Gigerenzer's Evolutionary Arguments against Rational Choice Theory: An Assessment

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Abstract

Rational Choice Theory (RCT) is, without question, one of the most important accounts of how we make decisions; despite this, though, its plausibility has been vigorously debated over many years. A recent innovation in this debate has been to appeal to evolutionary theory: both defenders and critics of RCT have come to build their positions in essential ways on evolutionary biological considerations. In this paper, I critically discuss this 'evolutionary turn' in the debate surrounding RCT further. To do this, I consider a specific set of evolutionary arguments: namely, those by a group of researchers surrounding Gerd Gigerenzer. In particular, Gigerenzer et al. argue that considerations based on natural selection show that, instead of making decisions in a RCT-like way, we rely on 'simple heuristics' – basic rules that make for quick, but often still quite accurate decisions. However, as I try to make clearer in this paper, their arguments turn out to be unconvincing: evidentially, they suffer from the fact that we are lacking crucial information about our past, and methodologically, they suffer from the fact that they are unable to suggest genuinely novel phenomena or hypotheses to investigate. Since the same problems also befall many other evolutionary arguments in this area, I therefore conclude that the evolutionary perspective has, as yet, contributed little to the debate surrounding the plausibility of RCT.

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I. Introduction

How we combine our beliefs and desires to make decisions is widely considered to be a major unresolved puzzle (see e.g. Nichols & Stich, 2003, chap. 1). One of the key hypotheses advanced in this area is that *Rational Choice Theory* (RCT) makes for useful inroads into how this combination comes about: that is, it is frequently claimed that RCT can be seen as a fairly accurate description of the cognitive mechanisms underlying our choice behaviour (see e.g. Hausman, 1995). This idea, however, is also very controversial – several other authors think that RCT in fact provides *no* useful insights into how we make decisions at all (see e.g. Rabin & Thaler, 2001). As yet, this debate is still unresolved.

Recently, though, there has been a dialectical innovation in this debate that promises to move it closer to its resolution: the appeal to evolutionary theory. In particular, it has been claimed that by taking into account the fact that our minds are bound to have been shaped to a considerable extent by *natural selection*, the descriptive accuracy or inaccuracy of RCT can be more easily assessed (see e.g. Cooper, 1987, 1989; Gigerenzer & Selten, 2001; Okasha, 2007).[1] Unsurprisingly, given the scale of disagreements in this area, this argumentative strategy itself has then become highly controversial – for example, in a well-publicised dispute, Kahneman and Tversky squared off against Gerd Gigerenzer, with the former attacking the usefulness of

[1] Note that there is also a more indirect appeal to evolutionary theory that is sometimes being made in this context – one based on the fact that we share a (close) common ancestor with numerous other animals (see e.g. Carruthers, 2006). This common ancestry is important, as it implies that studies about how these other animals make decisions can tell us something about how we make decisions. However, since there are still major differences between us and other animals, and since direct, natural selection-based arguments have a lot of interest on their own, I shall focus solely on the latter here.

evolutionary theory for this debate, and the latter defending it (see e.g. Gigerenzer, 1991; Kahneman & Tversky, 1996; see also Stanovic & West, 2003; Samuels et al., 2002, 2004).

It is this appeal to evolutionary theory that I seek to assess in this paper: is it true that various evolutionary considerations can play a major part in the discussion concerning the plausibility of RCT as a theory of how we make decisions, or is it the case that these are, by and large, entirely irrelevant? Note that this is not to be confused with assessing the plausibility of RCT as a theory of how we make decisions *itself*: the goal is merely the assessment of *the importance of evolutionary theory* in the evaluations of this plausibility – no further conclusions concerning this plausibility are drawn here.

Instead of discussing the relevance of evolutionary theory for assessments of the plausibility of RCT as a theory of how we make decisions *directly*, though, I proceed by assessing the plausibility of a *specific set of evolutionary arguments* – namely, those given by Gigerenzer et al. (see e.g. Gigerenzer & Selten, 2001; Gigerenzer, 2008). This approach has the benefit of being less abstract and of allowing for more depth in the treatment of the issues raised; furthermore, since Gigerenzer et al.'s arguments seem to be symptomatic of a wider class of accounts in this area (a point to which I return below), it does not lead to major losses in generality either.

The structure of the paper is as follows. In section II, I clarify what is meant by RCT here. In section III, I lay out Gigerenzer et al.'s theory of simple heuristics. In section IV, I present and assess Gigerenzer et al.'s evolutionary arguments against RCT. In section V, I consider various objections and replies to the worries presented in the previous section. I conclude in section VI.

II. Rational Choice Theory as a Descriptive Theory

There are many different interpretations of RCT, and, unfortunately, no agreement yet as to which of these is the most important one (see e.g. Bermudez, forthcoming; Hausman, 1995). To evaluate whether and how the evolutionary approach to the assessment of RCT is meant to work, therefore, it is necessary to make clearer exactly how RCT is to be interpreted.

To do this, it is best to begin by considering the central thesis of RCT: agents can be represented as *maximising subjective expected utility* (see e.g. Bermudez, forthcoming; Hausman, 1992; Hargreaves Heap et al., 1992; Luce & Raiffa, 1957; Harsanyi, 1977). There is much debate about exactly how this thesis is to be made more precise; fortunately, for present purposes, this issue can be left open (for more on it, see e.g. von Neumann & Morgenstern, 1944; Savage, 1954; Jeffrey, 1983; Eells 1982; Cartwright, 1983; Joyce 1999). What matters here is just the fact that there are three kinds of interpretation of this idea of subjective expected utility maximisation that need to be distinguished: normative, predictive, and descriptive ones. Consider them in turn.

1. Normative Readings of Rational Choice Theory

The first kind of interpretation of RCT sees it as a normative theory that expresses necessary conditions concerning how people *ought* to choose (see e.g. Bermudez, forthcoming; Hausman, 1992; Fishburn, 1981). For this reason, the theory is not to be seen as trying to *explain* or *predict* how people act, but merely to *judge* how 'rational' their actions are (of course, to the extent that people actually *are* rational, the theory will also be able to play some explanatory and predictive roles – see e.g. Dennett, 1989; Gergely & Csibra, 2003).

However, it turns out to be best to set this interpretation aside when it comes to evaluations of *evolutionary arguments* for and against the plausibility of RCT. Primarily, this is because, if RCT is read normatively, then, in order to be pertinent to discussions about the plausibility of RCT, evolutionary arguments would need to be shown to be able to overcome the fact that 'is' statements do not, in general, entail 'ought' statements (an insight most commonly attributed to Hume, 1740/2000, III, I.2). That is, since an evolutionary perspective can only yield *descriptive facts* about the way we make decisions, it would be necessary to show how these kinds of facts can contribute anything to what decisions we *ought* to take. This is problematic, since if the history of meta-ethics is any guide, finding an answer to this question is very difficult – as of now, there is no undisputed way of deriving the normative from the descriptive. Hence, in the present context, interpreting RCT in a normative way introduces a number of meta-ethical pitfalls that are better avoided.[2]

2. Predictive Interpretations of Rational Choice Theory

The second type of interpretation of RCT sees the theory as being an *instrumentally useful* set of claims that allows for the prediction of the actions of individuals or groups (see e.g. Friedman, 1951; Satz & Ferejohn, 1994; Gul & Pesendorfer, forthcoming; Sterelny, 2003, pp. 89-90). According to this reading, acceptance of the idea that agents can be represented as maximising subjective expected utility commits the theory only to seeing agents *as if* they were doing this – it does not need to claim that they are *actually* doing so.

In the present context, the problem with this interpretation is that it is not clear how evolutionary theory could even *in principle* contribute to the assessment of this sort of project. If

[2] Note also that, given the plausibility of *some kind* of 'ought implies can' principle, the evaluation of non-normative versions of RCT would still be important, even if the only plausible interpretation of RCT is normative.

what needs to be addressed is the question as to whether RCT is useful for predicting people's behaviour, then it seems clear that what needs to be determined is the extent to which that theory was able to predict *past* choices (maybe modulated by how *complex* the theory is – see e.g. Forster & Sober, 1994). Given this, it is hard to see why – and, indeed, how – one should consider facts about our *evolutionary history* in the determination of the *future predictive accuracy* of RCT. For this reason, in what follows, I shall disregard this reading, too.

3. Descriptive Interpretations of Rational Choice Theory

According to the last major type of interpretation of RCT, the theory aims to *describe* the psychological processes that are actually going on when people make decisions – that is, it sees RCT as claiming that, when deciding what to do, an agent uses her beliefs and desires to determine which action maximises her subjective expected utility. Therefore, on this reading, RCT makes the following empirical commitments (see also Hausman, 1992, 1995; Pollock, 2006; Bermudez, forthcoming):

(i) agents have beliefs and desires of different strengths, and
(ii) in deciding what to do, they determine which action maximises their desire-satisfaction in light of their beliefs about the states of the world that may occur.

As made clear by (i) and (ii), therefore, a descriptive reading of RCT has it that decision making is based on a psychological mechanism that is *informationally unencapsulated* (it takes into account all of the considerations available to the agent), *optimising* (it tries to determine the best solution, given these considerations), and *domain-general* (it works the same way in all circumstances). Given this, the key question surrounding the plausibility of RCT comes to be the following: do (i) and (ii) accurately describe our decision making mechanisms?

In order to make an assessment of this question possible, though, it immediately needs to be noted that RCT cannot *literally* be true – after all, it is highly *idealised* (see also Hausman, 1992). In particular, (i) and (ii) assume that agents are logically omniscient and have massive memory powers – something that is clearly false for us (in fact, solving the required maximisation problems goes beyond most actually realisable computational systems – see e.g. Selten, 2001, pp. 14-15; see also Samuels et al., 2004, pp. 42-44). On some level, therefore, RCT *cannot* possibly be an accurate representation of our decision making system.

However, this fact ought not to be overemphasised either: there is a clear sense in which RCT can be called descriptively accurate *despite* it employing statements that are strictly speaking false (see also Hausman, 1995; Pollock, 2006). The best way to see this is by noting that these falsehoods could be of two kinds: they could be genuine (Galilean) *idealisations*, or they could be *fictions*.[3] In the former case, they would refer to actually existing features of our mind (e.g. beliefs and desires of different strengths, and a decision-making mechanism that is informationally largely unencapsulated, targeted at optimal outcomes, and fairly domain-general), but which are distorted in certain ways to make them theoretically tractable. In the latter case, they would not be based on any facts about our minds at all. Given this, it seems perfectly reasonable to see RCT as descriptively accurate if the former case obtains, and as inaccurate if the latter case obtains – and that despite the fact that it is highly idealised.[4]

[3] For more on (Galilean) idealizations, see e.g. McMullin (1985) and Cartwright (1983, 1990).
[4] This point can also be expressed with the help of Chomsky's performance / competence distinction (see also Samuels et al., 2004, pp. 9-11): is it the case that RCT gives an accurate account of our reasoning *competences* – if not always of our reasoning *performances*?

What, then, ought we to think about the descriptive accuracy of RCT (so understood)? This question has turned out to be surprisingly difficult to answer, mainly because the empirical success of RCT is quite ambiguous. On the one hand, RCT is one of the most powerful and important theories of the social sciences: it is appealed to in many different contexts, and has turned out to be highly useful in explaining a large variety of behaviours – from narrowly economic ones (as in standard economic analysis) to broader sociological ones (see e.g. Becker, 1976) and even paleontological and biological ones (see e.g. Mithen, 1990).

On the other hand, though, the theory has also been shown to lead to spectacular explanatory failures. A large body of social psychological research (see e.g. Allais, 1951, Ellsberg, 1961; Kahneman & Tversky, 1979; Gigerenzer et al., 1999) has shown that, in many instances, RCT is wide off the mark in accounting for the behaviour that people actually engage in. Furthermore, even outside of the laboratory, the theory has turned out to get things wrong quite frequently (see e.g. Rabin & Thaler, 2001; Satz & Ferejohn, 1994).

It is for this reason that the appeal to evolutionary theory appears to be quite tempting here: this appeal might, at least prima facie, be useful for giving further insight into how we make decisions, and thus, into how plausible RCT is as an account of these decisions. In particular, given the fact that our minds are biological organs – and thus shaped by the same factors that shape all biological entities – evolutionary theory may be able to provide a novel source of considerations that can help clarify the status of RCT as a descriptive theory. What remains to be done, therefore, is to see to what extent evolutionary theory is *in fact* helpful in the evaluation of the plausibility of RCT (understood descriptively). To determine this, begin by considering the major alternative to RCT in the literature: Gerd Gigerenzer's theory of simple heuristics.

III. Gigerenzer et al.'s Theory of Simple Heuristics

A group of researchers surrounding Gerd Gigerenzer (including, among others, Reinhard Selten, Peter Todd, and Peter Hammerstein) have recently argued that RCT is deeply mistaken about how we make decisions, and that this becomes particularly clear if we view the issue from an evolutionary perspective.[5] In this, they take their cue from the work of Herbert Simon (see especially Simon, 1957), but elaborate his theory along several dimensions. In this section, I shall lay out the basic tenets of their theory in as much as detail as necessary.[6]

The main idea behind Gigerenzer et al.'s theory is that the interplay between beliefs and desires is not as described in (ii) above, but is instead modulated by 'simple heuristics' – basic rules that are easy to apply and which make for quick, but often still quite accurate decisions. Specifically, they claim that we make decisions using mental mechanisms that consist of the following three components (see Gigerenzer & Selten, 2001, p. 8; Sadrieh et al., 2001, p. 93):

(1) *Simple search rules*: instead of combing through all the information the organism has access to, the decision making mechanisms only consider a small subset of that information.

(2) *Simple stopping rules*: instead of determining the optimal point at which the search for more information should be stopped, the decision making mechanisms acquire information only until an easily determinable threshold has been reached.

[5] While not necessarily a closely knit group, I shall refer to these researchers *jointly* under the heading 'Gigerenzer et al.'. Also, I shall refer to the theory they develop interchangeably as being concerned with 'bounded rationality' and 'simple heuristics'. Note also that much of Gigerenzer et al.'s work is concerned with *theoretical* rationality (that is, with how we reason with and about *beliefs*) – which, though, is not so relevant here.
[6] Note that, just like in the case of RCT, Gigerenzer et al.'s theory can be read in normative, predictive, or descriptive way; however, for the same reasons as sketched above, only the descriptive reading is relevant here.

(3) *Simple decision rules*: instead of determining the optimal way in which the information is to be used to come to a decision – i.e. by maximising subjective expected utility – the decision making mechanisms determine which action the organism engages in on the basis of merely crude assessments of the considered data.

While there is much more that could be said about these simple heuristics, for present purposes it is enough to note that they are, in many ways, diametrically opposed to RCT: they are *informationally encapsulated*, *satisficing*, and *domain specific*.

To see this, consider someone deciding which make of car to buy (see e.g. Gigerenzer, 2001; Todd, 2001, pp. 56-62). On the RCT picture, she collects vast amounts of information about the different makes available, combines all of this information with her desires about what kind of car she wants to own and, on this basis, comes to an optimal decision about which model to buy; furthermore, she would use essentially the same type of reasoning to decide whom to marry. By contrast, on the simple heuristics picture, she collects only a few pieces of information about the makes of car in question and decides on the basis of just these pieces of information by picking the first make that goes beyond a threshold in their values; importantly, this might be very different from how she decides whom to marry. This illustrates clearly how large the difference is between the theory of bounded rationality and RCT: the former sees the agent as processing *less* information more *quickly* and *crudely* than what is proposed by the latter.

With this in mind, it is now possible to consider Gigerenzer et al.'s evolutionary arguments for their theory and against RCT. The next section aims to do this.

IV. Gigerenzer et al.'s Evolutionary Arguments against Rational Choice Theory

In order to show that the theory of bounded rationality gives a better account of how people make decisions than RCT, Gigerenzer et al. put forward various evolutionary arguments. However, before it is possible to consider these arguments in more detail, it is necessary to make a general remark concerning their structure.

Gigerenzer et al. concentrate solely on *natural selection* as determining which decision making mechanism ought to be expected to evolve. As is well known, however, natural selection is not the only factor influencing the evolution of a trait (for the locus classicus for this kind of worry, see Gould & Lewontin, 1979). In particular, firstly, since we always deal with finite populations, there will always be an element of *randomness* in what evolves – specifically, it is possible that, purely by accident, the trait that actually evolves is less adaptive than another available one (see also Sober, 2008, chap. 3; Gillespie, 1998). Secondly, there is always the possibility of various *genetic or developmental constraints* altering the course of evolution (see e.g. Dawkins, 1982, 1986; Kitcher, 1985): genes may be linked to other genes, they may be pleiotropic, or they may be embedded in complex developmental systems – all of which may make it harder for the most adaptive traits to evolve. Finally, the *environment* the organism develops in may prevent the most adaptive traits from actually being expressed (e.g. because it is characterised by certain nutritional deficiencies).

In the present context, though, these adaptationist worries can be left aside. Showing that some trait was adaptive in the relevant set of environments (i.e. in the environments the type of organism is likely to have evolved in) does give a *prima facie* reason to think that the trait actually evolved. While such a reason may be defeasible, it still ought to be given some weight in one's investigations: it is universally accepted that natural selection has significantly shaped the evolution of many (if not most) traits (see e.g. Orzack & Sober, 1994; Dawkins, 1986). Because of this, it must be accepted that establishing the adaptive importance of some trait provides *evidence* of its existence (even though that evidence may not be conclusive). Since this is all that Gigerenzer et al. are seeking to show, their focus on natural selection can be seen to be entirely innocuous in the present context.

To see what the issues here really are, it is necessary to look at the *details* of their arguments. These arguments fall into two categories: direct arguments favouring the evolution of minds based on simple heuristics over minds based on RCT, and indirect arguments suggesting that simple heuristics fit better to certain theories of our general cognitive evolution than RCT does. Consider them in turn.

1. The Adaptive Value of Decision Making Speed, Frugality, and Accuracy

Gigerenzer et al. claim that, from an evolutionary point of view, there are (at least) three features of a decision making mechanism that have important consequences for its adaptive value (see e.g. Todd, 2001, pp. 53-54; see also Sober & Wilson, 1998, chapter 10). Firstly, the *faster* an organism can make decisions, the fitter it is (ceteris paribus): it will often be the case that speedy reactions to the various changes in an organism's environmental situation are highly beneficial to its chances of survival and reproduction (see also Carruthers, 2006; Laland, 2001, p. 244). Secondly, the more valuable resources (like energy, attention, and concentration) the organism gets to *save for other uses*, the fitter it is (ceteris paribus): organisms that do not spend much energy calculating what to do have more resources available for other things – like doing what they decided to do. Thirdly, the more *accurate* the organism is in adjusting its behaviour to the state of the world, the fitter it is (ceteris paribus): organisms that stand still when it would have been better to run away (and vice versa) will have a much harder time avoiding major injuries and reproducing successfully than those that make the opposite decisions.[7]

In short: from an evolutionary point of view, it is important to obtain as much decision making speed, frugality, and accuracy as possible. Of course, since there are often interdependencies among the three factors – so that improvements in one dimension lead to losses in others – it frequently will be impossible to maximise all three factors *simultaneously*; instead, *joint* maximisation will be all that is on offer. What is clear, though, is that, from an evolutionary point of view, *all* three factors ought to be taken into account in evaluating a decision making mechanism, as they all impact its adaptive value.

Given this, Gigerenzer et al. claim that RCT seems to make the mistake of overlooking exactly this point: the theory does not appear to pay any heed to factors other than *accuracy*. It takes no account of the required length or costliness of the deliberation: according to it, making an accurate decision is the all-important value.[8] However, as just noted, this may well be highly maladaptive: there may be many cases where sacrificing accuracy for speed or frugality may be greatly beneficial. In turn, this makes RCT look very dubious from an evolutionary perspective (see also Gigerenzer, 2001; Sadrieh et al., 2001). By contrast, simple heuristics are *tailored* to allow for fast and frugal decision making: they place strong restrictions on the amount of information they consider and on how thoroughly that information is processed; in turn, this cuts down the time and resources it takes to compute the right decision (see also Todd, 2001; Sadrieh et al., 2001).

[7] Obviously, all of these factors would need to be defined more clearly to present a fully worked-out version of this argument. For present purposes, though, the rough statement in the text is sufficient.

[8] It may be tempting to reply that one could use RCT to calculate the optimal amount of time that should be spent on *deliberating* about a certain decision. However, this may invite an infinite regress: how much time should we spend on calculating how much time we should spend on deciding what to do (and so on)? This is a well-known problem for RCT, but not one that needs to be solved here (see also Smith, 1991).

This impression of adaptive advantage may be further strengthened when it is noted that many simple heuristics can be just as accurate – or even more so – than RCT in many situations. In the right context, making decisions just based on a single factor, for example, yields actions that are close to or better than what the optimising RCT perspective would suggest (see e.g. Gigerenzer, 2001, 2008; Sadrieh et al., 2001). Primarily, this is due to the fact that, sometimes, only very few cues are needed to obtain good evidence about the state of reality, so that it is unnecessary to acquire a lot of information when trying to make an accurate decision. This is important, as it suggests that simple heuristics may not only be faster and more frugal than RCT in getting the agent to act, but also that the losses in accuracy that they entail may be quite small or even zero (a sort of dominance argument in favour of simple heuristics).[9]

In short: since simple heuristics are likely to be much better at balancing accuracy, speed and frugality than RCT – which does not even *attempt* to do so – natural selection is likely to prefer them to the latter. In turn, this makes RCT evolutionarily implausible. However, there are several flaws with this argument, which make it ultimately unconvincing.

In the main, these problems centre on the fact that we lack the information necessary to assess whether the considerations Gigerenzer et al. put forward really speak *in favour of* simple heuristics, or *against* them. This becomes clear from noting that, in order to assess whether simple heuristics really come out on top by being able to compromise accuracy for decision making speed and frugality, a rich understanding of the environment in which we evolved is necessary (as is also accepted by Gigerenzer et al. – see e.g. Todd, 2001, pp. 67-68; Sadrieh et al., 2001, p. 87). To see why this is so, note that Gigerenzer et al. seem to think that the fitness of a decision making mechanism is determined by an equation of the following sort:

[9] There is a more general point in the background here: as noted, for example, by Forster & Sober (1994) and Forster (1999), parsimony in a model can significantly enhance its predictive accuracy, as it reduces ‘overfitting’.

$W = a\,S + b\,F + c\,A$

where *S*, *F*, and *A* are the values of decision making speed, frugality and accuracy of the decision making mechanism in question, and *a*, *b*, and *c* their relative adaptive importances.

Given this, what we need to know in order to determine whether simple heuristics are more adaptive than a RCT-based decision making mechanism is, firstly, the values of the parameters (*a*, *b*, *c*), and, secondly, the values of the variables (*S*, *F*, *A*) for the two decision making mechanisms in the environments we evolved in. This is necessary for two reasons.

On the one hand, if it were to turn out that *c* is large – i.e. if the environments we evolved in put a large premium on accuracy – then Gigerenzer et al.'s argument would lose plausibility (see also Sadrieh et al., 2001, p. 87). This is because, in this case, the benefits in speed and frugality of simple heuristics might have been *swamped* by the losses in accuracy they entail (small though they may be). That is, with large enough values of *c*, concentrating on it alone – as is done by RCT – may be an evolutionary biologically defensible position.[10]

On the other hand, if the value of *A* was very small for simple heuristics and very large for RCT, then Gigerenzer et al.'s argument equally suffers. To see this, assume that $a \approx b \approx c$, and that $S_{SH} > S_{RCT}$, $F_{SH} > F_{RCT}$, but also that $A_{RCT} >> A_{SH}$ (where the subscripts SH and RCT stand for 'simple heuristics' and 'Rational Choice Theory' respectively). If the last inequality is large enough – i.e. if $(A_{RCT} – A_{SH}) > (F_{SH} – F_{RCT}) + (S_{SH} – S_{RCT})$ – it would then be quite likely that RCT is more adaptive than simple heuristics, rather than the reverse.[11] Put differently: if, for

[10] Put differently: sometimes, the complexity of the situation requires a more complex model to avoid 'underfitting'. See also note 9.
[11] If the 'flat weighting' of the three factors is considered implausible, some adjustments to this argument need to be made. As will be made clearer below, though, if anything, this is likely to *favour* RCT, not to speak against it.

simple heuristics, the losses in accuracy *in the relevant environments* were sufficiently large, then RCT-based decision making might have been more adaptive, *despite* it being less fast and less frugal.

The trouble with these possibilities is that, so far at least, we have absolutely no means of ruling them out. That is, at this point, we completely lack the kind of information necessary to rule out values for (*a*, *b*, *c*) and (*S*, *F*, *A*) that make RCT more adaptive than simple heuristics (see also Sadrieh et al., 2001, p. 88). In the main, this is because we do not know the exact environmental conditions under which we evolved, which decision problems we were facing, when these problems became particularly pressing, how we went on to solve them, what the consequences were of the various solutions we tried out, and so on (for a case study of the complexities involved in this sort of project, see Mithen, 1990; see also Richardson, 2007; Todd, 2001, pp. 67-68). In short, as it stands, we lack any of the information that is required to get Gigerenzer et al.'s argument off the ground.

Moreover, what we do know about the conditions under which we evolved seems to make the relative adaptiveness of RCT actually quite plausible. It is by now widely accepted that a key role in our cognitive evolution was being played by our *social environment* (see e.g. Sterelny, 2003, pp. 208-209; see also Byrne & Whiten, 1988): we constantly had to engage with other (not necessarily closely related) conspecifics in a way that had major implications for our survival and reproduction. To be successful in such an environment, we needed to be able to predict and explain the actions of *other* organisms with some precision, and to generate appropriate behavioural responses.

However, *pace* Gigerenzer & Selten (2001, p. 10), it seems that simple heuristics cannot handle these kinds of situations very well (see also Stanovic & West, 2003; Buller, 2005, pp.

158-160). This comes out easily from noting that when it comes to predicting the decisions of other organisms, there are many problems of strategic interaction to take into account: in my dealings with another organism, I have to take into account that *it* takes into account what I decide to do when it decides what to do (and so on). Moreover, there is no guarantee that other organisms always react in the same way to the same environmental circumstances – their internal states, for example, may be different, thus prompting different reactions to the same external circumstances.

Under these conditions, relying on simple heuristics may well have been highly *maladaptive*: the resultant behaviour is likely to be very rigid, and thus easily exploited. That is, there may not have been fixed, stable decision making problems that simple heuristics could become tailored solutions to (a point that will also become important again below). If so, however, decisions based on simple heuristics might have been *very* inaccurate – and, given the importance of interpersonal relations and the dangers of ostracisation, such inaccuracies may have been quite costly, despite the fact that they may have come with gains in decision making speed and energetic expenditure. In other words, in terms of the above equations: it is in fact quite plausible *both* that c was large *and* that $A_{RCT} >> A_{SH}$ (see also Todd, 2001, pp. 67-68).

Note that, given the uncertainties involved, this does not make for a particularly strong argument in favour of RCT either. The point is just that if one *were* to make an evolutionary argument based on the kinds of considerations Gigerenzer et al. put forward, it seems *at least as likely* to be an argument in favour of RCT as one against it. For these reasons, Gigerenzer et al.'s first evolutionary argument is unable to provide much in the way of support for a move away from RCT. As it turns out, however, their second evolutionary argument does not fare much better – and that for similar reasons.

2. *Massive Modularity*

The second evolutionary argument that Gigerenzer et al. appeal to in order to support simple heuristics rests on the idea that the latter fit much better with recent advances in evolutionary psychology than RCT does – in particular, they connect much more easily to the 'Massive Modularity Thesis' (MMT) (see e.g. Todd, 2001; Cosmides & Tooby, 1996; Samuels et al., 2002). This thesis states that the mind consists of a collection of special-purpose modules that are adapted to deal with particular environmental problems (see e.g. Cosmides & Tooby, 1992; Pinker, 1997; Carruthers, 2006). It should be quite obvious why the theory of simple heuristics fits better to the MMT than RCT does: different simple heuristics can be seen as different modules that are dedicated to solving particular decision-making problems. By contrast, an RCT-based decision making mechanism is based on one domain-general *central processor* – exactly the sort of design that the MMT opposes. Accordingly, the truth of the MMT sits much more easily with the truth of the theory of simple heuristics than with that of RCT.

In the present context, this fit between simple heuristics and the MMT matters, as there are *evolutionary considerations* that are commonly seen to speak in favour of the latter thesis. These considerations are of two types: one of these focuses on the benefits of a massively modular mind itself, and the other focuses on the nature of cognitive adaptations in general. Consider them in turn.

The first reason centres on the (alleged) fact that having a massively modular mind is itself adaptive: it is said that only this kind of mind allows for easy, quick, and biologically cheap alterations in our cognitive traits (see also Carruthers, 2006, pp. 12-29; Samuels, 1998). The idea is that it is highly adaptive to be able to change parts of our minds without having to redesign the whole: since any change in some part of an organism is likely to be costly, the fewer changes one has to make, the better. A massively modular organisation thus is helpful, as it allows an organism to change only those parts of its mind that need to be changed, leaving the rest (largely) untouched.

The second evolutionary reason favouring a massively modular mind centres on the (alleged) fact that all that natural selection can design are specific solutions to the specific adaptive problems that were faced – not general solutions to general problems (see e.g. Cosmides & Tooby, 1992). In more detail, the idea here is that since our ancestors did not have to solve the problem of being a good decision maker *in general*, but only that of successfully selecting mates, choosing foraging locations, and so on, they did not need to evolve a general propensity to make good decisions, but only special propensities of being good at selecting mates, choosing foraging cites, and so on. By implication, this means that their minds came to consist of a large number of specialised adaptations – i.e. that they became massively modular.

In this way, Gigerenzer et al. can claim that there is further evolutionary support for the theory of simple heuristics – namely, via the evolutionary support for the MMT (see e.g. Hammerstein, 2001; Todd, 2001). Once again, though, there are major problems with this argument. To see this, consider the two aspects of this argument in turn.[12]

Firstly, upon closer consideration, the more specific version of that argument turns out to be fallacious: there is no reason – either theoretical or empirical – to think that independent alterability is *generally* adaptive: in particular, for traits that are *functionally* integrated, *evolutionary* integration may be highly adaptive. For example, if successful locomotion requires the integration of visual and auditory information, then it may be highly adaptive to ensure that changes in one's visual processing are *correlated* with changes in one's auditory processing (for

[12] In what follows, I assume that the overall argument here is *valid*: that is, I accept that the truth of the MMT really favours the theory of simple heuristics over RCT. However, this may be questioned as well – for it might be that massive modularity is consistent with there only being one, RCT-based, decision module.

a more detailed treatment of this issue, see Schulz, 2008a). This is important, as it means that any reason for thinking that it was adaptive for our decision making mechanism to be organised in a massively modular way must rest on the specifics of that mechanism.[13]

However, we again lack any of the required empirical information to assess this situation: we do not know if it was adaptive to be able to change each of our decision making abilities individually, or whether they are so highly integrated that a domain-general approach was more beneficial. There seems to be evidence for both possibilities: some of our decisions do seem to make for significant synergies if solved conjointly (our decision about which kind of prey to hunt seems to be adaptively related to our decision who to mate with – after all, some prey can only be hunted in a group), and some do not (what colour of clothes we decide to wear does not seem to stand in any sort of special relation to what names we decide to give to our children). For this reason, until the key premises of the first version of the massive modularity-based argument become further substantiated, this version cannot be seen to be very compelling.

Alas, the second, more general version of that argument turns out to be not much better. The major problem here is that it is not clear that it is true that all specific adaptive problems require specific solutions (see e.g. Buller, 2005, pp. 144-146; Sterelny, 2003, chap. 10). In particular, it is not clear why a *novel* solution has to be found for every novel problem – sometimes, old solutions may be put to use also in different and novel circumstances (see also Dawkins, 1986). Importantly, whether specific solutions were needed in the case of our decision making abilities is highly questionable: we lack exact knowledge about what the adaptive problems were that we had to face (see also Sadrieh et al., 2001, p. 88), and what we do know suggests that, in many cases, our adaptive problems were instances of a general problem – namely, that of *dealing with*

[13] It is interesting to note that a very similar issue has occupied ecologists: namely, the assessment of the benefits and disadvantages of being a 'generalist' vs. being a 'specialist' in some niche (see e.g. Wilson & Yoshimura, 1994). I thank Elliott Sober for pointing this out to me.

a complex social environment. Without more information on this score, therefore, we are not in a position to determine if our adaptive problems were numerous and variegated enough to warrant the evolution of specific solutions, or if they were merely 'variations on a theme' that could be handled well by a non-specialised decision mechanism (see also Buller, 2005, pp. 145-147).[14]

In sum, therefore: the mere fact that we had to solve specific decision making problems does not point to simple heuristics being more adaptive than an RCT-based mind. These specific problems may not have needed novel solutions at all – in particular, they may have merely been instances of a general problem (that of dealing with a complex social environment), which in turn required a general, non-specialised solution.

On the whole, it thus seems clear that Gigerenzer et al.'s evolutionary arguments cannot play a major evidential role in the debate surrounding the plausibility of RCT. The considerations they put forward are simply not backed up by sufficient evidence to provide compelling support for the theory of simple heuristics, and against RCT.

Before discussing this conclusion in more detail, though, it is now useful to briefly consider an alternative interpretation of Gigerenzer et al.'s evolutionary arguments: maybe they are not trying to appeal to evolutionary theory in an *evidential* way at all – maybe they are using the evolutionary considerations merely in a *heuristic* way (see e.g. Machery, forthcoming; Samuels et al., 2004)? In particular, maybe Gigerenzer et al.'s appeal to the evolutionary perspective should be judged for its usefulness in *suggesting* various novel hypotheses about how our

[14] Of course, this is consistent with this non-specialised mechanism being of the simple heuristics type. However, the point here is just that evolutionary theory cannot be used to argue in favour of the latter *via* the MMT (moreover, the idea that our non-specialised decision making mechanism is based on simple heuristics is anyway made implausible by the fact that complex social environments do not have the right kinds of stability properties to make simple heuristics adaptive: see also Sterelny & Griffiths, 1999, pp. 331-332; Sterelny, 2003, pp. 208-209; Buller, 2005, p. 147).

decision making mechanism might work and about various phenomena it may be worthwhile to investigate further? If so, then the above, evidence-focused criticisms are beside the point: the evolutionary considerations here are used only heuristically, not evidentially.[15]

The problem with this alternative interpretation is that is not clear that Gigerenzer et al.'s arguments can in fact live up to this sort of heuristic use of evolutionary theory. One of the major difficulties here is that many alternative theories of our decision making mechanism are already known. In fact, as noted earlier, much of Gigerenzer et al.'s work is an extension of that of Simon (1957), which questioned RCT in essentially the same way as they do – without however appealing to evolutionary theory. This is further supported by the fact that many of the particular heuristics Gigerenzer et al. are putting forward – like 'Take the First' – do not seem to be directly inspired by rigorous *evolutionary* thinking at all, but by casual observations of *current* everyday life (e.g.: bigger cities are better known across the world). For this reason, it is not clear that much that is novel has in fact been suggested by the evolutionary perspective of Gigerenzer et al. – and hence, appeals to a heuristic reading of their arguments ring somewhat hollow.[16]

Overall, therefore, it becomes clear that Gigerenzer et al.'s attack on RCT cannot draw much strength from the evolutionary considerations they put forward. To make the case for this (rather negative) conclusion even stronger, it is now useful to consider a number of objections that might be raised against it.

[15] I thank Gerd Gigerenzer for some useful discussion concerning this objection.
[16] This may even be true for one of the flagship discoveries of Gigerenzer et al.'s work on theoretical rationality: the fact that presenting data in terms of frequencies ameliorates the incidence of base-rate neglect. As made clear e.g. in Kahneman & Tversky (1996), this discovery may actually first have been made by the latter two researchers– without appealing to evolutionary theory.

V. Objections and Replies

There are two objections, in particular, that is useful to discuss here; they concern the existence of a *weaker form* of Gigerenzer et al.'s theory, as well as the *scope* of the present criticism. Consider them in turn.

1. A Weaker Version of the Theory of Simple Heuristics[17]

The first objection to the above criticism accepts its conclusion as it stands, but argues that there might be a weaker version of the theory of simple heuristics that avoids the problems raised earlier. In particular, it notes that, instead of saying that *all or most* of the decisions we make are based on simple heuristics, Gigerenzer et al. might merely be taken to claim that *some* of our decisions are based on simple heuristics – or, even more weakly, that *some aspect* of our decision making mechanism is based on simple heuristics. This may be enough to overcome my criticism, which views RCT and the theory of simple heuristics as mutually exclusive.

While certainly interesting and worthy of further consideration, this weakened version of Gigerenzer et al.'s attack does not, however, seem to be well suited to the present discussion. In the main, this is because, if it did turn out that a significant proportion of our decisions (e.g. all those dealing with our social environment) were based on an RCT-type mechanism, then that theory would be vindicated in its key aspects. In particular, it would then turn out that, contrary to what the theory of simple heuristics claims, there *are* informationally unencapsulated, maximising, domain general psychological processes. Equally, saying that simple heuristics have 'something to do' with how we make decisions is not very plausible, as a defender of RCT can

[17] I thank Yuichi Amitani and Shannon Spaulding for (independently) suggesting this objection to me.

easily accept this much: for example, these heuristics might merely be used as tools for *approximating* the computations inherent in RCT.[18]

In short: for Gigerenzer et al. to be able to present a compelling attack on the descriptive accuracy of RCT, simple heuristics must be seen to be *integral parts* of our decision making mechanism, not merely to be somehow *involved* in the latter. Given the above, though, this is not something that Gigerenzer et al.'s evolutionary argument could possibly establish.

2. Other Evolutionary Arguments are Better

The second objection to the worries raised in the previous section accepts them as a criticism of Gigerenzer et al.'s attack on RCT – but notes that the implications of this are fairly narrow. In particular, it notes that the above has not shown that evolutionary theory is not useful for the debate surrounding RCT *at all*: it has merely shown that *Gigerenzer et al.'s* evolutionary argument is not very compelling. This matters, as there are many other evolutionary arguments that might *not* fall prey to the considerations brought up above. For example, Cooper (1987, 1989) presents very different evolutionary considerations concerning the plausibility of RCT, as does Robson (2001, 2002), and many evolutionary game theoreticians (see e.g. Skyrms, 1996).[19] For this reason, the scope of the criticisms raised here may seem to be very narrow – far from being *representative*, Gigerenzer et al.'s arguments might in fact be quite *unique* in their difficulties.

[18] This implies, though, that these heuristics are not really 'simple' – they would need to have a very wide *range of applicability* (i.e. be *roughly* domain general). In particular, instead of being specific tools tailored to solving specific problems, they would then be fairly general computational aides for solving fairly general problems – for example, like MCMC analysis and Bayesian phylogenetics. I thank Brett Calcott for useful discussion of this point.
[19] Another negative evolutionary argument against RCT that has some formal connections to that of Cooper (1989) is in Okasha (2007). However, this, too, fails to be fully compelling, but for reasons that are internal to that argument and which it would not be useful to re-rehearse here – for more on this, see Schulz (2008b).

However, it turns out that the above criticism actually transfers quite easily to other evolutionary arguments. To see this, note that the same lack information that is at the heart of the criticism here also befalls many of these other arguments. For a telling example of this, consider Cooper’s (1987) account. Cooper claims that the most significant aspects of at least one prominent form of RCT – namely, that of Savage (1954) – can be derived from a simple evolutionary model (based on an infinitely large population of agents making decisions with different heritable choice functions). The derivation of this result is quite ingenious, but not so pertinent for present purposes. What matters here is just that small changes in the assumptions of Cooper’s model can lead to complete failures of the evolutionary derivation of RCT – up to the point that the model switches from *supporting* RCT to *disconfirming* it (as is accepted even by Cooper himself: see e.g. Cooper, 1989).

This matters, as it is utterly unclear whether the key assumptions of his model are *in fact* true – indeed, at this point, we do not even have methods at our disposal that would allow us to come *closer* towards the determination of their truth. Because of this, Cooper’s model cannot show that evolutionary theory is useful for the assessment of RCT either – and that for exactly the same reasons driving the criticism of Gigerenzer et al.’s argument. Importantly, much the same applies to many evolutionary game theoretic models and the accounts of Robson (2001, 2002), suggesting that the scope of the above worry is in fact quite wide-ranging (see also Rosenberg, 2003, p. 327).

Of course, this might not deter a defender of the evolutionary approach from claiming that yet other arguments can be given that avoid such worries altogether, or that, over time, the needed information about our past will be obtained. However, until these other arguments are *actually* formulated, and until this information is *actually* obtained, the above criticism still stands. For this reason, it becomes clear that, while the scope of the present paper is restricted to one particular evolutionary argument, the issues it brings up do range more widely, and affect other arguments as well.

VI. Conclusion

I have tried to argue that the evaluation of the plausibility of RCT as an (idealised) theory of how we actually make decisions does not gain much by Gigerenzer et al.'s appeal to evolutionary theory. Since the issues unearthed are likely to also apply to other evolutionary approaches towards RCT, it thus becomes clear that, if there are theoretically useful ways of appealing to the theory of evolution in debates about the plausibility of RCT, they have not yet been uncovered.

Importantly, this conclusion also yields a more general lesson. For evolutionary arguments to be compelling elements in the debate surrounding RCT, it matters whether they are *robust* under changes in their assumptions, and whether the appropriate kind of *information about our ancestral environment* exists. In particular, unless it can be shown that the arguments support the same conclusion no matter what the exact historical circumstances were, or unless it can be shown that their assumptions do not fundamentally misrepresent these circumstances, the evidential strength of these arguments will not be great. For this reason, the above can also be read as a call for more work that connects the rather abstract and theoretical arguments that are commonly given in this context with the actual empirical facts on the ground – for only this is likely to make for progress in our understanding of how we make decisions.

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