

Economics, Neuroeconomics, and the Problem of Identity*

By John B. Davis**

Abstract

This paper reviews the debate in economics over neuroeconomics' contribution to economics. It distinguishes majority and minority views, argues that this debate has been framed by mainstream economics' conception of itself as an isolated science, and argues that this framing has put off the agenda in economics issues such as individual identity that are increasingly important in connection with the social and historical context of economic explanations in a changing complex world. The paper first discusses how the debate over neuroeconomics has been limited to the question of what information from other sciences might be employed in economics. It then goes on to the individual identity issue, and discusses how economics' top-down, closed character generates a circular individual identity conception, while bottom-up, open character of psychology and neuroscience, and their continual concern with the changing relation between theory and evidence, has produced four competing individual identity conceptions in neuroeconomic research.

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1. Mainstream Economics in the Context of Neuroeconomics

Neuroeconomics is a relatively new field in economics whose emergence, like other new fields in economics, reflects the increasing influence of other sciences on economics, in this case neuroscience. The influence of other sciences on eco-

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** Department of Economics, Marquette University, PO Box 1881, Milwaukee, WI 53201 and Amsterdam School of Economics, University of Amsterdam, Valckenierstraat 65–67, 1018 XE Amsterdam, Netherlands. The author can be reached at john.davis@mu.edu or j.b.davis@uva.nl.

nomics challenges economics' postwar self-isolation as a science with limited relation to other sciences, and poses an alternative vision of economics as a stronger science when more closely integrated with other sciences. Yet for more than a half-century mainstream economists have actively resisted this alternative vision, arguing that neoclassical economics represents the only advanced social science, and that economics would be weaker were it to move closer to other sciences. Indeed, the economics imperialism of the 1970s and 80s, as a corollary of this posture, was an attempt to instead export economics' understanding of what good science required to other sciences (Lazear 2000; cf. Davis 2016). However, since the 1990s there have been multiple reverse imperialisms toward economics, reflecting other sciences' attempts to export their different understandings of what good science requires to economics. What does this dispute regarding good science involve, and does it challenge economics' postwar self-isolation?

Regarding neuroeconomics, the way in which economists have debated whether neuroeconomics has anything to offer to economics has been to debate what types of evidence economics ought to employ. This debate regarding evidence, however, has been largely framed as a debate over whether new types of evidence developed in other sciences ought to be incorporated into economists' existing understanding of what good science requires, thus presupposing economics' status as an isolated science. I take sections two and three of this paper to show this, first setting out the majority view among economists regarding why evidence from psychology and neuroscience will not contribute to explanations of behavior in economics, and then showing how a minority view in economics, represented primarily by behavioral economists and neuroeconomists, which favors incorporating evidence from psychology and neuroscience into economics, has been advanced in such a way as to largely presuppose economics' conception of itself as an isolated science.¹

But my main goal in this paper is to question the basis for mainstream economics' self-isolation by addressing how the effect of this framing has been to push off economics' agenda any serious discussion of the social and historical context in which economic explanations operate. What does it mean to say mainstream economics has a vision of itself as an isolated science, and what

¹ The neuroeconomics approach supported by behavioral economists has been pejoratively termed "behavioral economics in the scanner" (Ross 2008). There is an alternative understanding of neuroeconomics I do not discuss here associated with the work of Glimcher (2003; 2010) that argues the brain can be modeled using the principles of standard economic theory. Since my discussion focuses on how neuroscience might influence economics rather than how economics might influence neuroscience, I set aside discussion of this approach to focus on the behavioral economics-inspired approach, which indeed is more representative of neuroeconomics for most economists. In addition to Ross, see Vromen (2008) and Fumagalli (2010) for discussion of the differences between the two approaches.

kind of science does this involve? Most fundamentally, the mainstream vision of economics as an isolated science is the vision of a science whose principles generalize to any and all social contexts and are always true everywhere. It is the vision of an essentially top-down science entirely embedded in its own logic as compared to more bottom-up sciences such as psychology and neuroscience whose vision of science is built around a continually changing relationship between evidence and theory. The mainstream's vision of economics, that is, is of a closed, self-referential science which has no context but itself, whereas by comparison sciences like psychology and neuroscience are open sciences whose context is the world which they investigate. The economics imperialism of the 1970s and 80s was thus not an elective move on the part of Chicago and Virginia, but an inevitable concomitant of the practices of a closed science. From this perspective, the reverse imperialism of other sciences towards economics beginning in the 1990s was thus as much a response to mainstream economics' vision of science as it was an attempt to introduce new concepts and new types of evidence into economics.²

If this vision of economics as an isolated science, then, has pushed off the agenda issues concerning the social and historical context in which economic explanations operate, what issues do I have in mind? I refer particularly to one ontological issue that should be of paramount importance to economics (but isn't), namely, how we should understand the identity of individual persons as economic agents. Mainstream economics, of course, is above all individualist. But the evolution of economic relationships in a world affected increasingly by technological change and globalization raises serious questions about the status of individuals in contemporary society. If the mainstream's commitment to individualism derives from a very old fashioned model of the economy as exchange between small producers, then it is reasonable to suppose that potential theoretical insights from other sciences regarding what individuals are in a more complex world should be welcome in economics. Indeed, psychology and neuroscience have struggled with the issue of identity in their own empirical practice – neuroscience, for example, in regard to *who* it is in the scanner when evidence is collected regarding cognitive processing.

Mainstream economics nonetheless continues to operate with a preference or utility conception of the identity of individual persons. Individuals are treated

² Central to mainstream economics' defense of itself as a closed science is a matter I will not discuss in this paper, namely, its methodological commitment to covering law explanations which generalize explanatory principles across contexts. A motivation for this commitment is the unity of science ideal, which in this instance sees economics as a science of universal law-like relationships on the model of physics. For a discussion of an alternative methodological commitment to constitutive explanations which are sensitive to contextual variety, see the important paper by Herrmann-Pillath (2016). For a discussion of the role of *ceteris paribus* reasoning in sustaining covering law/unity of science explanations, see Hausman (1992).

as distinct from one another and function as independent economic agents because they are each assigned their own preferences or utility functions. Neuroscience, however, investigates the neural basis for individual preferences. So it finds itself asking questions economists are unwilling to even recognize, and neuroeconomists then find themselves limited to arguing with the mainstream over a purely epistemological matter regarding what new types of evidence might be valuable in economics.

In section four, then, I try to explain why mainstream economics ignores the issue of individual identity in terms of its nature as a self-isolating science. Essentially, its top-down, closed character leads it to rely on a circular utility conception of individual identity. Though empty empirically, it has the advantage that it can be applied anywhere and everywhere that ‘agents’ can be assigned utility functions, thus rendering the whole issue of its social and historical context of application irrelevant. In section five, I then discuss how the nature of neuroscience and neuroeconomics as disciplines that are built around an open relation between theory and evidence struggle with explaining individual identity in empirical research on cognitive processes, particularly empirical research employing scanner technologies. The latter type of explanation effectively attempts to replace the nominal utility identity conception of mainstream economics with an identity conception realistically determined by the current social-technological context of neuroscientific research, but the entire issue remains in the shadows of economics’ debate over neuroeconomics and evidence. Finally in the concluding section six, I briefly comment on what might be said about economics’ possible evolution in the future in relation to other disciplines.

2. Why Neuroscience Does Not Matter for Most Economists

The main reason, then, why the majority of economists believe that neuroscience has little if anything to contribute to economics is that they regard neuroscientific data as irrelevant to explanations of decision-making (cf. Gul and Pesendorfer 2008). They hold this view because the standard theory of rational decision-making in economics – the revealed preference approach – is formulated in such a way that individual preferences can only be indirectly inferred from individuals’ observable choices. It follows that preferences themselves have no independent evidentiary standing in explanations of choice behavior, so that any science that offers explanations of what might determine preferences is essentially redundant to economics. In effect, the main theory of decision-making in economics is formulated in such a way as to isolate itself from all evidence except that evidence which economics itself generates in terms of its preferred theory of choice behavior. Consequently, for most economists the issue at hand is not the more classic methodological or epistemologi-

cal one of how evidence of any kind and no matter what its scientific origins might support one theory of decision-making versus another, but rather a more parochial one regarding how a selected type of evidence fits one particular theory of decision-making.³

I characterize this strategy as an isolationist one and note that it has specific implications for the representation of individual persons as economic agents. Though preferences themselves are unobservable, revealed preference theory does not abandon the concept of preference itself, and in fact employs it in a special way in the standard preference or utility conception of individuals. The explanation is as follows. First, individuals are assumed to be rational, a characteristically economic idea, meaning that they generally behave consistently in conditions of scarcity in markets judged to be free and competitive, also a characteristically economic idea. Second, individuals' preferences are assumed to fulfill a set of formal assumptions or 'axioms' selected and adopted so as to guarantee that people's actual preferences can be characterized as *well-defined* or *well-ordered*. Third, the von Neumann-Morgenstern utility function theorem then states that individuals with well-defined preferences can be assigned individual (homothetic) utility functions that explain their decision behavior in conditions of scarcity (von Neumann and Morgenstern 1944). This then gives us the preference or utility conception of individuals. Thus, just as only evidence of observable choices in market settings is relevant to revealed preference theory's explanation of decision-making behavior, so the utility function identity conception of individual persons as economic agents is also grounded in the evidence regarding choice available only from economics.

It might be asked, however, if preferences are unobservable and only inferred from individuals' observable choices, why should we suppose people possess utility functions? For proponents of revealed preference theory, however, this question is ill-formed. You cannot ask whether people actually *have* utility functions on the order of saying that a utility function is a property a person could possess, because utility functions are not regarded as observable natural properties people might or might not have. Rather utility functions are merely constructed formal representations that economists ascribe to people in order to explain their choice behavior *as if* they possessed utility functions. It might then be complained that this reasoning is circular since it relies on assuming a set of axioms constructed in such a way as to be consistent with revealed preference evidence of choice behavior characterized in such a way as to be consistent with those axioms. For proponents of revealed preference theory, however, this complaint is also misguided since it fails to understand the role that instrumentalist modeling methodology plays in economics. Instrumentalism

³ The view of revealed preference I provide here is intended as one broadly characteristic of most economists' thinking. For more sophisticated views of revealed preference theory, see Hausman (2008) and Hands (2013).

(Friedman 1953) has as its principle tenet that explanations in economics need not be realistic – they may even be circular – as long as they predict well. A model, that is, is essentially just a tool whose value is determined by its usefulness. Thus even if there were neural and cognitive evidence explaining people's preferences which supported saying people had certain observable natural characteristics and therefore certain properties as decision-making agents (e.g., Lichtenstein and Slovic 2006), this would be of no particular value to economists since in their view the 'as if' utility function representations of individuals and their modeling of revealed preference behavior are already sufficiently predictive. Again, any such evidence would be redundant to economics as a predictive science.

The majority of economists consequently believe that neuroscience has little if anything to contribute to economics. Their (i) revealed preference theory of choice behavior, (ii) its axiomatic, well-ordered preferences, utility function basis, and (iii) its instrumentalist methodological defense constitute an integrated theoretical-methodological framework which serves to make economics' explanations self-sufficient and in no need of other science resources. Let us turn, then, to the minority view regarding neuroeconomics, where we see that those who argue that economics would benefit from closer connection to other sciences have targeted these three positions, thereby presupposing this vision of economics as an isolated science.

3. Why Neuroscience Should Matter According to Some Economists

(1) In contrast to the majority of economists who believe neuroscience has little to contribute to economics on the grounds that data from psychology and neuroscience are irrelevant to explanations of rational decision-making, the minority view is that there is considerable evidence from both psychology and neuroscience that people do not make decisions in the way described by standard rationality theory, implying that richer data sources could improve explanations of choice behavior (e.g., Kahneman, Knetsch, and Thaler 1991; Kahneman 2003; Camerer, Loewenstein, and Prelec 2005). Revealed preference theory, we saw, rules out any investigation of what underlies decision-maker preferences because choices observed in markets are thought to fully reflect rational behavior. It follows, then, that if on the contrary economic agents do not always behave rationally, what underlies decision-maker preferences is no longer clearly unimportant and may well be relevant to explanations of choice.

(2) The behavioral 'anomalies' of psychological and neuroscientific data seem to show decision-makers regularly exhibiting anomalies relative to the axioms governing preferences that they violate (Thaler 2000). That such 'anomalies' are apparently not uncommon then means it is no longer clear what

axiomatic foundation *ought* to underlie choice theory, or indeed whether choice theory *should* even have axiomatic foundations. I express this in terms of ‘ought’ and ‘should’ in order to emphasize the larger methodological argument behavioralists make regarding the empirical basis for standard choice theory’s axiomatic foundations. Their larger methodological argument (cf. Heukelom 2014) is that an axiomatic, top-down type theory of behavior can only provide a normative account of choice – how people should act in order to be rational – whereas behavioral economics offers an empirically-driven, bottom-up type theory of behavior that provides a descriptive account of choice – how people actually act whether or not this fits some prior set of logical requirements. General principles of explanation are not ruled out, but have a provisional or hypothetical status rather than a logical one. From this perspective, for behavioralists an axiomatic approach to theory does not lead to the sort of good empirical science that is practiced in psychology and neuroscience.

(3) If decision-makers regularly violate the standard axioms governing preferences, then it follows that they cannot be ascribed distinct individual utility functions. Again, the standard view is not that people actually possess utility functions as natural characteristics, but rather it is *as if* they had utility functions, where this ‘as if’ reasoning and dismissal of realism is justified in instrumentalist-predictionist methodological terms. Behavioral economists, however, have been critical not only of the ‘as if’ utility function foundation for explaining economic behavior, but also of a methodology that eschews realism on the grounds that it predicts well (e.g., Camerer 2006; Berg and Gigerenzer 2010). In their view, standard decision theory does not predict well, but even if it did, good explanations should both predict well and realistically describe the characteristics of decision-makers in light of the evidence we have from their behavior.

Consider, then, how two leading behavioral economic theories of what decision-makers are reflect this empirically-driven, bottom-up behavioral approach as an alternative to mainstream revealed preference theory.

Herbert Simon (e.g., 1976) advanced an early behavioral theory of decision-making intended to realistically explain how people actually behave that explained decision-making in a procedural rather than substantive rationality terms. Procedural rationality is rule-based rather than goal (utility maximization)-based kind of behavior. As rule-governed it has the advantage that it can be explained empirically in terms of observable patterns of behavior. Simon then framed his characterization of decision-makers so as to reflect this: decision-makers are satisficing information-processing agents (rather than utility maximizers), where satisficing was explained in terms of attaining observable thresholds in information processing needed to make decisions.

Daniel Kahneman and Amos Tversky initially developed their empirically-based heuristics and biases explanation of non-standard decision-making beha-

vivors (Kahneman and Tversky 1973; Tversky and Kahneman 1974), and then set out their prospect theory account of decision-makers (Kahneman and Tversky 1979). Like Simon, they drew on evidence from psychology that economists had ignored in order to identify regularly observable behavioral characteristics of decision-making. From this evidence they then inferred that individuals possessed subjective value functions (rather than utility functions) in which the value of outcomes for individuals is determined relative to observable reference points.

Neuroeconomics, then, is simply an extension of these strategies from psychology to additional sources of data produced by neural imaging. “Neuroscience uses imaging of brain activity and other techniques to infer details about how the brain works” (Camerer, Loewenstein, and Prelec 2005, 9). How the brain works presumably underlies how people make decisions. However, neuroscience tells us that the brain’s organization and functionality do not correspond very well to mainstream theory’s understanding of how the rational decision-maker behaves. “While not denying that deliberation is part of human decision making, neuroscience points out two generic inadequacies of this approach – its inability to handle the crucial roles of automatic and emotional processing” (ibid., 10). Decision-making, then, combines cognitive and affective mechanisms, and does not rely exclusively on rational deliberation regarding relative values conveyed by prices. Neuroeconomists thus agree with behavioral economists that standard theory offers a normative account of rationality. Preferences are not well-ordered and people do not appear to have ‘as if’ utility functions.

Note, then, that the minority and majority views in economics regarding neuroeconomics share agreement that the issue immediately dividing them is whether data from psychology and neuroscience are irrelevant to explanations of decision-making in economics. Yet behind this disagreement lies a further dispute over what good explanations in economics involve, with the mainstream relying on a formal axiomatic approach to choice and behavioral economists and neuroeconomists preferring an empirically-driven approach to choice. How could this deeper division have come about if social science in the postwar period was largely driven by a single set of historical forces associated with continued increase in sophistication of the scientific method, rapid advance of information-processing capacities, and a generally perceived need to further apply the fruits of science to social improvement?

The answer, I believe, essentially lies in economics’ postwar turn away from the other social sciences brought about by its unique commitment to formalization and ever greater reliance on mathematical argument (Weintraub 2002). This ‘formal turn’ in mainstream economics went hand-in-hand with the narrowing of the vision of the economic process itself to the Walrasian general equilibrium model as elaborated in Arrow-Debreu terms (Arrow and Debreu 1954; cf. Blaug 2003). This effectively isolated economics from other social

sciences, and undermined discussion of economics' relation to other social sciences – its science context. When this issue arose anew in connection with 1970s and 80s economics imperialism, it arose only in distorted fashion in the guise of how economics might substantively transform other social sciences without affecting its own content.

I turn, then, from the issue of mainstream economics' science context to the issue of its social context. The framing of the debate regarding neuroeconomics as a debate over whether economics operates independently of other sciences effectively worked to isolate economics from important questions regarding its social context – in particular the fundamental issue of what individual economic agents are. This issue could not really be raised as long as the main debate regarding economics' relation to other sciences concerned the kinds of evidence other sciences generated. In the next section, then, I address how this issue is set aside by economics' self-isolation as a science and in the following section I address how neuroscience and psychology have explored individual identity in connection with different ways they have sought to understand the relation of theory to evidence.

4. How Mainstream Economics Explains Individual Identity

To begin, it is worth stating that the reason economics needs to be able to explain individual identity is tied up with its being a causal science. Being a causal science entails explaining how causes bring about effects, which in turn requires being able to identify what things function as independent causes in cause-effect sequences. Most mainstream economists assume individuals are independent causal agents, and many reject the view that groups of individuals act as causal agents. They accordingly need to be able to explain what makes individuals distinct from one another *en route* to saying that they act as independent causal agents. Otherwise they run the risk of fabricating explanations of cause-effect sequences and falsely describing how economies work. Thus explaining identity, or explaining the identity of agents, underlies causal science.⁴

We saw above that mainstream economics explains the distinctness or independent identity of individuals in terms of the preference or utility conception of individuals. Their view is that if individuals' preferences are well-ordered

⁴ I treat distinctness, or individuation, as one of two criteria that need to be fulfilled to explain the identity of any entity, and the re-identification of entities on the basis on which they are explained as distinct as a second criterion that needs to be fulfilled if an entity's independent identity is enduring (Davis 2011). Here I focus only on this first criterion – because it is not fulfilled by the preference-utility conception of the individual.

according to the standard axioms, they can each be assigned independent individual utility functions. Note, then, how this explanation is circular. An individual's well-ordered preferences that allow the individual to be represented by and identified with an independent individual utility function are of course that individual's own preferences, not someone else's preferences. Thus the preferences-utility conception of the individual says that if one has one's own (well-ordered) preferences, one can be represented with a utility function and then identified as an independent individual. This, however, only assumes what needs to be shown. What in effect is done is to delimit sets of properties found in the world that are already seen to belong to individuals, and then say this delimited set 'identifies' individuals. In contrast, in a non-circular individuation strategy for showing distinctness of an entity one delimits some set of properties in the world that do not in any way presuppose an entity said to possess them, and only then ascribes individual identity to that delimited set of properties on the grounds that they function as a single thing. That is, individual identity arises out of how the world happens to work and how it happens to individuate causal agents.⁵

That the preference/utility conception of individuals is not only circular but also largely meaningless can be seen from the fact that mainstream economists regularly claim all sorts of 'agents' – whether single individuals, collections of individuals such as firms and nations, individuals' different selves, animals, machine algorithms, etc. – can equally be said to have assignable well-ordered preferences, and can therefore be identified as independent causal agents that can be represented by their own respective utility functions. In effect, since their individuation procedure is circular, it cannot discriminate between real world entities to which it applies, and thus has no way of explaining how the utility identity conception attaches to the world. Philosophically speaking, then, the mainstream approach lacks an adequate theory of reference or semantic explanation of how its terms pick out entities in the world.

Why does the mainstream employ a transparently circular individuation procedure for identifying causal agents? I argue that as an isolated science this follows from its top-down closed nature. Since the strategy of such a science is to universalize its principles and employ them in any and all contexts of application without adjustment, it needs to adopt a logical type of approach that in advance fully determines in every case how evidence is organized and explained. That logical approach then stems from its axiomatic approach to preferences, which accordingly produces its circular construction of individual

⁵ In Davis (2011, 7) I give as an example of a non-circular individuation procedure how Coase (1937) explains the individual identity of firms by delimiting nonmarket exchange as a distinct domain of economic activity that has its own set of causal effects different from what the domain of market exchange involves. The identity of firms is an outcome of our understanding of kinds of exchange phenomena. See the following section where I show how psychology and neuroscience employ this strategy.

identity. Individual identity in this regard is only a nominal concept rather than real one – in effect, a Kantian *Ding an sich*, or a thing only as it is in itself, which since not something explained through human understanding in conjunction with empirical evidence must therefore be unknowable and mysterious. How, then, might individual identity be explained by neuroscience?

5. How Neuroscience Explains Individual Identity

As discussed in section three, psychologists and neuroscientists argue there is considerable evidence of ‘anomalies’ in people’s decision behavior that imply people’s preferences do not invariably conform to the standard axioms governing well-ordered preferences. This then undermines ascribing individual utility functions to people and the standard basis for saying individuals act as independent causal agents. At the same time, many psychologists and neuroscientists appear inclined to believe, like most economists, that individuals often act as independent causal agents, even if they also believe that groups of individuals can be causal agents. What alternative basis, then, might they offer for individuating people (and groups of people) as independent causal agents? Here I review a spectrum of four different types of strategies for explaining the identity of individuals as independent economic agents, moving from a sort of thinking that resembles economics’ traditional individualist utility function strategy to a quite different sort of thinking associated with the idea of distributed cognition.

(1) The thinking that most resembles economics’ identity conception is Kahneman and Tversky’s prospect theory, which identifies individuals with their respective value functions V (Kahneman and Tversky 1979, 275). One thing that is distinctive about their view is that decisions are always made from a reference point (where individuals are more concerned about losses than gains). So in contrast to standard utility theory, decisions are always made from a *location* in the spatio-temporal sense of a past inherited position. While ‘location’ can be interpreted in many ways, one thing that can be said to be implied by an agent having a ‘location’ is also having a body, since being in some place involves there being something occupying that place, call it a body. From this perspective, individuals could then be said to be distinct from one another and identified as independent causal agents in virtue of their having special access to the different bodies they have. Thus, in a bottom-up way, we observe decision-making has a bodily *location* and then in a non-circular way we individuate decision-makers by their bodies.

(2) The independent body conception of individual identity, however, is problematic for a reason unrelated to its adequate individuation procedure. Psychology and neuroscience both offer models whereby individuals have quite different ways of processing information. For example, one common strategy

is to distinguish between myopic or short-sighted selves and planning or far-sighted selves (Thaler and Shefrin 1981; Fudenberg and Levine 2006). Another is to distinguish between quick, intuitive processing selves and slow, deliberative processing selves (Kahneman 2003). Thus, if individuals' different ways of processing information largely work independently of one another, though they belong to one body, this would rather justify saying individuals are made up of multiple selves and thus not identifiable as single selves. So having a single body location is insufficient for explaining individual identity, unless it could somehow be argued that individuals' multiple selves are compelled to function as a single bodily unit despite this involving different types of decision-making.

(3) That individuals' multiple selves are compelled to function as a single bodily unit has indeed been argued using game theory. The 'games' that a person's multiple selves play then produce intra-personal equilibria type outcomes for the single person, so that the person functions as an identifiable independent agent despite being made up of distinguishable selves. (a) One such strategy uses non-cooperative game theory to explain how individuals with multiple selves act as single individuals in virtue of their ability to develop overall self-confidence to overcome the division between myopic and farsighted selves associated with weakness of will. Individuals are then single individuals because they exercise self-control over their many selves (Bénabou and Tirole 2002, 2003; cf. Davis 2011, 50 ff.). (b) In another strategy cooperative and non-cooperative game theory have been used together to explain how non-cooperative interaction between individuals compels cooperative interaction between individuals' multiple selves (Ross 2005; cf. Davis 2011, 125 ff.). That is, interpersonal equilibria between individuals and intrapersonal equilibria between individuals' multiple selves are mutually determining.

However one regards these game theory conceptions of individual identity, they have the advantage that they employ a non-circular individuation procedure. Though their proponents might be predisposed to identify single people as individual agents, in both cases people only get credited as such when their multiple selves can be observably shown to function as single individual agents. Interestingly, moreover, both of these game theory strategies for explaining individual identity also go beyond delivering explanations that focus exclusively on the internal unity of individuals by allowing for a complementary supporting role for external social structures, culture, and institutions. In the case of (a), the self-control approach, people are also said to develop personal rules that reinforce self-confidence (Bénabou and Tirole 2004). Rules, even personal ones, have a public quality that tends to give them further force. So self-control operates within social structures. In the case of (b), the combined cooperative and non-cooperative game theory approach, people are also said to keep track of how they function as single individuals with narratives they report about themselves, that is, autobiographies (Ross 2005, 285 ff.).

Should we suppose, however, that all autobiographies effectively have co-authors because narratives of any kind are socially constructed (Dennett 1991), then culture and institutions are added to social structure to provide a further basis beyond the individual to the explanation of what makes individuals independent agents.

If we say, then, that these two game theory explanations are *internalist* because they first focus on selves *internal* to the individual, then these further supporting apparatuses can be characterized as *external* social aspects of individual identity, or as forms of *external scaffolding* for individual identity (Clark 1997). The internal-external distinction, then, while perhaps not the best way of representing identity, is nonetheless particularly helpful for understanding what especially distinguishes the fourth strategy for addressing individual identity, the distributed cognition approach.

(4) First note what the technology of neuroscientific and neuroeconomic research using scanner technologies and magnetic resonance imaging (MRI) involves. Single individuals are placed in scanners, and their brain activity is observed under different conditions. In the case of neuroeconomics, individuals engage in various types of economic behavior, such as playing the ultimatum game, and how the brain is activated then provides the basis for theoretical claims about what motivates people in such games, and thus about the nature of economic behavior. While it might seem, then, that placing an individual body in a scanner *de facto* establishes the body as the subject of investigation as in (1) above, in fact the placing of a person's body in a scanner presupposes that the scanner-reading capacities have been *normalized* so as recognize that person's brain activity as not only human brain activity, but also as an average human brain activity. That is, as neuroscientists and neuroeconomists know, individual brains are not scanned *de novo* but always relative to a benchmark *normal* brainset that has been constructed, tested, and tuned from a sample of individuals intended to be representative of individuals who will enter the scanner (Dumit 2004; Davis 2010).

This tells us that the cognition the particular individual in the scanner engages in must be understood relative to the cognition individuals engage in who have been previously scanned in the construction of the 'normal' brainset. So the cognition we observe in a particular scanned individual is in effect an instance of cognition distributed across a population of individuals. The distributed cognition idea in this sense is the idea that human cognition or information processing is spatially and temporally distributed in the world, not housed strictly within individuals and added up across them. Yet if cognition is distributed in this way, it follows that what makes particular people independent individuals must be similarly understood in a distributed way. That is, just as we need to understand individual cognition within a system of distributed cognition, so we need to understand individual identity within a system of individual identity. Two points can be made in this regard.

First, since scanner technology is just one type of technology, in principle what individualizes people can consequently vary according to the technology in use. Compare another quite different technology: digital currencies that work through the blockchain technology, such as bitcoin. What this involves is a distributed digital ledger that requires those transacting in the currency employ a cryptographic key that uniquely and securely identifies them as independent individuals. Like the scanner, the technology thus individualizes people relative to a population who are all similarly individualized. So it follows that different technologies individualize people differently. Thus, how we might understand individual identity depends in a bottom-up way on how research technologies mediate theories of behavior and the evidence those technologies generate.

The second point concerns the need to understand distributed identity systemically. Consider the ‘external scaffolding’ concept above in (3). Personal rules in their social uptake and narratives requiring others’ participation support individual identity in a way that goes beyond what individuals themselves do. Yet these scaffolds only add an *external* facilitating dimension to individuals’ behavior. This way of putting things, that is, misses how distributed systems subsume the internal-external distinction. While it may seem that the way scanner technology works is to compare particular individuals with individuals on average, thus explaining individual identity relative to social groups still in essentially an individualist manner, the use of the technology clearly also works in the opposite direction, since evidence regarding collections of scanned individuals also has implications for how neuroscientists construct average or ‘normal’ brainsets. Consequently the proper perspective is one in which individuals have independent identities only in a system of independent identities. From this perspective, just as how changes in research technologies change the basis on which researchers investigate such systems, so also changes in the social basis for behavior that they investigate will also change the basis on which individuals are dependent. From the distributed cognition point of view, the systemic means of research used to investigate behavior presupposes the distributed nature of individual identity itself.

6. Economics’ Possible Evolution

In this paper I argued that the debate in economics regarding neuroeconomics fails to address deeper issues facing economics associated with the changing relationships between theory and evidence. In the last two sections I have contrasted two quite different approaches to the issue of what constitutes individual identity in order to show both how the issue has been pushed off the agenda of mainstream economics and how a different type of science opens up thinking on the subject to a range of conceptualizations. This leaves the question of economics’ future. I conclude with two brief comments on economics’ possible evolution in light of its interaction with other sciences.

First, it is difficult to believe economics can sustain its practice of and commitment to being an isolated science in the long run. From a history of economics perspective, the record seems to be that dominant approaches alternate with periods of pluralism, and dominant approaches once superseded do not return to orthodoxy (Davis 2008). From a social and historical point of view, globalization and rapid change in technology have had and will surely continue to have transformative effects on science just as they do on society. If one believes that economics' postwar self-isolation was in part a product of the Cold War and the need to show that capitalism's mathematics of markets was superior to communism's planning of economies, then it seems reasonable to think that with this pretext gone economists will search for other conceptions of economics' nature and purpose, and these could well involve greater integration with other sciences. The ongoing reverse imperialism since the 1990s suggests that this is indeed occurring.

Yet at the same time one should not underestimate how deeply rooted economics' commitment is to rational decision theory, the heart of its nature as a self-isolated closed science. Nor should one underestimate how an explanatory strategy based on applying a universal behavioral principle in any and all settings might serve a different need in societies likely to be increasingly confronted with problems of bureaucratically administering large populations. Should this, moreover, involve continually addressing new, unexpected forms of social conflict, a social science that always has an explanation of what this seems to involve and what should thus be done might be welcome, however inadequate a theory and policies always based on the same recommendations might be. Economics' social context, then, will presumably continue to create priorities different from its science context, and as we cannot anticipate very well how its social context might evolve, caution is advised regarding making predictions about economics' character as a science in the future.

References

- Arrow, Kenneth and Gerard Debreu. 1954. "Existence of an Equilibrium for a Competitive Economy." *Econometrica* 22: 265–290.
- Bénabou, Roland and Jean Tirole. 2002. "Self-Confidence and Personal Motivation." *Quarterly Journal of Economics* 117 (3): 871–915.
- 2003. "Self-Knowledge and Self-Regulation: An Economic Approach." In *The Psychology of Economic Decisions: Vol. 1: Rationality and Well-Being*, edited by I. Brocas and Juan Carrillo, 137–167. Oxford: Oxford University Press.
- 2004. "Willpower and Personal Rules." *Journal of Political Economy* 112 (4): 848–886.
- Berg, Nathan and Gerd Gigerenzer. 2010. "As-if Behavioral Economics: Neoclassical Economics in Disguise?" *History of Economic Ideas* 18 (1): 133–165.

- Blaug, Mark. 2003. "The Formalist Revolution of the 1950s." *Journal of the History of Economic Thought* 25 (2): 145–56.
- Camerer, Colin. 2006. "Behavioral Economics." In *Advances in Economics and Econometrics: Theory and Applications*. Vol. 2, edited by R. Blundell, W. Newey, and T. Persson, 181–214. Cambridge: Cambridge University Press.
- Camerer, Colin, George Loewenstein, and Drazen Prelec. 2005. "Neuroeconomics: How neuroscience can inform economics." *Journal of Economic Literature* 43 (1): 9–64.
- Clark, Andy. 1997. *Being There: Putting Brain, Body and World Together Again*. Cambridge, MA.: MIT Press.
- Coase, Ronald. 1937. "The Nature of the Firm." *Economica* 4 (16): 386–405.
- Davis, John. 2008. "The Turn in Recent Economics and the Return of Orthodoxy." *Cambridge Journal of Economics* 32 (3): 349–366.
- 2010. "Neuroeconomics: Constructing Identity." *Journal of Economic Behavior and Organization* 76: 574–583.
- 2011. *Individuals and Identity in Economics*. Cambridge: Cambridge University Press.
- 2016. "Economics Imperialism versus Multidisciplinarity." *History of Economic Ideas*. Forthcoming in press.
- Dennett, Daniel. 1991. *Consciousness Explained*. Boston, MA: Little Brown.
- Dumit, Joseph. 2004. *Picturing Personhood: Brain Scans and Biomedical Identity*. Princeton, NJ: Princeton University Press.
- Friedman, Milton. 1953. *Essays in Positive Economics*. Chicago: University of Chicago Press.
- Fudenberg, Drew and David Levine. 2006. "A Dual Self Model of Impulse Control." *American Economic Review* 96 (5): 1449–76.
- Fumagalli, R. 2010. "The Disunity of Neuroeconomics: A Methodological Appraisal." *Journal of Economic Methodology* 17 (2): 119–31.
- Glimcher, Paul. 2003. *Decisions, Uncertainty and the Brain: The Science of Neuroeconomics*. Cambridge, MA: MIT Press.
- 2010. *Foundations of Neuroeconomic Analysis*. Oxford: Oxford University Press.
- Gul, Faruk and Wolfgang Pesendorfer. 2008. "The Case for Mindless Economics." In *The Foundations of Positive and Normative Economics: A Handbook*, edited by A. Caplin and A. Schotter, 3–39. Oxford: Oxford University Press.
- Hands, Wade. 2013. "Foundations of Contemporary Revealed Preference Theory." *Erkenntnis* 78 (5): 1081–1108.
- Hausman, Daniel. 1992. *The Inexact and Separate Science of Economics*. Cambridge: Cambridge University Press.
- 2008. "Mindless or Mindful Economics: A Methodological Evaluation." In *The Foundations of Positive and Normative Economics: A Handbook*, edited by A. Caplin and A. Schotter, 125–51. Oxford: Oxford University Press.

- Herrmann-Pillath, Carsten. 2016. "Performative Mechanisms." In *Enacting Dismal Science: New Perspectives on the Performativity of Economics*, edited by I. Boldyrev and E. Svetlova. London: Palgrave Macmillan. Forthcoming in press.
- Heukelom, Floris. 2014. *Behavioral Economics: A History*. Cambridge: Cambridge University Press.
- Kahneman, Daniel. 2003. "Maps of Bounded Rationality: Psychology for Behavioral Economics." *American Economic Review* 93 (5): 1449–1475.
- Kahneman, Daniel, Jack L. Knetsch, and Richard Thaler. 1991. "Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias." *Journal of Economic Perspectives* 5 (1): 193–206.
- Kahneman, Daniel and Amos Tversky. 1973. "On the Psychology of Prediction." *Psychological Review* 80 (4): 237–51.
- 1979. "Prospect Theory: An Analysis of Decisions under Risk." *Econometrica* 47 (2): 263–91.
- Lazear, Edward. 2000. "Economic Imperialism." *Quarterly Journal of Economics* 115 (1): 99–146.
- Lichtenstein, Sarah and Paul Slovic, eds. 2006. *The Construction of Preference*. Cambridge: Cambridge University Press.
- Neumann, John von, and Oskar Morgenstern. 1947 [1944]. *Theory of Games and Economic Behavior*. 2nd ed. Princeton, NJ: Princeton University Press.
- Ross, Don. 2005. *Economic Theory and Cognitive Science: Microexplanation*. Cambridge: MIT Press.
- 2008. "Two Styles of Neuroeconomics." *Economics and Philosophy* 24 (3): 473–484.
- Simon, Herbert. 1976. "From Substantive to Procedural Rationality." In *Method and Appraisal in Economics*, edited by S. J. Latsis, 130–31. Cambridge: Cambridge University Press.
- Thaler, Richard. 2000. "From Homo Economicus to Homo Sapiens." *Journal of Economic Perspectives* 14 (1): 133–41.
- Thaler, Richard, and H. M. Shefrin. 1981. "An Economic Theory of Self-Control." *Journal of Political Economy* 89 (2): 392–406.
- Tversky, Amos and Daniel Kahneman. 1974. "Judgement under Uncertainty: Heuristics and Biases." *Science* 185 (4157): 1124–31.
- Vromen, Jack. 2010. "Neuroeconomics: Two Camps Gradually Converging: What can Economics Gain from It?" *International Review of Economics* 58: 267–85.
- Weintraub, E. Roy. 2002. *How Economics Became a Mathematical Science*. Durham, NC: Duke University Press.