

Is a Multi-Level Theory of the Agent Necessary? The Vernon Smith Perspective

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Abstract:

Vernon Smith asserts that in order to realistically represent the multi-level nature of agents, it is necessary to go beyond economic theory. Drawing on resources from various disciplines, including the cognitive sciences, social psychology, and neuroscience, Smith builds two concepts: constructivist rationality (an individual's conscious, deliberate use of reason, which leads to variability) and ecological rationality (a spontaneous, unintentional emergent social order, which acts as a mechanism of evolutionary selection). Key to this explanation is a three-level conceptualization of the agent: 1) the internal order of the mind; 2) the external order of social exchange; and 3) the extended order of markets. The existence of these levels allows agents to respond in complex ways adapted to their environments, representing the multi-level nature of human beings.

Key Words: Vernon Smith, multi-level analysis model, multi-level agent theory, ecological rationality, constructivist rationality

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Introduction

Vernon Smith's theory is one of the most advanced in building a multi-level explanation of agents. Throughout over 50 years of economic experiments, Smith contrasted neoclassical theory with reality, and made progress in constructing an alternative theory. This experience has turned him into one of the most original, informed, and critical-thinking economists of the twentieth century. As a result, Vernon Smith was awarded the Nobel Prize in economics in 2002.

Smith challenges the notion that the economics and humanities are distinct from one another and not related. Beyond the disciplines and scientific specialization, he asserts that it is necessary to place human beings at the center of analysis. To Smith, a new form of approaching human beings as the object of study was required, building on what Jan Osborn and Bart Wilson—revisited by Smith—called *humanomics* (Smith, 2012).² This paper aims to reconstruct the response Smith would give to the question: how can we represent the multi-level nature of human beings?

If the idea is to realistically represent the agent, we must go beyond mere economic theory. Smith explores responses, not in the normative space of economic axioms or theorems, but rather in a broader set of other disciplines: neuroscience, psychology, biology, the social sciences, and the humanities. Each and every one of them, in each level of reality, helps him identify complementary properties and mechanisms. He aspires to unified, interdisciplinary explanations of human nature.³

The structure of this paper is as follows. The first section summarizes the efforts made by economic theory to explain the nature of economic agents. Then, we examine Smith's concepts of constructivist and ecological rationality. In the second section, we review his three orders: *i*) the internal order of the mind; *ii*) the external order of social exchange; and *iii*) the extended order of markets. Finally, we conclude with the importance and implications of Smith's interdisciplinary oeuvre.

The Controversy Surrounding the Economic Agent

Is it necessary and possible to build a theory of the economic agent? In various ways, the neoclassical school aspires to answer this call. Edgeworth and Fisher, beginning with physical signs, infer the unobservable hedonistic reasons (pleasure-pain) underlying decision-making (Colander, 2007). In the early 1930s, Samuelson, Arrow, and Debreu constructed a mathematical structure for choice, starting with the most simple or primitive choices possible. This theory sought to establish an ideal normative framework that would elucidate the process of choice and the efficient allocation of resources (Glimcher *et al.*, 2009).

Beginning with Samuelson (1938), attention shifted to revealed preferences; rather than explaining the factors underlying the choice process, this work focused only on the observed consequence of preferring one option over another. The environment does not influence the agent, and the agent neither communicates nor interacts with others. The revealed axiom preference suppresses interest in the social and psychological nature of decision-making. As such, neoclassical theory breaks the bond between psychology and economics (Bruni and Sugden, 2007).

Von Neumann and Morgenstern (1944) join the chorus with their expected utility theory, which is a formal explanation for decision-making in situations of uncertainty. With it, they contributed to laying the groundwork for game theory and, akin to rational choice theory, they assume that their *ideal* agents have extraordinary abilities. Learning is represented as an algorithmic improvement in statistical inference (Mirowski, 2009). However, although expected utility theory acknowledges that deliberation capacities are key in decision-making processes, it is inadequate in making predictions when an ecological understanding of behavior is sought (Smith, 2002; Tversky and Kahneman, 1987; Gigerenzer *et al.*, 1999; Ostrom, 2005; Poteete, Janssen, and Ostrom, 2012).

In 1953, Maurice Allais observed that the behavior of agents violates the central axiom of *independence* in the expected utility theory. Daniel Ellsberg (1961) moreover demonstrated that the ambiguity of evidence upon which judgment is constructed can influence choices, in this way violating one of the central axioms of rational choice theory. The response to these critiques, crafted by Milton Friedman (1966) in *The Methodology of Positive Economics*, affirms that for neoclassical theory, it is entirely irrelevant whether or not the assumptions with which the theory is constructed are realistic; what matters, as it were, is their predictive capacity. From this point of view, the experimental evidence indicating the profound anomalies of rational choice can be disregarded.

Herbert Simon, and later on, Daniel Kahneman and Amos Tversky, at the end of the 1970s and the beginning of the 1980s, conducted numerous experiments, demonstrating that the Allais and Ellsberg paradoxes represent only a small sample of the much broader universe of anomalies. Behavioral economic theorists signal that the mind makes *systematic errors*, against the dogmatic assumption made by rational choice theory that the mind is logical. Judgments and decisions are better understood as heuristic processes, in which cognition and emotions participate (Kahneman, 2012; Hodgson, 2013).

The empirical discoveries of experimental economics (Plott and Smith, 2008; Smith, 2008; Ostrom, 2005) and neuroeconomics (McCabe and Smith, 2002; Camerer, Loewenstein, and Prelec, 2005; Krueger, Grafman, and McCabe, 2008; Glimcher, Camerer, Fehr, and Poldrack, 2009) demonstrate that human beings confront more complex situations than those posed by neoclassical economics, with limited capacities and in the face of great uncertainty. Despite these limitations, human beings have survived and prospered, because they have developed tools to remedy some of these constraints and to deal with situations in changing environments (Oda, 2007). Accordingly, for example, it is different to engage in an exchange in an environment with an abundance of resources than in a precarious environment, just as it is different to engage with known members of a group rather than with strangers⁴ (Ostrom, 2005; Smith, 2008).

It is for this reason that explanations that reduce behavior to a single variable or motivation fail to recognize the wealth and complexity of human nature. An agent has multiple attributes⁵ (Sen, 2006; Nussbaum, 2010); manifold capacities: emotional, cognitive, deliberate and automatic thought, etc. (Hodgson, 2013; Ostrom, 2005); and not just one, but several different neuroanatomical modules or regions that compete with one another and cooperate in the decision-making process (Hayek, 1952; Camerer, Loewenstein, and Prelec, 2005). But, how does Vernon Smith study these different dimensions?

Constructivist and Ecological Rationality

In pursuit of a realistic explanation of the agent, Vernon Smith abandons the utilitarian and normative perspective of neoclassical theory. He considers it necessary to find an approach consistent with the way in which other disciplines represent the human being, and consistent with what flesh and blood men and women think. This leads him to study the Scottish philosophers, in particular, the moral philosophy of Adam Smith and David Hume, and it is beginning with them, inspired by Hayek's (1960, 1967, 1973, 1988) works and based on an extensive and rich empirical experience provided by experimental economics, that he started to consider the agent, far from being perfectly and completely rational, as reliant on two forms of rationality: *i*) constructivist and *ii*) ecological (Smith, 2003, 2004, 2008).⁶

***i*) Constructivist Rationality**

Derived in part from Descartes, Bacon, and Hobbes, constructivist rationality is traditionally identified with the postulates of the *standard model of the social sciences*. An agent is characterized as selfish and maximizing. He makes decisions coldly, seeking only to optimize his gains, defined as pure wealth or utility. In summary, the *economic man* (Smith, 2003).

Vernon Smith recognizes that an agent has rational capacities of consciousness and deliberation, but does not accept the assumptions of complete and perfect information, which are indispensable hypotheses of neoclassical theory. On the contrary, he posits the existence of incomplete and imperfect information, as well as time constraints that weight on the decision-making process. It is impossible to

be consciously involved in each and every single situation of daily life. It is simply not possible to calculate the costs and benefits of each alternative when decisions must be made under time pressure, or with information scarcities (Smith and Szidarovsky, 2003).⁷ Pursuant to the concept of *limited rationality* from Herbert Simon (1996), Vernon Smith considers that agents have limited cognitive resources.

Smith assigns a key function to constructivist rationality: it is a powerful mechanism that “in cultural and biological evolution ‘...’; is good at generating variation, but not selection. Constructivism is indeed an engine for generating variation, but is far too limited in its ability to comprehend and apply all the relevant facts to serve the process of selection, which is better left to ecological processes” (Smith, 2005a: 207). Reason is a powerful mechanism that creates novelty and generates new subsets of rules. However, consciousness and deliberation are limited in their capacity to select facts and variations.

ii) Ecological Rationality⁸

Deliberation processes only explain part of the story. The agent must use other capacities or resources in order to survive. Ecological rationality, through time and the environment, selects the best variants to resolve situations the agent faces, resulting from the use of conscious reason. It allows only the best practices to survive and spread, whether through imitation, explicit teaching (Smith, 2002), experience, or collective processes of trial and error (Smith, 2005a).

Ecological rationality is an “emergent order based on trial-and-error cultural and biological evolutionary processes. It yields home-and socially-grown rules of action, traditions, and moral principles” (Smith, 2005: 206). These *home-grown rules of action* related to the “autobiographical character of memory” (Smith, 2005a: 204) express forms of experience and learning—conscious and unconscious—belonging to each individual and which lead to the emergence of unintentional forms of behavior. Likewise, the rules, traditions, and moral principles are integrated into the analysis as the set of institutional rules that spontaneously emerge in society.

From this perspective, ecological rationality contributes to an understanding of the “emergent order in human cultures” (Smith, 2005a: 206), the outcome of unintentional biological and cultural evolutionary processes. This rationality represents distinct and successful forms, both individual and collective, of prior adaptation, and permits adaptation to changing environments. Accordingly, “the behavior of an individual, a market, an institution, or other social system involving collectives of individuals is

ecologically rational to the degree that it is adapted to the structure of its environment" (Smith, 2008: 36).

In laboratory experiments, the existence of this rationality contributes to explaining how individuals with *zero intelligence* or who are too *simple* to use instruments of constructivist reasoning adapt to their situation (Smith, 2008). This is so, insofar as these individuals have the unconscious capacity to discover the intelligence contained in the rules and structure of the situation (Smith, 2008). It is the ecological conditions that drive the individual to make efficient decisions, rather than the assumptions of economic theory revolving around the internal structure of choice and individual valuations.

In contrast with the strategy of the agent in neoclassical economic theory—monothematic, excessively rational, and converted into a utilitarian machine in terms of its reaction—, the response of an agent endowed with ecological rationality is context-dependent.⁹ Individuals do not always act the same way, even in situations that may seem very similar to one another. Depending on the context, the same individual may act selfishly or opportunistically, or be conditionally cooperative or altruistic.¹⁰ Individuals are capable of creating back-up strategies, and are able to select the right course of action to take in a concrete ecological environment.¹¹ This poses a key question: what capacities enable an agent to make decisions with respect to a changing environment?

The Three Orders of the Mind

One of the most intriguing empirical findings in experimental economics is that agents' behavior changes in an impersonal environment (where they tend to behave as non-cooperators) and a personal environment of exchange (where they tend to be cooperators) regardless, in both cases, of whether the interactions are with strangers. Vernon Smith examines this issue at three levels: the internal order of the mind, the external order of social exchange, and the extended order of the market (Smith, 2008).

i) The Internal Order of the Mind

Just like Hayek in *The Sensory Order* (1952), Smith is interested in explaining the way in which the mind is organized, aiming to capture the idea of a self-organizing and flexible internal order. The mind is the non-conscious product of the joint biological and cultural evolution of our brain (Smith, 2008). One of the qualities of this order is that it begins with experience, and with the lowest cognitive cost possible, the agent learns and adapts to the surroundings.¹²

Vernon Smith understands *mind* to refer to the brain circuit that operates deliberately and has *conscious self-awareness* (Smith, 2009: 177). From the perspective of decision-making and problem-solving, one of the most important products of awareness is that the agents are, in no negligible sense, autonomous: they can choose, reject, or undo a choice. And the most distinctive, insofar as they have language, is that they can be self-aware in this process.

Conscious mind or attention is a scarce resource, which is why the brain has developed mechanisms to conserve these specialized capabilities to confront critical non-habitual tasks.¹³ That is why the brain allows some of memory and learning to depend on unconscious forms of attention.¹⁴ We do not remember—Smith asserts—having learned the majority of our operational knowledge. Natural language is the most notable example, but so is music and practically everything that constitutes our progressive socialization. We learn the rules of a language and efficient social relations without ever receiving explicit instructions, simply by being exposed to our families and social networks (Kagan and Lamb, 1987; Page Fiske, 1991; Kagan, 1994; Pinker, 1994). “That the brain is capable of off-line subconscious learning is shown by experiments with amnesiacs who are taught a new task.¹⁵ They learn to perform well, but memory of having learned the task escapes them (Knowlton *et al.*, 1996)” (Smith, 2005b: 205). Ergo, it is necessary to recognize that the mind does not control the learning processes essential to our survival.

It is then that Vernon Smith asserts, emphatically, that it is “necessary to constantly remind ourselves that human activity is diffused and dominated by unconscious, autonomic, neuropsychological systems that enable people to function effectively without always calling upon the brain’s scarcest resources—attentional and reasoning circuitry” (Smith, 2002: 204). Automatic thought processes contribute to rapid adaptation and reduce the demand for computing capacities, and moreover integrate knowledge that the conscious mind is incapable of understanding. “The brain knows things that the mind does not understand” (Smith, 2009: 179).

The science of the brain aims to explain how it functions, and what features are common or different in the brains of adaptable agents. Vernon Smith wrote: “But I believe that most of our learning about the brain will come from the study of the breadth of extreme variations in particular mental characteristics across individuals in the population. It’s the breadth of variation, not the average that is significant in humans, and perhaps all primates” (Smith, 2009: 178). To Smith, it is essential to integrate into analysis the mental and neuro-anatomical outliers across the range of individuals.

ii) The External Order of Personal Socioeconomic Exchange

The second order is centered on human socializing in small groups of interaction. Diverse factors affect how an agent will behave, in a joint mix of cultural and biological evolution, where the latter provides the abstract potential for definition and the former shapes diverse alternative forms of observable solutions.

Key to the functioning of this order is reciprocity, which is the foundation, in human nature, of our unique status as creatures of social exchange, being universal, spontaneous, and of great evolutionary value. As Adam Smith wrote: “kindness is the parent of kindness” (Smith, 2008: 201). To Smith, there is no suggestion of a deliberate calculation in an act of reciprocity, but rather it is an act that occurs naturally as part of a style acquired throughout history (Smith, 2008).¹⁶ The evolutionary argument is that a predisposition to reciprocity is an adjustment value, which has persisted through diverse cultures of *homo sapiens* for two or three million years (Plott and Smith, 2008). This capacity enabled forms of positive and negative reciprocity to emerge (McCabe, Rasenti, and Smith, 1996).¹⁷ In other words, part of our evolutionary history as animals made it possible for us to develop evolved and complex forms of cooperation and ownership (Smith, 1998). “Reciprocity in human nature (and prominently in our closest primate relative, the chimpanzee) is the foundation of our uniqueness as creatures of social exchange which we extended to include trade with nonkin and nontribal members long, long, before we adopted herder and farmer life styles” (Smith, 1998: 3).

Human beings are characterized, pursuant to Adam Smith (which Smith mentions) by their “disposition to truck, barter, and exchange” (Smith, 2000: 16). Engaging in trade is a quality that distinguishes us from animals. “It is common to all men, and to be found in no other race of animals (...) Nobody ever saw a dog,” wrote Smith, “make a fair and deliberate exchange of one bone for another with another dog” (Smith, 2000: 16). There is a key difference between reciprocity and exchange. Reciprocity is the exchange of favors: I’ll scratch your back if you scratch mine. It means exchanging the same resource or thing at separate moments in time, “not simultaneously” (Smith, 1998: 3). Exchange, trucking, or trade, on the other hand, entails *simultaneously* exchanging two different objects, not favors. It is a form of interaction that demands greater cognitive sophistication than the reciprocity game. The human capacity of exchange arose in the last 100,000 years, embedded in linguistic processes. This capacity is the foundation of the emergence of self-sustaining ownership rights (Smith, 1985, 1998).

Exchange implies uncertainty. It requires a double concurrence of desires to trade two different pairs of goods. In the biological evolutionary timescale, those individuals equipped with strategic interactive capacities were more successful in evolving towards more widespread forms of social exchange. What does Vernon Smith believe are the cognitive capacities that permitted reciprocity to evolve towards exchange?

He presupposes the existence of distinguishable capacities inherent to human beings. To McCabe, Smith, and LePore (2000: 4004), the important principle that permits better coordination is "derived from the human capacity to read another person's thoughts." Such "mind-reading" enables the agent to detect the intentions underlying the reciprocity (Smith, 2008).

Likewise, based on a memory of favors given and received, an agent can engage in "mental accounting" and "goodwill accounting" (McCabe and Smith, 2002). Kindness towards others and working for the good of others are sophisticated forms of behavior, consistent with long-term self-satisfaction and closely tied to creating value and upholding one's reputation. In personal exchanges, reciprocity is used to reduce risk, recognizing that the desire to maintain a good reputation (a high goodwill count between candidate agents for engaging in exchanges) can change the behavior of an agent (McCabe and Smith, 2002).

In evolutionary psychology, "humans have a faculty of social cognition, consisting of a rich collection of dedicated, functionally specialized, interrelated models [...] organized to collectively guide thought and behavior with respect to the evolutionarily recurrent adaptive problems posed by the social world" (Cosmides and Tooby, 1992: 163). Based on this idea, McCabe and Smith (2002) describe a series of functional models specialized in solving the evolutionary problem of social exchange:

1) *Goodwill accounting module*. Based on Coleman's idea of social capital; in this module, an individual keeps track of the amount of goodwill his partner has earned. In every trade where there is reciprocity, points are added to the account, while the perception of unfairness or deceit chips away at goodwill. The higher the amount accumulated, the more likely an individual is to perform a trade.

2) *Friend-or-foe module*. Derived from the principles of action to attribute intentionality from the Premack siblings,¹⁸ it functions as an "early warning system" (McCabe and Smith, 2002) which helps, through environmental or personal information, attribute intentions to other players and avoid those perceived as negative.

3) *Cheater detection module*. Estimates the probability that one player will cheat in the trade, using computational theory questions for the adaptive problem of the exchange, developed by Cosmides and Tooby: "What can be gained from the trade? Where are the greatest gains to be had? What is my partner trying to achieve? What is implicit in the contract, if there is one, with my partner? Is there a trap in this contract? How would my partner react if he caught me cheating?" (McCabe and Smith, 2002: 327).

4) *Shared attention module*. Permits the individual to change dyadic information to triadic information (from "he is thirsty" to "he knows, that I know, that he is thirsty"), which is essential to reading intentions and reciprocity.¹⁹ In this module, McCabe and Smith cover five modules hypothesized by Baron-Cohen:

(a) intentionality detector (ID); (b) eye direction detector (EDD); (c) shared-attention mechanism (SAM); (d) theory-of-mind mechanism (TOMM), believing that they will all be interconnected such that the ID and EDD serve as information inputs for the SAM, which will in turn become an input for the TOMM (McCabe and Smith, 2002: 327).

Together, these capacities permit the construction, learning, and discovery of individual and group preferences. As asserted by Hoffman, McCabe, and Smith (1996: 23-24) about one of the outcomes of their experimental economics:

A one-shot game in the laboratory is part of a life-long sequence, not an isolated experience that calls for behavior that deviates sharply from one's reputational norm. Thus, we should expect subjects to rely upon reciprocity norms in experimental settings, unless they discover in the process of participating in a particular experiment that reciprocity is punished and other behaviors are rewarded. In such cases they abandon their natural instincts, and attempt other strategies that better serve their interests.

In keeping with the tenets of evolution, groups that rely on these capacities discover norms and heuristics that help them reduce transaction costs and remain in existence over time. Norms that last long enough are, on the personal level, internalized and then become common practices. These practices may lead to social laws or norms, although given the changing nature of any environment, emerging practices may always arise that permit adaptation to the context and reduce transaction costs (Smith, 2008).

In other words, reciprocity and personal social exchange—exclusive to human beings—permit specialization, the division of labor in increasingly numerous groups of humans, improved productivity, and welfare. Reciprocity is at the heart of building partnerships in societies without a State, the cement of social constructions that enables the provision of essential public goods (Smith, 2008).

***iii*) The Extended Order of the Market**

Laboratory experiments have demonstrated the notable capacity of their unsophisticated subjects to discover equilibrium states, even without the tools presupposed by the neoclassical model (rationality and unlimited time, complete and perfect information, etc.). According to Vernon Smith, it is likely that this achievement will be the result of the agent making use of the institutions of the impersonal market. This analytical perspective of the functioning of the market diverges from neoclassical theory in the sense that what is essential in neoclassical theory is to explain how supply and demand adjust to match

each other, but for Vernon Smith, the most pertinent focus is to study the behavior of the market as a discovery process (Smith, 2012).²⁰

So, how does this process come about? It is illustrative to follow Vernon Smith's logic of argumentation on this subject. Once the processes are formed, people are ready to discover, through calculations, what it is that they do and do not like, what they do and do not desire, what they want to consume or produce, and how to innovate. In Vernon Smith's point of view, "neoclassical economics turned this message upside down and inside out; it define equilibrium conditional 'n preferences and technology (specialization alternatives) being given and known to individuals, and was mute as to how and what information was to be required. But dozens of millennia before Smith wrote, his axiom had driven human adaptations (...)" (Smith, 2012: 8). In impersonal exchange, agents employ the rules and information existing in the market. Through these rules and information, agents economize the personal mental effort required to clarify the information, create, agree upon, and implement new rules for each new trade. The markets aggregate information beyond what each individual, alone, knows or is capable of comprehending.

Even when information is distributed heterogeneously and asymmetrically between agents, it is possible, through a narrow trial and error process, to converge on a sufficiently good point of stability. The equilibrium is reached not as the result of a deliberate and conscious strategy, but rather as the result of patterns of collective interaction, learning, and imitation. For this reason, the use of the market, by demanding few mental resources of agents, permits greater productivity through specialization.

Therefore, the set of responses the agent will give changes depending on whether he finds himself in a situation of personal exchange or a market situation. In the former case, the capacities of mind-reading, goodwill accounting, recollections of previous exchanges, and a personal search for information in the environment are used. All of these comprise the essential sources of information and knowledge in personal exchanges. In a market situation, by contrast, where relationships are impersonal and, therefore, it is much more feasible to behave opportunistically, the agent will rely more on formal institutions. In this way, ecological and constructivist rational capacity permit the agent to adapt to his environment, building solutions consciously or use those that have already been proven and screened evolutionarily.

Conclusions

Is a multi-level theory of the agent necessary? From the perspective postulated by Vernon Smith, it is indeed. This multi-level vision is necessary to place the human being at the center of the discussion relating economics with the humanities, crafting alternative responses beyond the axioms of neoclassical

economics and closer to reality. In turn, this entails challenges as to the adequate representation of this multifaceted nature.

How can the multi-level nature of the agent be represented? To answer this question, Vernon Smith crafted, building on resources from various disciplines, two concepts: *constructivist rationality*, alluding to an individual's capacity to engage in deliberation and consciousness, which creates variability; and *ecological rationality*, which points to the spontaneous and unintentional emergence of the social order, and which acts as a selection mechanism. The cornerstone of this explanation consists of the three orders: 1) the internal order of the mind; 2) the external order of personal exchange; and 3) the extended order of the impersonal market.

Smith teaches us that in order to reconstruct the behavior of agents, information and knowledge beyond the traditional confines of economics are necessary. It is not feasible for any discipline on its own to address multi-level phenomena. Explanations of human nature that draw on neuroscience, cognitive psychology, biology, sociology, and economics, among others, in combination, elucidate human complexity with greater precision. Likewise, each discipline offers the possibility to design rigorous experiments. And, if the aspiration of theory is to construct falsifiable hypotheses, it is useful to dialogue between disciplines.

Vernon Smith engages in fertile and critical dialogue with neoclassical theory. He models competitive and anonymous situations, specific to the impersonal market, in which constructivist rationality helps to predict what will happen in the choice process, but is not enough to comprehend ecological behavior. Vernon Smith is concerned with a realistic examination of personal and impersonal exchanges in natural and experimental conditions. Just as Allais, Ellsberg, Simon, and Kahneman design critical experiments to demonstrate the anomalies of the model of rationality in neoclassical economics, Vernon Smith contributes to explaining how flesh and blood individuals discover and adapt to their surroundings.

Involved for over 50 years in experimental economics, Vernon Smith is one of the most experienced researchers in the field. This is precisely because the prevailing conventional economics approach has focused on constructing coherent and aesthetically attractive buildings distant from reality. In fact, Vernon Smith advises against reading only economics.

I importune students to read narrowly within economics, but widely in science. Within economics there is essentially only one model to be adapted to every application: optimization subject to constraints due to resource limitations, institutional rules, and/or the behavior of others, as in Cournot-Nash equilibria. The economic literature is not the best place to find new inspiration beyond these traditional technical methods of modeling (Smith, 2005 a: 208).

As such, he critically combines the findings of economic psychology, behavioral game theory, and experimental economics with other scientific disciplines. And just as, at the time, he signaled the need

for a new sub-discipline, neuroeconomics (Smith, 2005a, 2005b), he has also proposed *humanomics* as a new space within which a broad set of disciplines from the social sciences and humanities can converge, sharing the same central ambition and concern: explaining the nature of human beings. Therein resides the intent of this paper to identify the nature of scientific progress entailed by the multi-level explanation of agents proposed by Vernon Smith, to serve as a gateway to the tradition he represents.

²It is revealing that Smith chose the title “Adam Smith on Humanomic Behavior” (2012) for one of his most recent papers.

³One of the hazards of an interdisciplinary vision is that its superficiality can turn the scientist into a dilettante. Is it possible to elude this risk and engage in serious, informed, and profound interdisciplinary studies of human nature? We believe it is. Smith's body of work is exemplary in this sense.

⁴In neoclassical theory, an agent always looks to maximize his utility in the same way. The ecological context is of no relevance. Just like modern biology represents the existence and dynamics of multidimensional evolutionary processes that occur at different speeds and times, so does economics, in studying the individual (Hodgson, 2013).

⁵A person can have multiple identities. A person can be a woman, a feminist, a mother, a worker, a Christian, a Mexican, a member of a political party, etc. The decisions he or she makes will depend on the context and therefore the identity implied.

⁶Smith borrows the two ways of categorizing rationality as constructivist and ecological from Norman (2002).

⁷The example used by Smith in this respect is choosing products in a supermarket. If the agent had to consciously evaluate all of the possible options and combinations, the effort and cost of mental processing would be extraordinarily high, generating opportunity costs superior the benefits (Smith, 2005a).

⁸The proposal to integrate the concept of "ecological rationality" in economic theory must be explained as the result of the dialogue Smith maintained as an economist with neuroscience, biology, psychology, cognitive anthropology, ethnology, and more sciences. The rational ecological order finds its precursors in Hume, Adam Smith, and Hayek (Smith, 2002, 2004).

⁹For example, someone might be a loving father in the morning, an inflexible boss or indiscriminate negotiator during the day, and a pious believer at night.

¹⁰This analysis is in concordance with the results of Henrich *et al.* (2001); Poteete, Janssen, and Ostrom (2012); Bowles and Gintis (2011); and more.

¹¹This same perspective has been captured in the concept of “heuristics” developed by Gigerenzer and Selten (2002).

¹²An explanation of mental processes that is consistent with the explanatory principles of neuroscience (Kandel, Schwartz, and Jessell, 2001; Edelman, 1989).

¹³As Hayek (1988: 68) wrote, “if we stopped doing everything for which we do not know the reason, or for which we cannot provide a justification, we would probably soon be dead.”

¹⁴One of the clearest forms of unconscious learning, which does not require attention, is an infant learning a language (Smith, 2008).

¹⁵Knowlton *et al.* (1996) demonstrate that there is a dual divorce between explicit memory, declaratory, which can be associated with constructivist rationality, and implicit memory, non-declaratory and related to unconscious learning by habit. In their experiments, they demonstrate that amnesiac patients exhibit normal learning in task resolution, but were unable to recall the training session during which they had managed to learn. On the contrary, other patients with brain damage were unable to learn how to solve the task, but could remember the training session. Knowlton concludes that there exists gradual and incremental learning (a characteristic of learning by habit) that takes place in the brain *neostriatum* and another type of learning, declaratory and conscious, which occurs in the limbic-diencephalic and neocortical zones.

¹⁶Reciprocity has frequently been seen in primates (De Waal, 1989, 1996; Brosnan *et al.*, 2008; Chen and Hauser, 2005).

¹⁷There exists *positive reciprocity* when Agent A responds similarly to the acts of the transfer of goods and favors from Agent B. On the other hand, *negative reciprocity* occurs when an individual is punished for not positively reciprocating the social exchange (McCabe, Rasenti, and Smith, 1996).

¹⁸David and Ann Premack conducted a series of studies showing infants films of geometric figures in motion, to determine how it is that they attribute intentionality in social interactions. Their results demonstrated that infants observe the movements to determine whether or not an object has a target, because "if an object has its own movement, directed towards a goal, and a flexible route depending on the environment, then this object has the potential to help or harm other objects (Hauser, 2008: 176). Depending on whether the object helps others to achieve their objectives or not, it is qualified as positive or negative.

¹⁹The fact of knowing that the other player knows what is known allows for responses to be read as empathetic and generates the basis for reciprocity. It is not the same thing for someone to offer you food, for no reason at all, than to offer you food knowing that you are hungry. The second case creates a bond, a much stronger obligation to be matched in kind.

²⁰Smith finds this form of representing the market in Adam Smith's theory: “This intellectual and experiential history led to Smith's Wealth and his ‘fundamental axiom of market behavior as a discovery process’” (Smith, 2012: 3). Smith is also in debt to the work of Hayek in explaining how agents discover prices in the market.

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