tance for those economists who are starting to reconsider the super "rational" view of economic man, as well as for social scientists already aware of the social and cultural malleability of human behavior. Among the many interesting findings reported in the study, my comments focus mainly on the discovery that college students in industrial societies are *less* "rational" in their decision-making compared to people living in small societies lacking a modern market economy. This finding must be surprising for those who believe that people living in industrial societies are more "individualistic" – putting self-interest ahead of the collective interest – than people who are less involved with a market economy. Surprising and counter-intuitive findings often fuel new advances in science, and therefore I admire the authors for providing us with this important insight.

Nevertheless, interpreting this finding will certainly kindle a great deal of controversy. The authors adopt a "preferences, beliefs, and constraints approach" (sect. 9, para. 2) in interpreting their results, according to which "agents maximize a *preference function* subject to informational and material *constraints*" (sect. 9, para. 2, emphasis in original). They further argue that humans "acquire the beliefs and preferences appropriate for the local social environment" (sect. 9, para. 4). These are very general statements, and there is more than one manner in which these principles are applied for interpreting the findings. I propose three plausible alternatives for the authors' consideration.

Preferences are different. The most straightforward interpretation of the finding, which I believe is the closest to the authors' position, is that people acquire different preferences in different societies. In particular, people who have been exposed to a market economy acquire a preference for fairness and reciprocity, presumably because such a preference would assist exchange in market-based societies by ensuring proper behavior. This interpretation seems to provide a decent description of the findings, but faces a challenge when explaining why market exposure works at the group level but not at the individual level. Gains associated with market-relevant preferences should predominantly work at the individual level. There may be an aggregation effect of individual dispositions, but this should not eliminate the effect of individual exposure to market activities.

Sensitivity to cues that suggest the experimental situation is a form of social exchange. The second explanation is more compatible with the group level effect of exposure to a market environment. In societies and communities that are widely exposed to market activities, the stories people use in describing their own and others' behavior may involve market-relevant concepts. Such stories and the way people talk about their activities cannot be confined to a particular individual; they have to be shared by community members if they are to make any sense at all. Cultural beliefs and stories are fundamentally a group level phenomenon. Once people begin using market-relevant vocabulary, they become sensitive to cues of fairness and reciprocity that suggest an activity is market related. Hence, they should be quicker to perceive the abstract rules of the experimental game as a form of social exchange. According to this interpretation, preferences are not necessary to explain differences in behavior; two people in an experimental game could make different decisions if one perceives the game as a form of social exchange and the other does not, even if they are given the same information beforehand and share an identical preference for fairness.

The activation of heuristics. The third interpretation is similar to the second in that it emphasizes the importance of cues connecting experimental games to relevant forms of social exchange. However, it is different from the second in that cues activate heuristics rather than the perception of relevance of particular preferences. In psychology, a number of dual-process models have been applied to behavior (Chaiken 1980; Metcalfe & Mischel 1999; Petty & Cacioppo 1986; Pyszczynski & Greenberg 1987; Zajonc 1980). According to these models, judgment and decision-making often involve two, separate but parallel information processes. One is fast, automatic, unconscious (i.e., does not require attention), and intuitive (heuristic decision-making), whereas the other is slow, intentional, conscious, and rational (reasoned decision-making). Either process can be used to make a decision, and different conclusions can be made by the two processes. If the decision involves serious consequences, and if sufficient attention is devoted, the reasoned process can supersede the heuristic process. However, because the heuristic process works faster, we often draw our conclusion before the reasoning process can catch up and, in many cases, reason is invoked simply to "justify" a decision that has already been made (Haidt 2001). The heuristic information process is often the default option, automatically operating without conscious allocation of attention. Assuming that the cues available in experimental games are likely to be interpreted as suggestive of social exchanges in market-based societies, one possible interpretation of the current finding is that a decision heuristic relevant to social exchange is activated during an experimental game, thereby enticing the participant to automatically behave more equitably (Kiyonari et al. 2000). It is likely that the cultural beliefs shared by traditional people do not sensitize them to market-relevant cues in experimental games and, consequently, they may not perceive experimental games as a form of social exchange. In the absence of proper heuristics to use in experimental games, people in communities with less or no market exposure are "forced" to use reasoned information processing and make "rational" decisions.

Although, personally, I believe this last interpretation to be the most plausible, this is ultimately an empirical matter. The challenge will be to design an experiment powerful enough to test the validity of these three alternatives. Some of the experimental techniques used by cognitive psychologists to assess how much information processing is involved in a particular decision task may be useful in such an endeavor.

Economic man: Self-interest and rational choice

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Abstract: "Economic man" assumes not only self-interest, but also rationality of choices. The finding that ultimatum game offers can be explained by ambiguity aversion as well as pessimism, plus other findings, suggests the usefulness of taking bounded rationality more into account. Neurodevelopmental and heritability research supports the authors' emphasis on the importance of social learning and socialization.

The target article offers impressive and ground-breaking research. There is heterogeneity in the protocols used by the various field researchers, to be sure, and yes, there are difficulties in interpreting the data and obvious dangers of data mining. But the article does provide the methodological foundations for behavioural research which is more homogeneous and sophisticated in design and more focused in terms of theoretical predictions. This, I believe, is an important achievement.

Self-interest is indeed a key assumption of "economic man," and one that typical experimental evidence – reviewed, for example, in Camerer (2003) and Fehr and Gachter (2000b) – shows to have been violated again and again. Neurodevelopmental evidence proves the importance of the learning environment in determining interpersonal behaviour (Zizzo 2003a), and fits well with the importance of socialisation highlighted by the authors in explaining cross-cultural differences. The brain is significantly plastic in development in response to environmental input (Quartz & Sejnowski 1997). One way in which both genetic and environmental input affect biological neural networks is by determining the functioning and shaping up of neurotransmitter systems (e.g., Duman et al. 1997). Serotonin appears to regulate how

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agents perceive social decision problems (Zizzo 2002a), while dopamine might facilitate social learning processes (Zizzo 2002b). There is evidence suggesting a role for environmental input in how the serotonergic system works in individual brains, both with monkeys (Higley et al. 1993) and with humans (Oxenstierna et al. 1986). Monkeys growing up in a socially deprived environment have abnormally high levels of serotonin, related to inappropriate aggression (Higley et al. 1994; Kraemer et al. 1989; Lilly et al. 1992). In normally reared monkeys serotonin and dopamine are closely correlated, whereas in socially deprived monkeys they are not (Kraemer et al. 1989).

The authors' emphasis on the social learning of preferences is supported by heritability studies (e.g., Rutter 1997; Zizzo 2003a). For example, in Rushton et al. (1986), only around 50% of the variance of self-reported altruism, empathy, and aggressiveness is explained by the genes. Miles and Carey's (1997) meta-analysis found that genes might account for up to 50% of the variance in aggression in questionnaires and self-reports, but also that "observable ratings of laboratory behavior found no evidence for heritability and a very strong family environmental effect" (p. 207). Children growing up in different social environments may develop significantly different social preferences.

Self-interest, however, is not the only key assumption of "economic man," and the neurodevelopmental and heritability evidence can be interpreted both in terms of development of differential preferences as of differential social cognitive skills and perspectives. (Perfectly) rational choice – the idea that maximisation subject to informational and material constraints is all there is to choice – is the other key assumption, and the theoretical analysis provided by the authors is slightly unclear on this. Henrich et al. note the possibility of rationality limitations but claim that game playing does not require "very high levels of reasoning or omniscience" (sect. 9, para. 3). This may be so, but surely one possible source of cross-cultural variations lies in violations of the rationality rather than the self-interest axiom. Although this is not the focus of the authors' work, there are revealing signs that this is the case. The authors' largest dataset concerns ultimatum game offers, and they show that a possible explanation of ultimatum game offers behaviour lies in a combination of pessimistic beliefs and ambiguity aversion. Rubinstein (1998) defines the knowledge of the problem as one important dimension of economic rationality. Cross-cultural variations in how agents face up to uncertainty seem an obvious signal that there are not just differences in preferences, but also differences in cognition. It is suggestive that the Orma appeared to assimilate the public good game to what was for them a prototypical social setting, the *harambee*, because it indicates that something like similarity-based or case-based decision reasoning may be going on in the presence of an unfamiliar task (Gale et al. 1995; Gilboa & Schmeidler 2001; Zizzo 2003b). Indeed, as the authors recognize in their theoretical discussion, the correlation of the market integration index with behaviour can be explained in cognitive terms, in the development of "distinctive cognitive capacities and habits." Though the authors downplay the importance of framing in the discussion of the design, they themselves stress its possible role in the theoretical discussion. It is quite possible that some of the cognitive variations can be explained in terms of parsimonious and stable social utility functions; but whether this is generally true is very unclear, and decision-making approaches that explicitly recognise bounded rationality in determining the procedure of choice may be called for.

The attempts made by the authors to identify within-group variations in preferences and cognitive skills, and their impact on behaviour, were fairly unsystematic, so it is difficult to see what to make of them without additional research. This is not meant to be a criticism: in a first study of this scale, obviously not everything could be done. Still, that education does not predict game behaviour should not be taken as an indicator that cognitive abilities may not have played a role at the individual level. Transfer of knowledge from one task to another does take place in some cases but not in others (Reeves & Weisberg 1994; Zizzo 2005). Knowledge of the laws of physics may not be especially helpful to be an expert billiard player: there is a difference between explicit knowledge that people learn and store in memory and implicit knowledge of how to actually do things (Shanks & St John 1994). Therefore, that education should modify game play should not be taken as a foregone conclusion, as implicit cognitive skills may differ from, say, abstract numeracy skills. On the "heterogeneity of preferences" front, there is evidence pointing to large and systematic differences in preferences within fairly homogenous populations (e.g., Burlando & Guala 2005), but this requires more complex experimental designs than those used by the authors. They may also, no doubt, be harder to implement in the field, but this is a challenge worth taking, I think.

Authors' Response

Models of decision-making and the coevolution of social preferences

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Abstract: We would like to thank the commentators for their generous comments, valuable insights and helpful suggestions. We begin this response by discussing the selfishness axiom and the importance of the preferences, beliefs, and constraints framework as a way of modeling some of the proximate influences on human behavior. Next, we broaden the discussion to ultimate-level (that is evolutionary) explanations, where we review and clarify gene-culture coevolutionary theory, and then tackle the possibility that evolutionary approaches that exclude culture might be sufficient to explain the data. Finally, we consider various methodological and epistemological concerns expressed by our commentators.

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