problems even with correctly applying a seemingly easy logical inference rule such as the famous Modus Tollens rule. What is striking, however, is that performance improves considerably if the task is framed such that subjects are alerted to the possibility of cheaters threatening an existing precious social contract and where the challenge for subjects is to detect cheaters. On the basis of this experimental finding and of some evolutionary theorising about necessary requisites of social co-operation, the evolutionary psychologists posit the existence of a specialised cheater-detection module (Cosmides 1989, Cosmides and Tooby 1992).

This brings us to a second aspect of the third alternative. Both evolutionary psychologists and members of the ABC-group stress the multi-facetness of evolutionary pressures that gave rise to the evolution of several specialised psychological mechanisms. Our ancestors did not only face the evolutionary problem of how to acquire sufficient nutritious food,[21] for example, but also of how to find a suitable mate, how to protect themselves against predators and climatic changes and how to secure and

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[17] Space constraints do not permit a thorough introduction and discussion of the main tenets of evolutionary psychology and the ABC-group ('ABC' stands for Adaptive Behavior and Cognition). I have to confine my attention here to those facets that are most relevant for the present purposes. The interested reader might want to consult Barkow, Cosmides and Tooby (1992), Buss (1999), Gigerenzer *et al.* (1999) and Todd and Gigerenzer (2000).

[18] Sometimes it is argued that evolutionary psychology is sociobiology clothed in a new dressing. A significant difference between the two seem to be, however, that sociobiology held that natural selection worked directly on behaviour, whereas evolutionary psychology holds that it is the psychological mechanisms underlying behaviour that are selected (Cosmides and Tooby 1987).

[19] Strictly speaking, there are two different kinds of 'channelling' processes involved here. One is the the process of ontogenetic development in which genes prescribe the development of mature psychological mechanisms to some extent. The second process is one in which the developed mechanisms, as proximate causes of behaviour, channel further learning and reasoning of the mature being (see Carruthers 2003).

[20] This suggests that Robson's assumption that at a minimum, individuals are always capable of 'Pavlovian' associative learning (Robson 2002), is unfounded.

[21] It seems Robson mainly focuses on the problem of food acquisition. Field (2001) argues that economists have tended to assume that coping with foraging problems is all there is to human behaviour.

reap the mutual benefits from co-operation. The working hypothesis is that our ancestors evolved a suite of domain-specific psychological mechanisms, each of which is activated only if stimuli are of the appropriate kind. Each mechanism has its own specific input conditions. Only if some stimulus satisfies its input is a mechanism activated. This 'content-sensitivity' of mechanisms allows for *flexibility* in behavioural responses to different environmental circumstances. A change in circumstances may imply that the input conditions of some mechanism that was activated so far is no longer satisfied. This implies that that mechanism is now 'switched off'. If the input conditions of some other mechanism are now satisfied, then that mechanism will be activated, often leading to different patterns of learning and decision-making. Even if the same learning mechanisms are always activated, they are likely to generate new types of behaviour if the individuals in question gather new experiences. Mechanisms may allow for even more flexibility in behaviour if, as is mostly assumed, they themselves have a conditional form (for example: "If conditions of type A obtain, do X; if conditions of type B obtain, do Y"). What this shows is that having a 'general' cognitive capacity to compare options and to choose the appropriate one is not the only way to get behavioural flexibility. Behavioural flexibility may be accomplished also by a set of fixed psychological mechanisms (Carruthers 2003).

Robson assumes that preferences, beliefs and rationality are three distinct components that can be and should be sharply distinguished. Learning and decision-making are assumed to take place against a background of fixed utility functions. In the psychological mechanisms of the third alternative, by contrast, affective and cognitive components are interwoven.[22] The output of the mechanisms may be new beliefs. But psychological mechanisms may also produce new desires. Whether or not they produce rational behaviour, in the sense of optimal responses to stimuli, depends first and foremost on the issue whether or not the stimuli provided are approximately the same as those that gave rise to the evolution of the mechanisms in the first place. It is these ecological circumstances that the mechanisms are adapted to, and if present circumstances differ markedly from these, maladapted 'irrational' behaviour may be expected. Perhaps the best way to conceive of the whole trajectory between perceptible inputs and behavioural outputs is in terms of a (possibly vast) set of interlocked mechanisms, where the outputs of some mechanisms serve as the inputs of other mechanisms in the chain (Sperber 1996 and Carruthers 2003). In the chain both affective and cognitive components, 'desires' and 'beliefs', are changing and intertwined. In particular, 'desires' are not the fixed inputs that Robson takes them to be.

The learning and decision-making processes envisioned in the third alternative are more constrained than the learning and decision-making processes in Robson's favoured second alternative. Robson does not take the third alternative into consideration. *Prima facie* it might seem that if he had done so, he would have had an easy time showing that the 'utility alternative' he believes evolved would have outperformed the third alternative. After all, it seems that individuals having an unconstrained capacity

[22] See Vromen (2002 and 2003a) for a further discussion of what implications this might have for economic theory.

to learn and decide always have evolutionary advantages over individuals having a constrained capacity. But in the next section we shall see that proponents of evolutionary psychology and members of the ABC-group argue that there are sound evolutionary reasons to expect that the third alternative rather than Robson's second alternative has evolved in *homo sapiens*.

8. What is selected for? Costs and benefits

How could individuals that have a constrained capacity for learning and decision-making ever have outperformed individuals that have unconstrained capacities? Here are, in a nutshell, the answers given by leading proponents of evolutionary psychology and the ABC-group respectively:

> Different adaptive problems frequently have different optimal solutions, and can therefore be solved more efficiently by the application of different problem-solving procedures. When two adaptive problems have different optimal solutions, a single general solution will be inferior to two specialized solutions. In such cases, a jack-of-all-trades will necessarily be a master of none, because generality can be achieved only by sacrificing efficiency. (Cosmides and Tooby 1992, p. 179)[23]

> "fast and frugal heuristics employ a minimum of time, knowledge, and computation to make adaptive choices in real environments […] the purest form of bounded rationality is to be found in fast and frugal heuristics, which employ limited search through objects (in satisficing) or cues and exploit environmental structures to yield adaptive decisions" (Todd and Gigerenzer 2000, p. 731).

Although there may be a few differences between the two answers given here, there is a general thrust in them that can be rephrased as follows. The presupposition is that for an extended period of time our ancestors faced not a single evolutionary problem, but several recurrent evolutionary problems or pressures.[24] Under such circumstances, having a general, unconstrained problem-solving device is less efficient than having several special-problem solving devices. Such special-problem solving devices are constrained in the sense that they are 'pre-programmed' by certain heuristics. It is precisely because they are constrained in this sense that, compared with a general unconstrained problem-solving device, the devices save on deliberation and computation costs (see also Cosmides and Tooby 1994). Pre-programmed rule-based behaviour avoids laborious and time-consuming search. What is more, heuristics-guided behaviour reliably produces similar behaviour under similar circumstances. By contrast, if there are recurrent situations, flexible, deliberate choice entails a greater risk that mistakes are made, for example in the assessment of circumstances or in the reasoning process following it. Having an unconstrained general problem-solving device does not by itself guarantee that optimal solutions are always chosen!

The flip-side of the coin here, however, is that heuristics that do well in recurrent problem situations may fail to lead to satisfactory results in new, unprecedented problem situations. Proponents of evolutionary psychology and the ABC-group stress that our ancient special-problem solving devices may well be maladapted to present circumstances. Even if it involves higher deliberation- and computation costs, having a general problem-solving device on balance could be advantageous if there is massive novelty. In novel situations flexible, deliberate choice may allow for responses that

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[23] See also Cosmides and Tooby (1987), 295 and Cosmides and Tooby (1994), 329.

[24] Evolutionary psychologists call this the Environment of Evolutionary Adaptedness (EEA).

match new circumstances better than behaviour led by innate mechanisms and it is possible that this more than compensates for the surplus of costs involved. But if proponents of evolutionary psychology and the ABC-group are right, we simply do not avail of such a general problem-solving device because it never evolved in the first place.

Note that in his comparison of potential advantages and disadvantages of either alternative Robson only considers costs. Potential or possible *benefits* of either alternative are not taken into consideration. That innately encoded behaviour may have some benefits if individuals are confronted with recurrent problem situations, for example, is ignored by Robson. But this, it can be argued, is understandable, since Robson mainly focuses on evolutionary problems of novelty. Part of the disagreement between proponents of evolutionary psychology and the ABC-group on the one hand and Robson on the other can be traced, it seems, to an empirical disagreement about the sorts of evolutionary problems and pressures that have given rise to the most significant features of our current behaviour-generating machinery. Robson emphasises problems of complexity and novelty that called our capacity to decide consciously on the basis of preferences into existence. Proponents of evolutionary psychology and the ABC-group tend to emphasise the plurality of psychological mechanisms that evolved in response to a multitude of recurrent evolutionary problems. A general capacity to learn whatever there is to be learnt and to solve whatever problem presents itself to us, they argue, is not among those mechanisms. Moreover, they argue that when it comes to identifying significant features of our behaviour-generating machinery, conscious planning and decision-making is only the tip of the iceberg. Underneath there is a multitude of dispositions steering behaviour in a mostly unconscious way.

As far as *costs* are concerned Robson seems to turn things upside down. When discussing how the two competitors deal with the appearance of an additional consumption bundle, Robson seems to argue that innately encoded behaviour brings more computational costs with it than flexible, deliberate choice. The arguments put forward by the evolutionary theorists just discussed by contrast suggest that behaviour led by innate mechanisms entails fewer computational costs than flexible, deliberate choice. Furthermore, they do not just argue that flexible, deliberate choice is more costly, they also argue that it is more prone to making mistakes and errors. Robson seems to pay no attention to the possibility that individuals acting upon their utility functions may make mistakes. In Robson's depiction it is not even clear that on top of the costs that the individuals make in assigning utilities to consumption bundles there are extra computational costs involved when individuals act upon their utility functions. Robson does speak of extra costs on top of the costs made for assignments of utilities. But Robson has a fixed cost in mind here that is related to "… the extra cognitive capacity needed for the individuals to compare utilities and to choose the appropriate bundle" (Robson 2002, p. 93). Note that Robson speaks of an extra cognitive *capacity* here, and not of extra cognitive activities. It seems that Robson believes that there are no extra variable costs involved in exercising the extra cognitive capacity. He believes, it seems, that once utilities are assigned, choosing the appropriate bundle does not require extra computational efforts. This runs counter to the portrayal of ot-

her evolutionary theorists, in which the extra computational costs involved in case-by-case deliberation are emphasised.

Robson compares the costs involved in either alternative as follows.

> How then do the costs of the two alternatives compare? The utility approach may involve a cost for each assignment of utility to a consumption bundle. It may also involve a fixed cost for the extra cognitive capacity needed for the individuals to compare utilities and to choose the appropriate bundle. However, the overall cost of the utility function approach only increases in a linear fashion, as the number of possible consumption bundles becomes large. On the other hand, if Nature dictated the better of each pair of bundles, without recourse to utility, there might be some neural cost for each such pair. Since the number of pairs grows more quickly than does the number of bundles, as the number of bundles increases, it follows that the cost of the alternative also grows more quickly than the number of bundles. Thus, the use of a utility function is preferred whenever there are sufficiently many bundles. (Robson 2002, pp. 93-4).

What makes Robson believe that there are more neural costs involved in the alleged alternative, in which behaviour is fully innately encoded, than in the utility approach is, it seems, that he assumes that fully innately encoded behaviour proceeds on the basis of *pair-wise* comparisons between consumption bundles. Robson seems to assume that in order to find out whether some new bundle is to be chosen new pair-wise comparisons have to be made between the new bundle and each 'old' bundle separately. Thus if there are already 10 bundles available, adding one new bundle requires that 10 additional pair-wise comparisons are to be made; if yet one more bundle is added to this, 11 additional pair-wise comparisons are to be made, and so on.[25] But why should we assume that fully innately encoded behaviour proceeds pair-wise? It seems this assumption is arbitrary. It is clear that this assumption perfectly suits Robson's purpose to show that the alternative is more costly than the utility approach. But Robson does not give any independent justification for it. Moreover, Robson's further assumption that there is some neural cost for each pair-wise comparison is not argued for either. Robson's remark that it is relative cost of the computations that decides what alternative is selected suggests that the neural costs at stake in the 'Nature dictates' alternative are due to computations that are involved in pair-wise comparisons. But what computations are involved in pair-wise comparisons if our behaviour is assumed to be fully innately determined? Robson does not tell us. The internal neural machinery in the alternative individuals making the comparisons is a black box in Robson's discussion. The only thing that is clear is that the computations in question are not executed consciously by the individuals.

What are the costs involved in the utility approach? Robson argues that there are *variable* costs involved in assigning utilities to consumption bundles and that there are *fixed* costs for the cognitive capacity needed to compare utilities and to choose the appropriate bundle. But if the neural costs at stake are really due to computations made, this seems to be a strange way to depict the neural costs involved. Keep in mind that Robson holds that in the utility approach the assignment of utilities to bundles is done by Nature. What this implies is that Robson assumes that with the appearance of a new bundle, natural selection will see to it that some assignment of utility to the new

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[25] In general, if there are already n consumption bundles, the appearance of one more bundle necessitates making n new pair-wise comparisons.

bundle will become innately encoded.[26] As Robson says next to nothing about this part of the story, once the encoding is established it is unclear what computations are involved and what neural costs are associated with these every time the new bundle is encountered. What is clear, however, is that no new efforts by the individuals are involved to assign utilities to the new bundle. Once the encoding is established, the assignment of utility is settled once and for all.

By contrast, it seems that new efforts on the side of individuals may be required to compare utilities and to choose the appropriate bundle every time the new bundle is encountered. In every new situation in which the new bundle is encountered there may be different sets of alternative bundles available, each time requiring new comparisons. And the costs of obtaining the bundles may be different from the one situation to the other, each time requiring new choices of the appropriate bundle. Thus, contrary to what Robson argues, the neural cost for each assignment of utility to a consumption bundle is fixed and the costs for comparing utilities and for choosing the appropriate bundle seem to be variable.

It seems that Robson is mixing up different sorts of processes and the costs involved in them. When he talks about a variable cost for assigning utilities to consumption bundles the sort of process involved is *phylogenetic evolution*. The tacit (and questionable) assumption Robson makes is that for each new consumption bundle our ancestors were confronted with, natural selection has hammered some assignment of utility to the bundle somehow into our brains. Robson calls the costs involved variable because he assumes that new costs linked to this process of hammering or encoding have to be made for each new consumption bundle. The extra cognitive capacity needed for individuals to compare utilities and to choose the appropriate bundle is likewise a product of natural selection. The capacity also must have been encoded somehow in phylogenetic evolution. And in this process costs are involved too. But the assumption that Robson makes here is that these costs have to be made only once. Once the capacity is in place, no new costs have to be incurred when new bundles appear.[27] In this sense the costs involved in the phylogenetic evolution of the capacity are fixed. Thus if the costs involved are meant to apply to phylogenetic evolution, Robson seems to be right in arguing that in his own scenario the encoding in the brain of utility to a new consumption bundle entails variable costs and the encoding of the extra cognitive capacity entails a fixed cost.

The problem, however, is that when Robson is comparing the relative costs of the utility approach and its alternative, he is not comparing costs related to processes of phylogenetic evolution. Instead, what he is comparing are costs related to *brain proces-*

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[26] Note that for this to happen the appearance of the new consumption bundle must pose a pressing and enduring problem (which runs counter to Robson's claim that there is problem of novelty at stake here). Furthermore, note also that in Robson's story it is totally unclear what the individuals do before 'Nature' has genetically assigned a utility to the new bundle.

[27] I already argued that since Robson believes that utility functions evolved prior to rationality, the existence of this capacity cannot be presupposed when analysing the evolution of utility functions (as Robson does). But apart from this, Robson is right that the costs involved in the evolution of the capacity do not depend on the emergence of new bundles.

ses. As indicated earlier, Robson compares neural costs due to computations that are implemented in brains.[28] What counts here are not the costs that were made long ago in phylogenetic evolutionary processes, but the costs associated with brain activities in each alternative when individuals are presented with consumption bundles. What counts, for example, are neural costs involved in making flexible responses to novel and complex situations on the basis of pre-existent and (for the time being) fixed utility functions. In order to calculate these costs, what we need to know are the costs involved in the neural processing of utility functions and the neural costs involved in comparing utilities and in choosing the appropriate bundle. On the basis of what Robson says, it is impossible to make these calculations. What is unclear, for example, is how many neural costs are involved in processing some utility function when making flexible responses. But what seems to be clear is that *exercising* the cognitive capacity to compare utilities and to choose the appropriate bundle may entail making new neural costs in each new situation. Thus, in terms of neural costs *variable* costs are involved here. So when the relevant costs in Robson's scenario are neural costs, Robson seems to be wrong in arguing that the extra cognitive capacity entails a fixed cost.

To complicate things even further, there seems to be yet another process at stake that brings its own kind of costs with it. This process is the one we already came across in the previous section: ontogenetic development. In a sense, this process is the missing link between the first and the second sort of process that we just discussed. In the first sort of process, phylogenetic evolution, natural selection has endowed us with genetic material. In the second sort of process, brain processes, mature individuals, individuals with fully developed capacities and properties are studied. Ontogenetic development is about how fertilised eggs with some genetic material grow out into mature individuals. Since the process of ontogenetic development takes time and energy, the process itself also involves making costs. Robson implicitly refers to such costs when he argues that "Implementing a more costly alternative would require a larger brain and therefore greater metabolic energy resources for building and maintaining this organ" (Robson 2002, p. 93).[29]

It seems that *if* we accept for the sake of argument Robson's (2002) evolutionary scenario, and *if* we assume that relative costs are decisive for what alternative evolved by natural selection, then what we need are *comprehensive* (total) cost calculations. On the basis of the above discussion we can say that comprehensive cost calculations involve three different sorts of costs. First of all there are *imprinting costs*. Imprinting costs are costs that are associated with the genetic encoding of utilities and capacities. These are the costs that Robson has in mind when he argues that with each appearan-

[28] It is not at all obvious that neural costs depend on the number of computations made. It seems entirely possible that making a few, complex computations involve higher neural costs than making many, simple computations. Indeed, making up a new comprehensive ranking may take more effort than the sum of the efforts implied in making pair-wise comparisons.

[29] Strictly speaking, maintaining the brain in some mature individual does not belong to ontogenetic development. Robson seems to be right that maintaining the brain too implies using resources. What this suggests is that there are relatively high fixed energy costs involved in having a sophisticated brain even if some of its capacities are not exercised (even if, that is, no extra neural costs are made).

ce of a new consumption bundle, variable costs are costs that have to be made to encode some utility to the bundle and a fixed cost is made to encode the 'extra cognitive capacity'. Second, there are *developmental costs*. Developmental costs are costs that are associated with the ontogenetic development of the neural embodiment of the capacity, given its genetic encoding in the fertilised egg. Note that these costs have to be incurred even if the capacity is not used or exercised by the mature individual. Finally there are *neural costs*. Neural costs are costs that are associated with brain activities, and more specifically with computations implemented in the brain. These are the costs that mature individuals make when they use their ontologically developed and genetically encoded capacity to compare utilities and choose the appropriate bundle. If all three sorts of costs are taken into account, it is not at all obvious that the alternative with the innately encoded utilities wins out.

9. Concluding remarks: how to discipline evolutionary speculations

Robson's reasoning is sloppy and questionable, as we have just seen. The same holds for Robson's interpretations of the results of his modelling efforts. This sloppiness in reasoning and in interpreting his own modelling results stands in stark contrast with the admirable rigour and tractability accomplished in the formal modelling itself. Let me give one more example of Robson's sloppiness in interpreting his modelling results. In his attempt to show that having a utility function is necessary for achieving evolutionary success, Robson (2001b) rests content with demonstrating that only those strategies are evolutionary successful that display some appropriate utility function (which he calls the biological utility function) in a *revealed preference* sense. But, as is well known, revealed preference theory is consistent with quite different conceptions of how behaviour is generated within individuals than the one Robson is trying to defend (see, for example, Binmore 1994). That is, it is perfectly possible that fully genetically determined behaviour satisfies the demands of revealed preference theory. Preferences and utility functions can be (and actually have been) ascribed to relatively cognitively unsophisticated animal species that obviously do not make conscious and deliberate decisions on the basis of preferences and beliefs. Therefore, contrary to what Robson himself apparently believes, the modelling result obtained here falls short of establishing what Robson wants to establish.

Robson argues that he is willing to reconsider and perhaps revise elements of economic theory on evolutionary grounds. As we have seen in section 2, however, this is true only to a limited extent. It seems Robson is firmly committed to the basic analytical framework of standard economic theory. In this framework the three key characteristics are preferences, beliefs and rationality. In the framework the characteristics are linked in a way that is reminiscent of 'folk psychology': people act rationally upon their beliefs and preferences. This framework structures the organisation of Robson's discussion of what assumptions in economic theory can be held upright when looked upon from an evolutionary perspective. Robson forces every single possibly relevant evolutionary consideration to fall neatly into one of the categories related to the three key characteristics. The framework seems to function as some sort of straightjacket that 'evolution' should be squeezed into. As the discussion of Robson's evolutionary

rationale for the existence of utility functions already indicated, this straightjacket sometimes turns out to be a *Procrustean bed*.

Robson seems to rule out the possibility in advance that any sound insight derived from evolutionary considerations or theories could call the framework itself into question. Evolutionary considerations and theories might jeopardise the more specific conventional assumptions that economists make *within the framework*, Robson seems to think, but they cannot possibly undermine the framework itself. Thus, it does not seem to be a co-incidence that immediately after mentioning the fruitful 'constraining' role of evolutionary considerations and theories Robson goes on to praise economics for having developed an overarching analytical framework:

> In general, an evolutionary basis helps to maintain constraints on economic theory. Moreover, an evolutionary explanation for individual behavior helps maintain the key analytical advantage that economics has over the other social sciences – that of being based on an overarching theory. (Robson 2002, 90).

Apparently, the constraints imposed by 'a biological basis' cannot possibly be such that the 'overarching theory' of economics has to be given up.[30]

Yet it can be argued that it is exactly this possibility that other evolutionary theorists, working on roughly the same subject as Robson (namely, the evolutionary basis of human behaviour) draw our attention to.[31] If proponents of evolutionary psychology and of the ABC-group get the picture of the proximate causes of human behaviour roughly right, the conventional basic analytical framework of standard economic theory cannot be sustained. It is not that there would be no place anymore for an account of human behaviour in terms of preferences, beliefs and rationality. But these three key characteristics would appear in an altogether different light. *Preferences* (at least if they are defined over consumption bundles, as Robson does) are not the immutable bedrock phenomena that Robson takes them to be. They are rather the outputs of psychological mechanisms and modules. This means both that preferences are products rather than fixed integral parts of the human mind and that they can change during an individual's lifetime.[32]

Beliefs may be revised because of learning effects, as Robson assumes. But the learning at stake is quite different from how Robson depicts it. Robson assumes that the most primitive form of learning (in not very sophisticated animals) is Pavlovian asso-

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[30] A different interpretation can be given of the two sentences in the quote (an interpretation, moreover, that is consistent with other parts of Robson's work): the overarching theory that economics provides us with is itself used to give the evolutionary explanation for individual behaviour. But on either interpretation the upshot is that Robson believes that the analytical framework of economics is useful (for explanatory purposes) no matter what constraints the 'evolutionary basis' comes up with.

[31] Other recent interesting work on this includes a.o. Ben-Ner and Putterman (1998), Henrich et al. (2001) and Nesse (2001).

[32] Basic emotions may be immutable, 'bedrock' parts of the human mind (Griffiths 1997). These emotions may play a large role in the production of preferences for specific consumption bundles, but they cannot be equated with them (as Robson seems to do). It seems likely that individuals with the same basic emotions but with different experiences (inputs) develop different preferences (see also Witt 1991). It also seems obvious that if preferences are defined over consumption bundles (as Robson does) the influence of *culture* and cultural evolution on preferences should not be underrated (see, for example, Boyd and Richerson 1985, Aunger 2001, and Laland and Brown 2002).

ciative learning and that we humans avail of a more sophisticated capacity to learn, enabling us to learn more rapidly and accurately in complex settings (Robson 2002, pp. 101-102). Perhaps so, but Robson's underlying assumption that in both forms of learning individuals are able (if expedient) to form *any* association is clearly contradicted by proponents of evolutionary psychology and of the ABC-group. All animals (including us) are innately disposed to form some particular associations quite quickly, reliably and effortlessly, while having great difficulties in forming other associations. All learning is constrained in the sense of being guided by heuristics.

In the conventional economic framework that Robson endorses there is a strict separation between affective and cognitive elements in decision-making. The affective elements are assumed to be fixed preferences and the cognitive elements are assumed to be beliefs and their revision because of learning effects. By contrast, proponents of evolutionary psychology and the ABC-group argue that affective and cognitive elements in human behaviour cannot be separated so neatly. Affective and cognitive elements are rather intricately interwoven in a complex web of interconnected psychological mechanisms. Even in relatively simple forms of behaviour there is such a complex web operating, covering the whole trajectory from the perception of some experiential input and the processing of information to some behavioural output. Furthermore, both elements, and not just the cognitive ones, are likely to change when traversing this trajectory.

Furthermore, in this scheme of things *rationality* is not the unconstrained general-purpose capacity or device that is portrayed in the conventional economic framework. Rationality is rather fragmented and scattered over the various psychological mechanisms and modules. As these mechanisms and modules are assumed to have evolved as responses to stable environments in an ancient past, their 'rationality' may well be confined to these environments (or some contemporary counterparts of them). This is what the concept of *ecological rationality* of the ABC-group is all about. Our 'fast and frugal heuristics' can be expected to yield satisfactory results only in ecological circumstances that resemble those in which they arose. If present-day circumstances are very much unlike the original circumstances, heuristics may be activated that are not up to the task, 'wrong' cues in the environmental may be focused on or the informational database consulted may be unsuitable.

Thus we may safely conclude that the basic picture of human behaviour emerging from evolutionary psychology and the ABC-group is very different from the one Robson is trying to base on evolutionary considerations. How come that Robson missed all this? It is not that Robson is wholly unaware of this branch of literature. Occasionally he refers approvingly to the evolutionary psychologists Pinker and Cosmides, for example. But perhaps he fails to notice that the implications of their views at least potentially undermine what he apparently takes to be beyond reasonable doubt: the correctness of the conventional economic framework. Alternatively, perhaps Robson believes that he is on much firmer ground when he is engaged in rigorous formal modelling that is consistent with economic theory's basic framework than when he is rel-

ying on other evolutionary work.[33] At any rate, the confidence Robson puts in the framework apparently is so strong that the possibility does not even occur to him that there might be no evolutionary basis for the framework.

In general, Robson seems to make a rather selective use of other work done in evolutionary theory.[34] As indicated earlier, he refers to recent work done in neurophysiology (LeDoux, Damasio, Gazzaniga and others). But he seems to be looking only for support for his pre-conceived views. What is perhaps most telling is the way in which he tries to counter Stephen Jay Gould's complaint that many evolutionary theorists rest content with producing 'just-so stories' (Robson 2001a, 11, footnote 3). On Robson's understanding the problem with just-so stories is that they are *ad hoc*. The problem is, he alleges, that they are not general and complete. But this is not the point Gould was trying to make. Gould's point was rather that just-so stories are too general: they pay insufficient attention to specific circumstances and conditions in particular evolutionary processes. What they downplay in particular is that pre-existing structural constraints (which themselves may be outcomes of prior evolutionary processes) channel ongoing evolutionary processes.[35] With the structural constraints in place these ongoing evolutionary processes may be steered in a direction different from the direction evolutionary processes would run without them (Gould 2002, p. 1026).

If ever there was any justification for Gould's complaint that evolutionary theorists (and adaptationists in particular) indulge in *just-so stories*, I submit, it is here in Robson's own attempt to give an evolutionary underpinning of economic behaviour. As was discussed in the previous sections, Robson makes no attempt to make it credible on the basis of historical evidence that his evolutionary scenarios ever actually unfolded (at least approximately). No evidence is provided, for example, that our ancestors ever actually faced the evolutionary problems that Robson stipulates or that the alternatives that Robson specifies ever actually competed with one another. Moreover, although Robson argues that our preferences evolved prior to the evolution of our capacity to act rationally, his working hypothesis in his own account of the evolution of preferences is that our ancestors chose rationally before their preferences were fully evolved. As I tried to point out, in Robson's own evolutionary scenario quite different things might have evolved if Robson really had endowed our ancestors with minimum or zero rationality. To put it in Gould's terms, with the structural constraints of our prehuman ancestors in place evolution might have taken a different course.

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[33] For a forceful attempt to argue that economics should learn from biology (and the other natural sciences) rather than indulge in self-complacency, see Wilson (1998).

[34] Robson is by no means the only economist making such a selective use of evolutionary theory. See, for example, Krugman (1999). For a general discussion of the vicissitudes of cross-disciplinary learning, see Vromen (2003b).

[35] It has to be noted that Gould levelled this criticism also against evolutionary psychology (see also Ehrlich and Feldman 2003 for a recent critique of evolutionary psychology along similar lines). But compared with Robson they at least take the trouble of checking whether the postulation of psychological modules withstands experimental scrutiny. Furthermore, in his latest book Gould took a more reconciliatory stand towards evolutionary psychology (Gould 2002, p. 1264).

One might put it like this. The structural constraints that Robson accepts for his own evolutionary work are not derived from historical and anthropological evidence and from empirically informed evolutionary theorising, but from his adherence both to economic theory's conventional framework and to the canons of rigorous formal modelling. His adherence to economic theory shows twice: first, in his use of economic theory to analyse evolutionary processes and, second, in his presupposition that whatever might come out of these analyses fits into economic theory's conventional framework. Proponents of evolutionary psychology and the ABC-group demonstrate that the former does not necessarily vindicate the latter. The correctness of Robson's presupposition does not necessarily follow from economic analyses of evolutionary processes. A clear-headed and coherent application of economic theory might well show that economic theory's basic analytical framework lacks an evolutionary rationale.

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