EEA necessitate a distinction between subpersonal and personal optimization (Stanovich 2004). A behavior that is adaptive in the evolutionary sense is not necessarily instrumentally rational for the organism (Cooper 1989; Skyrms 1996; Stein 1996; Stich 1990). We must be clear when we are talking about fitness maximization at the subpersonal genetic level in the EEA and utility maximization at the personal level in the modern world. In short, our conceptions of rationality must be kept consistent with the entity whose optimization is at issue.

Distinguishing optimization in the EEA from instrumental rationality for a person in a modern environment opens the way for a constructive synthesis of the unified theoretical view of the target article with the research on anomalies and biases in the judgment and decision-making literature of cognitive psychology and behavioral economics (Samuels & Stich 2004; Stanovich 1999; 2004). The processes that generate the biases (shown not just in the laboratory but in real modern life, as well; see Camerer et al. 2004; Dunning et al. 2004; Hilton 2003) may actually be optimal evolutionary adaptations, but they nonetheless might need to be overridden for instrumental rationality to be achieved in the modern world (Kahneman & Frederick 2002; 2005; Stanovich & West 2000).

Of course, talk of one set of cognitive processes being overridden by another highlights the relevance of multiple-process views in cognitive science, including the dual-process theories now enjoying a resurgence in psychology (Evans 2003; Kahneman & Frederick 2002; 2005; Sanfey et al. 2006; Sloman 1996; Stanovich 1999; 2004) – theories that differentiate autonomous (quasi-modular) processing from capacity-demanding analytic processing. Such views capture a phenomenal aspect of human decision making that any unified view must at some point address – that humans in the modern world often feel alienated from their choices. The domains in which this is true are not limited to situations of intertemporal conflict. This alienation, although emotionally discomfiting, is actually a reflection of an aspect of analytic processing that can contribute to human welfare. Analytic processing supports so-called *decoupling operations* – the mental abilities that allow us to mark a belief as a hypothetical state of the world rather than a real one (e.g., Carruthers 2002; Cosmides & Tooby 2000; Dienes & Perner 1999; Evans & Over 2004; Jackendoff 1996). Decoupling abilities prevent our representations of the real world from becoming confused with representations of imaginary situations that we create on a temporary basis in order predict the effects of future actions. Thus, decoupling processes enable one to distance oneself from representations of the world so that they can be reflected upon and potentially improved. Decoupling abilities vary in their recursiveness and complexity. At a certain level of development, decoupling becomes used for so-called meta-representation – thinking about thinking itself (see Dennett 1984; Perner 1991; Whiten 2001). Meta-representation – the representation of one's own representations – is what enables the self-critical stances that are a unique aspect of human cognition. Beliefs about how well we are forming beliefs become possible because of meta-representation, as does the ability to evaluate one's own desires – to desire to desire differently (Frankfurt 1971; Jeffrey 1974; Velleman 1992).

Humans alone (see Povinelli & Bering 2002; Povinelli & Giambrone 2001) appear to be able to represent not only a model of the actual preference structure currently acted upon, but also a model of an idealized preference structure. So a human can say: I would prefer to prefer not to smoke. The second-order preference then becomes a motivational competitor for the first-order preference. The resulting conflict signals what Nozick (1993) terms a lack of rational integration in a preference structure. Such a mismatched first-order/second-order preference structure is one reason why humans are often less rational than bees are, in an axiomatic sense (see Stanovich 2004, pp. 243–47). This is because the struggle to achieve rational integration can destabilize first-order preferences in ways that make humans more prone to the context effects that lead to the violation of the basic axioms of utility theory. The struggle for rational integration is also what contributes to the feeling of alienation that people in the modern world often feel when contemplating the choices that they have made. People seek more than Humean rationality. They seek a so-called *broad rationality* in which the content of beliefs and desires is critiqued and not accepted as given. That critique can conflict with the choice actually made. The conflict then can become a unique motivational force that spurs internal cognitive reform.

Evolutionary psychology, ecological rationality, and the unification of the behavioral sciences

DOI: 10.1017/S0140525X07000854

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Abstract: For two decades, the integrated causal model of evolutionary psychology (EP) has constituted an interdisciplinary nucleus around which a single unified theoretical and empirical behavioral science has been crystallizing – while progressively resolving problems (such as defective logical and statistical reasoning) that bedevil Gintis's beliefs, preferences, and constraints (BPC) framework. Although both frameworks are similar, EP is empirically better supported, theoretically richer, and offers deeper unification.

We applaud Gintis's call for the unification of the behavioral sciences within an evolutionary framework and his objections to the parochialism and lack of seriousness that have allowed traditionalists to continue to embrace mutually incompatible models of individual human behavior. Curiously, however, Gintis comments that prior to his proposal the "last serious attempt at developing an analytical framework for the unification of the behavioral sciences was by Parsons and Shils (1951)" (target article, Note 2). Gintis's proposal might be clearer if he had addressed *evolutionary psychology* (EP) as a fully formulated alternative framework (with a well-developed research tradition involving hundreds of scholars). Either Gintis thinks that the EP framework, with its core "integrated causal model" (Tooby & Cosmides 1992), is not "serious," or the name "evolutionary psychology" misleads him into thinking it is only a branch of psychology rather than an encompassing framework for unifying the behavioral sciences (Cosmides et al. 1992; Tooby & Cosmides 1992).

Evolutionary psychology started with the same objections – to the mutual incompatibility of models across the behavioral sciences, and their inconsistency with evolutionary biology. It also started with the same ambition Gintis expresses – the eventual seamless theoretical unification of the behavioral sciences. Gintis says:

> Psychology could be the centerpiece of the human behavioral sciences by providing a general model of decision making for the other behavioral disciplines to use and elaborate for their various purposes. The field fails to hold this position because its core theories do not take the fitness-enhancing character of the human brain, its capacity to make effective decisions in complex environments, as central. (sect. 3, para. 5)

This exact rationale drove the founding of evolutionary psychology decades ago, but such statements sound time-warped in 2007, when countless researchers across every behavioral science subfield both within and beyond psychology take the "the brain as a decision-making organ" and "the fitness-enhancing character of the human brain" as the central starting point for their research.

There is considerable convergence in the two frameworks (on culture, evolutionary game theory, etc.), but it is illuminating to examine where they diverge. For example, EP would consider evolutionary game theory an ultimate – not a proximate – theory. More importantly, EP rests on the recognition that in cause-and-effect terms, it is the information-processing structure of our evolved neurocomputational mechanisms that is actually responsible for determining decisions. This is because selection built neural systems in order to function as computational decision-making devices. Accordingly, computational descriptions of these evolved programs (for exchange, kinship, coalitions, mating) are the genuine building blocks of behavioral science theories, because they specify their input-output relations in a scientific language that (unlike BPC) can track their operations precisely. For example, kin selection theory defines part of the adaptive problem posed by the existence of genetic relatives; but it is the architecture of the human kin detection and motivation system that controls real decision making, not an optimization function (Lieberman et al. 2007).

The design of these programs is *ecologically rational* (Cosmides & Tooby 1994) rather than classically rational either in Gintis's BPC minimalist sense or in widely accepted stronger senses. Classically, decisions are considered irrational when they depart from some normative theory drawn from mathematics, logic, or decision theory (such as choice consistency, the propositional calculus, or probability theory). Departures are indeed ubiquitous (Kahneman et al. 1982). However, these normative theories were designed to have the broadest possible scope of application by stripping them of any contentful assumptions about the world that would limit their generality (e.g., p and q can stand for anything in the propositional calculus).

Natural selection is not inhibited by such motives, however, and would favor building special assumptions, innate content, and domain-specific problem-solving strategies into the proprietary logic of neural devices whenever this increases their power to solve adaptive problems. These special strategies can exploit the long-enduring, evolutionarily recurrent ecological structure of each problem domain by applying procedures special to that domain that are successful within the domain even if problematic beyond it. These decision-making enhancements are achieved at the cost of unleashing a diverse constellation of specialized rationalities whose principles are often irrational by classical normative standards but "better than rational" by selectionist criteria (Cosmides & Tooby 1994).

Research on the Wason task, for example, indicates that humans evolved a specialized logic of exchange that is distinct from "general" logic – and so produces "faulty" choices. Its scope is limited to exchange, and its primitives are not placeholders for any propositions p and q, but rather *rationed benefit* and *requirement*. It uses procedures whose success depends on assumptions that are true for the domain of exchanges, but not outside it. Because of this, it solves reasoning problems involving exchange that the propositional calculus cannot solve. Evidence indicates that this mechanism is evolved, reliably developing, species-typical, neurally dissociable, far better than general reasoning abilities in its domain, and specialized for reasoning about exchange (Cosmides & Tooby 2005). Indeed, economists might be interested in learning that the neural foundation of trade behavior is not general rationality, but rather, rests on an ecologically rational, proprietary logic evolutionarily specialized for this function. (For comparable analyses of the ecological rationality underlying Ellsberg Paradox-like choices, and an evolutionary prospect theory to replace Kahneman and Tversky's [1979] prospect theory, see Rode et al. [1999].)

The Theory of Mind (TOM) mechanism is a specialization that causes humans to interpret behavior in terms of unobservable mental entities – beliefs and desires (Baron-Cohen et al. 1985). We think that the discipline of economics was built out of this seductive framework through its mathematical formalization, without awareness of the extrascientific reasons why its foundational primitives (beliefs, preferences) seem intuitively compelling while being scientifically misleading. Like BPC, TOM does not see the mind's many mechanisms, resists seeing that many computational elements do not fractionate into either "beliefs" or "preferences," and does not recognize that the "knowledge states" inhabiting these heterogeneous subsystems are often mutually inconsistent (Cosmides & Tooby 2000). The BPC framework is a partial, occasionally useful, ultimate theory of selection pressures that our evolved programs partly evolved to conform to. It is distant from any core model of individual behavior that could unify the behavioral sciences. For that, we need the progressively accumulating product of EP: maps of the computational procedures of the programs that constitute our evolved psychological architecture.

Emotions, not just decision-making processes, are critical to an evolutionary model of human behavior

DOI: 10.1017/S0140525X07000866

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Abstract: An evolutionary model of human behavior should privilege emotions: essential, phylogenetically ancient behaviors that learning and decision making only subserve. Infants and non-mammals lack advanced cognitive powers but still survive. Decision making is only a means to emotional ends, which organize and prioritize behavior. The emotion of pride/shame, or dominance striving, bridges the social and biological sciences via internalization of cultural norms.

We agree wholeheartedly that evolutionary theory must serve as the basis for unifying the behavioral sciences. Other, specifically behavioral, theories apply only to some limited domain of behavior, such as personality, learning, cultural beliefs, or cognition. Another strength of Gintis's model is his emphasis on neural mechanisms. However, when he focuses on decision-making, he commits the very same error of excluding essential categories of behavior.

If we step back and view behavior from an evolutionary standpoint, it becomes apparent that fitness-enhancing behaviors themselves, rather than decision-making or other cognitive processes, are paramount. Ultimately, selection can operate only on the behavioral consequences for the individual organism. All animals must execute some basic, essential behaviors, such as feeding, respiration, excretion, defense, temperature regulation, and reproduction. This is true even of protozoans, which lack learning or cognition. Only mammals possess a cerebral cortex, seat of most behaviors of interest to Gintis.

Decision making in simple (but often very successful) animals is virtually absent. Behavior consists of responding automatically to releasers as they are encountered. Therefore, Gintis's model would not apply to these animals, or to the stereotypic behaviors of more complex organisms, such as primates' reflexes and facial expressions. Yet all these behaviors are already included in a model of behavior that is truly comparative and emphasizes naturally occurring behaviors – an ethological one.

A model of human behavior that does not easily integrate data from other species, risks excluding all the emerging information about our close genetic relationship to other species. It also risks ignoring the adaptive features of bodily systems that interact with the central nervous system, thus perpetuating the mind-body schism.