

that it doesn't *always* serve this function, and even systematically subverts fitness in some circumstances (e.g., when used to facilitate transactions within families), and so is also, to that extent, a drug.

This distinction applies to too many things too easily. Most sexual activities of modern humans are recreational and costly, and so do not support, and sometimes subvert, their expected fitness. In wealthy societies, the same goes for food. Psychoactive drugs, for that matter, are also tool-like; consider the familiar sequence that begins with a drink bought in a bar and leads to the production of children. Perhaps L&W would say that sex and food are both tool-like and drug-like, just as money is, while drugs are also tool-like. But metaphors are valuable only insofar as they discipline and structure thought. Contrasts that exclude nothing are (functionally) empty.

L&W say things that suggest the following response. Sex and food are pre-cultural motivators, but money is not. Therefore, sex and food *in general* must be tools for enhancing fitness, whereas in the case of money the jury is out until we devote theoretical reflection to the matter. But L&W have no independently stable ontology of types of motivators at their disposal. There is no human instinct for "sex in general"; there are just dispositions to particular sorts of sexual activity in particular sorts of circumstances and *not any one* of these dispositions is always fitness-promoting.

Our objection would be churlish if money were, like cocaine but unlike most sex, *typically* pathological with respect to function (fitness-enhancing or otherwise; again, sex *is* typically pathological with respect to *fitness*). But this would be so only if true miserliness – sheer hoarding of money for the sake of having it and not for status, security, and so forth – were widespread. Such miserliness is in fact extremely rare. (When they mention it in support of their argument, L&W cite no prevalence studies, surprising or otherwise.)

The poverty of L&W's case here is a special case of the poverty of a whole species of evolutionary psychology. This species aims to identify a restricted set of basic pre-cultural motivators. Then it hypothesizes modules for seeking and evaluating instances of these motivators. The modules, being narrow specialists, can be fooled into misevaluation by things that mimic the targets for which the modules were selected; these are drug-like rewards.

Human cognitive architecture is probably modular to some extent. But hunting for definite, cross-environmental reward types that are *the* agents responsible for selection of the modules reflects a simplistic and naive view of evolutionary dynamics and complexity. Such hunts can sometimes have heuristic value if they are taken with a pinch of salt *and* if the explanatory target has very shallow cognitive interpenetration – for example, human preferences for sweets and fats, or male heterosexual preferences for curvaceous women, the prototype instances that show off evolutionary psychology in its best light. Money isn't very much like ripe fruit or rounded hips in *that* respect – very little of widespread attraction to people is. So money, like almost everything, is tool-like and drug-like. Is saying this really a helpful contribution to scientific understanding?

L&W twice allude to a truly powerful way of studying reward when they mention "neuroeconomics," including the study of differential brain responses to variances in reward types, frequencies, delays, and contexts. They are wrong, though, to cite neuroeconomics, specifically Glimcher (2003), as having identified a "trade module" or a distinctive neural response to trade-related stimuli. There is no such finding. What Glimcher and other neuroeconomists report are neural capacities to learn to predict values of rewards in *many* contexts, not in specifically *trade-related* contexts. In fact, the early progress in neuroeconomics is bad news for evolutionary psychology of L&W's type, for it shows that brains nimbly learn to compare rewards across whole ranges of settings and cultural manipulations of setting (e.g., McClure et al 2004), not that they are systems

that refer their input robotically back to a fixed stock of ancestral reward types and thereby get tricked in bars and casinos. Biological brains, that is, are multi-modal evaluation and resource allocation machines; it would be surprising if any creature capable of representing multiple such evaluations to itself proved incapable of latching onto money given the chance. Capuchin monkeys, for example, have been trained to use multiple fungible fiat currency (Chen et al., in press).

Study of the brains of problem gamblers suggests there is indeed an interesting relationship between drugs and money, but not one resembling L&W's metaphor (see, e.g., Potenza et al. 2003). Problem gamblers don't appear to value money for its own sake. But they *do* appear to be typical, perhaps even *prototypical*, addicts. Cocaine addicts may not value *cocaine* for its own sake. Rather, gamblers and cocaine addicts have more difficulty than other people convincing their brains that they are receiving enough reward, at a fast enough rate, as a *generalized* target. Here reward just means: anything that mobilizes neural attention. Thus, as Rachlin (2000) has stressed, gambling and chemical stimulants are close substitutes for social interaction. Behavior with respect to money is just like behavior with respect to stereotypical drugs *because* money is such a reliable tool for getting what the brain is always looking for, namely, relief from boredom. But it isn't money itself that is the drug, it is gambling. Money in the gambling addict is – literally – a tool for getting drugged.

Tools, drugs, and signals in the road from evolution to money

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Abstract: The problem of the biology of money is twofold: It subsumes both the identification of behavioral mechanisms that account for the power of money as an incentive, and the elucidation of the phylogeny of such mechanisms. The drugs–tool distinction, as articulated by Lea & Webley (L&W) in their fascinating synthesis, is a welcome step toward their solution. Compared to the direct invocation of instinctual drives, however, conditioning processes provide a conceptually and empirically clearer road from evolution to money.

The nearly absolute displacement of weaker non-monetary modes of production by the global expansion of capitalist economies, begs the question that the authors ask: Why are people so interested in money? The answer is less trivial than it appears. The obvious answer is not incorrect, but rather, as is made crystalline in the target article, it is incomplete. To explore the shortcomings of that explanation, the authors have christened it as "Tool Theory," characterized its means-to-end connotations, and moved forward to evaluate one exciting possibility: that there is a biological rationale, beyond the mere utilitarian, for the rewarding character of money. For motivation theorists, the reality of a connection between biological functions and motives is as obvious as Tool Theory (e.g., Maslow 1943); nevertheless, biological explanations are, at best, a growing but still marginal element of economic discourse. The science of money is still disconnected from the science of life, and the target article insightfully points at issues that may bridge this gap.

The question of the biology of money is meaningful only if it inquires about how a *specific* motivated behavior (money seeking) is mapped to *specific* evolutionary demands. The conventional character of money and its short natural history, however, preclude any direct connection between money and nature. This point is well argued by the authors, who conclude that there cannot be a "money instinct." Consequently, the research question is only viable through a roundabout: Money

must operate through basic behavioral mechanisms which themselves are related to (or, rather, *must* be related to) fitness maximization. The mediatory role of these presumed behavioral mechanisms breaks the problem of the biology of money into two parts: (a) what behavioral mechanisms are involved in money seeking (proximate causes)? and (b) what is the evolutionary rationale of such mechanisms (ultimate causes)? These two distinct problems are not clearly separated by the authors, as evidenced by the mechanisms selected for their synthetic theory of monetary behavior.

According to L&W, money may be metaphorically described as a tool, or as a drug. These two functions are easily mappable to two general behavioral mechanisms familiar to behavior analysts: operant and Pavlovian conditioning. In operant terms, money may serve as the lever that, when properly manipulated, yields reinforcing consequences. In Pavlovian terms, money may serve as the cue signaling the availability of attractive stimuli, eliciting responses of approach and anticipation, among others. The tool versus drug distinction, however, does not fully match the operant versus Pavlovian dichotomy. Tools yield “real” rewards, whereas drugs are “nonfunctional” substitutes for “real” rewards. The tool–drug dichotomy presumably encompasses all possible motivational roles of stimuli like money, which in themselves are not “real” rewards. The terms in quotation marks are defined by their contribution to fitness. Certainly, operant and Pavlovian conditioning, as general mechanisms, are significant contributors to the fitness of complex organisms, and they are demonstrably facilitated by a congruency of stimuli and responses that is only attributable to evolutionary processes (e.g., Garcia & Koelling 1966). But once operational, conditioning is agnostic of the “reality” of the reinforcement process. And so is money: it may work as a tool to obtain fitness diminishers like crack cocaine, and it may work as a “functional drug,” signaling incoming food ingestion when we inspect our wallet in a restaurant. It is not clear how either one of these two cases fits the tool versus drug distinction. The completeness of the tool–drug approach is undermined when we consider the possibility of using a tool to obtain a drug, or of using a drug as a tool. The basic metaphors are conceptually close to conditioning mechanisms, but they need to reconfigure their link to selective advantage as a separate problem.

In the target article, the Skinnerian operant approach is described as a “Drug Theory” on the basis of its characterization of money as a conditioned reinforcer. Interestingly, “operant money theory” could be described also as a “Tool Theory” on the same basis, if one is of the persuasion that conditioned reinforcement derives its value from signaling the relative proximity of other reinforcing events (e.g., Preston & Fantino 1991). If such is the case, there is no reason to agree with the authors’ claim that conditioned reinforcers must work in the same way as unconditioned reinforcers. Furthermore, positive informative signals may elicit behavior completely unrelated to the signaled reinforcer (e.g., a ringing phone may signal an awaited call, but few would engage in a conversation with the phone), or very similar to the consummatory response (e.g., autoshaping in the pigeon; Allan & Zeigler 1994). In other words, money, qua conditioned reinforcer, may be described as a tool or as a drug, and neither description appears to be exclusive. The compatibility of these descriptions is an issue that goes beyond money and into the discussion of the interaction/identity of operant and Pavlovian conditioning (e.g., Lajoie & Bindra 1976).

Although reciprocal altruism and play may be involved in the interest for money, their invocation as instincts to explain monetary behavior is unwarranted. The connection between behavioral mechanisms and evolution is not examined to such an extent as to rule out the empirically verifiable possibility that both behaviors are derivable from general mechanisms. Consider the situation of cooperating in a prisoner’s dilemma game, when playing against a perfectly reciprocating strategy (or tit-for-tat; Axelrod 1984). Sanabria et al. (2003) have demonstrated that pigeons may

learn to cooperate in this game, but only if each choice between cooperation and defection produces a stimulus that is predictive of reciprocation (i.e., a conditioned reinforcer or punisher). Pigeons are obviously not hardwired to reciprocate the actions of a computer at the expense of immediate gratification, but they can learn it. Maybe money operates, partially, as an analogue of the cooperation stimulus, bridging over what we give up for money, and what we obtain for it.

The tool–drug metaphors bring economic motivations closer to their biological substratum, but they can be improved. Their symmetry with conditioning mechanisms suggests a fruitful course of action. These mechanisms may well function as mediators between evolution and some socially arranged behavior (Gutnisky & Zanutto 2004; Skinner 1984). Such function, unlike instinctual drives directly linked to evolution, is readily verifiable in nature.

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Memetics and money

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Abstract: Lea & Webley’s (L&W’s) Drug Theory solves many puzzles surrounding money-related behavior. I explore supplementing the Drug Theory with ideas from gene–culture coevolution theory and memetic theory.

Lea & Webley’s (L&W’s) discussion of money as a drug represents an ingenious synthesis of disparate literatures. The theory is, however, specifically oriented toward explaining the *origins* of money (“our task is to offer the best account we can of the biological origins of the money motive”; sect. 1.4). I would like to raise the possibility that a theory that moves beyond the origins of money to focus on its ongoing manifestations might find a greater role for culture. That is, once money is in existence, the symbolic aspects of money-related behavior may function in such a way as to make them not simply classifiable as instances of the Drug Theory (as argued in sects. 3.3.2 and 5.2). To account for the ongoing manifestations of money-related behavior, I believe that the Drug Theory will need to be supplemented with ideas from gene–culture coevolution theory and memetic theory.

In L&W’s discussion, “function” always refers to biological function. This is true in both their Tool Theory and their Drug Theory. In the former, money gives indirect access to biological rewards, and in the latter, money “covers cases where it gives direct access to the systems that subserve such rewards but in an illusory, nonfunctional way” (sect. 2.3). But what about human goals and desires that have completely slipped their genetic/biological moorings? Neither the Tool nor the Drug Theory would seem to have much to say about such cases, or at least both theories need to be supplemented to encompass this situation. The alternative is to contest a fundamental assumption of most memetic theorists – that memetic goals can become detached from genetic fitness considerations and indeed can become detached from the interests of the vehicle (person) hosting them (Blackmore 1999; Dennett 1995; Stanovich 2004).

A view of money that recognizes memetic goals that are detached from genetic goals does have affinities with views in the modern sociology of money discussed by L&W. However,