

Bounded Rationality and Bounded Individuality¹

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Abstract: This paper argues that since the utility function conception of the individual is derived from standard rationality theory, the view that rationality is bounded suggests that individuality should also be seen as bounded. The meaning of this idea is developed in terms of two ways in which individuality can be said to be bounded, with one bound associated with Kahneman and Tversky's prospect theory and the 'new' behavioral economics and a second bound associated with Simon's evolutionary thinking and the 'old' behavioral economics. The paper then shows how different bounded individuality conceptions operate in nudge economics, agent-based modeling, and social identity theory, explaining these conceptions in terms of how they relate to these two behavioral economics views of bounded rationality. How both the 'new' and 'old' individuality bounds might then be combined in a single account is briefly explored in connection with Kirman's Marseille fish market analysis.

Keywords: bounded rationality, bounded individuality, nudge economics, agent-based modeling, social identity theory, Marseille fish market

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1 Introduction: The rationality-individuality connection

There has been considerable debate in economics for many years about the meaning and nature of rationality, and so how economics is to be understood in the future is likely to depend in important ways on how these debates proceed. But the position of this paper is that this debate needs to be seen in somewhat larger terms, since how rationality is conventionally understood is closely tied to the way in which individuality – that is, the *Homo economicus* utility function representation of the individual – is conventionally understood. In this larger picture, challenges to the standard view of rationality are also challenges to the *Homo economicus* utility function view. In addition, there are problematic aspects of the *Homo economicus* conception that create additional questions regarding the standard view of rationality. Thus I will argue that these two conceptions are rigorously and deductively tied together in standard theory in ways that go well beyond commonplace Robinson Crusoe stories, and that this means that they stand or fall together.

It is interesting, then, that very little of the critical examination of rationality theory in economics in recent decades has brought the closely connected utility conception of the individual view into the picture, as if one could revise rationality theory and maintain the *Homo economicus* conception, and interesting in particular that one reasonable caution on this score has been entirely disregarded. Specifically, as any student of economics knows, rationality analysis can be applied to any type of agent, and bears no special connection to the human individual. But if rationality theory applies equally to different kinds of ‘individuals’ – single individuals, collections of individuals such as firms and nations, parts of individuals such as in neuroeconomics, animals, and machine algorithms, etc. – then it can be argued that it really has no specific connection to any of these types of ‘individuals’ despite the fact that rationality analysis as it has been logically developed in standard theory is conventionally said to apply to an ‘individual’ *Homo economicus* agent.

The simple point, all students learn, is that rationality theory is a free-use tool with no particular connection to the concept of agency and no particular association with the idea of an individual human being that is supposed to exercise this tool. As Gerhard Debreu so clearly put it: “an axiomatized theory has a mathematical form that is completely separated from its economic content” (Debreu, 1986, p. 1265). Or as Herbert Simon earlier said with respect to standard rationality theory: “It is a gun for hire that can be employed in the service of any goals we have, good or bad” (Simon, 1983, pp. 7-8). Is it any wonder, then, that there has been many a slip

between the cup and the lip when it has come to applying rationality theory experimentally in the lab with real human individuals, as the evidence now overwhelmingly shows (e.g., Smith, 2010)?

What I take this all to imply is that any account of behavior in economic life, however rational that behavior is argued to be, needs to be somehow explained in terms of some understanding of the nature of the agent that exercises that behavior. Thus if economics is concerned with the behavior of 'rational individuals,' it needs to explain what it is about individuals that allows us to ascribe rationality however understood to them. But how does one go about this? Here I attempt to draw broadly on the main line of critique directed at standard rationality theory in recent decades in order to ask what it might be said to imply about the nature of individuality. I assume that there is indeed an overall direction of research on rationality in economics, and that it moreover has specific implications for how we might go about re-explaining individuality and the rationality-individuality connection. It may strike some that there is no clear overall direction of research on rationality in economics in recent decades, but my judgment is that a large number of economists and philosophers now agree that rationality needs to be somehow redefined as bounded. Of course there are many ways in which one can explain how rationality is bounded, but the basic point seems to be that standard axiomatic rationality needs to be bounded by human characteristics that we believe we can ascribe to most individuals. People only possess certain cognitive capacities, and probably not all those capacities that have been attributed to them in standard rationality theory. What, then, does this imply about the nature of individuality?

In this paper I thus extend the bounded rationality idea to include the idea that individuality is bounded, and interpret this to mean that people, though we still look upon them as separate individuals, are limited in their capacity to act in the purely independent way in which they are portrayed as acting in standard theory. That is, there are bounds on individuality just as there are bounds on rationality – we are still individual, though boundedly so just as we are still rational, though boundedly so – and we accordingly need to understand the ways in which these bounds operate if we are to fully understand economic behavior. Indeed, recognizing the extent to which individuals act independently is central to understanding cause-and-effect processes in economic life and thus to economics as a causal science. If individuals are not completely independent agents as in the *Homo economicus* conception, but rather have a bounded individuality, then standard reasoning misrepresents how causal processes operate in the economy. This paper distinguishes two such bounds on individuality, and traces them to two different bounded rationality critiques of standard rationality theory – one associated with the 'new' behavioral economics and one

associated with the ‘old’ behavioral economics.² The paper then discusses a bounded rationality account that combines these two bounds in a single account of bounded individuality.

Section 2 begins by reviewing the standard connection between rationality and individuality as advanced by John von Neumann and Oskar Morgenstern in their *Theory of Games and Economic Behavior*. It then looks at the ‘new’ and the ‘old’ behavioral economics critiques of standard rationality theory to distinguish two different views of how individuality can also be seen as bounded. Section 3 shows that bounded individuality conceptions are implicit in nudge economics, agent-based modeling, and social identity theory, and compares these approaches according to how they draw on behavioral economics’ two critiques of rationality and individuality. I argue that nudge economics’ ‘constrained individuality’ view essentially abandons behavioral reasoning for the standard view of rationality and individuality, while agent-based modeling’s bounded individuality conception draws on the ‘old’ behavioral economics and social identity theory’s bounded individuality conception draws on the ‘new’ behavioral economics. Section 4 then argues that Alan Kirman’s Marseille fish market analysis combines an agent-based modeling approach with social identity theory to produce an account of rationality and individuality that synthesizes the two behavioral economics critiques of standard theory. Section 5 concludes by briefly revisiting the premise of the paper, that any discussion of bounded rationality requires a discussion of bounded individuality. Why is it, I ask, that rationality and individuality in economics have not been jointly investigated not only in standard theory but also in its behavioral critiques? I suggest the answer lies in the the methodological reasoning underlying standard theory’s view of rationality and individuality.

2 From standard rationality-individuality to bounded rationality-individuality

Standard rationality theory, or expected utility theory, is axiomatic in nature in that it is formulated around a specific set of logical assumptions (completeness, transitivity, independence, and continuity) chosen in order to produce well-defined preference orderings (von Neumann and Morgenstern, 1944). The ‘von Neumann-Morgenstern utility function theorem’ then states that if these four axioms are satisfied, any set of well-ordered preferences can be represented by a distinct (monotonic) individual utility function. The utility function is the theory’s individual conception.

² I offer a somewhat different view of how individuality can be seen as bounded in Davis (2011).

Note, then, that rationality and individuality are deductively and logically connected concepts, because, on the one hand, the utility function representation of the individual is logically inferred from the axiomatic assumptions held to govern preferences, and because, on the other hand, the selection of those assumptions is guided by the need to be able to logically infer a single distinct utility function that assures that choice is rational, where this is understood as choice consistency. Moreover, a common understanding of choice consistency – that rational individuals who are consistent in their choices cannot be money-pumped out of existence in trades to eliminate all their resources – shows that individuality and rationality mutually imply one another. Violation of choice consistency implies the non-existence of the utility function individual.

Explanations of the relationship between what agents are and what kinds of choices they make can of course be generated in different ways, such as through the familiar methodological procedure of formulating theoretical hypotheses, and then refining and validating them through some sort of empirical investigation. But standard theory's axiomatic approach essentially finalizes its theoretical claims about the rationality-individuality relationship before confronting them with evidence that might bear on them. This leaves the theory's predictions about choice behavior and the properties it ascribes to preferences and thus to individuals especially vulnerable to empirical disconfirmation, given that its formulation occurs entirely apart from any evidentiary basis. The logical character of standard rationality-individuality view is also the source of its inability to discriminate between different kinds of 'individuals' in that the idea of a set of well-defined preferences is formulated in such a way as to abstract from anything that tells us what the bearer of preferences is, since utility functions can be ascribed to any type of agent. This discrimination problem, it seems fair to say, is one example of the set of problems facing any theory formulated logically without regard to its empirical standing.

Needless to say, experimental research over many years now has cast serious doubt over whether the standard theory's axiomatic assumptions regarding what underlies rationality actually underlies the choices people make. Given the rationality-individuality connection, then, these doubts should not only be directed at expected utility theory, but also at its companion *Homo economicus* utility function conception of the individual. That this conception is also implicated can be seen from what two different kinds of responses to this experimental research. According to Chris Starmer (2000), one type of response to the experimental evidence (especially the repeated violations of the independence axiom) – which he refers to as “conventional theories” in non-expected utility theory – has been to come up with revised sets of axiomatic assumptions to

redefine what counts as a set of well-ordered preferences. He labels these revised preferences ‘as if’ preferences to capture the usual meaning of ‘as if’ methodological reasoning in economics where modeling assumptions are made, irrespective of their realism, that appear to predict well. But what these “conventional theories” in non-expected utility theory do is not only change the account of what properties underlie rationality, but also re-frame the standard *Homo economicus* view, since individuals are now also reconceptualized in terms of their ‘as if’ preferences and must thus now also have ‘as if’ utility functions. But what does it mean to say that an individual has an ‘as if’ utility function? Since ‘as if’ reasoning is usually intended at least in part to circumvent the requirements of realism, it cannot be the case that this change offers a more realistic description of the individual. The object in “conventional theories” in non-expected utility theory according to Starmer is to preserve the axiomatic basis for rationality. Consequently the concomitant aim must be to also secure the standard view of the individual with even less concern for its descriptive adequacy.

The second response to the experimental research on preferences that Starmer distinguishes has produced what he refers to as “nonconventional theories” in non-expected utility theory where the choices made by individuals cannot be “reduced to, or expressed purely in terms of, a single preference function” (Starmer, 2000, p. 339). Starmer classifies Daniel Kahneman and Amos Tversky’s prospect theory (1979) as the pre-eminent example of a “nonconventional” non-expected utility theory. What is of course especially distinctive about prospect theory is that it explains human decision-making as being anchored by reference points that serve to frame individual choices. Since choice always occurs from some framing reference point, it cannot be “reduced to” or explained solely in terms of preference orderings but rather needs to be explained in terms of preference orderings plus reference points, each contributing somehow to the nature of the choice. Kahneman (2003) went on (after Tversky’s death) to treat prospect theory explicitly as a theory of bounded rationality. I argue, therefore, that the introduction of reference points makes it necessary to also treat prospect theory as a theory of bounded individuality. There are two ways in which this can be understood.

In the first place, while individuality is still understood in terms of preferences, because the choices individuals make on the basis of these preferences are bounded by being anchored in circumstances in which they are made, what individuals must also reflect how their choices are anchored and bounded by these circumstances as well. Individuals cannot act, as the unbounded *Homo economicus* does, as if the circumstances anchoring choice are irrelevant. For Kahneman and Tversky, then, what specifically anchors choice is broadly speaking the position the individual

occupies. However, individuals' positions in principle could refer to many kinds of factors that explain people's locations in the world, including for example what might be termed social reference points such as social groups, as investigated in social identity theory (e.g., Tajfel *et al.*, 1971).

In the second place, individuality is also bounded by the fact that reference points can change over time. Kahneman and Tversky argue that "a change of reference point alters the preference order for prospects" (Kahneman and Tversky, 1979, 286). Over time, changes in reference points occur because people's circumstances change. This means that alterations in "the preference order for prospects" create discontinuities over time in individuals' preference sets. That is, an individual's preference order at one point in time can be entirely different from the individual's preference order at another point in time. Thus, not only is individuality bounded *at a point in time* in virtue of its being anchored by reference points and the circumstances of choice, but it is also bounded *through time* since the circumstances of choice often change. This then gives us two dimensions in which individuality can be said to be bounded from the point of view of prospect theory.

To clarify these two dimensions, consider how proponents of standard theory might evaluate the status of boundedly rational individuals in prospect theory. On the standard view, rational individuals make consistent choices, and therefore cannot be money-pumped out of existence (primarily because the preferences of rational individuals are transitive). However, when choice is bounded by reference points, individuals' preferences can be intransitive, and they are then indeed at risk of being money-pumped out of existence. Further, intransitive preferences are also possible when reference points change over time and alter the "preference order for prospects." Choices which could be transitive under one choice anchor may become intransitive when that choice anchor changes. Introducing reference points, then, essentially opens up the possibility that the individual is money pumped out of existence and disappears *at any point in time*, while change in reference points opens up the possibility that *through time* individuals fragment into multiple prospect functions, or multiple selves. From the perspective of standard theory, we might say that individuality in prospect theory is bounded in virtue of being potentially eliminable *at any point in time* and discontinuous *through time*.

The main ideas behind bounded rationality, of course, were developed earlier by Herbert Simon in what now gets called the 'old behavioral economics as compared to the more recent, now 'new' behavioral economics (c.f., Sent, 2004). But it is important to see that Simon understood the idea of

bounded rationality somewhat differently from how it came to be understood by Kahneman (2003) in connection with prospect theory. Boundedness for Kahneman is basically explained in terms of the properties of the decision-maker, and this is something Simon also addressed in the emphasis he placed on decision-makers' cognitive and computational abilities. However, from the time of his earliest thinking about bounded rationality (Simon, 1956), Simon clearly understood rationality to be bounded not just in virtue of the nature of decision-makers' cognitive abilities but also in virtue of how those abilities functioned in the different sorts of decision environments in which they were exercised. Indeed, Simon rejected the subjectivist utility function representation of individuals which abstracts from the environment of choice, whereas Kahneman and Tversky saw it as their task to modify that representation to produce a more psychologically realistic account of human behavior. Simon later nicely captured the difference between his view and theirs in his adaptation of Marshall's famous (supply and demand) scissors metaphor: "Human rational behavior ... is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor" (Simon 1990, p. 7).

Bounded rationality for Simon, then, also entails a somewhat different view of how individuality is bounded than we find in prospect theory. For Kahneman and Tversky, individual choices are anchored in but not otherwise influenced by decision-makers' environment in that individuals' preferences are still subjectively defined and not shaped by the world. In contrast, for Simon the autonomous subjective utility function representation of the individual needed to be abandoned altogether. Prospect theory locates choice in the world in the sense that choice always occurs in specific circumstances, but in Simon's thinking the world contributes in a more significant way by influencing subjectivity as well since our preferences evolve as a result of our interaction with the world. This distinction may be reformulated in terms of the exogeneity-endogeneity distinction by saying that in prospect theory – as in standard rationality theory – individuality is basically *exogenous* to the world, or explained subjectively apart from the way the world is and might influence it, whereas in Simon's thinking individuality is to a significant extent *endogenous* to the world, or explained as it is because of the way the world operates upon it, thus making aspects of the objective world a part of individuals' subjective world.

In contrast to individuality being bounded in prospect theory in virtue of its being potentially eliminable at any point in time and/or discontinuous over time, then, in Simon's thinking individuality is bounded in virtue of its being determined to some degree by non-individual, non-

subjective sorts of phenomena associated with its environment. Thus rather than say the individual disappears altogether or fragments into multiple prospect functions (or multiple selves), for Simon individuality is in some way a function of environmental processes. Individuality is consequently bounded in the sense that it is less a determining factor or causal force influencing the way the world works, though Simon still looks upon individuals as having an impact on the way the world works. Note, then, that much of the recent experimental research in new behavioral economics on what are generally termed 'prosocial' motives essentially addresses this, since it investigates how individuals may act in concert with others so that customary rules, principles of morality, social habits, evolved behaviors, etc. that are features of the (social) environment of choice are significantly determinative of individual behavior. Simon was in fact quite interested in the influence these kinds of social settings have on individuals from early in his career in connection with his study of individual behavior in organizations under the label of 'administrative behavior' (Simon, 1947).

How are we then to express this alternative behavioral understanding of how individuality is bounded? The challenge for Simon's conception involves showing how people still retain some sort of individuality when their individuality is in some fashion endogenous to the environments they occupy. For Simon, this was to be explained in terms of his conception of individuals as self-organizing beings. I have discussed this conception elsewhere (Davis, 2011, pp. 140ff), and here only note what its main idea involves in order to provide a sense of how individuality is bounded for Simon. Thus, a self-organizing agent behaves in a homeostatic manner by constantly adapting itself to its environment. Environmental factors operate upon self-organizing agents, but they are still agents in that they also act upon those environmental influences in such a way as to continually reconstitute themselves as agents over time. Self-organizing agents consequently evolve *as individual agents* over time in virtue of how they interact with their environments. Consequently, Simon combines an ecological rationality conception and an evolutionary bounded individuality conception.

Thus the two bounded rationality critiques of expected utility theory in 'new' and 'old' behavioral economics generate two different sorts of critiques of the standard *Homo economicus* utility function conception of the individual and two different views of what an alternative bounded individuality might involve. To what extent, then, has recent economic theorizing implemented these alternative conceptions of individuality? In the following section, I distinguish three different

bounded individuality conceptions, and compare them according to how they each draw on behavioral economics' two critiques of rationality and individuality.

3 Three bounded individuality conceptions

The three bounded individuality conceptions discussed and compared in this section are derived from nudge economics, agent-based modeling, and social identity theory. Nudge economics is an extension of prospect theory that places particular emphasis on economic and social policy design. It accepts Kahneman and Tversky's main conclusions about the nature of human decision-making, but is still close to standard thinking in that it looks upon policy as a means of restoring rational behavior (and thus implicitly traditional individuality). Agent-based modelling adopts Simon's self-organizing approach to rationality and individuality by employing a view of how agents learn from their interaction with one another. It endogenizes individuality to interaction, and as an evolutionary view is farthest from the standard utility conception. Social identity theory explains individual behavior in terms of individuals' multiple social group identities, regards these as social reference points for decision-making, and thus employs Kahneman and Tversky's thinking in this respect. It falls between nudge economics and agent-based modeling in that it rejects standard rationality and individuality but does not develop an evolutionary account of individuals.

i. Nudge economics: Constrained rationality and constrained individuality

For Richard Thaler and Cass Sunstein (2008), human decision-makers exhibit a variety of imperfections and biases in their reasoning, but with guidance on the part of rational experts they can be encouraged or 'nudged' to act rationally. On this view, the meaning of bounded rationality is in effect 'constrained full rationality,' or the idea that full rationality applies except when people operate under various psychological constraints that limit the scope of its normal exercise. Though Thaler and Sunstein see their view as an extension of prospect theory, in fact it does not fit Kahneman and Tversky's theory very well, since for the latter people's choices always reflect reference points that influence choice, and the idea that they might somehow be encouraged to disregard them through policy experts' redesign of choice architectures goes against the main thrust of the theory. Indeed, if standard rationality is understood as consistency, and reference

points allow for intransitive choices both at any point in time and over time, then standard rationality basically mis-describes the nature of choice. The problem with Thaler and Sunstein's interpretation of Kahneman and Tversky is that they start from the perspective of standard rationality theory, and accordingly see the psychological heuristics and biases people exhibit as incidental and correctable rather than as fundamental to their nature. In contrast, as psychologists, Kahneman and Tversky see the human psychological make-up as essential to how people make choices.

In regard to individuality, then, a 'constrained full rationality' approach implies a 'constrained full individuality' or 'constrained *Homo economicus*' approach. For Thaler and Sunstein, the individual only contingently fails to function in the usual purely autonomous way standard theory assumes when psychological factors influence its exercise of rationality. This implies that the effects on individuality of reference points from Kahneman and Tversky's analysis – that individuality is eliminable at any point in time and can be discontinuous over time – can be ignored or at least do not play a role in the long run after nudge policies have their effects. Putting aside that this involves a departure from Kahneman and Tversky, there is something paradoxical about this view of individuality associated with the role Thaler and Sunstein accord rational experts. They assume, of course, that the preferences of rational experts are theirs alone and that the people policy is intended to influence have their own preferences. But in the standard axiomatic account of the properties of preferences, there is nothing to indicate who any given set of preferences belongs to. It is customarily assumed that preferences must always be personal preferences, but this assumption is never justified, and indeed it is circular to label a set of preferences a particular individual's own personal preferences by reference to that individual (cf. Davis, 2011, pp. 6-9). In fact, an individual's 'personal' preferences could well be someone else's preferences, such as the rational expert's preferences through the framing the expert's nudging policy involves. This would fit with the argument above that bounded individuality for Kahneman and Tversky is eliminable at a point in time and can be discontinuous over time, since the rational experts' preferences would then substitute for the preferences of those policy aims to influence at any point in time, while a succession of nudge policies in effect could make individuals into a sequence of different or multiple selves. Thus it seems fair to say that the conception of bounded individuality Thaler and Sunstein advance ultimately fails as a 'constrained individuality *Homo economicus*' approach.

ii. *Agent-based modeling: Learning and interaction*

Agent-based modeling examines how individuals interact in complex adaptive systems. Following Simon, individuals are different from the standard *Homo economicus* individual in demonstrating a capacity to learn what they want from their circumstances and revise their behavior accordingly. Individuals are represented as always having multiple hypotheses about how to achieve their goals. From experience they “learn’ which hypotheses work, and this leads them to discard poorly performing hypotheses and generate new ‘ideas’ to put in their place” (Arthur, 1994, p. 407). The computational modeling procedure used to explain this learning process was pioneered by John Holland in his development of the idea of a genetic algorithm whereby agents or individuals revise their behavioral decision rules according to their relative fitness to their goals and revise their goals relative to their active decision rules (Holland, 1975). The essential idea is that learning occurs through targeted feedback loops which cause agents to revise and reorder these decision rules, causing some to be dropped or become inactive due to their poor performance and others to be prioritized and favored due to their comparative success. New decision rules may originate through combinations of past rules or by some process of discovery. This analysis of agents/individuals is then combined with an account of their environment as continuously exhibiting to two sorts of changes. On the one hand, it changes because the mix of behavioral rules that all interacting agents/individuals employ is constantly changing; on the other hand, it changes due to ‘shocks’ or system-wide environmental changes that are independent of this interactive rule revision process. As a result, agents/individuals continually revise their behavioral rules and associated goals. In effect, they are always learning how to behave in a constantly evolving world.

Note that in this conception individuals are not made up of sets of exogenous preferences as in standard rationality theory and prospect theory, but are rather made up of sets of behavioral rules and goals undergoing constant revision. And while from one point in time to the next these sets of rules and goals may display considerable overlap and as a result change only modestly (especially if the forms of interaction are relatively stable and environmental change is not dramatic), nonetheless over time agents/individuals are continually undergoing change. In contrast, while in prospect theory reference points change and alter preference orders for prospects, since preferences themselves are given and the subjective make-up of the individual is unchanging, there can be no account of how individuals adjust to changes in reference points. This means that over time individuality must be discontinuous and people are successions of multiple selves. In Holland’s genetic analysis, learning underlies an adjustment process whereby rules are

continuously abandoned and adopted, so that individuality is maintained through a type of feedback process that continuously reconstitutes the individual as a single (albeit changing) agent. In this sense, individuality is endogenous to the world yet also relatively independent of it in virtue of the capacity attributed to individuals to self-organize themselves through learning. Indeed, individuals are agents, or beings with causal powers, precisely because they possess this capacity.

iii. Social identity theory: Multiple selves

Social identity theory accounts of individuals in economics treat individuals as boundedly rational, and regards having social identities as central to their make-up. In his analysis of the different ways of explaining the 'privateness' of the person, Amartya Sen (1999, 2002) essentially describes individuals as boundedly rational when he supposes they identify with others, often in social groups, and act in a non-instrumentally rational manner by forming commitments to them. Commitment, he says, breaks "the tight link between individual welfare ... and the choice of action" (Sen, 2002, 214). Indeed, people can make commitments to others that are counter-preferential in nature. One way, then, in which commitment and social identity can be understood is through individuals' use of first-person plural rather than first-person singular speech: "'We demand things; 'our' actions reflect 'our' concerns; 'we' protest at injustice done to 'us' (Sen, 2002, 215). Similarly, but from a somewhat different perspective, game theorist Michael Bacharach also treats individuals as boundedly rational when he argues, using psychology's social identity theory, that individuals who identify with others ask themselves, not 'what should *I* do?' but rather 'what should *we* do?' (Bacharach, 2006). Bacharach suggests that people often see themselves as members of teams rather than as independent individuals, and on those occasions make choices that are appropriate to them as team members rather than as independent individuals. Thus, as with Sen, when people socially identify with others, they not only set aside what standard rationality prescribes, but also behave in a boundedly individual manner by making something external to themselves, namely, the others and social groups with which they identify, determinative in some sense of themselves as individuals.

Sen and Bacharach agree that individuals have many social group identities. In effect, individuals simultaneously have multiple social group identity reference points. This implies that when social groups have overlapping memberships (for example, with members who have both race and

gender social identities), and social groups are in conflict with one another, individuals acting in the interest of any one of their social identities may find themselves acting contrary to the interests of another one of their social group identities. This is like the problem of having intransitive preferences, since a person's preferences could be transitive with respect to one social group identity but not across their social group identities. Then individuality might be sustained for a person with respect to one of their social group identities, but is effectively eliminated for the person in connection with their social group identity with which they are in conflict if they lose that identity. Sen hints at a way of addressing this issue by suggesting that individuals have an ability to reflect upon and deliberate over how to reconcile their competing social identities (Sen, 1999). A capacity to reflect on how one organizes one's social identities as a set of personal reference points could be seen as parallel to the self-organizing capacity learning has in agent-based modeling. Bacharach's view is less clear in this regard, though he does claim that just as individuals have an ability to see themselves as team members of social group, so they also have an ability to see themselves as a kind of team made up of many social group identities. His team view of the individual, that is, implicitly also gives individuals a capacity to self-organize themselves. Social identity theory thus draws on Kahneman and Tversky's reference point thinking, but only suggest how it might be developed in as an evolutionary account of individuality.

4 Kirman's agent-based modeling social identity approach: The Marseille Fish Market

In this section I discuss how Alan Kirman combines an agent-based modeling approach and social identity theory in his analysis of the Marseille fish market in a way that draws on both behavioral economics' critiques of rationality and individuality (Kirman, 2011a, 2011b). To motivate this discussion, consider again the difference between the standard view of individuality and bounded individuality. In the *Homo economicus* conception, individuals' utility functions are exogenous and unitary in the sense that individual decision-making is always consistent. Individuals are, in effect, always unboundedly individual in that nothing limits their individuality. In contrast, when rationality is bounded, individuality is bounded by factors external to the individual that operate upon the individual. In effect, such factors function as if they were inputs to an individuality production function. The 'output' produced, however, is, not the person *per se*, but rather the degree to which individuals function as relatively independent beings, or the degree to which their individuality is bounded, according to the kind of role the external factors operating on individuals

play as inputs in the individuality production process. In Kahneman and Tversky this boundedness is understood in terms of the influence reference points have on individuals; in Simon it is understood in terms of the evolving relationship between individuals and their environments. Accordingly different models of bounded individuality can be distinguished in terms of how these external factors are modeled, as well as in terms of the sensitivity of the individuality 'output' to the estimates of the values of the parameters of the model. This can be illustrated by Kirman's model of the Marseille daily fish market.

In the model, some buyers form loyalties to some wholesale sellers, and consequently exhibit a bounded individuality produced by their 'learning' to socially identify with those sellers over a series of repeated transactions. Prior to forming any loyalties to sellers, buyers place different probabilities on the profits they expect to earn from visiting different sellers. The sellers all supply essentially the same product, but can be differentiated according to the degree to which they are willing to accommodate and prioritize certain buyers in performing transactions. Buyers then learn to update their initial probabilities for earning profits by observing the different profits they earn from their visits to different sellers. Their behavioral adjustment evolves through a kind of reinforcement learning in which the weights they place on what they earn from different sellers depends on how buyers learn as measured in terms of a reinforcement learning parameter β . In addition, buyers are future oriented, and sensitive to a discount rate factor γ , since loyalty to particular sellers projects profits into the future. Thus, both past and the future time horizons influence their how buyers become loyal to certain sellers.

However, when buyers become loyal to and socially identify with certain sellers who they then repeatedly visit, they pay higher than competitive prices for the fish sold by these sellers. Thus not only do they revise their seller search behavior by becoming loyal to certain sellers, but they also revise their goals from pure profit to profit plus accommodating seller relationships. That is, their profit-seeking goal is revised to include social identification with certain sellers as they revise their decisions about which sellers to visit. In terms of the idea of an individuality production function, loyal buyers who pay higher prices can then be said to exhibit a lower degree of individuality, while those buyers who are not loyal to any particular sellers and pay competitive prices (termed random shoppers in the model) exhibit a higher degree of individuality. Thus the model describes a distribution of different types of buyers, and differentiates degrees of boundedness in buyer individuality according to the extent to which a person's individuality is endogenized to their social interaction with and loyalty to others through learning in a search across sellers over time.

Kirman's model, then, combines not only agent-based modeling and social identity theory, but also combines the two ways of understanding bounded individuality in 'new' and 'old' behavioral economics. Buyer identification with sellers functions as a social reference point in buyer decisions about visiting sellers. The learning process that buyers engage in revises their search rules and goals in evolutionary, self-organizing manner. Note that this synthesis has advantages over either of the behavioral frameworks taken alone. It adds an account of how individuals adjust their behavior in a reference point framework, and it adds an account of what might be called decision landmarks to the analysis of how individuals evolve over time. I don't attempt to set this out in terms of the idea of an individuality production function, but what weight these different dimensions of the analysis then have in explaining bounded individuality would depend on the evidence for different empirical settings regarding the parameters of such an analysis. Clearly how people socially identify with others and how they adjust their behavior over time depends on the social and historical context, as in the Marseille fish market case. Thus the extent to which individuality is bounded varies across such contexts as well.

5 The methodology of the standard view of rationality and individuality

The premise of this paper is that the debate in economics over the meaning and nature of rationality needs to be understood in larger terms than just what rationality involves, since how rationality is understood in standard theory is closely tied to the way in which individuality is understood. Why is it, then, that individuality in economics has not been an important subject of investigation, not only in standard theory but also in its behavioral critiques? Part of the answer, I believe, lies in the nature of the methodological reasoning employed in standard economics, and in the limited recognition in economics of how important methodological reasoning is to economics.

What is distinctive about standard rationality theory since von Neumann and Morgenstern, then, is its axiomatic basis. Indeed, this approach to rationality is so widely accepted in economics that few economists reflect on its methodological commitments, either in epistemological or ontological terms. In epistemological terms, the axiomatic approach implies, first, that knowledge of what rationality is takes the form of a set of logical properties constituting well-ordered preferences (completeness, transitivity, independence, and continuity) from which we then deduce or infer what actual rational behavior must involve. Second, it means that evidence for the theory can only

illustrate or confirm the theory; it can never provide grounds for questioning, falsifying, or refuting the theory. That is, since logical properties are by nature necessarily true, any theory formulated in logical terms can never be disconfirmed by the empirical evidence. In contrast, when a theory's main assumptions are formed provisionally or hypothetically rather than logically, the evidence produced by testing the theory can disconfirm the theory or lead to revision of its main assumptions. This view of the relationship between theory and evidence is generally the dominant one in science, but standard economics, at least with respect to the theory of rationality, has maintained the view that theory must be logical in form. It follows, then, that the nature of individuality is not an issue that requires any special treatment, since according to the 'von Neumann-Morgenstern utility function theorem' (that individuals with well-ordered preferences have distinct, monotonic utility functions), the nature of individuality is simply a logical consequence of what rationality involves.

Consider, then, what standard methodology in economics implies in ontological terms. Ontology concerns what exists, and ontological investigation as a form of methodological reasoning examines the grounds we have for assigning existence to different kinds of things. Knowing what exists is important for understanding what initiates cause-and-effect relationships. For example, in biology, species are said to exist because biologists believe they can provide grounds for distinguishing different kinds of living things. Causal relationships are then predicated on the existence of species. In economics, both separate individuals and collections of individuals such as business firms are believed to be existents. In the case of business firms, the grounds for supposing this lie in the reasons economists have employed to believe that firms act relatively independently as causal agents. In Ronald Coase's theory of the firm, firms are distinguished as agents in markets in virtue of their being constituted out sets of internal, non-market relationships that function cohesively (Coase, 1937). What, then, are the grounds for supposing separate individuals can also act relatively independently? I have attempted to address this issue at length elsewhere (Davis, 2011), and here only assert that we can investigate and discuss these grounds based on the evidence we have about how people act in the world and what we believe we know about them. However, this sort of ontological investigation is precluded in standard economics' logical derivation of individuality, and accordingly the issue of what constitutes individuality never arises. Indeed that individuality is even a methodological issue rarely arises in standard economics either.

The behavioral economics critiques of standard rationality have begun to demonstrate the importance of methodological reasoning in economics. Kahneman and Tversky and Simon's

emphasis on the observed psychological characteristics of decision-makers stems from the methodological view shared by most scientists that our fundamental assumptions need to be the product of our empirical investigation of the world rather than logically determined. Yet behavioral critiques of standard rationality generally prioritize examining specific assumptions in that theory, and place little emphasis on how the methodology of standard theory is problematic in itself (though see Wilkinson and Klaes, 2012, chapter 2). I suggest, thus, that enlarging this critique to make the methodology of economics central to economics would make the rationality-individuality connection more central to economics.

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