Methodological Foundations
for
Bounded Rationality as a Primary Framework

by
Shabnam Modarres-Mousavi

Virginia Polytechnic Institute and State University
Department of Economics

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Under Supervision of
Nicolaus Tideman, Chair
Catherine Eckel
James Garrison
Kent Nakamoto
Aris Spanos

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Abstract

Experimental observations have shown that economic agents behave in ways different from the maximization of any utility function. Herbert Simon sought to deal with this by positing that individuals do not maximize, but rather "satisfice." This was a radical departure from the traditional economic framework, and one that still has not been adequately formalized. But Simon's suggestion is only the smallest part of what is needed for a theory that reflects the actual behavior. For instance, Simon's framework cannot deal with the observation that the act of choice changes the chooser. This dissertation is further developing Simon's original ideas through embracing John Dewey's transactional thinking to attain an adequate theory of economic choice that accounts for boundedly rational agents.

I clarify that substantive rationality and bounded (procedural) rationality share the same basic utilitarian assumption of predetermined goals. In terms of a Deweyan (transactional) analysis, the idea of utilitarian "optimization" ultimately guides and constrains both theories. But empirical study of choice behavior and the behavior of subjects in experimental laboratories, both indicate that neither substantive nor procedural rationality can effectively account for actual economic choices.

I emphasize the importance of treating bounded rationality without reference to the rational framework. To me, bounded rationality implies a realistic picture of behavior, which is associated with emerging goals and not ones that exist prior to the making of a choice. I consider uncertainty as a normal characteristic of the situation, which in turn allows consideration of acting based on inconsistent information, just as people actually do. The basis of a systematic approach to behavior that can capture inconsistency is developed by Tom Burke. He mathematizes Dewey's logic. He allows for impossible worlds in the set of states. Thus, not only can the initial state space hold inconsistent states, the information set can include mutually inconsistent elements.

So the current neoclassical paradigm resembles the representative realism, but is there any good reason why we should accept this methodology as economists? Whatever one's ultimate metaphysics and epistemology, I want to show that an alternative approach to economic decision-making may prove highly useful in theory and practice.

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DEDICATION

To my honest and true friend **Reza,**
whose unconditional love has no replacement.

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Chapter One: Toward an Alternative Theory of Choice

I. Introduction

Decision-making, problem solving, scientific and non-scientific judgment, and inquiry are all different names for the same thing: resolving the question at hand. Every one of us deals, daily, with problematic situations, which are discomfiting, and thus call for action to resolve them. These situations range from a simple decision of "when to wake up in the morning" to the more challenging case of "whom to make friends with" to the more complex question of "where to invest" or the more general project of "how to spend resources to earn the greatest return." In the mindset introduced, developed and employed in this dissertation, all activities in the wide spectrum described in this paragraph are treated in the same way. My subject of investigation is the general form of decision-making.

There are numerous ways of finding a solution to a problem. The number of ways could well be as large as the number of decision-makers[1] or even as large as the number of case-individual pairs. Still, there are ways of describing, explaining, and formalizing the procedure of inquiry.[2] This is not the same as suggesting that all people apply some general rules in solving problems. Rather, it is an effort to describe decision-making in abstract terms and to evaluate the capacity of alternative frameworks to characterize decision-making. More specifically, I claim that every thinker has a philosophy of "truth-seeking."[3] When a thinker studies a question, she looks for an answer that fits her personal[4] beliefs. Furthermore, the tool she chooses to formalize her theory fits those beliefs as well. Let's say the philosophy of our hypothetical thinker includes this rule (R1): "There exists a true answer to my question." Let's further introduce a second rule (R2): "A truth-seeker converges to *the true answer* as long as the investigation is on the right track." Both these rules, R1 and R2, should be familiar to the reader. They are almost trivial. The problem I want to point to lies exactly in this *triviality*. I assert that these rules characterize the underlying philosophy of economists, who model human activity as utility maximization[5]. The same rules lead to optimization as the formalizing tool for utility-maximizing behavior.

It is important to distinguish two different stages of the current argument in order to avoid a likely misinterpretation. Although I seek to replace optimization theory with an alternative technical framework that allows conditioning on non-additive beliefs, my aim in this work is not to highlight the shortcomings of optimization for formalizing decision-

[1] One can also imagine more than one solution per person for a given problem.

[2] I am aware of the Austrian assertion that because people hold subjective beliefs, formalism is impossible. I do not believe that this idea refutes my effort.

[3] I intentionally don't talk about "truth". Truth-seeking is more relevant in my framework. The border between "truth" and "reality" is vague in most of the literature and in the minds of most of the people that I have encountered.

[4] In Dewey's sense of having "warranted assertability." That is they seek the soundest possible empirical and logical warrant for the theory they assert.

[5] In the most general sense.

making and introduce a better alternative for this purpose.[6] The choice of a technical tool, optimization or another theory, should be considered a secondary consequence of the beliefs that rule the mind of the modeler. The primary focus of my effort is the mindset of the thinker herself and how this mindset determines the technical tool; I want to analyze decision-making behavior from an alternative mindset and leave the identification of an appropriate tool for formalizing it to later work. These are two related but distinctive steps.[7] I claim that "optimization" befits an effort to capture the ideas of a thinker who believes in the existence of a real world of truth, independent of and prior to the procedure of inquiry. Thus, in this prominent mindset, what remains is to identify that preexisting *truth* in that *real world* out there (in theory), or get as close to *it* as possible (in empirical exploration).

The inquirer is always a constitutive part of the situation into which they inquire. We are participants rather than spectators in the problematic situations we strive to solve. We may think of problematic situations as a confluence of transacting events that includes the inquirer. A situation is problematic for the inquirer because something about the situation has disrupted their functional equilibrium. Something is vague, inexact, and uncertain about the situation. It is the task of inquiry to restore equilibrium by transforming the situation by determining something, some object, or configuration of objects (for example, a mathematical or logical function). Because the agents themselves are participants, such transformation of the situation often includes self-transformation. As Dewey puts it, "proleptically[8], objects are the objectives of inquiry."[9] We should get our ontology[10] from the logic of our inquiries instead of the logic of our inquiries from an assumed ontology. The objects (and their relations) with which we begin an inquiry are simply those that are the outcomes of prior inquiry, which are clear, exact, and determinate enough to use the initiate inquiry in the current context. If nothing about a given situation where clear enough, at least tentatively, we would experience chaos instead of a namable problem. I endorse the following definition of inquiry:

Inquiry is the controlled or directed transformation of an indeterminate situation into one tat is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole.[11]

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[6] A good source for this type of investigation is Laville (2000).

[7] Atkinson and Stern (1976) define two types of questions: rule questions and level questions. In the field of taxation, a rule question concerns the suitability of a tax, for instance, is Pigouvian tax better than a flat rate income tax? A level question is concerned with comparing the amounts of revenue raised by different taxes. Borrowing their terminology, questioning a mindset and introducing alternative rules of thinking could be called a rule investigation. Whereas finding suitable tools to formalize the characteristics of a phenomenon in a given mindset would be a level investigation. Therefore, in the current work, where the concern is to introduce an alternative mindset, level questions are irrelevant.

[8] Prolepsis: the generic notion of a thing, held to be either innate or naturally acquired in a way that naturally gave it a guaranteed veridical status.

[9] Dewey, J.. Logic: The Theory of Inquiry. In Jo Ann Boydstone (ed.), John Dewey: The Late Works, volume 12. Carbondale: Southern Illinois University Press, p. 122.

[10] Ontology: The assumptions about existence underlying any conceptual scheme or any theory or system of ideas. A Dictionary of Philosophy, Anthony Flew (1984).

[11] Ibid., p. 108.

II. A Philosophy for an Alternative Mindset

I reinvestigate the procedure of inquiry (choice) from an alternative mindset, which does not postulate a unique reality that can be reached by following a proper path. In the mindset that I choose for this reinvestigation, the mind of the seeker is part of the seeking procedure,[12] or inquiry. Inquiry starts when a state of equilibrium is disrupted and the inquirer seeks to restore equilibrium. "Reality" is what that is realized by the inquirer at each level of inquiry. This relative reality could remain true or be rejected in later steps of the inquiry. Also, an answer is considered "found" or the problem is "solved" when the inquirer stops the inquiry. She stops the inquiry when the discomfiting feeling of dis-equilibrium is removed by the restoration of equilibrium.[13] Note that I don't need to postulate a "reality" to describe the procedure of inquiry nor do I impose a constraint of some "truth" on the inquirer.

A wide variety of theories have been developed to characterize inquiry. I found the approach of John Dewey (1859-1952) particularly interesting. Dewey's last project, incomplete at his death, was the formalization of his logic. Logic for Dewey *is* the theory of inquiry. Tom Burke is seeking to complete the realization of Dewey's last intellectual effort.[14] By borrowing Dewey's world-view and Burke's technical analysis, I plan to develop an alternative approach to the analysis of decision-making. This alternative approach can be conceived only in an alternative mindset: a mindset that does not depend on (R1) and (R2). I expect that this alternative will provide useful operational explanations when applied to human behavior. Formally stating this idea and making sense of it for economists is a lifetime research agenda. Applying the idea to current economic frameworks is a way of illustrating the usefulness of the research agenda. The current thesis is the initiating phase of this agenda. I emphasize that the center of this investigation is the idea of defining descriptive rules for a general procedure of choice with the hope of shedding a new light on wide-ranging discussions in this field.[15]

III. How Did I Arrive at this Stage?

As soon as I became an economics student, I learned of the importance of bounded rationality. Each group of economists treat it in their own way; theorists called it boundedly rational when the agent deviates from any rational assumption, experimentalists used it to explain the "real" behavior of subjects in the lab, and so on. The intriguing point for me was that everybody accepts the necessity of the rational

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[12] It takes some serious practice to get used to the idea that the result of this alternative mindset is the elimination of any structural difference between scientific judgment and daily decision-making.

[13] Notice that a satisficer stops because she is tentatively satisfied with the answer, while a utility-maximizer stops because she has spent as much of some inquiry resource, such as time, as she believes the question warrants.

[14] He has found fuzzy sets and fuzzy logic to be appropriate tools for capturing Dewey's theory of inquiry.

[15] The study of actual human decision-making is no longer untraditional in economics. However, I acknowledge that suggesting an alternative mindset, through which these studies could be reinterpreted and potentially formalized, is very untraditional. Nevertheless, I intend to make this suggestion based on my best conjectures. Trying something untraditional brings social pressures to conform.

framework for theory while acknowledging the importance of bounded rationality for explaining actual behavior. I observed that bounded rationality has not provided us with an operational framework to substitute for rationality. I asked "why hasn't bounded rationality replaced standard rationality after almost half a century?" and "now that it hasn't, why hasn't it disappeared from the picture?" I received general answers such as " the formalization of this idea is so hard," as well as defensive answers, "if bounded rationality is messy but explains the reality, we should choose it over the cleaner but incorrect standard rationality theory." These answers didn't satisfy me, so I started to study Simon myself, talking to scholars of behavioral decision making, and exploring the literature of bounded rationality. This soon led me to read on non-EUT (non-expected utility theory) frameworks and drew my attention to the importance of the axiomatic structure that supports the formal subjective expected utility theory. I became especially obsessed with the role of Samuelson's "reasonable" assumption of consistency, imposed on all choice, as contrasted with empirical observations, which are pervasively incompatible with this assumption.

Another direction of my reading at the same time was American pragmatism. I was fascinated by Pierce's original approach to the nature of inference. I was not much affected by James. But I was absolutely taken with Dewey and his epistemology. Meanwhile, I encountered the only effort to formalize Dewey's theory of inquiry. Putting this together with the fact that Dewey treats every action as an inquiry in the most general manner, I started exploring the possibility of developing an axiomatic framework for bounded rationality, a framework that is not conceived as "deviations" from rationality but an original axiomatic framework based on the primitive idea of bounded rationality as stated by Simon in "Models of Man" (Ch. 13.)

I entertained the hunch that people who wanted to improve economics by importing some psychology into it didn't think deeply enough. They stayed at some outer level and started extensive "repair programs." With this in mind, I studied efforts in this field, hunting for the pitfalls in researchers' and theorists' methods. I came across the only axiomatization of bounded rationality by Barton Lipman, which I admired but was still uncomfortable with. Then I realized that what bothered me was his commitment to standard expected utility and probability theory. His model of bounded rationality could not explain the empirical use of irrelevant information by decision-making agents. In his model, he deals with this limitation artificially, by introducing an omniscient modeler who differentiates between the "correct" and "incorrect" states. In real world problems, there is no omniscient modeler to make this distinction, and so Lipman's model has a fundamental limitation.

Looking further into the methodology of approaches to bounded rationality, I found a distinct partition between what is considered modifiable and what is agreed to be untouchable. It seems to be agreed that it is not possible to falsify the assumption that the objective of rationality is antecedently existing, known, and fixed goals, and therefore this assumption has received little reexamination (Laville, 2000). Rather, most of the efforts to capture the idea of bounded rationality concentrate on finding formal ways to explain the limits of cognition.[16] It seems to me that in an alternative approach,

[16] Kliempt and Guth (ZIF, 2000) touch on the emerging nature of goals instead of teleological rationality. But they suggest a semi-normative theory of choice for producing good advice. I conjecture that a positive account based on emerging goals could be formalized.

rationality could be associated with goals that emerge in the choice process. Furthermore, this alternative framework could better explain the limitations that decision makers face. In short, I suggest that it is possible to formalize bounded rationality cleanly and clearly; it requires establishing a new framework of non-teleological rationality in which goals are emergent and uncertainty is normal. Note that this means that the long battle with uncertainty as an aversive characteristic to be minimized is transformed into an acceptance of uncertainty as an innocent characteristic of the environment present in every situation of choice. In philosophical terms, I suggest, loosely, that uncertainty should be considered ontological and not epistemological. Moreover, the need for a rational neo-classical axiomatization as a reference will end, so that this account, which hasn't been sufficient for quite a while, will no longer be necessary.[17]

Perhaps I am destined to be an outsider in economics. It is more lonely, but much more exciting, to be at the edge of a discipline than at the middle. And, of course, disciplines only expand at the edge.

IV. The Formal Argument

The advantages and disadvantages of global rationality, as used by economists, have been discussed for several decades. One can find numerous arguments for and against decision-making models that are based on rationality. There is also a considerable literature on a possible alternative framework, namely bounded rationality. Even so, little attention has been paid to practical frameworks that are not based on rationality. Further formal effort is needed, however, into why and where rationality is necessary.

IV-I. Two Competing Frameworks

Ordered preferences and perfect information[18] are customary assumptions for optimization and utility maximization and are widely used by economists and game theorists. While ordered preferences are in many ways essential to bounded rationality, as early as the 1930's people have debated whether an adequate notion of rationality requires perfect information. Herbert Simon is known for addressing some shortcomings of global rationality in *Models of Man.* Simon introduces the *satisficing agent* as a substitute for the rational agent and establishes satisficing behavior as an alternative model for global rationality. Theorists and modelers in marketing and organizational behavior have examined bounded rationality extensively.[19] Since the concept was introduced into economics by Simon in an extensive effort to capture features of actual human behavior, bounded rationality was viewed as the main alternative to neo-classical rationality. The major advantages claimed for bounded rationality are the plausibility of the agent and realism of the environment. The assumptions of neo-classical rationality amount to either an unrealistic individual or an unrealistic environment. The rational agent benefits from an unlimited capacity for evaluation that lets him analyze the entire environment. One resolution of this unrealistic picture is an oversimplified environment

[17] Frank Knight, who introduced a concept of uncertainty, referred to as ambiguity now days, thought a neo-classical account necessary though not sufficient.

[18] Stigler introduced the notion of "information" into economics.

[19] Among them: March, Thaler, Tversky…

that could be completely analyzed by the agent. But advocates of bounded rationality suggest that a boundedly rational agent is a more accurate depiction of real decision makers. However, this remains a claim rather than an established proposition. The main reason is that the bounded rationality model loses tractability as the model begins to deal with the realistic characteristics of an individual and/or environment. In contrast, the model of the rational agent offers a more easily applied framework for prediction, since it can be embedded in many different situations while preserving technical simplicity.

It is noteworthy that game theoretic models based on expected utility and game theoretic models based on bounded rationality have at least one thing in common: assigning *payoffs* to each outcome. Players are able to compare different payoffs in both models. Then the question is whether bounded rationality leads ultimately to optimization, or has something else to offer.

I will examine these competing models to evaluate their relative advantages, the limits of their application, and the validity of their claims. There are at least two important elements that should be considered: the positive and normative aspects of each theory. In order to build a sound analysis, it is imperative to examine the philosophy underlying the assumptions of each framework. Therefore, I will offer an extensive analysis of the philosophical side of my story in the next chapter. Here, attention is narrowed down to questions like the following: Where is the formal definition of rationality applicable? What are the legitimate boundaries of the notion of rationality? How good is the predictive or descriptive power of rational agent models? More specifically, what is the valid domain of interest when we use rational behavior as a descriptive tool? For example, what does it mean that Edward McClennen (1990) insists that backward induction in the finitely repeated prisoners' dilemma must be given up since it just cannot be rational not to co-operate at least to some extent in such situations? How does it affect or not affect the validity of theory when anomalies emerge every day in experimental laboratories? Is bounded rationality only a theory of non-optimal choice or can we go, formally, beyond this? Do we need to discard some of the models in favor of others? My answer would be that models are all unrealistic because a model is as an abstract tool for scientists. My approach has two sides: to pay closer attention to the technical possibility of switching between different notions of rationality as needed for the model[20] and to examine the possibility of developing an operational model for a boundedly rational agent.

V. My Plan

The major advantage claimed for bounded-rationality over neo-classical rationality is its capacity to model purposeful behavior characterized by the pursuit of goals rather than by mere maximization. An example of boundedly rational behavior is decision-making by a chess player, who does not consider all possible alternatives, but rather chooses the first alternative above her aspiration level. Aspiration levels provide short-term goals for a decision-maker and substitute for a more global goal of maximization. I reexamine Simon's assessment of the suitability of the idea of rationality. Building on Simon, I

[20] This is relevant to believing in a piecemeal rationality.

derive a new bounded rationality approach to address the shortcomings of expected utility theory.[21]

My work draws a picture of decision making from the perspective of bounded rationality as it was introduced initially. There is a multitude of bounded rationality models. All of them give several twists and adjustments to *rationality* in order to get as close as possible to the *real* individual-environment connections and reactions. I will focus on the satisficing agent introduced by Simon.[22] I locate the distinction (as well as shared assumptions) between bounded and unbounded rationality; I want to clarify where the departure from the traditional framework occurs in bounded rationality. Then I describe possible foundations for a formalization of bounded rationality as an independent (primary) framework.

A theory may or may not fit a certain phenomenon. But the fact that a tool is not useful in some areas should not lead us to think about retiring it. Instead, an active and creative mixture of tools can provide theorists with more power to solve their intellectual problems. Also, if one wants to suggest a new framework, one should build a model that has many of the favorable features of the model that is currently used.[23] This alternative should enjoy an independent formalization. Notice that to date, Simon's bounded rationality idea has only been explained with reference to rationality and not as an independent concept. I claim that bounded rationality could and should be completely removed from the rationality tradition, in order to discover the domain that befits it: bounded rationality has been planted in the wrong soil, which prevents it from fully flourishing.

VI. Basic Decision Models

I review a basic decision model to demonstrate *simplicity* as the main advantage of neo-classical framework. Simplicity is the factor that makes the current neo-classical economic core attractive. So it would be very ironic to find strong support for the major rival of the practical paradigm in the heart of pragmatism, especially if we view bounded rationality and neo-classical theory as rivals in terms of their underlying philosophies,[24] and not as compatible components of a single theoretical framework. In any case, my claim is that the philosophy resembling bounded rationality is rooted in pragmatism. Extensive elaborations on the philosophical arguments of this claim are the subject of chapter two.

The basic model includes an *agent* and a *world*. The agent is capable of choosing among alternative courses of action called *options*. While the agent does not know the

[21] Within optimization theory, there is an ongoing competition to replace expected utility theory (EUT) with several non-expected utility models. I explore an investigation without presuming optimization.

[22] I am specifically interested in introducing "process philosophy" as the philosophical counterpart for this group. A later direction would be employing this philosophy to shed light on the economic theory of decision-making.

[23] Kuhn historical approach to the structure formation of science is partly in the same line with this conjecture.

[24] I admit that the mainstream seems to have co-opted "bounded rationality" as far as the prevalent economic theory is concerned.

actual state of the world, the agent does know of several states in which the world might be. The simple model of decision-making imposes constraints on both the set of options and the states of the world. An *outcome* is an option-state pair. A behavioral rule tells the agent which action to choose in order to achieve an outcome. In general, a decision with *m* options and *n* possible states will have m*n possible outcomes. Now I turn to a famous decision model.

VI-I. Bayesian Decision Models

Bayesians assume that the agent has a coherent preference structure that is characterized axiomatically (transitivity, completeness…). They define a notion of a probabilistic mixture of outcomes, like a lottery with certain probabilities assigned to the outcomes. The problem is to characterize a *utility function*[25] that picks out the rationally preferred option solely as a function of the agent's preference structure. The agent's utility for outcome A is greater than that for outcome B *iff* he prefers A to B. And if the agent is indifferent between outcome B and a mixture of A and C, then the utility assigned to B equals the weighted (by probability) sum of the utilities of A and C.

A Bayesian agent's attitude toward the possible states of the world can be characterized by a probability function. This function represents the agent's *degrees of belief*[26] in the actuality of the various possible states of the world. The (probabilistic) weighted sum of the utilities of the outcomes associated with an option is the *expected utility* (EU) for that option. The *rational* choice for a Bayesian agent turns out to be that option which maximizes its expected utility.

Bayes's theorem states:

P (S/E) = P (S) * P (E/S)/P (E);

Where P (S) represents the agent's initial degree of belief, or prior probability that S is the true state of the world. The posterior probability, P (S/E), becomes the prior probability for later processing of additional data.

VI-II. On Optimization Theory

Optimization theory[27] (OT) is the building block of prevalent decision models, and Expected Utility Theory (EUT) is the most popular special form of OT. Among the main arguments for and against EUT, I focus on the theoretical difficulties, in this chapter, and the empirical refutation in chapter IV. The main theoretical difficulties that plague OT, and consequently EUT, stem from the technical assumption of these models; that one must accept an unrealistic description of the environment and unrealistic abilities for the economic agent.

[25] And not a relation (in the mathematical sense of functions and relations).

[26] These are subjective probabilities that are treated as being objective.

[27] Laville (2000) argues that OT and EUT are systematically related to each other and that they form a circular network of arguments.

VI-III. The Descriptive Power of Maximizing Models

The neo-classical model is enriched with both positive and normative aspects of behavior. But with respect to descriptive power, bounded rationality appears more appealing. Actually this very feature of bounded rationality is the strong reason for this framework to survive so long without offering a mathematically sound and flexible model.

A few alerts are necessary before introducing bounded rationality into the discussion. First, in the standard rational model, one can move an agent from a one situation to another and still employ the predictive power of the model. In contrast, changing the situation of a satisficer requires a change in the choice of aspiration level, therefore requiring a total reformulation of the problem to be solved. Another important note is the nature of what is called a boundedly rational agent in game theory. For a game theorist, the agent who fails to do what rationality predicts is facing some limits. These limits could be in the level of information, or the ability to process it. Put it colloquially, the agent is making a mistake by deviating from rational rules, and this is what is modeled in game theory under the title of bounded rationality. One sees now that this type of bounded rationality could be technically reproduced in the rational framework. But another structure is needed if there is no indifference; or if the agent chooses to consider some, and not all, of the information available; or if the agent cannot exhaust the means provided for him to achieve certain desirable ends, etc. And that is the main concern of bounded rationality, as introduced by Simon. Notice that Simon's *satisficing agent is not making a mistake when he chooses his non-optimal payoff*.[28] While maximizing involves choosing the best alternative, satisficing involves choosing an alternative that exceeds some criterion or target.

Departure from rational economic man and the whole realm of bounded rationality are the province of Herbert Simon's works. He started an important tradition, but *I believe that he didn't manage to deliver his primary message*. The main body of this dissertation will be dedicated to developing this claim. I will do this by critically reviewing Simon's works. Then I will investigate the structural requirements of a framework that can formally address the original idea of bounded rationality, by exploring Burke's logical formalization of Dewey's theory of inquiry. I chose this work because of its potential for developing an independent axiomatization for bounded rationality with no reference to a rational framework. This new framework for understanding actual human behavior is outside of mainstream economics and also cannot be captured by bounded rationality as it is currently conceived.

VII. Simon and Neo-classical Economics

Herbert A. Simon introduced the idea of bounded rationality, originally a psychological concept, into economics. He opposed the model of rational economic man on the ground of empirical evidence. Observing human behavior suggests a fundamental role for limited cognition as an aspect of decision-making that cannot be captured in the

[28] Dewey suggests a similar procedure for inquiry, in daily or scientific activities. There is no mistake, as an ever-improving loop of inquiry works, whenever the agent feels *or imagines* the need or the possibility for restoring the equilibrium.

neo-classical framework. Simon (1956) invited economists to leave their "armchairs" and start over by observing actual behavior. He discussed the idea that people cannot consider all their options in choosing their solutions to given problems. Thus their behavior cannot be captured in a framework that presupposes that they can. Simon considered two alternatives: adjusting aspiration levels and adjusting set of behavioral alternatives (*Models of Man*, Ch. 13).

I argue that his insights are valuable. I suggest further steps based on these early thoughts of Simon's. To do so, I use an alternative philosophical framework, rather than the predominant Humian perspective. The main characteristic of the Humian philosophy ruling the practice of economics, in my view, is the epistemological notion of uncertainty.

VIII. What is different and interesting in Dewey's Philosophy?

In the next chapter we will see that for Dewey, the choice of an action in the presence of incommensurable values is a genuine problem. As he sees it, "If values did didn't get in one another's way, if, that is, the realization of one desire were not incompatible with that of another, there would be no need of reflection."[29] Dewey's argument is neo-Aristotelian.[30] As another neo-Aristotelian, Martha Nussbaum, notes,

Aristotle knew of the view that a hallmark of rational choice is the measurement of all alternatives by a single quantitative standard of value. Such a "science of measurement," in his day as in ours, was motivated by the desire to simplify and render tractable the bewildering problem of choice among heterogeneous alternatives.[31]

Plato is the prime example of those committed to the following three principles identified by Nussbaum: (1) Metricity, or the notion that "each situation of choice there is some one value, varying only in quantity, that is common to all the alternatives;" (2) Singleness, or the assumption "that in all situations of choice there is one and the same metric. (3) Consequentialism, or the claim that "chosen actions have value not in themselves, but only as instrumental means to the good consequences that they produce."[32] Remarkably, Simon, the savant of ultramodern Turing-machine functionalism and rationality, adheres to all three principles.

For Dewey, "Deliberation is a work of discovery. Conflict is acute. . . . Deliberation is not an attempt to do away with this opposition of quality by reducing it to one of amount. It is an attempt to uncover the conflict in its full scope and bearing."[33] What we discover, or more accurately create, in deliberation is an end that will allow us

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[29] Dewey, J. (1932/1985). Ethics. In Jo Ann Boydston (ed.), John Dewey: The Later Works, Volume 7. Carbondale: Southern Illinois University Press, p. 210.

[30] Dewey took a neo-Aristotelian turn after arriving at Columbia and coming to know F. J. E. Woodbridge. See Sleeper, R. (1986) The Necessity of Pragmatism (New Haven: Yale University Press, pp. 7 and 92), Westbrook, R. B. (1991) John Dewey and American Democracy (Ithaca: Cornell University Press, pp. 119 and 321) and, Rockefeller, S. (1991) John Dewey: Religious Faith and Democratic Humanism (New York: Columbia University Press, p. 362). The prime difference between Dewey and Aristotle is that Dewey does away with fixed ends and purposes.

[31] Nussbaum, M. (1990). Love's knowledge. Oxford: Oxford University Press, p. 56.

[32] Ibid.

[33] Ibid. p. 150.

to functionally coordinate our transactions. Before examining the nature and structure of the emergence of ends in deliberation, though, let us examine the nature of the acute conflict.

The conflict is acute precisely because the values constituting the uncertain situation are incommensurable and yet the agent must coordinate them to achieve a satisfactory union. In Dewey's view of wide deliberation, "the thing actually at stake in any serious deliberation is not a difference of quantity, but what kind of person one is to become, what sort of self is in the making, what kind of world is making."[34] This is a "transactional" view, wherein the choice sustains a double to the self; it expresses the present self and forms the future self that will enjoy or abhor the consequences to come. Imaginative deliberation appeals to different elements in the constitution of the self. The situation is conflicted at least in part because the agent participating in it is conflicted. Things are in the making, and deliberate choice influences what eventually is made of the situation.

Dewey boldly asserts, "Taken by itself then economic action throws no light upon the nature of satisfaction and the relation of intelligence to it, because the whole question of satisfaction is either taken for granted or else is ignored by it."[35] Stated succinctly, Simon does not have a theory of satisfaction. At best, he only has a theory of satisficing under the assumption that deliberation has already determined a satisfactory state of affairs that would allow an agent to coordinate incommensurable values. Actually, he does not even have that much, as I am about to show. Dewey asserts, "In short the attempt to assimilate other activities to the model of economic activity (defined as a calculated pursuit of gain) is morally objectionable because the conception of such a being empirically falsifies empirical facts."[36] This is a bold claim, but I will provide empirical evidence to support it.

[34] Ibid.

[35] Ibid. p. 152.

[36] Ibid.

Chapter Two: Dewey's Re-conceptualization of Behavior[37]

> [E]very . . . choice sustains a double relation to the self. It reveals the existing self and it forms the future self . . . . Deliberation has an important function . . . because each different possibility . . . presented to the imagination appeals to a different element in the constitution of the self --John Dewey, *Ethics*

Abstract

This chapter provides an alternative to deliberation conceived as utility maximization of any kind, including Simon's bounded rationality and theory of satisficing. The claim is that a theory, such as Dewey's, that can deal with deliberation regarding incommensurable values, provides a better explanation of everyday economic behavior. Empirical evidence, adduced in the next chapter, will back this claim. Thus, economists would do better to concentrate on social practices in specific contexts and the neurophysiological basis of need and desire. Here, Dewey's biologically based psychological functionalism is used to analyze what J. E. Tiles calls "Turing functionalism," which characterizes Simon's cognitive psychology.[38] Turing functionalism assumes an ahistorical, decontextualized, dualistic, disembodied, and dispassionate mind, functioning independently of the agent's actions on the environment. Along the way it will be argued that the kind of cognitive psychology employed by Simon (see Chapter Three) is useless to economists. Moreover, it is demonstrated that Dewey provides us with what Joas calls a theory of creative action, which includes a theory of creative rationality. Such a theory is a practical and useful alternative to the prominent Humian paradigm of mainstream economics.

[37] This chapter is an extension and elaboration of a shorter paper with Jim Garrison, titled "Toward a Transactional Theory of Decision Making: Creative Rationality as Functional Coordination in Context," forthcoming, *Journal of Economic Methodology*.

[38] Tiles (1999). The Fortunes of "Functionalism." pp. 39-61, especially pp. 52-61.

I. Rationality and Action

What substantive (global) rationality, procedural rationality, and creative rationality present us with are three different theories of rational action. Dewey and Bentley (1949a/1989) carefully distinguish three kinds of action as follows:

Self-action: where things are viewed as acting under their own powers.

Inter-action: where thing is balanced against thing in causal interconnection.

Trans-action: where systems of description and naming are employed to deal with aspects and phases of action, without attribution to "elements" or other presumptively detachable or independent "entities," "essences," or "realities," and without isolation of presumptively detachable "relations" from such detachable "elements.[39]

It is easy to see that in substantial rationality there is no *transformative* interaction between agent and environment in either direction, but rather the agent's preference and environmental contingencies are both given in a theory of self-action. Likewise, procedural rationality as Simon conceives it describes an inter-action between the economic agent and his information exchanges that are causally mediated by his environment. Simon's assumption that the rational essence of the self, the central information processor, is unaltered by the consequences of its choices indicates that he does not abandon the core of self-action. Dewey, on the other hand, rejects self-action, employing a *transformative* "transactional circle" of stimulus and response, which are subfunctions of a single function rather than detachable relations between things and elements. In a footnote to their introduction of the word "trans-action," Dewey and Bentley state, "The beginnings of this attitude may be found in his [Dewey's] paper 'The Reflex Arc concept in Psychology'."[40] It is a transactional relation in which the agent not only creatively "constitutes" the stimulus or the object of choice, but the consequences of the process also constitute the agent. Similar remarks hold for the procedural process of choice in Dewey's theory of inquiry, formation of judgment, and rational action.

Recall the three main categories of psychological research on cognitive processes, according to Simon, learning, problem solving, and concept attainment. What Dewey says about the biological "existential matrix" of inquiry in his 1938 *Logic* addresses all three of these in ways that unify the biological basis of psychology with that of logic, including the psychology and logic of economic inquiry, rationality, and choice. For Dewey, "biological operations and structures are not sufficient conditions of inquiry, they are necessary conditions."[41] By not ignoring biological conditions, Dewey believes we may escape the "special metaphysical or epistemological problems" of dualism. These problems capture cognitive psychology precisely because they commit what Dewey calls arbitrary "intellectualism." Dewey declares:

By "intellectualism" as an indictment is meant the theory that all experiencing is a mode of knowing, and that all subject-matter, all nature, is, in principle, to be reduced and transformed till it is defined in terms identical with the characteristics presented by refined objects of science as such. . . . For things are objects to be treated, used, acted

[39] Dewey and Bentley. *Knowing and the Known*. pp. 101-102.

[40] Dewey and Bentley . *Knowing and the Known*. pp. 101.

[41] Dewey, *Logic: The Theory of Inquiry*, p. 32.

upon and with, enjoyed and endured, even more than things to be known. They are things had [intuitively] before they are things cognized.[42]

Knowledge, cognition, is not the only, or even primary, relation we have with the rest of reality, including economic reality, nor is it always the most important. Unless one is lost in decontextualized intellectualism like Simon, it is obvious that fundamentally economic transactions involve embodied, biological needs and desires whose intelligent satisfaction requires cognition and inquiry guided by ideas and knowledge.

II. Biology, Desire, and Action

Dewey helps us to look at the biological basis of economic rationality, which is not a disembodied utility calculation. For Dewey:

> Whatever else organic life is or is not, it is a process of activity that involves an environment. It is a transaction extending beyond the spatial limits of the organism. An organism does not live in[43] an environment; it lives by means of an environment.[44]

Economic transactions are always transactions involving organism and environment that transform both.[45] The environments of most interest are social environments involving individuals, social groups, and economic institutions that take natural resources and transport or refine them into products that satisfy embodied need and desire. There is a temporality to these trans-actions. Dewey declares:

> [L]iving may be regarded as a continual rhythm of disequilibrations and recoveries of equilibrium . . . The state of disturbed equilibration constitutes need. The movement towards its restoration is search and exploration. The recovery is fulfillment or satisfaction.[46]

The rhythm of equilibrium-disequilibrium-restoration of equilibrium is a fundamental activity cycle for all living things. Disturbed equilibration, disruption of functional coordination of organism-environment transaction, is the fundamental problem situation for Dewey. It demands searching, exploring, problem solving behavior that for such organisms as *Homo sapiens* leads to intelligent inquiry.

Dewey finds that living creatures are characterized by "presence in activity of need-demand-satisfaction."[47] *This is the most fundamental cycle of all economic activity.* It arises out of the rhythmic of equilibrium-disequilibrium-restoration of equilibrium activity cycle. The intelligent and eventually logical need-demand-*inquiry*-satisfaction activity cycle arises out of the fundamental cycle of life and all economic activity without breach of continuity. All living beings *aspire* to *satisfy* the demands of life.

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[42] Dewey, *Experience and Nature*, p. 28.

[43] Underlined words in quotes indicate my emphasis.

[44] Dewey, *Logic: The Theory of Inquiry*, p. 32.

[45] There is a quasi-mechanical quality to Simon's Turing machine metaphors of thought that contrast sharply with Dewey's more organic metaphors of functional unity.

[46] Dewey, Logic: The Theory of Inquiry, p. 34.

[47] Dewey, *Experience and Nature*. pp. 195-196.

The rhythm of equilibrium-disequilibrium-restoration of equilibrium and the resulting activity cycles comprise a functional coordination of transactions of which organism and environment, economic agent and context, are subfunctions.[48] According to Dewey,

> A certain modification of environment has . . . occurred, though it may be only a change in the conditions which further behavior must meet. On the other hand, there is change in the organic structures that conditions further behavior. This modification constitutes what is termed habit.[49]

The agent strives to functionally coordinate the entire problem situation through thought, feeling, and action, not just solve the problem in her mind. The transaction produces a modification of the involved agent that transforms her. That means the agent's habits, along with her needs, may change as she strives to satisfy them by functionally coordinating her transactions.[50] That is why every choice sustains a double relation to the self.

II-I. Habits and Choice

For Dewey, "Habits are the basis of learning."[51] From the beginning, habits were of major importance to the philosophic movement known as pragmatism. Far from being merely mechanical, habits for pragmatists weave together cognition, emotion, and action. Charles Sanders Peirce, the founder of pragmatism, observes, "Our beliefs guide our desires and shape our actions . . . . The feeling of believing is a more or less sure indication of there being established in our nature some habit which will determine our actions."[52] For Dewey, habits are will, "They form our effective desires and they furnish us with our working capacities. They rule our thoughts."[53] For him, habits are general predispositions to respond the same way given the same stimulus:

> [A]ll habits are affections, that all have projectile power, and that a predisposition formed by a number of specific acts is an immensely more intimate and fundamental part of ourselves than are vague, general, conscious choices. All habits are demands for certain kinds of activity; and they constitute the self.[54]

Habits are dispositions to act evincing emotions that constitute the organic basis of learning, the self, psychological, and logical functioning.

We cannot adequately comprehend the function of habits apart from their transactions with the habitat that conditions them, especially the social habitat. For Dewey "habits incorporate an environment within themselves. They are adjustments of

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[48] Look at *Logic: The Theory of Inquiry*. p. 40.

[49] Dewey, *Logic: The Theory of Inquiry*, p. 38.

[50] Of human organisms it is especially true that activities carried on for satisfying needs so change the environment that new needs arise which demand still further change in the activities of the organisms by which they are satisfied; and so on in a potentially endless chain. See Ibid., p. 35.

[51] Dewey, *Logic: The Theory of Inquiry*, p. 35.

[52] Peirce. *The Fixation of Belief.* p. 114.

[53] Dewey, *Human Nature and Conduct*, p. 21.

[54] Ibid. p. 21

the environment, not merely to it."[55] Thus, Dewey's theory of learning is completely at odds with that of Simon. He declares:

> The distinction of organism and environment is a practical and temporal one, arising out of the state of tension in which the organism at a given time, in a given phase of life-activity, is set over against the environment as it then and there exists. There is, of course, a natural world that exists independently of the organism, but this world is environment only as it enters directly and indirectly into life functions[56]

Genuine deliberation involves choosing among incommensurable values; or, in Dewey's theory of deliberation, choosing something that allows the agent to functionally coordinate incommensurable values to the agent's satisfaction. For Dewey the process of deliberation requires a transaction with the environment that satisfies our needs and desires. In this transaction the agent must not only creatively transform the environment but also undergo transformation herself. Consequently, when the agent chooses, not only does she express her existing preferences, but she also forms her future preferences. Indeed, not until the completion of the process of deliberation does the choosing agent know her preferences, nor can she gage her aspiration for securing preferences. Thus economic actors often literally *make* choices.

III. The Nature of Uncertainty

One of the most influential philosophical papers of the twentieth century shows that the attribution of uncertainty to our cognitive limits produces an inadequate theory of action. W. V. O. Quine's (1969) essay "Ontological Relativity," overthrew the notion that there is an ontological certainty of any given thing or event toward which the representations of mind (or logic) strive to correspond. Quine considers the problem of how a field researcher might learn the language of a culture strange to her. We assume the native speaker could just point at objects and give the researcher the name. Quine, though concludes:

When with Dewey we turn thus toward a naturalistic view of language and a behavioral view of meaning . . . . [We] give up an assurance of determinacy. To discover the meanings of the native's words we may have to observe his behavior, but still the meanings of the words are supposed to be determinate in the native's mind, When . . . we recognize with Dewey "that manning . . . is primarily a property of behavior," we realize that there are no meanings . . . beyond what are implicit in people's dispositions to overt behavior.

Simon would assume that if the native has a representation corresponding to the one way the world is, he can just download the information to the researcher in the form of words for objects. Using Deweyan arguments, Quine establishes *ontological* relativity, under-determination, or uncertainty, thereby, forcing us to give up on the idea that there is some one way the world is (represented in the natives or researchers mind) such that

[55] Ibid. p. 38

[56] Dewey, *Logic: The Theory of Inquiry*, p. 40.

we can construct schemata in our mind, or theories on paper, that approximately represent the one way the world is.

For Simon, as for the devotees of substantive rationality, though, ideally, and *objectively*, there still remains one predetermined, perfect, and fixed objective goal and one utility maximizing function that ideally optimizes the agent's utilities given contextual constraints, it is just that, *subjectively*, the agent does not know it. The dualism in this psychology is apparent. The uncertainty, typical of modern epistemology, is in the ability of the agent to construct a correct and complete preference relation. Further, the practical contextual constraints do not refute the ideals of substantive rationality such as utility maximization; rather, they provide contextual constraints on the conditions of application in terms of quantity of information, cost, and ability to process information. Objectively, substantive rationality holds, however tainted by subjectivity. Significantly, *Simon argues the ontologically uncertainty of quantum mechanics is irrelevant to the situations that concern economics*; they only involve what we will call "subjective psychological uncertainty." For Dewey, that the ontological uncertainty involving the trans-actions of knower with the known as a single system are acknowledged in quantum physics but are ignored in economics is an immense irony. For him, it is obvious that all transactions simultaneously, and more or less creatively, transform the agent and the environment, which together constitute the situation. Intuitively, one would economic transactions to provide primordial examples of such transactions; for example, securing such goods as food, water, or shelter leads readily to the basics of economic transactions.

In the next section we take up Dewey's implicit analysis of Simon's psychology and theory of economic logic and deliberation. However, their differences regarding the nature of uncertainty are so serious and fundamental that we feel compelled to say something here and now. In his monumental *Logic: The Theory of Inquiry* (the subtitle is important for our purposes), Dewey boldly challenges the very idea of subjective psychological uncertainty somehow existing apart from inquiry into an uncertain situation:

We are doubtful because the situation is inherently doubtful. Personal states of doubt that are not evoked by and are not relative to some existential situation are pathological . . . Consequently, situations that are disturbed and troubled, confused or obscure, cannot be straightened out, cleared up and put in order, by manipulation of our personal states of mind. The attempt to settle them by such manipulations involves what psychiatrists call "withdrawal from reality." Such an attempt is pathological . . . . The habit of disposing of the doubtful as if it belonged only to us rather than to the existential situation in which we are caught and implicated is an inheritance from subjectivistic psychology. The biological antecedent conditions of an unsettled situation are involved in that state of imbalance in organic-environmental interactions which has already been described. Restoration of integration can be effected, in one case as in the other, only by operations which actually modify existing conditions, not by merely "mental" processes.[57]

Here we have the ingredients of a very different logic, psychology, metaphysics, and epistemology. Dewey's philosophy relies on a biological base and assumes an agent that must carry out transactions with its environment in order to sustain its existence. While, for the sake of analysis, we may separate heart, lungs, circulatory system, oxygen, and

[57] Dewey. *Logic: The Theory of Inquiry*. pp. 109-110.

the flora that produce oxygen as a byproduct, they are one single functional system. What is external to an agent's skin remains, nonetheless, internal to its organic functioning. Similar remarks hold for knower and the known or buyer making a choice in a supermarket. Metaphysically, the agent is a transactional participant in a given situation. The situation includes the participant that ultimately chooses. Economists normally like to avoid philosophical questioning even more than psychological questions, but their analysis assumes answers to epistemological and metaphysical questions. Most economists, like Simon, simply assume objectivism and the knower versus known dualism. Ultimately, we believe these assumptions are disastrous for understanding a living organism in the environment such as a shopper in Wal-Mart.

IV. Satisficing versus Satisfaction

In this section we examine what Dewey means by an uncertain situation, satisfaction, equilibrium, and rationality and contrast his view with Simon's. We begin with Dewey's famous paper, "The Reflex Arc Concept in Psychology," which sets forth the functionalism associated with the Chicago School of psychology, sociology, and philosophy. Not surprisingly, Dewey has nothing to say anywhere in *The Collected Works*, about computers.[58] Still, it is surprisingly easy to convert his refutation of the reflex arc concept into a refutation of Turing machine functionalism. Dewey writes: "The older dualism between sensation and idea is repeated in the current dualism of peripheral and central structures and functions; the older dualism of body and soul finds a distinct echo in the current dualism of stimulus and response."[59] We hear the same echo in the dualism of information input and output with the computer as the central processor, structure, and function. It is the same epistemological dualism that has dominated Western thought since Descartes, and is precisely what is wrong with cognitive psychology's commitment to the mind as computer metaphor and to the Western epistemological tradition.

Dewey thought the whole notion of a special place between neurophysiology and sociocultural practice leads to the psychic mind versus the physical body dualism. Dewey gave an invited address celebrating the 25th anniversary of the American Psychological Association wherein he asserted:

[A]ll psychological phenomena can be divided into the physiological and the social [cultural], and that when we have relegated elementary sensation and appetite to the former head all that is left of our mental life, our beliefs, ideas and desires, falls within the scope of social psychology.[60]

In a magnificent chapter titled, "The Invention of the Mind" Richard Rorty shows that the notion of mind as inner arena of representations standing between the embodied subject and the world or environment is largely a Cartesian contraption. The chapter bears the mark of Dewey's influence on almost every page.[61] Rorty echoes Dewey in a

[58] A fact verified by Jim Garrison using the CD-ROM version of *The Collected Works* on his computer.

[59] Dewey, The Reflex Arc Concept in Psychology, p. 96.

[60] Dewey. *The Need For Social Psychology*. P. 54.

[61] Rorty. *Philosophy and the mirror of nature*. See chapter one.

later chapter when he declares, "The disappearance of psychology as a discipline distinct from neurology, and similar cultural developments, might eventually free us from the image of the Mirror of Nature."[62] De-emphasizing cultural, historical, and other contextual factors as of secondary importance to the crucial concerns of information processing is, for Dewey, to miss most of what matters in creative and intelligent action. So too is ignoring affective factors, since they determine what in our context we attend and respond to.

Simon and cognitive psychology assume a passive agent confined to the inner central processing of information provided by the environment in which, as Simon indicated above, we can ignore perceiving, sensing, or acting when we are concentrating on thinking. For Dewey, we cannot leave anything out even at the level of the reflex arc concept much less higher-level reasoning. Dewey's reconstruction anticipates his later transactional theory constructed with Arthur F. Bentley. A reader who substitutes means and ends for stimuli and response below can anticipate his later nonteleological theory of intentionality and means-ends procedural rationality. Further, if we substitute information input and output for stimulus and response in the passages cited below, we can, *mutatus mutandis*, construct for ourselves a Deweyan critique of Simon and Turing machine functionalism. For all these reasons, it is worth looking at his reconstruction of the reflex arc concept in detail.

IV-I. The Reflex Arc Concept and the Myth of the Given

The standard version of the reflex arc concept assumes a passive agent that some "external" stimulus must prod to action. For Dewey, the live creature is always already active by virtue of being alive. Therefore, he said, "we begin not with a sensory stimulus, but with a sensori-motor co-ordination."[63] The real beginning is a functional co-ordination. It is a dynamic *equilibrium* or homeostasis without which no organic creature can live. The active motor responses, including acts of attention, discrimination, and individuation, depart from a prior co-ordination of activity and function to restore functional co-ordination to the trans-action.

The crucial realization is that a stimulus is the consequence of transactional process involving the agent as a participant in a specified situation and not an antecedent condition. Indeed, until the agent attends too, selects, and actively responds to aspects of its context, nothing is a "stimulus" for that creature. Attention is itself a kind of response that contributes to constituting a stimulus that serves to redirect the co-ordination of subsequent transactions. Dewey insists that "it is the motor response or attention which constitutes that, which finally becomes the stimulus to another act."[64] The agent's action give shape and form to an otherwise senseless flux of sensations and, thereby "constitutes" a stimulus for further action. There is an element of *creative* transaction to even the simplest constitution of a stimulus.

Dewey reconstructs the interactive reflex arc concept or information input and output concept, into an organic *circle* of functional coordination of the agent's transactions:

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[62] Ibid., p. 121.

[63] Dewey, The Reflex Arc Concept in Psychology, pp. 97-98.

[64] Ibid. pp. 101-102.

Dewey concludes: "It is the co-ordination which unifies that which the reflex arc concept gives us only in disjointed fragments. It is the circuit within which fall distinctions of stimulus and response as functional phases."[65] Dewey further states:

What we have is a circuit, not an arc or broken segment of a circle. This circuit is more truly termed organic than reflex, because the motor response determines the stimulus, just as truly as sensory stimulus determines movement. Indeed, the movement is only for the sake of determining the stimulus, of fixing what kind of a stimulus it is, of interpreting it.[66]

The motor response (or, more likely, series of responses) "constitutes" the stimulus that redirects and guides activity. We might designate such circuits of co-ordination as agentic hermeneutic circles. What is crucial is that what is the stimulus and what is the response *emerges* in the transaction; neither is given. For Dewey, the agent's actions creatively constitute its information in its transactions with its context. For Simon, the passive agent merely process information it is given. Simon's information processing model is simply a special instance of the myth of the given.

Dewey boldly affirms, "The fact is that stimulus and response are not distinctions of existence, but teleological distinctions, that is, distinctions of function, or part played, with reference to reaching or maintaining an end."[67] Stimulus and response are merely subfunctions of a single act of functional coordination of the agent's transactions with the environment. There is an intentional nonteleological, backward and forward connection between stimulus and response in the process of creatively constituting the actual end achieved. Indeed, as Dewey remarks:

Now the response is not only uncertain, but the stimulus is equally uncertain; one is uncertain only in so far as the other is. The real problem may be equally well stated as either to discover the right stimulus, to constitute the stimulus, or to discover, to constitute, the response.[68]

The agent achieves the end of functional co-ordination whenever the subfunctions of the transaction (stimulus and response, means and ends, etc.) mutually "constitute" each other. Once "constituted" a stimulus may serve as a temporary intentional telos that temporarily guides the agents emerging activity.

Note, neither stimulus nor response, information input nor output, means nor ends, is fixed at the beginning of the transaction; instead, they are emergently "constituted" as a

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[65] Ibid. p. 109.

[66] Ibid. p. 102.

[67] Ibid. p. 104.

[68] Dewey. The Reflex Arc Concept in Psychology. p. 106. Later he states:

The circle is a co-ordination . . . . It is the temporary disintegration and need of reconstitution which occasions . . . the genesis of, the conscious distinction into sensory stimulus on one side and motor response on the other. The stimulus is that phase of the forming co-ordination which represents the conditions which have to be met . . . the response is that phase of one and the same forming co-ordination which give the key to meeting these conditions, which serves as instrument in effecting the successful co-ordination. The stimulus is something to be discovered; to be made out . . . . Moreover, it is the motor response which assets in discovering and constituting the stimulus. It is the holding of the movement [activity] at a certain stage which creates the sensation (p. 109).

consequence of creative transaction. The results are devastating to the idea of utility maximization understood as involving given and fixed goals, conditions, constraints, and preferences. Here the goals, preferences, conditions, and constraints emerge in the agent's transactions with the rest of the functions that constitute the situation in which it is itself a participating subfunction. There is a creative nonteleological structure to the relation of stimulus and response in Dewey's reflex circle that later differentiates into his nonteleological and hermeneutically circular theory of intentionality, meaning, mind, and rationality as means-ends coordination.

V. Inquiry, Nonteleological Intentionality and Means-Ends Schema

Let us now turn to problem solving and concept attainment. Most people casually familiar with Dewey assume all inquiry begins for him with a problematic situation, but that is not correct. The pattern of inquiry for Dewey starts with an *indeterminate* situation of disrupted functioning (disequilibrium) accompanied by feelings of distress. For Dewey, "that which is given in the strict sense of the word 'given' is the total field or situation."[69] Situations have a unique precognitive quality. Dewey declares, "The immediate existence of quality, and of dominant and pervasive quality, is the background, the point of departure, and the regulative principle of all thinking."[70] Initially we may only grasp this anoetic quality intuitively. Dewey insists, "Intuition precedes conception and goes deeper . . . . Intuition, in short, signifies the realization of a pervasive quality such that it regulates the determination of relevant distinctions or of whatever, whether in the way of terms or relations, becomes the accepted object of thought."[71] Simon's intellectualism cannot deal with the precognitive, anoetic component of situations that precondition all deliberation, yet economic behavior is intuitive in precisely Dewey's sense.

When the circumstances of the situation become clear and concise enough the precognitive situation becomes a problematic situation stateable in linguistic propositions. As Dewey states, "The unsettled or indeterminate situation might have been called a *problematic* situation. This name would have been, however, proleptic and anticipatory."[72] Remember, *it is the situation that is uncertain, indeterminate, or unsettled, not just the agent participating in it.*

Objects emerge from the qualitative situation in the course of emergent inquiry; they are artifacts of the art of inquiry. Dewey asserts:

> As undergoing inquiry, the material has a different logical import from that which it has as the outcome of inquiry. In its first capacity and status, it will be called by the general name subject-matter . . . . The name objects will be reserved for subject-matter so far as it has been produced

[69] Dewey. *Qualitative Thought*. p. 127.

[70] Ibid. p. 261.

[71] Ibid. p. 249.

[72] Dewey, *Logic: The Theory of Inquiry*, p. 111.

> and ordered in settled form by means of inquiry; proleptically, objects are the objectives of inquiry.[73]

Later, Dewey writes:

> Existence in general must be capable of taking on logical form, and existence in particular must be capable of taking on differential logical forms. Nevertheless, the operations that constitute controlled inquiry are necessary in order to give actuality to these capacities or potentialities [74]

Objects, things, logical forms, and concepts emerge in the course of inquiry when we carry out trans-actional operations on situations, because it is an immediately given, sensed, experience of existence. Dewey insists:

What is intended may be indicated by drawing a distinction between something called a "situation" and something termed an "object." By the term situation in this connection is signified the fact that the subject-matter ultimately referred to in existential propositions is a complex existence that is held together in spite of its internal complexity by the fact that it is dominated . . . by a single quality. By "object" is meant some element in the complex whole that is defined in abstraction from the whole.[75]

Dewey distinguishes between the immediately given existential situation, or context, and the, created, emergent, and named object, logical form, or concept.

Dewey concludes that "all conception, all intellectual descriptions, must be formulated in terms of operations, actual or imaginatively possible."[76] For him, "The organs, instrumentalities and operations of knowing are inside nature, not outside. Hence, they are changes of what previously existed: the object of knowledge is a constructed, existentially produced, object."[77] For Dewey, "The subject-matter of logic is determined operationally."[78] Accordingly, "A situation undergoes, through operations . . . transition from problematic to settled."[79] Thus, we are brought abruptly to Dewey's definition of inquiry.[80]

The operation of inquiry that create objects, logical forms, and concepts, and eventually transforms the uncertain, indeterminate situation, emerge from, and are continuous with, the responses that *constitute* stimuli at lower levels of organic functioning. For Dewey, all that is ever given is some existential situation; stimuli, objects of choice (i.e., motivating objects, meaningful objects, logical object, concepts, and objects of knowledge) the agent take creatively. For Dewey, agents literally *make* choices that, as the epigraph to this chapter indicates, transform the choosing agent as the

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[73] Ibid. p. 122

[74] Ibid. p. 387

[75] Dewey, *Experience and Nature*, p. 246.

[76] Dewey, *Logic: The Theory of Inquiry*, p. 95.

[77] Ibid. p. 168

[78] Ibid. p. 22

[79] Dewey, *The Quest for Certainty*, p. 185.

[80] "Inquiry is the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole." Dewey, *Logic: The Theory of Inquiry*, p. 108.

agent transforms the world. Dewey holds a theory of creative trans-action in which both the context of inquiry (and choice) and the agent's (the chooser's) habits undergo transformation in the process of carrying out an inquiry and making choices that satisfy the situation. In the next section, we will see that choice is an integral part of deliberation (i.e., inquiry) for Dewey. Like other objects, the objects of choice emerge in the process of deliberation, even when we begin with what we think are fixed options. The possible teloi (ends) of our actions are not fixed antecedent to deliberation for Dewey as they are for Simon; for Dewey, the possible teloi emerge or undergo transformation in the process. That is part of what it means to say he has a nonteleological theory of intentionality.

Almost all theories of action assume intentionality is teleological. Simon's theory of economic activity is no exception. Hans Joas rejects this stance in his *Theory of Creative Action*, where he elaborates and expands on what he calls Dewey's "non-teleological interpretation of intentionally."[81] To do so, he begins by looking at Dewey's distinctive theory of the means-ends schema, though eventually it is Dewey's notion of the situatedness of action that he prefers, because it captures the sense in which the larger situation, which includes the agent, is constitutive of action.

Dewey, like Simon, is committed to some form of procedural, purposeful rationality, or what Dewey calls instrumentalism. Dewey boldly asserts that "rationality is an affair of the relation of means and consequences, not of fixed first principles as ultimate premises or as contents of . . . criteriology . . . . Rationality as an abstract conception is precisely the generalized idea of the means-consequence relation as such."[82] He eschews all efforts to find eternal, immutable, or supernal rational foundations. Dewey notes, "As a general term, 'instrumental' stands for the relation of means-consequence, as the basic category for interpretation of logical forms."[83] Dewey remarks:

> Reasonableness or rationality has, however, been hypostatized. One of the oldest and most enduring traits in logical theory has converted rationality into a faculty which, when it is actualized in perception of first truths, was called *reason* and later, *Intellectus Purus*. The idea of reason as the power which intuitively apprehends *a priori* ultimate first principles persists in logical philosophy.[84]

Ironically, from a Deweyan perspective, Simon's theory of procedural rationality resembles the criteriology of pure reason. That is because ultimately, Simon adheres to the ideal of detached, pure, substantial rationality; his theory of procedural rationality is merely a concession to the fact that pure rationality most cope with imperfect information or cost of information. The inability to process information is simply a rational deficiency on the part of the agent. Simon's disembodied pure mind with its cognitive representations (schemata) existing somewhere between the embodied subject and the world is, ideally, a pure utility calculating Turing machine.

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[81] Joas, *The Creativity of Action*, p.157.

[82] Dewey, *Logic: The theory of Inquiry*, p. 17.

[83] Ibid. p. 22 fn.

[84] Ibid. p. 18

Joas quickly identifies what is wrong with the usual interpretations of the means-ends schema. These interpretations assume a predetermined and fixed telos of action. This is precisely what is wrong with Simon's theory of procedural rationality and the psychology that supports it. For any choice, Simon assumes that there are predetermined and fixed alternatives from among which the agent may choose. His theory confines deliberation to means not ends. For Dewey, deliberation involves both means and ends simultaneously as alternative phases of action.

It is here that Joas turns to Dewey. Joas emphasizes the *creativity* of instrumental means-ends rationality in Dewey's means-ends schema when he correctly observes that Dewey contrasts "action in pursuit of *externally* set goals" with "the ideal of action infused with meaning."[85] Unlike Simon, goals are never external for Dewey, and all mental activity, including rational action, has meaning infused.

For Dewey, as Joas observes, it is a mistake to assume that "the actor generally has a clear goal, and that it only remains to make the appropriate choice of means. On the contrary, the goals of actions are usually relatively undefined, and only become more specific as a consequence of the decision to use particular means."[86] As Joas recognizes, "Reciprocity of goals and means . . . signifies the interaction of the choice of means and the definition of goals."[87] Externally fixed goals lie beyond the reflective process intrinsic to creative action.[88]

Dewey also builds his instrumentalist theory of logic as functional means-ends co-ordination out of his reconstruction of the stimulus-response cycle. Remember, what is the stimulus and what is the response emerges simultaneously and reciprocally in the efforts of the agent to co-ordinate its transactions. What is means and what ends likewise emerge reciprocally and simultaneously. Dewey insists that "the difference between means and end is analytic, formal, not material and chronologic."[89] The existential situation at any given point in the inquiry is just what it is; it is the inquirer's needs, desires, interests, and purposes as they emerge and later in the course of inquiry that determine when a situation is satisfactory, functional coordination achieved, and the conclusion of inquiry reached. All living creatures aspire to satisfy the needs of functional coordination. These same purposes select what in the situation is means and what ends. The distinction of means from ends is a practical distinction made for purposes that satisfy the inquirer purposes in coordinating a situation; it is not a distinction of existence. A different inquirer might arrive at the same co-ordination only to identify some other aspect as the end sought. The tendency to focus only on the ends we sought is the reasons we often ignore *unintended* consequences.

Often we ignore unintended consequences because we are not interested in them or are unable to detect them, sometimes to our detriment. *Dewey finds it easy to account for unintended consequences of action*; they are just aspects of the situation at the conclusion of inquiry that the agent did not consider, anticipate, or attend to, but nonetheless emerged in the agent's efforts to trans-form the original situation. The most frequent

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[85] Dewey, *Logic: The theory of Inquiry*, p. 153.

[86] Ibid. p. 154

[87] Ibid.

[88] Ibid., p. 155

[89] Dewey, *Experience and Nature*, p. 280.

source of damaging unintended consequences is the failure to realize that an agent's actions not only transform the world, but, transactionally, they always transform the agent as well. *One of the serious shortcomings of Simon's theory of procedural rationality is that it is incapable of dealing with unintended consequences.*

VI. Intentionality, Experiments, and Choice

Practical reasoning, for Dewey, is playful experimentation that weaves intelligence into embodied need and desire. It involves carrying out experiments to explore various possible lines of action. Significantly, "experience" and "experiment" both derive from the Latin through the French for "a trial" or "knowledge through a trial" while "choice" derives from the Teutonic through the French for "to try, test." Dewey thought it best to carry out the experimental "trial in imagination" because that may save us from actually suffering the consequences. It is best to play with the possibilities rather than suffer the actual consequences. Choice emerges by playing with the functional relations among the various subfunctions of intelligent means-consequence reasoning. Ends-in-view are teleological for Dewey, but they are not fixed. Playfully varying plans as the situation requires, and as the situation becomes clearer, is a crucial part of creative rational action, just as rational action is part of creative action. The capacity to vary plans, to change the course of action is one of Dewey's conditions of freedom. Teleological theories of intentionality harness us to the carriage of convention.

Thinking this way allows us to reconceive intentional goal setting in a more creative and contextualized way. Accordingly, Joas writes, "goal-setting does not take place by an act of the intellect prior to actual action, but is instead the result of a reflection on aspirations and tendencies that are pre-reflective and have already always been operative."[90] Where are these aspirations located, one might wonder? Joas's answer is deceptively simple:

They are located in our bodies. It is the body's capabilities, habits and ways of relating to the environment which form the background to all conscious goal-setting . . . . our intentionality. Intentionality itself, then, consists in a self-reflective control which we exercise over our current behavior. If this non-teleological and instead self-reflective conception of intentionality does justice to the matter at hand, then it changes our picture of all action-related phenomena.[91]

Joas's Deweyan hunch is correct; bodily habits unconsciously perform many of the functions normally attributed to higher psychological functioning. Rendering the work of unconscious habits conscious through self-reflective inquiry allows us to gain conscious control over our goal-setting activity and, thereby, ourselves. If this is what Joas means then he agrees with Dewey.

Besides assuming that all action is teleological, most theories of action assume that actors can control their bodies "at will." Joas notes that, "the body can be controlled in the sense of being deployed for the actor's purposes is in fact an implicit assumption, for the body does not appear explicitly in most theories of action."[92] Certainly, the body does not explicitly appear in the work of Simon. *For Dewey, habits are will*; we control them when we identify them and condition them through reflective inquiry.

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[90] Joas, *The Creativity of Action*, p. 158.

[91] Ibid. p. 159

[92] Joas, *The Creativity of Action*, p. 167.

Joas provides three reasons why we should not accept the notion that an agent's body is always at her disposal and is always available to serve her purposes. First, such a model of action assumes a teleological understanding of intentionality. This model assumes we "conceive" a telos as our intentional object and then the "will," or some such psychological entity inside consciousness, orders the body to act to achieve the concept. Instead, on the non-teleological model, the ever-active body often works *unconsciously* to achieve ends. Further, conflicting habits lead to conflicting ends, or perhaps in a unique context, old habits cannot determine any end of action and so inquiry begins. Other times we just "play" with the possibilities and purposes emerge.

A second reason why we should not assume an agent's body is always at her disposal, according to Joas, is:

> [A]ction theory must defend itself against the accusation that it intrinsically leans more heavily in favor of an activistic relationship to the world, which is evidently culture-specific if not gender-specific, and thus does not fulfill its claim to universality.[93]

This seems like a serious problem to a pragmatist such as Dewey; after all, pragmatism derives etymologically from the ancient Greek word for "a deed," "a thing done," or "to do." Trans-action theory, though, can easily avoid this accusation. While it is true that every living creature must act by virtue of being alive, in a trans-action, the agent is receptive as well as purposive, sensitive as well as expressive. Further, it is important to realize every intentional act, even a teleological intention (an intention to achieve a specific end), has unintended consequences. We must suffer all the consequences of our actions, both those we intend and those we do not. Finally, intelligent action surely requires aesthetic perceptivity; to act effectively one must intuitively discern one's situation as well as grasp it cognitively. Receptive attitudes of openness and sensitivity matter if for no other reason than we only respond to what we attend to. *Attention is selective and selective attention involves emotion.* If we do not attend to the appropriate aspects of a context, it will not matter if our cognitive reasoning is perfect, we will still fail to co-ordinate our action effectively. For instance, a "pure" logician may fail miserably in the jungle if he cannot "see" the sign of the approaching tiger.

The third reason remarked on by Joas "why the body cannot simply be taken as the tacit assumption underlying a theory of action has to do with the problems of confining the body to an instrumental role."[94] So conceived, "the body is thought of as a permanently available instrument of pure intentionality."[95] For Dewey, control of one's body emerges slowly and then only after a long course of reflection between what we do and what we suffer consequently.

Near the end of his analysis of Dewey's non-teleological intentionality Joas observes:

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[93] Ibid.

[94] Ibid., p. 168.

[95] Joas, *The Creativity of Action*, p. 168.

> Every action takes place in a situation . . . what is missing, and what becomes immediately obvious the moment we adopt a non-teleological approach, is that it is not sufficient to consider human action as being contingent on the situation, but that it should also be recognized that the situation is constitutive of action . . . . Thus defined, the concept of 'situation' is a suitable replacement for the means-ends schema as the primary basic category of a theory of action.[96]

Means and ends are not distinctions of existence; they are useful methodological distinctions of function with respect to the agent's effort to functionally co-ordinate her transactions regarding some situation. Means and ends are subfunctions of the function of inquiry, which is the creative and controlled transformation of an indeterminate situation into a harmonious, unified whole.

VII. Deliberation versus Calculation

This section takes us to the core of Dewey's rejection of utilitarian calculative rationality and, thereby, to a Deweyan reason to reject Simon's theory of procedural economic rationality. Dewey argues that with the utilitarians, "Happiness was thus identified with a maximum net gain of pleasure on the basis of analogy with business conducted for pecuniary profit, and directed by means of a science of accounting dealing with quantities of receipts and expenses expressed in definite monetary units."[97] He then goes on to assert that "there exists a difference in kind between business calculation of profit and loss and deliberation upon what purposes to form."[98] Simon's mistake is the same as that of many other utilitarians; he thinks he can reduce all deliberation, all choice, to the equivalent of a business calculation regarding profit and loss. Ironically, such reductionism fails to capture genuine economic behavior. Before seeing why, let us mark the difference between business calculation and genuine deliberation.

Dewey finds mere business calculation an instance of narrow reasoning. According to him, the narrow sense "holds a fixed end in view and deliberates only upon means of reaching it."[99] Meanwhile, the wider sense "regards the end-in-view in deliberation as tentative and permits, nay encourages the coming into view of consequences which will transform it and create a new purpose and plan."[100] He goes on to observe that "business calculation is obviously of the kind where the end is taken for granted and does not enter into deliberation."[101] In the narrow case of having a predetermined end, we may only deliberate about the means. The paradigm is Humian. Passion, i.e., feeling of need and desire, assign the ends for which it is the office of rationality to find the means. For Dewey, seeking means to secure a predetermined telos is not deliberation at all; indeed, as we will find below, he does not think it is something we can actually do. For Dewey,

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[96] Ibid. p. 160

[97] Dewey, *Human Nature and Conduct*, p. 148.

[98] Ibid. pp. 148-9

[99] Ibid. p. 149.

[100] Ibid.

[101] Ibid.

genuine deliberation has a playful nonteleological intentionality wherein ends do not fully emerge until we know the means for securing them; without such means, the end is a fantasy, a wish, not a matter of rational deliberation. Putting it somewhat paradoxically, Dewey states, "Deliberation is not free [or playful] but occurs within the limits of a decision reached by some prior deliberation or else fixed by unthinking [habitual] routine."[102]

The fundamental error of utilitarianism in all its forms, including Simon's, is that it assumes that all alternatives, all objects of desire, all values are qualitatively the same. To assert that all values are commensurable and arrangable in a fixed hierarchy is, according to Dewey, "equivalent to the assertion that no real or significant conflict among them is possible; and hence there is no need of discovering an object an activity which will bring them into unity."[103] That is the same as saying, "there is no genuine doubt or suspense . . . The only 'problem' or doubt is as to the amount of pleasure (or pain) that is involved."[104] In such a circumstance, there is no genuine deliberation, and, indeed, it is possible to write a utility maximizing equation that relates quantities of the same value, and a fixed hierarchy exists because the quantities are well ordered. The mistake lies in confusing the subsequent calculation with genuine deliberation. At best, it is deliberation in the narrow sense; what makes it narrow is that it one-dimensional and it is one-dimensional because it only considers one value. The agent's activity is already functionally coordinated, or all that is required for such coordination is more (or sometimes less) of some one thing.

VII-I. Dewey's Rejection of Utilitarian Calculative Rationality: A Serious Challenge to Simon

For Dewey, "Habits are conditions of intellectual efficiency."[105] Negatively, embodied, impassioned habits constrain thought into preestablished channels. The result is "mindless action" in which there is no conscious, reflective thought. On the other hand, "Concrete habits do all the perceiving, recognizing, imagining, recalling, judging, conceiving and reasoning that is done . . . . Yet habit does not, of itself, know, for it does not of itself stop to think, observe or remember."[106] When habits of action fail, the agent must engage in reflection and deliberation to resolve the problematic situation. That is why learning and growth only occur in states of disequilibrium when the agent must strive to restore functional co-ordination. Similarly, genuine choice only occurs on such occasions. That is one reason why when we choose, we not only express our existing habitual self, we form our future self.

Wise choice involves considering the consequences for oneself as well as the environment, including other persons. One of Simon's most serious mistakes is thinking that "knowing and doing have no intrinsic connection with each other. Reason is asserted

[102] Dewey, *Human Nature and Conduct*, p. 149.

[103] Ibid.

[104] Ibid. p. 150

[105] Dewey, *Human Nature and Conduct*, p. 121.

[106] Ibid., p. 124

to have no responsibility to experience"[107] Recall that Simon insists that his theory of thinking considers perceiving information as secondary and unrelated to sensing or acting. In the tradition of Hume, Simon assumes that reason is at the disposal of emotion and the body always at the disposal of the agent's will. Joas states:

> The alternative to a teleological interpretation of action, with its inherited dependence on Cartesian dualisms, is to conceive of perception and cognition not as preceding action but rather as a phase of action by which action is directed and redirected in its situational contexts[108]

The dualism of Simon's thinking is transparent. It is much easier to understand the choices made by living beings if we understand that cognition and perception, along with need, desire, interest, imagination, and experimental action are phases, or subfunctions, of the function of deliberative choice. The human mind is not a Turing machine. Instead of maximizing utility or satisficing according to aspiration, living, embodied human beings have economic demands that they hope will satisfy their needs and desires for functional coordination of their transactions.

Simon's theory of deliberation assumes the mind is a satisficing Turing machine that begins with a fixed and final hierarchy of preferences and strives to choose the one that maximizes this preference hierarchy given such constraints as time, processing power, and cost of information. Compare it to Dewey's definition of deliberation:

> Deliberation is a dramatic rehearsal (in imagination) of various competing possible lines of action. It starts from the blocking of efficient overt action, due to that conflict of prior habit and newly released impulse. . . . Then each habit, each impulse, involved in the temporary suspense of overt action takes its turn in being tried out. Deliberation is an experiment in finding out what the various lines of possible action are really like . . . . But the trial is in imagination, not in overt fact. [109]

Deliberation permits intelligent choice, as it does for Simon, but it does so in an entirely different way. Imagination, habits, innate impulses, emotion, the body, and experimentation (in the etymological sense of "making a trial") are important parts of deliberation for Dewey. For Dewey, imagination is old habits adjusting to new situations. *An idea or hypothesis is a product of the imagination.* They are possible courses of action that, if carried out, could restore functional coordination. Dewey proposes a theory of creative rationality that, as Joas understands, is an important part of his theory of creative action.[110]

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[107] Ibid., p. 130

[108] Joas, *The Creativity of Action*, p. 158.

[109] Ibid., 132-133. Elsewhere, Dewey notes:

No "reasoning" as reasoning, that is, as excluding imagination and sense, can reach truth . . . . [The inquirer] selects and puts aside as his imaginative sentiments move. "Reason" at its height cannot attain complete grasp and a self-contained assurance. It must fall back upon imagination--upon the embodiment of ideas in emotionally charged sense. See Dewey, Art as Experience. p.40.

[110] In Dewey's theory of creative action, "rationality" itself is among those things we create and must constantly revise. "Reason," Dewey writes, " is not an antecedent force which serves as a panacea. It is a

Dewey asks, "What then is choice?" His answer is simple,

> Simply hitting in imagination upon an adequate stimulus to the recovery of overt action. Choice is made as soon as some habit, or some combination of elements of habits and impulse, finds a way fully open.[111]

Notice the reference to determining "an adequate stimulus;" Dewey's theory of rational deliberation is modeled on his reconstruction of the reflex arc concept. Dewey affirms, "The primary fact is that man is a being who responds in action to the stimuli of the environment. This fact is complicated in deliberation, but it certainly is not abolished."[112] We constitute the object of choice much as we do the object of inquiry, which, in turn we constitute much as creatures incapable of conscious rational deliberation constitute stimulus that controls our action. Said the other way around, *choice is the conscious, deliberative, and creative construction of a stimulus object or end that satisfies our need or desire to functionally co-ordinate our conduct*. In carrying out deliberation, we creatively transform ourselves as transactionally we creatively transform the world. Hence, when we choose something, we also chose who we want to become.

Dewey criticizes traditional versions of hedonistic calculation in ways that apply most directly to substantive rationality, but because we believe he holds utility maximization as his regulative ideal of action, it has consequences for Simon's more refined procedural version of rationality. The core intuition of the hedonistic calculus is that we should maximize pleasure and minimize pain; this max/min strategy operates as an unquestioned assumption of expected utility theory. Of course, at best the concepts of pleasure and pain are only subject to indirect measurement.

Dewey acknowledges the role, though not the exclusive importance of pleasure and pain to deliberation, but points out that it is not "a calculated estimate of future delights and miseries, but by way of experiencing present ones."[113] In fact, "The reaction of joy and sorrow . . . is . . . a response to objects presented in imagination as those presented in sense."[114] *Simon would find as little use for imagination as sense as he does for action*, but because imagination for him is simply an alternative state generator (e.g., a chess player entertaining possible configuration on a chess board), he might accept Dewey's claim that we, "think, through imagination, of objects into which in the future some course of action will run, and we are <u>now</u> . . . pleased or pained at what is presented."[115] Simon might well accept this latter criticism of substantive rationality, in part because he thinks psychology is relevant to economics. What Dewey says next, though, begins to expose weaknesses in Simon's stance:

> The calculative theory would have it that this subject-matter [of deliberation] is future feelings, sensations, and that actions and thought are external means to get and avoid these sensations. If such a theory has any

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laborious achievement of habit needing to be continually word over." Dewey, *Human Nature and Conduct*, p. 137; see also pp. 136 and 137.

[111] Ibid. p.134

[112] Ibid. p. 139. See also p. 144.

[113] Ibid., p. 140.

[114] Ibid.

[115] Ibid.

> practical influence, it is to advise a person to concentrate upon his own most objective and private feelings. It gives him no choice except between a sickly introspection and an intricate calculus of remote, inaccessible and indeterminate results. In fact, deliberation, as a tentative trying-out [experimenting] of various courses of action, is outlooking."[116]

Because Simon cuts thinking off from sensing or doing, most of what Dewey says above applies to him. Simon's psychology alienates the agent from the world of action by leaving him lost in disembodied, passionless Cartesian thought. There is no room to experiment with the world, much less creatively transform it. His model of rationality suffers as science as well as creative expression, while limiting the *activity* of choice.

Simon's psychology is cut off from action; it fails not only to recognize the artistic dimensions of action but also to recognize the moral. Consider Dewey's following comment:

> [A] man's judgment of future joys and sorrow is but a projection of what now satisfies and annoys him . . . . His estimate of future consequences of the agreeable and annoying is consequently of much greater value as an index of what he now is than as a prediction of future results.[117]

Simon's psychology cannot handle the fact that it is a moral and aesthetic as well as cognitive being that chooses, or that these aspects of one's being influence the choices made and the conditions of satisfaction. Satisfaction is also conditioned by embodied action upon the world. The conclusion is obvious, though difficult to accept. *Satisfaction is not confined to the mind, or even the body, it is a matter of the agent's transformative transactions with the world*. What satisfies the agent must satisfy the entire situation of which the agent is only a subfunction.

Because both the agent and the world undergo transformation in the process of inquiry, what satisfies the agent at the end of inquiry need not be what would have satisfied her at the beginning. Satisfaction is an emergent product of deliberation. Similarly, the hierarchy of satisfaction at the end of the process of deliberation is often not the one with which we began. Indeed, hierarchies of value mean much less for Dewey than for Simon, who could not do without them in his theory of satisficing. Said differently, Simon has a teleologically fixed theory of *satisficing*, while Dewey has a flexible nonteleological theory of *satisfaction*.

Dewey and Simon have very different notions of the good. Dewey says, "Good consists in the meaning that is experienced to belong to an activity when conflict and entanglement of various incompatible impulses and habits terminate in a unified orderly release in action."[118] For Simon, the good maximizes an objective fixed utility function given a hierarchy of values, while for Dewey the good unifies thought, feeling, and action within a problematic situation. For Dewey, such unity offers an aesthetic experience, while also having significant meaning for imputing potential consequences that may

[116] Ibid., pp. 140-141.

[117] Ibid., p. 142.

[118] Ibid. p. 146.

unify subsequent situations. For Dewey the good, unification of action, functional coordination, and satisfaction are the same.

Dewey acknowledges that "unification which ends thought in act may be only a superficial compromise, not a real decision but a postponement of the issue. Many of our so-called decisions are of this nature."[119] Often we settle for less than something that fully unifies a situation because sometimes that is the best we can do. The situation is much like the chess player who modifies her aspirations for a position so she can carry out an action, or make a "move," that is "good enough." For Dewey, that means it sufficiently coordinates the transaction (the match) such that final unification (winning) is postponed, but possible.

At some level, "good enough" is all Dewey thinks we ever get. He claims, "Even the most comprehensive deliberation leading to the most momentous choice only fixes a disposition which has to be continuously applied in new and unforeseen conditions, re-adapted by future deliberation."[120] Dewey declares:

> The business of reflection in determining the true good cannot be done once for all, as, for instance, making out a table of values arranged in a hierarchical order of higher and lower. It needs to be done, and done over and over and over again, in terms of the conditions of concrete situations as they arise. In short, the need for reflection and insight is perpetually recurring.[121]

He wonders, "Does not this reduce moral life to the futile toil of Sisyphus?" [122] Dewey's answer is, yes, if for us progress means a "control of conditions" that excludes the necessity of future deliberations," but no, if "continual search and experimentation to discover more meaning" is such that it "keeps activity alive and growing."[123]

Dewey notes that we often yield to temporarily intense impulse that achieves "a unity by oppression or suppression, not coordination."[124] Simon also insists, "behavior [action] tends to be described as 'irrational' in psychology when it represents impulsive response to affective mechanisms without an adequate intervention of thought."[125] Good chess players do not yield to impulse, suppression, or oppression. Unlike Simon, though, Dewey would think that good chess players have a larger repertoire of habits as well as the ability to carry out deliberation when those habits fail them that imaginatively explores yielding to various impulses in imagination where their actions (moves) are retrievable. It is not a matter of mentalistic representations corresponding to possible situations in the external world.

Dewey acknowledges the passion "of pecuniary gain is an undoubtedly powerful fact."[126] Still, he concludes:

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[119] Ibid.

[120] Ibid. p. 144.

[121] Dewey, *Ethics*, p. 212.

[122] Ibid. p. 144.

[123] Dewey, *Ethics*, p. 144.

[124] Ibid. p. 146.

[125] Simon, "From substantive to procedural rationality," p. 131.

[126] Ibid.

> But it and its importance are affairs of social not of psychological nature. It is not a primary fact which can be used to account for other phenomena. It depends upon other impulses and habits . . . . It cannot be used to define the nature of desire, effort and satisfaction, because it embodies a socially selected type of desire and satisfaction . . . . It affords, like steeple-chasing, or collecting postage stamps, seeking political office, astronomical observation of the heavens, a special case of desire, effort, and happiness. And like them it is subject to examination, criticism and valuation in the light of the place it occupies I the system of developing activities.[127]

The pecuniary value of profit or loss is simply one value among other, often incommensurable, values. Only by assuming all other values are analyzable in terms of this one value can the utilitarian maximizers construct their expected utility equations. Thus analyses such as Simon's depend on materialistic reductionism.

Expected utility theorists deceive themselves and us with a decontextualized psychology that buries their values deep inside the supposedly innate structures of the mind that include such supposed entities as innate rationality in the guise of computation programs and innate freewill. All this mental structure is supposedly completely decontextualized and located somewhere between the embodied neurophysiological subject and sociocultural practices. It is precisely such psychology that Dewey denies when he asserts *the importance of pecuniary gain is social not psychological.* Dewey's reasoning is closely allied to why Rorty in his own rejection of cognitive psychology concludes, "If assertions are justified by society rather than by the character of the inner reorientation they express, there is no point in attempting to isolate privileged representations."[128] . There are no privileged representations in the mind, including representations of privileged values, or privileged representations for how to calculate them. Thinking like this leads Howard Gardner to conclude, "Rorty is unable or unmotivated to come up with any arguments in principle against psychology, but feels that the discipline might well never have been invented, and that it may well some time disappear, to the regret of few."[129] Dewey's view seems to be similar.

One of Dewey's concerns about philosophical idealism in all its forms is that it attempts to decontextualize knowledge. Similar concerns apply to Simon's attempt to use a decontextualized theory of mind as a Turing machine to argue that it is possible to detach values from their social context. It is here that Dewey delivers his most damaging blow to expected utility theory and to Simon's attempt to rescue it via a psychology of Turing machine procedural rationality. Dewey observes:

> The uses to which gains will be put . . . are passed over only because they are so inevitably present. Support of family, of church, philanthropic benefactions, political influence, automobiling, command of luxuries, freedom of movement, respect from others, are in general terms some of the obvious activities into which economic activity fits. This context of activities enters into the real make-up and meaning of economic activity[130]

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[127] Ibid.

[128] Rorty. *Philosophy and the mirror of nature*. p.174.

[129] Gardener, *The Minds New Science*, p. 75.

[130] Dewey, *Human Nature and Conduct*, p. 153.

Simon's psychology, like all psychologies that presume there is a special psychic realm somewhere between neurophysiology and sociocultural practice and theory, ignores context. In this case, Simon ignores the larger context of social and cultural activities, along with their meanings and values, which gives economic activity its meaning and value in the wider sense.

The problematic situation involves the conflict of incommensurable meanings and values among these diverse domains of activities. In the agent's efforts to functionally coordinate her transactions it is impossible to establish a single, narrow, hierarchy of values without cutting them off from all other values. The agent's task is not determining such a hierarchy, but, insofar as possible, arriving at a dynamic equilibrium among a wide variety of values that allows the agent to *satisfy* her need and desire to maintain unified functioning. Dewey draws the obvious conclusion:

> Calculated pursuit of gain is in fact never what it is made out to be when economic action is separated from the rest of life, for in fact it is what it is because of a complex social environment involving scientific, legal, political and domestic conditions.[131]

Economic agents, as an empirical fact, cannot separate economic values from other social values. Rational economic agents are also moral and aesthetic agents. One cannot reconcile conflict concerning incommensurable values by utility calculation involving reduction to one supreme value because that simply proves there was no real value conflict to begin with. *Ignoring the social context of incommensurable values crucial to genuine economic deliberation is the most serious cause of the predictive inadequacy of models of economic choice.*

VIII. Concluding Remarks

Since the primary thing that distinguishes Dewey or Aristotle from Simon, Hume, the utilitarians or Plato is whether or not deliberation deliberates about ends, we will conclude this chapter with a discussion of the nature of the aims of deliberation, including economic deliberation.

Dewey's instrumentalism is as different from the Humian inspired instrumentalism of Simon, and the utilitarians, as is possible. For Dewey, "ends arise and function within action. They are not . . . things lying beyond activity at which the latter is directed."[132] There are no ends of action for any living creature; there are only ends of deliberation. For Dewey, ends as "ends of <u>deliberation</u> . . . are redirecting pivots <u>in</u> action."[133] There are no absolute teloi, ends, or values for Dewey below which all other values exist in a fixed and final hierarchy. Dewey also draws a very important distinction between "ends-in-view and "ends." End-in-view are imaginative possibilities that serve as guides to action, but in a strict sense "an end-in-view is a means in present action; present action is

[131] Ibid.

[132] Ibid. p.154

[133] Ibid. p. 155

not a means to a remote end."[134] Blueprints are means to the end of constructing a building. An end *per se* is simply what we get at the end of deliberation, whether it is what we want or not; it is an existential state of affairs. If we get what we want, it is the final, emergent telos of deliberation; it is not the end of action. Ends-in-view are constantly adjustable and usually evolve as inquiry unfolds. Further, rarely is the existential end actually achieved entirely the same as that which we intended at the beginning of deliberation. This is one way that meaning can emerge out of inquiry and not just initiate and infuse it.

Dewey, contra Hume, denies that ends are ever entirely separable from means. Unlike modern champions of instrumentalism, means often constitute the end for Aristotle and Dewey, just as bricks, artisanship, and mortar constitute the building upon completion. The experienced builder may tell what kinds of tools workers used on the job and can surely evaluate the quality of the artist who executed the work as well as the architect's design. Dewey described the organic relations thus: "The connection of means-consequences is never one of bare succession in time . . . . There is a deposit at each stage and point entering cumulatively and constitutively into the outcome. A genuine instrumentality for is always an organ of an end."[135] Connecting means with ends is not a linear exercise; Dewey insists on "the thoroughly reciprocal character of means and end in practical judgment."[136] What is means and what ends *emerges* in the *creative* effort to co-ordinate some situation, some context of action much as what is stimulus and what response emerge in any living organism's effort to *constitute* a stimulus that controls subsequent action. At any point in the process of functionally co-ordinating means and consequences, we might decide that what we have thus far accomplished is more valuable than our original end-in-view and decide to simply stop satisfied. Such a choice is easier for those whose non-teleological intentions allow them to play with possibilities, rather than work toward predetermined, fixed, and final goals.

What is means and what are ends in a functionally coordinated situation depends on the purposes of the agent; they are not distinctions of existence. The end, the situation, is whatever it is; another agent might strive to arrange the same unity, but find the end in another aspect. As Dewey describes it:

> The doctrine of fixed ends not only diverts attention from examination of consequences and the intelligent creation of purpose, but, since means and ends are two ways of regarding the same actuality, it also renders men careless in their inspection of existing conditions.[137]

The unity of means and ends in the actual existential end actually achieved is the reason there are always unintended consequences of every action and every end of deliberation.

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[134] Ibid. p. 156

[135] Dewey, *Experience and Nature*, p. 276.

[136] Dewey, *The Logic of Judgments Of Practice*, p. 37.

[137] Dewey, Human Nature and Conduct, p. 160.

Dewey's critique of traditional, teleological theories of intentionality has a back-and-forth playfulness in Dewey's means-ends schema that makes it non-teleological. Joas declares:

> Dewey rejects the common tendency to distinguish play from work on the grounds that the former is goal-free. According to Dewey, play most certainly does involve goals in the sense of an inner regulation of action . . . . [T]he goal orientations involved in play are not fixed externally and maintained irrespective of inner resistance to them. Those who play can be said to be free because they are able to abandon or redefine the current goals if their actions no longer promise fulfillment.[138]

This playfulness releases not only creativity, but also the occasion for freedom in action. For Dewey, "Intelligence is the key to freedom in act."[139] The exercise of intelligence in Dewey's instrumental means-consequence logic, the theory of inquiry, is the key to freeing our trans-actions and, indirectly, facilitating self-control.

As Joas indicates, play is part of a non-teleological theory of intentionality. Dewey proclaims that "play has an end in the sense of a directing idea which gives point to the successive act" although the anticipated end "is rather a subsequent action than the production of a specific change in things. Consequently play is free, plastic."[140] Work, by contrast, envisions a more definite end, goal, or value that is more remote and enlists sustained effort. Play passes into work without breach of continuity for Dewey:

> Both are equally free and intrinsically motivated . . . . Work is psychologically simply an activity which consciously includes regard for consequences as part of itself; it becomes constrained labor when the consequences are outside of the activity as an end to which activity is merely a means. Work which remains permeated with the play attitude is art.[141]

The ability to imagine and play creatively with alternative possibilities is a crucial part of freedom because it allows us to vary plans according to our desires; so comprehended, freedom is a crucial part of intelligent inquiry.

Dewey's theory of purposeful rationality is not linear means-ends connectionism where means hook up to some predetermined end like the engine to the caboose of a long train; instead, it is a matter of functional means-end co-ordination wherein means often constitute the end just as bricks and mortar constitute a building once the architect's plans are executed. Indeed, like stimulus and response, means and ends mutually constitute each other. That is why we must deliberate about means and ends simultaneously. *Simon thinks we only deliberate about means because ends can be given in advance.* The result is a mistaken teleological theory psychological intentionality that combines with a mistaken theory of economic rationality.

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[138] Joas, *The Creativity of Action*, p. 155.

[139] Dewey, *Human Nature and Conduct*, p. 210.

[140] Dewey, *Democracy and Education*, p. 211.

[141] Ibid. p. 214.

Dewey has a nonteleological theory of intentionality in which the ultimate end is always to restore functional coordination to the agents' transactions, including, of course, economic transactions. Such unity is the true source of satisfaction in life, including our economic lives. Nonteleological intentionality, functional coordination, and satisfaction are among the constitutive properties of Dewey's theory of deliberation, a theory which has the ability to account for rational choice in the context of value incommensurability such as we typically encounter in the market.

Simon's psychology of economic rationality not only assumes a socially decontextualized mind whose primary function is to carry out Turing machine calculations, he also assume a mind that is decontextualized from the material conditions of the environment involved in the agent's habits and impulses that give substance to economic need and desire. Interestingly enough, Dewey defends utilitarianism against those who would emphasize embodied factors alone as determiners of action. He concedes that unconscious "impulse and habit, not thought, are the primary determinants of conduct," but that is precisely why he thinks we need a theory of conscious, intelligent deliberation.[142] Dewey writes, "The error of utilitarianism is not at this point. It is found in its wrong conception of what thought, deliberation, is and does."[143] Dewey is right regarding utility theory in general and right regarding Simon in particular.

[142] Dewey, *Human Nature and Conduct*, p. 153

[143] Ibid.

Chapter Three: Bounded Rationality and Substantive Rationality Do Not Fit in the Same Paradigm[144]

> Students have a major advantage over us teachers in that, they are not (yet) indoctrinated by the body of literature so firmly rooted in the notion of rational man-- Ariel Rubinstein[145]

Abstract

This chapter clarifies the similarities and differences between substantive (global) and bounded rationality. I question the wisdom of interpreting bounded rationality as a deviation from substantive rationality. I argue that only this approach can justify the usage of same axiomatic framework for both types of rationality. Furthermore, I claim that by adopting a new paradigm for analyzing bounded rationality with reference to itself (as opposed to with reference to rationality), a clean formalization of bounded rationality becomes possible. Continuing from last chapter, I suggest replacing teleological rationality with nonteleological intentionality.[146] This, in turn, means that we need to consider an alternative nature for uncertainty, an alternative that has been acknowledged by philosophers for some time.[147] Thus, both legs of a new and creative (bounded) rationality will land in an alternative paradigm that has the potential to be formalized as an operational framework. That would supplement the primary idea of bounded rationality and would eventually redirect research efforts onto an altogether new path.

I. Mainstream Economics Paradigm

The standard paradigm of mainstream economics is a coherent one. Expected utility theory is a legitimate product of this paradigm that fits in very well. The alternative idea of bounded rationality,[148] which has been around for half a century, has provided many useful insights into how people actually behave. However, bounded rationality has failed to provide the profession with an operational formalism. I claim that it will never do so either!

Bounded rationality has one leg firmly placed in the old paradigm. This leg, which people are not willing to question is teleological rationality. However, the other leg of bounded rationality—cognitive limitations—is only *assumed* by advocates of bounded

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[144] A modified version of this chapter is under review to be published in a book on the contemporary status of behavioral sciences, Ed. Elias Khalil.

[145] Ariel Rubinstein. Modeling Bounded Rationality. p.5

[146] In chapter two, what Hans Joas calls John Dewey's nonteleological theory of intentionality, rational action, and choice was contrasted with the teleologically intentional structure of procedural and substantive rationality, to make this point more clearly from another perspective. We saw that a theory of creative rationality in decision-making moves beyond substantive and bounded rationality by rejecting the notion of epistemological given-ness of some ideal maximizing function that should, normatively, determine choice.

[147] Quine (1969)

[148] Invented by Herbert Simon, Models of Man, 1955.

rationality to have the same placement. Therefore, most of the efforts to capture the idea of bounded rationality can be portrayed as trying to fit the second leg into the standard paradigm of expected utility and regular probability theory. I assert that the second leg, cognitive limitations, is not compatible with the standard paradigm and therefore cannot be placed in it. The light that is provided by the idea of cognitive limitations comes from another source. I claim further that the efforts to place it in the same framework as the first leg will inevitably be in vain, as has been true so far. I also believe that the idea of bounded rationality is valuable and should be absorbed and captured in economics studies. But the correct way to do so is to replace the first leg with an alternative that fits well in the paradigm in which the second leg belongs.

To clarify this argument I will explain both sides of the bounded rationality idea. I will show what bounded rationality and substantive rationality share,[149] that is, the leg I propose to replace with a new one. Also, I will demonstrate the merits of the idea that constitutes the second leg of this approach and argue that this leg does not belong in the current paradigm (it is using the wrong psychology) and so can never be captured by the practice and tools of this paradigm (any form of optimization).

II. Satisficing Behavior

The famous boundedly rational agent is *satisficing agent*. In Simon and Newell's initial presentation of the idea of satisficing (1972), a satisficing agent is able to categorize any outcome of a decision problem as either "satisfactory" or not. If there is exactly one such option, the *boundedly rational* agent chooses it. There is no guarantee, however, that any option will be satisfactory or that there is not more than one satisfactory option. And so the model of a satisficer is still incomplete. The main use of satisficing models has been in related research on human problem solving.

Simon (1975)[150] aimed to construct definitions of "rational choice" that were modeled more closely on the actual decision processes in the behavior of agents (he calls them organisms) than definitions previously proposed. He outlined a model for the static case and described dynamic extensions of this static model by introducing two adjusting concepts: *an adjusting aspiration level* to capture how the individual explores alternatives; and *an adjusting set of alternatives (A0)* to describe what happens when the individual decides to consider more or fewer behavior alternatives. In the case of adjusting the aspiration level, if discovering satisfactory alternatives is easy (or difficult) the agent's aspiration level rises (falls). Adjusting the set of alternatives is an elaboration of the information gathering process; if it is easy (difficult) to find satisfactory alternatives the set narrows (broadens). The more persistent the agent, the greater the role played by the adjustment of A0, relative to the role played by the adjustment of the aspiration level.

Simon addressed a broad paradox: economic theory of the firm and the theory of administration attempt to deal with human behavior in situations where behavior is at least "intentionally" rational. But the behavior of such collective entities cannot be

[149] The Humian ground.

[150] *Models of Man*, Chapter 14: "A Behavioral Model of Rational Choice"

explained by means of a representative rational agent.[151] This is because when we assume the global rationality of classical theory, the problem of internal structure of firms or other organizations largely disappears. To solve this problem, Simon replaces the "economic man" of global rationality with "administrative man," that is, a choosing organism of limited knowledge and ability.

There are many economic phenomena of this sort, that are difficult to understand without a model of bounded rationality. While this argument is extremely appealing, and the idea has enjoyed immense attention for a long time, among different major social sciences, it suffers from the lack of a formal structure. A very challenging question has remained a puzzle: how do we form a proper axiomatization of somewhat rational individuals? In what follows I take some steps in this direction.

II-I. Satisficing or Maximizing?

Neither pure satisficing nor pure maximizing is likely to be observed in the real world. A maximizing agent compares all the alternatives and chooses the best; a satisficer stops comparison after the first *satisfactory* alternative. Maximizing requires consistent and single-scale preferences; satisficing treats the target of each dimension as an independent constraint. A *better* bundle could be neglected by the satisficer if a bundle that is worse, but above aspiration level, is considered first. Also, the aspiration level could be too high to make *any* decision possible.

In interpreting the empirical data, there is no easy way to distinguish between maximizing and satisficing behavior. Believers in maximization use an extensive definition of preferences to capture the deviations from maximizing. In other words, they are capable of rationalizing almost every behavior.[152] On the other hand, advocates of satisficing behavior offer a variety of definitions of targets to account for deviations from satisficing. Thus, the difficulty of linking empirical data to theoretical statements lies in the fact that it can be done tautologically either way.

III. Characteristics of Bounded Rationality

Simon claims that the theory of bounded rationality has better descriptive and predictive power but has not been utilized sufficiently because people have not realized that it works well compared to expected utility theory. He suggests more empirical and experimental studies should be the starting point for the formation of theories of the decision making processes of both consumers and firms.[153] He describes the five salient characteristics of economic phenomena:

> [T]he properties of the system itself influence the behavior only to the extent that they limit the perfection of its adaptation to the environment. There may be limits both on its ability to compute what is the rational behavior and its ability to carry out the behavior computed.[154]

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[151] Guth and Kliemt (2000, ZIF) address this issue more specifically.

[152] Becker * has a rational model for almost every phenomena. Nevertheless, Simon's interpretation of Becker is interesting: Sometimes he seems to refer to Becker as an evidence for his claims! And in * he says, what Becker calls irrational is what I call boundedly rational…

[153] Simon, Herbert A., "*Methodological Foundations of Economics,*"

[154] Ibid, p. 25

Let's call the first ability *Knowing* (knowing what is rational) and the second one *Doing* (actualization of knowledge). Now, draw a system boundary so that all limits on *Doing* are outside the skin, while all limits on *Knowing* are inside the skin. Then causes of departures from rationality (limits on *Knowing*) *define "bounded rationality."*

The neglected half of economics, Simon claims, is "the study of the limits on human computational ability and how these limits influence intendedly rational behavior"[155] He find this negligence a profound deficiency and compares it to the omission of gravity from astrophysical theory. Also, he refers to modifications of perfect rationality to take account of search behavior (or responses to uncertainty) as insufficient efforts. What he offers instead is the description of an alternative to neoclassical theory, an alternative that excels, he claims, in terms of power and veridicality.

The focus of neoclassical theory, Simon says, is "Choice among a fixed set of alternatives based on a fixed utility function."[156] However, the theory does not explain "The origins of the alternatives; [or] the content of the utility function; [or] how items are placed in the agenda for decision; [or] by what computational means the agent connects alternatives with their consequences, measured in terms of utility."[157] Simon finds these unexplained dimensions crucial both to understanding and to predicting real world behavior. He claims that bounded rationality deals with areas of behavior that neoclassical theory neglects, while preserving empirically based neoclassical findings. However, bounded rationality requires extensive empirical assumption, where neoclassical theory enjoys the brevity and power of the assumption of maximization of subjective expected utility. Elsewhere, Simon criticizes Friedman's "principle of unrealism" and declares it "with out any logical support."[158] Therefore, he requires realistic assumptions for a behavioral theory, and he concludes that the only way to construct such a theory is by providing the field with ample empirical evidence.[159]

For Simon, human choice begins with the need for a decision and continues with generating or identifying alternatives that meet this need. The latter part, where all possibilities *cannot* be exhausted and the effective search must be directed by knowledge, is for Simon the more important part of decision-making.[160] Simon compares neoclassical theory, where "knowledge of discovery process is available to the agent," with the

[155] Ibid. He is not talking about emotion, unreason, and irrationality, but rather the complexity of the world and the finiteness of human abilities.

[156] Ibid. p. 26

[157] Ibid.

[158] Simon, Herbert A., "Methodological Foundations of Economics," p. 28.

[159] He believes that economics graduate students should be taught techniques for gathering relevant data rather than mere mathematical delicacies.

[160] As an example, Simon considers the design part of production in the car manufacturing process.

cognitive theory,[161] wherein "new alternatives are discovered by heuristic search through problem space."[162] Simon declares:

> [I]n human problem solving, search is usually directed by rules of thumb[163] , called heuristic, that are based on prior knowledge of the structure of the domain.[164]

In another work, Simon 1981, shows that heuristic search is ubiquitous, from medical diagnosis to architectural design. Elsewhere[165] he demonstrates that heuristic search can even account for scientific discovery as one form of creation of new alternatives.[166] Ronald Giere, praising Simon, adds that a scientist is a satisficer, not a rational decision-maker.[167]

The heuristic search will end by the application of a *stopping rule*, that is, a way of deciding when the search should be halted. It usually cannot guarantee that the stopping rule that is used is optimal, but it says that the value attained by stopping is "satisfactory."[168] In psychology this issue is addressed through the concept of an *aspiration level*. Simon defines aspiration level:

> [O]n the basis of past experience, the problem solver forms a judgment of the quality of solution he or she can expect to attain with a reasonable investment of effort. This judgment defines the level of aspiration.[169]

Stigler (1961) says "If the costs and yields of search were known, the stopping rule could be determined as the solution of a problem of optimization."[170] The problem with this view is that these costs and benefits are not known. Hence, *to explain the phenomenon of "search" a theory must postulate some kind of a feedback mechanism to adjust aspiration levels, without the possibility of estimating the optimal values of the feedback parameters.* Simon defines:

> Satisficing [is] the process of finding alternatives by heuristic search with… a stop[ping?] rule based upon adjustable aspirations.[171]

He compares the utility function with the satisfaction criterion:

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[161] Basis for bounded rationality

[162] In the car manufacturing example: they search for parts, then combine existing parts and test them to see if that meets the need.

[163] To the best of my knowledge, this term was used first by Veblen.

[164] Simon, *Methodological Foundations of Economics*.

[165] Langley, Simon, Bradshaw, and Zytkow, 1987; Kulkarni and Simon, 1988

[166] Although it is not clear to me to what extent "satisficing" and "heuristic search" are equivalent.

[167] Giere, *Explaining Science: a Cognitive Approach*

[168] Simon, 1955

[169] Ibid.

[170] This resembles the Bayesian theory of choice: the agent chooses an action where the marginal subjective cost equals the marginal subjective benefit.

[171] Simon, 1956a

> [The] satisfaction criterion can have much weaker properties than required by a neoclassical utility function…. The satisfaction criterion can be multifaceted without a need for comparability across facets. The theory postulates a set of satisficing levels instead of a utility function. The malleability of different levels of satisfaction can only be determined empirically and they should not be comparable, necessarily.[172]

Simon clearly states: "Like the theory of utility maximization, satisficing theory does not completely determine, a priori, the content of the utility or satisfaction function, but the satisficing theory says a good deal more about that function than does utility theory."[173] But he does not provide a function that reflects satisficing behavior and thus the claimed advantage cannot be explicitly verified.

III-I. Attention and Stopping Rules

For Simon, another neglected fact in neoclassical theory is "how items are placed on the agenda for decision"[174] A theory of bounded rationality derives the agenda-determining mechanisms from psychological research on the *phenomena of attention*. Attention cannot be directed to everything. For survival of the system, two kinds of need should get attention: (1) real-time needs: threats/opportunities of environment, (2) periodic needs: replenishment of draining resources. The first kind of need puts new items on the agenda or removes some . . . . For economic agents these mechanisms need not be biological, but can include all sorts of learned behavior.[175]

The functions that are attributed by neoclassical theory to the utility function are divided, in theories of bounded rationality, between satisficing stopping rules, in the form of levels of aspiration that determines when search for alternatives should halt, and mechanisms of attention direction that place new items on the agenda for decision.[176]

Simon compares behavior from neoclassical viewpoint with bounded rationality: "In neoclassical theory, behavior is shaped by the environment, and takes on whatever shape the environment demands for utility maximization. In the theory of bounded rationality, *behavior is shaped by interaction between the environment and the computational capabilities of the actor* who is trying to adapt to that environment. If an account is to be given of behavior, then neither environment nor computational [capability] can be ignored."[177]

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[172] Ibid.

[173] Simon, *Methodological Foundations of Economics,* p. 30

[174] Ibid.

[175] Example: a business organization has a "planning" department, that is, a department to scan the environment and determine when particular matters require attention.

[176] A long-term goal of my research is to develop a fully economic theory (not interdisciplinary) of agenda setting and searching for alternatives. The first step seems to be to show the possible existence of such a system and to specify the conditions needed for such a formulation.

[177] Simon, *Methodological Foundations of Economics.*

IV. Optimization: The Available Developed Tool

Operations research (OR) operates within the usual framework of neoclassical economics, but the tool is only useful if actual (numerical) answers can be obtained from it. Simon observes that most of the research in OR is directed toward improving the computational efficiency of OR tools.[178] *Unlike economics*, with its *exclusive attention to the environment of decision*, operations research pays equal or more attention to the computational costs of the decision process and to its computational efficiency. Linear programming (LP) dominates operations research because of powerful and general computational algorithms.

Simon points out that the availability of tools like operations research and linear programming creates the illusion that we can make optimal decisions in the neoclassical way. But the optimum can be found only after the problem has been formulated in the way that meets the definition of a linear programming problem: linear objective function and linear inequalities for constraints. But he asks: "How many real world problems are capable of this?" Then he admits: "If we could embed linear programming in a system for finding approximate LP formulation[s] for real problems, we would have powerful device for satisficing. [!!!]LP can bring utility into inequality constraints." Notice that Simon clearly states that some type of optimization is an appropriate framework for capturing bounded rationality.[179]

For Simon, (1) A decision procedure must satisfy *computational feasibility*, (2) Replacing optimization with satisficing (as the goal) reduces computational demands. He wants to put operations research (OR) together with heuristic search (drawn from artificial intelligence; indirectly from research on human decision-making). Finally he suggests that we have to use *expert systems*[180] in practical decision-making.

V. Behavioral Theory versus Neoclassical Economics: Which One Is a Better Theory?

Simon places the computational (and behavioral) theory of economic behavior against neoclassical theory and poses following questions:

- Which one is a better *normative* theory? (i.e. provides better *advice* for economic actors)
- Which is a better *descriptive* theory? (i.e. gives a more *veridical picture* of economic phenomena of the world)

He answers, the normative value of each framework is limited by computational power, and bounded rationality's computational requirements are lower than neoclassical theory's requirements. Further, the computational requirements of tools like operations research (together with artificial intelligence) shape the normative tools more and more in

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[178] Ibid.

[179] It seems to me, though, that this approach only seeks what industrial system engineers call a dual to an LP. Therefore, it suggests a dynamic in one side of the decision situation, the constraints. My suggestion in contrast is doubly dynamic in both the objective function and the constraints. (The example Simon use is Stigler optimal diet problem (Stigler, 1945, p. 33) where the utility function is represented by inequalities and objective function represents a budget constraint).

[180] He does not provide an explanation for this.

the direction of a theory of bounded rationality. About empirical/descriptive accuracy: a major neoclassical claim is that supply-demand mechanisms work. It is true that when prices are unconstrained many markets get close to equilibrium. But this does not hold for the labor market or the market for capital goods. (They show persistent underemployment, which is hidden in terminological innovations like "the natural rate of unemployment"!) Moreover, downward sloping demand and upward sloping supply are consistent with satisficing. Simon dismisses the ability of econometrics to provide evidence for neoclassical theory: econometricians need over-identified models to verify neoclassical propositions with data, and a comparison with non-neoclassical models is required; even over-identified models just show interest in profit-making not at all in maximizing profit, and econometric methods for handling aggregate data are extremely noisy.[181]

V-I. Unrealistic Assumptions of Neoclassical Economics

Milton Friedman (1953) argued that a theory cannot be judged by realism of its assumptions, but only by its efficacy in making predictions (Friedman's principle of unrealism). Simon believed that this argument suffers from five major flaws:[182]

> Neoclassical theory does not have a notable record of correct predictions. In the area of supply and demand (the most successful area of neoclassical theory) it has not been compared to alternative theories.

In predicting economic time series, the credible "lead variables" are postulated empirically and not from neoclassical theory.

Truth of assumptions is among any theory's valid inferences. A theory can be falsified by the falsification of its assumptions. No logic system supports the principle of unrealism.

Friedman was confused between unrealism and approximation. In our theories we trade off a little accuracy for a significant gain of parsimony. In short, Simon says that *unrealism is no virtue* and unless careful attention is given to the goodness of the approximation that is required, it can be fatal.

Another defense is: the assumptions of neoclassical theory cannot be tested directly because the behavior they describe (utility maximization) cannot be observed. The fallacy is that they have been observed (Kahnemann and Tverskey, 1973) and the observations have not agreed with the assumptions of neoclassical theory.[183]

In the same fashion, Vernon Smith and Charles Plott (1982) cry:

> Actual economic behavior should be ignored no more. The evidence is already ample for bounded rationality. The matter is to strengthen the capabilities of the bounded rationality theories for making predictions about a wide range of economic phenomena. And that comes with learning more details of human decision-making behavior…

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[181] Simon, *Methodological Foundations of Economics*

[182] Ibid.

[183] Business decision-making is public to a great extent. Both documents and discussions are observable and analyzable. Also, market researchers have done comparable studies of the decision-making behavior of consumers. Some of this research is addressed in Chapter IV.

V-II. Predictive Power

The predictive power (not accuracy) of neoclassical theory comes from the parsimonious assumption of maximizing subjective expected utility. But how can a theory be applied before its assumptions tested empirically? Simon says: it is not allowed in physics, so why should it be allowed in economics?[184]

Simon, cleverly, draws our attention to the similar methods used by Keynes to explain business cycles (1936) and by Lucas (1981) to explain unemployment*. Simon says the recipe is the same: Take the rational-man hypothesis and add just one speck of irrationality. (let labor suffer from a bit of money illusion…to be able to get equilibrium not at the full employment rate but at a natural one). Notice that the nature of the speck and where you inject it (into labor or into business) results in different policy advice for government, which is the application! So, Simon exclaims: "How could you choose this without empirical observation?" Thus Simon reminds us that bounded rationality is just as dependent on empirical data as neoclassical theory is. For bounded rationality starts from observation rather than the assuming omniscient rationality and realizing the need for empirical observation at the final level. Therefore, Simon finds no practical advantage for neoclassical theory over bounded rationality.

V-III. The Role of Expectations

Simon believes that the individualism of neoclassical theory ignores the role of expectations in decision-making.[185] Expectations are beliefs about the future. These beliefs are formed in an environment of communication with many other people. A realistic theory of belief formation should include the influence on us of others in the society. This is an empirical question and so, cannot be settled within the context of "rational expectations."[186]

Simon challenges neoclassical advocates with some other difficulties: (1) Natural selection: Nothing in the evolutionary mechanism guarantees the existence of (the neoclassically assumed) abler competitors, hence nothing guarantees profit maximization as opposed to satisficing with aspiration values based on competitive standards. And (2) the aggregation problem: The problem is how to derive, from a theory of human problem solving, inferences about organizations, markets and economies. For perfectly competitive markets, neoclassical theory seems better. But note that neoclassical theory is limited to "static" equilibrium. (Even when there is a time dimension, the path of the

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[184] I guess it could be true for physics-type theories ONLY, and the social or behavioral models don't require this testability of their assumption? Oh dear, I am defending Friedman! But seriously, it could be principally discussed that whether theories of social science have/could have a different nature from the theories of science? Like being formed and validate based on a "behavioral logic"?

[185] Dewey provides an answer to this difficulty by introducing the concept of social intelligence. See Chapter two.

[186] Muth originally formalized the idea of rational expectations with the intention of using it as a microeconomic concept. The usage of rational expectation in macroeconomics by Lucas was contrary to Muth's intentions and his belief about the appropriate usage of this concept.

system is determined by initial conditions and possibly stochastic events; there is no scope for human innovation.) Simon asserts that neoclassicals postulate properties of the "representative individual/firm" a priori and use this ideal entity for aggregation. On the other hand, bounded rationality (e.g. for consumer behavior) samples the relevant population and arrives at properties of aggregates by taking properly[187] weighted sums or averages of individual behavior. He claims that for business firms, bounded rationality does incentive studies that provide a tool to determine how robust the aggregations are. And so Simon concludes that bounded rationality leads to inferences that are limited but more accurate, for they rest on empirical evidence rather than a priori presuppositions. Simon suggests two priorities that need development: methods of observation at a micro level, and discovering how to aggregate micro data.[188]

VI. Value in Decision Models

Before turning to the theoretical connections between bounded rationality and expected utility theory, I want to make a digression and draw attention to the importance of the concept of value in capturing decision-making behavior. The role of value is of crucial importance in a normative decision model. Even a normative decision theory does *not* dictate how the agent should evaluate specific outcomes. Rather, it imposes some ordering on the agent's relative evaluation of outcomes and thus takes the agent's own value as *given*. Incidentally, that is a main concern for Dewey and Bentley, as I understand them from "Knowing and the Known." Let us look at the procedure they suggest for inquiry and the new meaning they provide for "value as valuable" in their transactional perspective. Contemporary value theory produces a confrontation of positivism versus objectivism, i.e., value as mere psychological or physiological responses versus value tied to an antecedent standard that is objective and absolute. Ryan (1998) suggests that the transactional reconciliation of value is principally valuation; valuation being "intelligence formation and application of problem-solving methods." In a secondary sense, value denotes the goods and objectives obtained in valuation.

Thus dynamics are required to accommodate this concept of valuation, and that is a feature I look for in bounded rationality. I assert that the original idea of bounded rationality contains a rich concept of valuation, whereas the continuing efforts to fit the idea into the standard economic paradigm failed to capture this capacity. We continue with the demonstration of the common elements of substantive and bounded rationality, and along the way we argue that imposing the teleological characteristic of substantive rationality on bounded rationality is a practice that is doomed to fail. Therefore, a shift from the predominant paradigm is in order. We will be able to fully enjoy the light that is offered by acknowledging the cognitive limits of rationality only when we implement this idea in a paradigm that allows us to play with teleological rationality: a transactional framework and not a cognitive one.

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[187] It is not clear to me, and Simon does not provide an empirical exercise to explain the way in which this *proper* weight would be determined.

[188] He says that these should be promoted and rewarded among graduate students instead of the virtues mathematics.

VII. Substantial Pure Rationality versus Bounded Procedural Rationality: Maintaining the Bond of Teleological Intentionality

The rest of this chapter poses a challenge to both the neo-classical framework of rational choice and models of bounded rationality and deliberation. I show that the idea of utilitarian "optimization" ultimately guides and constrains theories of bounded rationality as well. They both assume that there is one predetermined, perfect, and fixed objective goal and one objective function that ideally maximizes the agent's utility, given contextual constraints. Both substantive and procedural rationality assume a straight-line *teleologically* intentional theory of rationality; that is, they both assume some predetermined, fixed, and final ideal end of action. In this sense, procedural, or bounded, rationality is only what substantive rationality looks like when placed in an actual context where a psychological rather than merely logical agent is limited by the information available, the cost of information, or their ability to process the information. For both, one assumption remains unchanged: the essence of "man" is detached and autonomous pure rationality.

We begin with Herbert A. Simon's contrast between substantive and procedural rationality. According to Simon:

> Behavior is substantively rational when it is appropriate to the achievement of given goals within the limits imposed by given conditions and constraints. Notice that . . . the rationality of behavior depends upon the actor in only a single respect—his goals. Given these goals, the rational behavior is determined entirely by the characteristics of the environment in which it takes place.[189]

Notice that substantial rationality assumes fixed and final goals predetermined by the agent; that is, teleological intentionality. It also assumes an autonomous, unchanging center of self-action that can determine unalterable goals before action, independently of all environmental characteristics. Further, note that the environment is given independent of the agent's actions upon it. It is a dualistic model in which there is no interaction between agent and environment in either direction, so both agent and context remain unaltered by the process of choice.

In contrast to substantive rationality, according to Simon, "Behavior is procedurally rational when it is the outcome of appropriate deliberation. Its procedural rationality depends on the process that generated it."[190] Simon writes, "When psychologists use the term 'rational', it is usually procedural rationality they have in mind."[191] Interestingly enough, Simon connects the processes of deliberative, procedural rationality with the psychology of William James. Since their different concepts of psychological and logical deliberation eventually divide Simon and Dewey, this connection is especially interesting since James's biologically based psychology influences Dewey immensely, while Simon largely ignores the biological body and

[189] Herbert Simon. From substantive to procedural rationality. p.130

[190] Ibid.

[191] Ibid. p. 131

neurophysiological functioning altogether.[192] This difference is important because in many ways Simon's primary achievement was to psychologize economics; it seems though, that he chose the wrong psychology. This section argues that Herbert Simon merely psychologizes standard economic accounts of substantive rationality without fundamentally undermining the ultimate telos of utility optimization or the idea of a predetermined and fixed telos to the activity of rational choice. Further, from his viewpoint, the essence of the self, its rationality, remains unaltered by the consequences of choice, however much bad choices may corrupt the body.

VII-I. Simon and Cognitive Psychology

In the book that serves for many as the official history of the cognitive science movement, Howard Gardner remarks that Herbert Simon was "one of the founders of cognitive science."[193] It is necessary to look at Simon's psychology before examining the economic logic of his theory of choice. In this way we can provide an account of what Simon's psychology means for his theory of bounded economic rationality.

Simon identifies and discusses the psychology of deliberation or choice under four headings; we consider them in his order. First, there is the "study of cognitive process."[194] Simon writes, "procedural rationality is usually studied in problem situations—situations in which the subject must gather information of various kinds and process it in different ways in order to arrive at a reasonable course of action, a solution to a problem."[195] So conceived, there are three main categories of psychological research on cognitive processes: "learning, problem solving, and concept attainment."[196] According to Simon, learning research "is concerned with the ways in which information is extracted from one problem situation and stored in such a way as to facilitate the solving of similar problems subsequently."[197] Problem solving research "focuses especially upon the complementary roles of trial-and-error procedures and insights in reaching problem solutions."[198] Finally, concept attainment "is concerned with the way in which rules or generalization are extracted from a sequence of situations and used to predict subsequent situations."[199] As we will see in the next chapter, taking account of all Dewey has to say about these categories, it will prove easy to show that Dewey's understanding of them deviates significantly from Simon's.

The second heading in Simon's discussion of the psychology of deliberation is "computational efficiency."[200] Computational efficiency is concerned with the computing time or effort required to solve a problem by a basically serial operating system requiring

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[192] See Dewey, J. (1930c/1984). From Absolutism to Experimentalism. There, Dewey acknowledges the extensive influence of James, while indicating that it largely "proceeded from his Psychology" (p. 157). What he most admires is James's functionalist "biological conception of the psyche" (p. 157).

[193] Howard Gardner. The Mind's New Science. p. 22

[194] Simon, "From substantive to procedural rationality," p. 132

[195] Ibid.

[196] Ibid.

[197] Ibid.

[198] Ibid.

[199] Ibid.

[200] Ibid.

certain irreducible times to perform particular operations. According to Simon, computational efficiency is "a search for procedural rationality, and computational mathematics is a normative theory of such rationality."[201] Note that rationality remains utilitarian, calculative rationality. What he says next is very important:

In this normative theory, there is no point in prescribing a particular substantively rational solution if there exists no procedure for finding that solution with an acceptable amount of computing effort. So . . . although there exist optimal (substantively rational) solutions for combinatorial problems . . . and although these solutions can be discovered by a finite enumeration of alternatives, actual computation of the optimum is infeasible for problems of any size and complexity.[202]

Notice the objective telos of rationality remains optimization, although the quantity, complexity, cost of the calculation, etc. necessarily qualifies it. Simon assumes that substantive calculative and teleological rationality are the objective, fixed, and final *ideal* from which bounded rationality deviates only as much as calculative complexity etc. requires.

Third, there is "computation; risky decisions."[203] Here Simon makes a bold, but, for him, necessary claim: "Man, viewed as a thinker, is a system for processing information."[204] Simon believes that this fact, in conjunction with computational efficiency, explains why so much empirical research fails to confirm "subjective expected utility" theory.[205] The mind as computer is the second of the five central features of cognitive psychology, according to Gardner.[206] Gardner identifies the other four features as:

(1) "the belief that, in talking about human cognitive activities, it is necessary to speak about mental representations and to point [to?] a level of analysis wholly separate from the biological or neurological, on the one hand, and the sociological or cultural, on the other;" (3) "the deliberate decision to de-emphasize certain factors which may be important for cognitive functioning but whose inclusion at this point would unnecessarily complicate the cognitive-scientific enterprise. There factors include the influence of affective factors or emotions, the contribution of historical and cultural factors, and the role of the background context in which particular actions or thought[s?] occur;" (4); "cognitive scientists harbor the faith that much is to be gained from interdisciplinary studies" (5) "a key ingredient in contemporary cognitive science is the agenda of issues, and set of concerns, which have long exercised epistemologists in the Western philosophical tradition."[207]

Simon adheres to all five of the features of cognitive psychology identified by Gardner. Dewey rejects all except the fourth.

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[201] Ibid. p. 133

[202] Ibid.

[203] Ibid.

[204] Ibid.

[205] Ibid. p. 134

[206] Gardener, The Mind's New Science, p. 6.

[207] Ibid. pp. 6-7.

The fourth heading in Simon's discussion of the psychology of deliberation is "Man's computational efficiency."[208] Simon boldly asserts, "Like a modern digital computers [sic], Man's equipment for thinking is basically serial in organization."[209] Simon qualifies this statement by declaring:

In my comparison of computer and Man, I am leaving out of account the greater sophistication of Man's input and output system, and the parallel processing capabilities of his senses and his limbs. I will be primarily concerned here with thinking, secondarily with perceiving, and not at all with sensing or acting.[210]

Presumably, perceiving implies identifying information (as opposed to processing it) while sensing involves gross experience including feeling. Like the third feature of the cognitive science research program, Simon thinks we may bracket these issues for later study because they do not intrude on "Man's" essential rationality.

VII-II. Simon and Turing Machines

Turing functionalism argues that computers (Turing machines) think just like the mind, but the physical realization of thought is entirely different. That is, the circuitry of the computer is not the same as that of the brain. What matters is that there are states of the computer that function just like states of the brain. Presumably, we may call these "mental states." Very different physical entities, e.g., a computer or a brain, may nonetheless perform the same functions, hence they are functionally equivalent. In other words, while two systems may have different hardware, if they can run the same software program they are functionally the same. Turing functionalism becomes simply "functionalism" when something besides a computer performs the functions. Functionalism also preserves the idea of the mind as a region of representations standing between the embodied subject and the world, including the social world. Functionalism obviously assumes a mind (software) versus body (hardware) dualism. Hilary Putnam, the creator of Turing functionalism, eventually not only recanted, but also provided a rigorous refutation.[211] Putnam's refutation will not be discussed here except to observe that it is very congruent with some of the things that will be said below in the critique of Simon's functionalist psychology.[212]

Simon finds, "For most problems that Man encounters in the real world, no procedure that he can carry out with his information processing equipment will enable him to discover the optimal solutions."[213] * Simon asserts that research on chess playing provides three significant findings on human computational efficiency. First, "they have shown how he [the player] compensates for his limited computational capacity by searching very selectively through the immense tree of move possibilities."[214] Second, "they have shown how he stores in long-term memory a large collection of common patterns . . . together with procedures for exploiting the relations that appear in these

[208] Simon, "From substantive to procedural rationality," p. 135

[209] Ibid.

[210] Ibid.

[211] See Putnam, Minds and Machines.

[212] See Putnam, Representation and Reality.

[213] Ibid. p. 134

[214] Ibid. p. 136

patters."[215] The expert chess player has complex heuristics for selective search in conjunction with massive knowledge of significant patterns, which, together, constitutes her procedural rationality in deciding how to move in a game of chess. Finally, and most influentially for Simon's economic logic of bounded rationality, he states:

Third, the studies have shown how a player forms and modifies his aspirations for a position, so that he can decide when a particular move is 'good enough' (satisfices), and can end his search . . . . They depend upon aspiration-like mechanisms to terminate search when a satisfactory alternative has been found.[216]

Simon then contrasts this information-processing notion of rationality with substantive rationality. The only difference that makes a difference is that something less than the optimal choice will *suffice* in computational procedural rationality, not because there is not an optimal choice, but because of the size of the selection set, complexity of calculation, and cost in actual situations.

VII-III. Simon and Substantive Rationality

Simon identifies four causes for concern with substantive rationality that emerged after World War II. The first is, "The real world of business and public policy."[217] Here the context of "real-world business environments" introduced environmental constraints and contingencies with which the model of substantial rationality could not readily contend. These constraints on the ideal model of substantial rationality involve "inventing and constructing " practical "problem-solving procedures."[218] In practice, according to Simon, this led to the kinds of modeling that exemplify that notion of "satisficing."[219]

Next, is "Operations research."[220] Here the digital computer becomes important and the demands of computability required "two kinds of deviation from classical optimization: simplification of the model to make computation of an 'optimum' feasible, or, alternatively, searching for satisfactory rather than optimal answers."[221] Simon sees both of these "as instances of satisfying behavior rather than optimization."[222] The third cause for the preference for procedural models involved "Imperfect competition."[223] In such situations, choice depends on the choices made by other actors (e.g., one's competitors). Here there just are no fixed rules of substantive rationality, only contextually dependent procedures. Finally, there are, "Expectations and uncertainty."[224] Simon asserts, "Making guesses about the behavior of a competitor . . . is simply a special case of forming expectation in order to make decisions under uncertainty . . . .

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[215] Ibid.

[216] Ibid.

[217] Ibid. p. 137

[218] Ibid., p. 138

[219] Ibid

[220] Ibid. p. 138

[221] Ibid. p. 140

[222] Ibid.

[223] Ibid.

[224] Ibid. p. 143

Uncertainty, however, exists not in the outside world, but in the eye and mind of the beholder."[225] So stated, uncertainty is a matter of the choosing agent's subjectivity; it is a psychological not an ontological uncertainty. To reduce such uncertainty, the agent engages in "forecasting procedures," "seeks to improve data," and takes "actions to buffer the effects of forecast errors," actions to reduce the sensitivity of outcomes to the behavior of competitors," and "actions to enlarge the range of alternatives."[226] Simon assumes objectivism. Presumably, the world, the context, the environment, or what have you has only one state in which it can be and for which there is one utility maximizing function. The agent's epistemological problem is to construct a representation that approximates this one objective, optimizing formula. This specification of the agent's problem presumes the theory of meaning described above, in which there is one world, or one representation for each "thing" in the world, so there is always a string of propositions that name the things that comprise a situation.

VIII. Hume's Theory of Rationality: the Common Ground for Neo-classicals and Simon

It is not hard to locate the source for Simon's thinking, or that of the entire utilitarian school for that matter. Modern theories of procedural or instrumental rationality trace their origin to the tradition of British empiricism, especially the philosophy of David Hume. In a complete departure from the ancient and medieval stance deriving from Aristotle, Hume considers himself to have "prov'd, that reason is perfectly inert, and can never prevent or produce any action."[227] Reason may no more serve as a motivation for action than it may serve as an end. Hume concludes, "reason alone can never produce any action, or give rise to volition"[228] For Hume, "Reason is, and ought only to be, the slave of the passions." On his account, the passions are objects of desire, the agent's preferences, their goals, reason only serves to guide the passions to completion in some object or end; it may never serve to motivate or cause action. Remember, the rationality of the agent's behavior only depends on the agent in a single respect—his goals. Reason is the mind's own bureaucracy; its office is to execute the commands it receives from us. A good bureaucrat accepts whatever ends are assigned and works diligently to achieve them, given the constraints of information and the cost of information. Because Reason is a good bureaucrat, it has no deficiencies in calculation.

Hume is the primary source for conceptions of practical reason as a rational instrument detachable from whatever ends to which motives have coupled it. Hume thinks each individual the engineer of a locomotive fueled by passions of pleasure or pain. Thus fueled, the engineer drives the train to a series of destinations, or ends, during his life while reason tells him when to change tracks and couples or uncouples cars along the way. Simon's theory of psychology and rational economic choice often seems to chug along like Hume's train. We saw in chapter two that Dewey defies Hume by showing how practical rationality is a creative act.

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[225] Ibid.

[226] Ibid. pp. 143-144

[227] David Hume. A Treatise of Human Nature, p. 458.

[228] Ibid. p. 414

Chapter Four: Expected Utility Theory versus Empirical Evidence: How Do People Actually Behave?

Abstract

As you read this chapter, you will note a fundamental distinction between prescriptive models (also called normative models) of rationality and descriptive models. Psychologists write about descriptive models, the ones that describe how and why people actually make choices in the real world, rather than how they should make choices to maximize an expected utility function in a perfect Von Neumann-Morgenstern world.[229] *This literature drifts away from classical economic theory. However, my primary emphasis is on reviewing what the evidence tells us about actual human behavior, rather than on any specific applications.*

[229] Savage (1954) developed the subjective expected utility framework.

I. Empirical and Experimental Evidence

A thorough and unbiased study of decision-making takes us inevitably to other disciplines. There is now a vast literature on the topic. In psychology alone, there are more than one hundred books, about 3500 research articles, two major journals and a chapter every three to five years in the Annual Review of Psychology.[230] There are sizable literatures in biology and anthropology as well. Alas, few economists read it! The literature clearly shows that economics has been built on profoundly false assumptions about human behavior and preferences, and indicates what economics might become if its practitioners would read beyond their discipline.

So far I have referred mainly to one psychologist: the late Herbert Simon. He was a great person and a great thinker. Many economists were outraged when he won the Nobel Prize in economics in 1978. They said, "He is not one of us! He does not deserve the prize because he attacked the foundations of our discipline!" It was quite a scandal. Now his work is often acknowledged in economics,[231] and almost as often ignored. Many other psychologists have written about rationality, beginning with William James[232] and Sigmund Freud. Among the best known today are the late Amos Tversky, Daniel Kahneman, Paul Slovic, Robyn Dawes, Dave Messick, Ken Hammond, Hillel Einhorn, Masanao Toda, Egon Brunswik, Anatol Rapaport, Robin Hogarth, Ward Edwards, Baruch Fischhoff, John Axelrod, and Sarah Lichtenstein.[233] A few brave political economists have attempted to incorporate some of this thinking into economic discussion, but they remain on the edges of the discipline.[234] Experimental economists show increasing interest in incorporating findings from other disciplines into economics. However, they remain faithful to standard probability theory and the fundamental assumptions traditionally imposed on decision-making. At most, they develop formalizations of bounded rationality through partial modifications of the standard framework.

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[230] From personal correspondence with Warren Thorngate, professor of psychology at Carlton University, CA.

[231] There was an entire session dedicated to the influence of Herbert Simon on the practice of economics held at ASSA/AEA meeting in Atlanta January 2002. Prominent economists such as Kenneth Arrow and Douglass North acknowledged the importance of Simon's ideas.

[232] John Dewey was deeply influenced by James in his psychological views.

[233] Some of their early work is reproduced in a reader called "Judgment and decision making: An interdisciplinary reader" edited by Hal Arkes and Kenneth Hammond, Cambridge University Press, 1986.

[234] Included are Jane Mansbridge's "Beyond Self Interest", Peter Albin's "Barriers and Bounds to Rationality and Robert Frank and Philip Cook's "The Winner-Take-All Society". Wonderful discussions of the biological alternatives to economic principles come from Anatol Rapaport and from much of the artificial life literature.One of the best mathematical treatments of this biology-economics link comes from Ross Cressman.

I-I. Two Famous Paradoxes

Allais and Ellsberg introduced two experimentally recognized paradoxes within traditional expected utility theory (EUT.)[235] In each, an axiom of the EUT is violated.

The Allais paradox states that Independence principle of EUT is verified when subjects who prefer A to B also prefer C to D in a situation like the following:

A: 100 million with certainty

B: 500 million with 10% AND 100 million 89% AND nothing with 1%

C: 100 million with 11% AND nothing 89%

D: 500 million with 10% AND nothing 90%

But empirical results are diametrically opposed to the prediction of theory! Prudent subjects who choose A over B also prefer D to C. Hence the paradox, for such preferences violate the substitution axiom, and therefore are inconsistent with the EUT criterion.

The Ellsberg paradox results from a violation of the sure-thing principle. A typical experiment is the following:

Urn1: 100 balls, unknown ratio of red and black

Urn2: 50 red and 50 black balls.

Gamble1: Bet on Red1 or Red2

Gamble2: Bet on Black1 or Black2

Making a bet, subject wins if he draws a ball of the same color that he bet on.

Results show that both Red2 and Black2 are more probable. This is a demonstration of incoherent (inconsistent) subjective probabilities.

II. The Essence and Shortcomings of EUT

An enormous amount of theoretical effort has been devoted to developing alternatives to EUT, and this has worked hand-in-hand with an ongoing experimental program aimed at testing those theories. The experiments in the economic laboratories show that the standard theory does not fit the facts. Therefore, developing a better understanding of the determinants of individual choice behavior seems a natural research priority. Now the intriguing question is whether economic experiments have been generating a serious contender for replacing EUT, at least for certain purposes.

Starmer (2000) sets out what he takes to have been key theoretical developments in the area, to review the related evidence and draw conclusions about the current state of art and the prospect for the future. He focuses on i) "descriptive" as opposed to "normative" theory, and ii) modeling choice under "risk" as opposed to under "uncertainty."[236] To focus on developing a "satisfactory" account of "actual" decision behavior in situations of "risk", he pays specific attention to the concepts of probability weighting and loss aversion.

Using non-expected utility models to explain real behavior is an interesting and active field in economics. Experimental economics plays a key role in investigations that

[235] I have personally verified the result of their experiments in my classrooms.

[236] All consequences and probabilities are known to the agent who confronts a situation of "risk" in contrast to a situation of "uncertainty" in which at least some of the outcomes or probabilities are unknown.

provide evidence for valid and more realistic modeling of behavior. Expected utility theory (EUT) has a fair number of deficiencies. Many economists have worked on some alternatives that can operate better at least for certain purposes. Experimental research provided this field with a rich ground of controlled observations that could both shed a light on the shortcomings of this model and provide theorists with ideas to develop alternatives and improvements. Developing a "satisfactory" account of actual decision behavior in situations of risk as a central issue. Optimization theory, as defined broadly, provides a rich theoretical framework that is capable of accommodating the anomalies within EUT as presented below.

II-I. Alternatives to EUT

Among the alternative to EUT is non-transitive preference theory. In this theory of choice, we are able to talk about people maximizing their utilities without transitive preferences. Bell, Fishburn, and Loomes & Sudgen all proposed this theory independently in 1982. Loomes and Sudgen (1987) present a version of this theory called regret theory. Despite a conventional theory that assigns value independently of individual prospects, regret theory allows comparisons between the consequences of alternative choice options. They introduce the "regret aversion" assumption which implies that a large difference between what you get from a chosen action and what you might have gotten from an alternative gives rise to a disproportionately large regret, so people prefer greater certainty in the distribution of regret. Consequently, regret theory could explain the standard violations of the independence axiom for statistically independent prospects.

Weighted Utility theory is a special case of regret theory, used by Segal and Spivak (1990) to resolve counter-intuitive implications of EUT that are carried through to non-expected utility theories, which have similar smoothness properties. The fact that risk averse behavior can be generated by nonlinear probability weighting, even when the utility function has a linear form, is the reason why models with probability transformations do not imply approximate risk neutrality for small risks. Therefore, aversion to probabilistic insurance could be explained by over weighting of the small probability of non-payment.[237]

III. Psychological Findings Relevant to Economics

Economics conventionally assumes an individual with coherent preferences, who rationally maximizes a utility function, given a set of options and probabilistic beliefs. In what follows, we will look at experimental evidence that can be explained by slight modifications of the standard economic framework, as well as empirical cases, which increasingly challenge standard economics. Rabin (1998)[238] calls the relevant psychological evidence to economists' attention. He suggests that "a blooming [of] understanding would come out of an active exchange between the two disciplines." He deliberately avoids arguments that question the relevance of behavioral research to economics, because he finds no intellectual benefit in such a discussion. He simply holds

[237] Weighted utility theory could be used to explain insurance purchasing behavior that violates the expected utility theorem axiom of transitivity. An experiment performed by Wakker, Thaler and Tversky.

[238] This section and next one are mainly adopted from Rabin (1998).

that incorporating psychological findings into economics is doable and embodies no methodological complication. He invites economists to treat relevant psychological claims as presumptively plausible: Claims such as irrational investment as a result of reading too much into the short term performance of stock market, or the resentfulness of employees who feel they are mistreated. He further says that "the methodological illicitness of departing from habitual assumptions is rooted in lack of awareness of empirical findings and that this prejudice should be abandoned in favor of empowering the economics framework." The emphasis should be put on "what we learn from experience[239] not how to conduct one."[240]

IV. Modifications to the Rational Conception of Human Choice in Psychology

- **A more realistic utility function:**

Changes in outcomes relative to preferences will change the preference structure and ordering. And thus the preference ordering does not depend merely on the absolute levels of outcome but on the changes according to their status quo. People have a directed preference for gains and losses; they dislike loss significantly more than they like a gain of the same amount. Furthermore, people depart from self-interest in favor of goals such as fairness, reciprocal altruism, and revenge. Mild modifications could capture this phenomenon to some extent. These modified frameworks are faithful to standard economics. A method for considering the effect of reference points (the primary status) is to incorporate habitual levels of consumption into utility analysis. Traditionally we consider the utility at time t, $u(t)$ as a function of consumption at time t, $c(t)$. In addition to that, we can define a preference level at time t, $r(t)$, which depends on consumption before t or at the expectation of future consumption or both. Then $u = u(r, c)$ at any time t, will be a more general function that accounts for reference point influence on behavior.

- **On loss aversion:**

The displeasure of loss being greater than the pleasure of same size gain is implied by the regular concave utility function that holds for familiar explanation of risk-aversion. But loss aversion says more than this. Tversky and Kahneman (1991) show that people value modest losses almost twice as much as gains of the same magnitude. This suggests an abrupt change in the slope of the value function at the reference level.

Mehra and Prescott (1985) and Epstein and Zin (1990) observed that according to macro data, expected utility theory cannot provide us with an explanation for the attitudes toward large-scale risks and small-scale risks at the same time. Rabin (1997, "calibration theorem") shows that no concave utility function can do so. Rabin then captures both risk attitudes in an expected utility framework by introducing a reference-based kink in the utility function. Segal and Spivak (1990) develop a non-expected utility theory to explain the same thing.

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[239] Contrary to Rabin's view, the importance of the methods of conducting experiments is stressed highly by Simon.

[240] Rabin (1998), "Economics and Psychology."

Thaler (1980), Kahneman, Knetsch, and Thaler (1990) identify and illustrate the endowment effect as a phenomenon related to loss aversion. People value a thing higher after possessing it.[241]

Two other related observations are as follows: a status quo bias, where people choose not to trade when different goods of the same monetary value have been allocated to them randomly (see Knetsch, 1989); and diminishing sensitivity, meaning they move from risk-aversion over gains to risk-loving over small losses (see Kahneman and Tversky, 1979).

Raymond Hartman, Michael Doane, and Chi-Keung Woo (1991) report empirical evidence for a status quo bias in consumer demand for electricity. Loss aversion has been investigated and supported by John Shea (1995a, 1995b) through observing a smaller increase in consumption level in response to good news than the decrease in consumption in response to bad news.[242]

An example of a model that takes the above considerations into account is given by economists Ryder and Heal (1973). They develop the idea of a parameter *a* that measures the speed with which reference points are adjusted, which is correlated with the weight that people put on the past consumption. For a long run utility maximizer, the current reference level $r(t)$ is calculated as a weighted average of the past reference level $r(t-1)$ and past consumption level $c(t-1)$. Evidence is sparse for the two ideas that this model rests on: that reference levels exist, and that changes in reference levels affect people's preferences.

- **Fairness:**

Experimental research reveals many instances of subjects' behavior that cannot be explained by pure self-interest: big contributions to public goods, sharing money voluntarily, sacrificing money to punish unjust behavior by other subjects. Hence, realism[243] suggests that economists should depart from the presumption of naïve self-interest and move toward models that permit human considerations such as equity, fairness, and status-seeking. The last has been shown to play an important role in employee behavior.

This is a good place to mention that some market structures such as double-auction generate self-interested behavior in the laboratory. However, the fact that self-interest explains behavior in some cases should not lead us to ignore institutional and environmental effects on behavior in other cases. Nor should it be used to argue that a completely different framework is needed to explain all economic phenomena. From a pragmatic point of view, any model could be good as long as it achieved the objective of our inquiry, namely, explaining consumers' behavior.

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[241] It doesn't intuitively appeal to me. I have my mind full of the experiences and observations that lead to the decrease of value after possession, in human relationships, ownerships, and so on. After all, what happens to "grass is greener at the other side of the fence"? I should see where I am being wrong, or possibly irrelevant?

[242] Replicated by Bowman, Minehart, and Rabin; same conclusions and suggestions.

[243] Economists in the main stream seem to largely accept and follow Friedman's principle of unrealism (as Simon names it). Friedman (1954) alluded to Carl Hempel's empiricism criterion and exclaimed that the soundness of a theory is accepted, independent of the verification of its assumptions, as long as it works.

- **Altruism:**

A person shows altruism if she puts positive and non-negligible value on the well-being of others. One should be careful about incorporating simple altruism in a behavioral model. Yaari and Bar-Hillel (1984) investigate the behavior of disinterested subjects who are asked to vote for a just distribution of a resource. The subjects are asked to divide two sources, A and B, of an imaginary Vitamin F between two people with different power of absorbing that vitamin from each source. Simple altruism predicts the socially efficient outcome, which produces the maximum total of vitamin F. But 82% of the subjects voted for an outcome that equalizes the welfare gains of the recipients, which is the solution to a maximin problem and produces a smaller total welfare. Yaari and Bar-Hill tested the robustness of equalizing welfare gains and found evidence that people depart from it in extreme cases, where the maximin gain criterion becomes morally unsound. The conclusion is that people simply choose equal distributions of resources, unless an extreme case leads them to a maximum welfare approach.

An important concern is the extent to which people weight their normative and disinterested opinions when they are personally involved. One way to investigate this question in the laboratory is an ultimatum game. Andreoni and Miller (1996) report that people leave from ten to thirty percent of available money for their partner, when they can take it all.

In the everyday economic decisions, though, people's general perceptions of fair behavior may adjust over time. Robert Franciosi et al. (1995) offer evidence that in competitive markets people may eventually come to believe that the prevailing price is fair. However, pure self-interest cannot explain the behavior in a competitive spot market: Fehr, Kirchler, and Weichbold (1994) report a labor market experiment where behavior never converges to the self-interested outcome.

- **Judgment Bias and Belief:**

People show biases in judgment under uncertainty. These biases lead to errors in maximizing utility. In other words, we tend to infer too much from too little evidence; we weigh the evidence with a biased attitude, and we misread the evidence in favor of our own hypothesis or belief. Learning and experience do not always help to remove our biases. Capturing these biases is a serious challenge for the standard economic assumptions. The lesson from observation of phenomena like loss aversion and status quo bias is that to capture preferences about the allocation of goods among others we must consider the "piecemeal"[244] nature of social norms, that is, the one-pie-at-a-time conception of fair division problems. Various studies suggest that people consider equitable sharing over changes in total endowments and not the total endowments.

Preferences with respect to allocations of goods among others are affected not only by the changes in consumption that others will experience, but also by a concept of reciprocal altruism. Beliefs about other people's intentions and motivations affect human

[244] Some game theorists show a tendency to consider a "piecemeal" rationality for economic agents [Selten, different conceptions in different works].

responses. There seem to be a spillover from "good" or "bad" deeds of others.[245] It seems to me that these non-positive reflections should increase when going from a social level to individual behavior.

Individuals react differently to take-it-or-leave-it offers according to the motives they attribute to those who make the offers. Sally Blount (1995) reports the average minimal acceptable offer for an ultimatum game of splitting $10 was $2.91 when the proposing party takes the rest; $2.08 when a third person makes the offer; and $1.20 when a computer splits the money.[246] I conjecture that these amounts would not converge to a "rational" reaction over time.

Finally, contrary to the "cheap talk" argument in economics, David Sally (1995) demonstrates the importance of pre-decision communication in enhancing cooperation. In his "coordination game" experiment, communication without commitment yields high contributions to a public-good, approaching or attaining efficient equilibria.

- **Intention:**

We interpret others' motives based on our beliefs about their beliefs (second degree beliefs) about the consequences of their actions. We reward people's apparently generous behavior based on our inferences about whether or not they were seeking to be the recipients of greater generosity later.

An interesting series of studies suggest an alternative framework for explaining the mechanism of setting wages. It has been observed that the "efficiency wage," which is associated with high effort, is well above the market clearing wage rate. Akerlof (1982) suggests thinking of the relationship between firm and its workers as a "gift exchange." Fehr, Kirchsteiger, and Riedle (1993) show that workers reward firms for setting high wages and put low effort in for wages they find to be unfairly low.

It is important to distinguish the role of outcome vs. intention. Economists consider the resulting allocation as the sole important argument in the formation of social and individual preferences.[247] The presumptive nature of this framework will become clear in the following example:[248]

Tom and Bob find two apples in their way to school. Tom picks them up and gives the smaller one to Bob. Bob expresses his unhappiness. Tom asks Bob what he would do, if he picked the apples from the road. Bob says that he would have given Tom the bigger one. Now, Tom looks at Bob in surprise: "Don't we both get what you wanted?"

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[245] But note that when it comes to a social level, we never attain enough observation, rather we form our beliefs about others' related behavior based on limited observations which are, usually, not statistically accurate…I don't know where shall I go with this, does this line lead to social norms and values; institutions, and so on or it is an instance of reading too much in one instance, both or none?

[246] "ultimatum game" first developed by Werner Guth, Rolf Schmittberger, and Bernd Shwartze (1982). For more literature on this subject see Thaler (1988), Guth and Reinhard Tietz (1990), Cramer and Thaler (1995).

[247] John Geanakoplos, David Pearce, and Ennio Stachetti (1989) modify conventional game theory by allowing payoffs to depend on players' beliefs as well as their actions. Using their framework, Rabin (1993) formalizes the role of intentions in fairness judgments.

[248] I modified a story that I read in Frank Ryan's (1994), p. 21.

The point is that the satisfaction with events is not a mere result of the final outcome.[249]

- **Subjective probabilistic assessment:**

Rational economic agents form correct beliefs based on the laws of probability. That is possible because of the assumption that objective probabilities of events are available. In actuality, though, people let an immediate pleasure lead them to a choice that is inconsistent with their long-run preferences. Moreover, often we do not predict our future preferences correctly, and we do not correctly assess the well-being we experienced from past choices. This evidence suggests a problem with the basic framework in which neoclassical economics formalizes behavior: maximizing a utility function that preserves its coherency in the long run. An attempt to build a framework that accounts for the available evidence necessitates a serious departure from standard theory, since it embodies an alternative to a fundamental assumption of the standard theory.[250]

V. Questioning Some Accepted Facts

Mainstream economics employs a powerful combination of methods: methodological individualism, mathematical formalization of assumptions, and sophisticated empirical field-testing. Rabin says that in the light of these methods we can understand psychological findings. He further suggests that we integrate and incorporate these findings into economics, to enrich our field and expand the scope of choices that economics can explain.

Economists usually place a high premium on mathematical and logical accuracy, thereby ignoring important details of human behavior. The intriguing question remains unresolved: is there a meaningful trade-off between mathematical accuracy and detailed quantification on one side and describing the details of real human behavior on the other hand? Or this is just another version of the prominent dualistic approach, like "tractability" and "parsimony" versus "integrating realistic evidence into our research"? Can we avoid all the dualistic tradeoffs by employing an integrative new framework for our understanding of human behavior? My answer is affirmative.[251]

VI. Shopping in the Marketplace

Jean Lave, a social anthropologist of cognition, has carried out empirical research on consumers' use of mathematical calculation in supermarkets. The results explicitly reject

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[249] further: Charness (1996) conduct experiments to differentiate two hypothesis of worker-firm relationship. [this is important if I want to learn about differentiating between different hypothesis that come to mind as a pure idea or as suggestions for possible explanation of some research outcomes.]

[250] Omitted topics of economic relevance: status, envy, and social comparisons; conformity and herd behavior; self-serving biases and motivated cognition; the tendency of "extrinsic motivation" (e.g., organizational incentive schemes) to drive out "intrinsic motivation" (e.g., the internal drive to excel at your vocation); and a mass of research on learning from cognitive and developmental psychology.

[251] Note: incorporating findings of another discipline is not a straightforward task! We should examine our fundamental common grounds as well as our different basis before attempting to absorb other disciplines' findings.

Simon's version of calculative Turing machine rationality while strongly bolstering Dewey's critique. Lave clearly states her fundamental claim, " 'Cognition' observed in everyday practice is distributed--stretched over, not divided among--mind, body, activity and culturally organized settings (which include other actors)."[252] She explicitly rejects the ideas of decontextualized, ahistorical representations that carry out mental function apart from activity, along with any dualism that separates mind from body or emotion from cognition. Lave uses the term "functionalist" to correctly characterize "the core theoretical formulations of cognitive psychology," which she sees as committed to decontextualized, ahistorical representations along with "self-perpetuating, closed, input/output systems."[253]

According to Lave, "What motivates problem-solving activity in everyday situations appears to be dilemmas that require resolution."[254] These are not well-defined problems; instead, "It is a matter of conflicting values and viable alternatives, which are neither right nor wrong, and no one of which is entirely satisfactory."[255] She concludes, "There is a shift here in the conception of problem solving activity from a value free, context free technology of [calculative] means, to a value laden, conflict driven, situationally-specific direct form of experience."[256] Lave directly attributes such false claims to Simon, along with the belief that choice is "body-free and factual" and "consists of hierarchically organized discrete chunks" in which the "social world is acknowledged only in the form of professional occupations, translated immediately into knowledge domains."[257] She finds no social context in Simon's analyses. Economic agents in the marketplace are engaged in contextualized rational action in which perception is not secondary and sense or acting are impossible to ignore, and the conflict of values clear.

Lave calls attention to "the virtually error-free arithmetic performance by shoppers who made frequent errors in parallel problems in formal testing situations."[258] Calculation in a complex context is curiously different from the contrived "puzzles or problems assumed to be objective and factual. They are constructed 'off-stage' by experimenters, for, not by, problem solvers."[259] The abstract, decontextualized problem that is assumed to be the norm of calculation is not the subject's problem except in the secondary sense of wanting to secure praise or avoid approbation. She concludes that "in this genre 'problems' are small-scale demands for an acquiescent problem solver to operate on the information given by a problem giver using algorithms or formal inferential reasoning [i.e., programs] to match a correct or ideal answer."[260] This genre demands "narrow" deliberation characterized by simple teleological intentionality where the one right answer is predetermined in advance and assign to the subject to find.

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[252] Lave, J. Cognition in Practice. p.1

[253] Ibid. fn., p. 190.

[254] Ibid. p. 139

[255] Ibid.

[256] Ibid.

[257] Ibid. pp. 88-89

[258] Ibid. p. 158

[259] Ibid. p. 35

[260] Ibid.

Lave readily acknowledges the value of marginal utility calculations in everyday supermarket shopping. In fact, as Lave's studies show:

In subtraction or difference calculations, the shopper took the difference between prices, then the difference between quantities and made a marginal utility judgment. Such calculations take the form, "I will get two ounces more for six cents more. Is it worth it?"[261]

Shoppers, even those who do poorly on pencil and paper tests, generally can carry out these calculations to degrees of approximation adequate to making good choices in terms of marginal utility in the supermarket.[262] As Lave notes, "There is a question about quantitative relations to be resolved, but not a problem for which there is a numerical solution."[263] Calculation can answer questions that have a predetermined, fixed, and final answer, telos, or end. It is deliberation in only the narrowest possible one-dimensional sense where everything is, obviously, commensurable, but it is not a problem in the wider sense of choice among incommensurable values. The shoppers' problem is not calculation; they can in fact do that well enough. They have the processing ability, they have sufficient data, and it does not cost very much, etc. That is not their problem. The shoppers' problem is to functionally coordinate their shopping activity satisfactorily. Lave indicates:

> [A]n activity-in-setting that is labeled by its practitioners as a routine chore is in fact a complex improvisation. Descriptions of the activity as "habitual" and "routine" lead shoppers to interpret their own activity as repetitive and highly similar across episodes, rather than to treat its nonmechanical, generative [creative] variability as a defining characteristic.[264]

Lave recognizes Dewey's rhythm of equilibrium-disequalibrium-restoration[265] of equilibrium, even thought the shoppers may not. Often in her observations "activity will unfold unproblematically and effortlessly. In relation to this expectation 'problems' take on meaning as conflicting possibilities for activity, or trouble with ongoing activity, that snag or interrupt the process of shopping."[266] Habits of action fail us in genuine problem situations; if it were just a matter of making the calculation, then one would only have to acquire the habit, or the computing program. We deliberate when our habits of action fail us and novel impulses are released. Most of what Simon describes is deliberation only in Dewey's narrowest sense, which is really not deliberation at all.

In yet another observation that Dewey might have made, Lave notes "that arithmetic in the supermarket often serves . . . other-than-arithmetic intentions and purposes."[267] These include: (1) "Inventory," or "how much may be bought at one time without waste or spoilage."[268] (2) "Storage capacity," or "as the shopper considers the sizes of five and

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[261] Ibid. p. 119

[262] Ibid. p. 158

[263] Ibid. p. 119

[264] Ibid. p. 155

[265] See chapter two.

[266] Ibid. p. 156

[267] Ibid. p. 121

[268] Ibid. p. 120

ten pound packages relative to shelf height and space available in her kitchen."[269] (3) "Shoppers care about the taste, nutritional value, dietary implications and aesthetics of particular groceries."[270] To this list of often incommensurable values, we would add that perhaps they have moral concerns about consuming certain kind of products or perhaps they boycott certain fruits and vegetables to support workers' unions.

Lave makes the interesting point that standard school mathematics in most industrialized nations "is a powerful locus for teaching rational, utilitarian interpretations of arithmetic, money and the standardized dimensions of material goods."[271] The standard curriculum teaches calculative rationality in the form of decontextualized algorithms wherein "word problems" have no genuine context except the classroom task of finding the one right algorithm. She concludes that "standard systematizations of quantitative relations are to children in school, specifically characterized as instrumental means to reach goals defined elsewhere."[272] That means school mathematics ensconces teleological intentionality. It seems that they also teach docility. In Democracy and Education, Dewey says, "Plato defined a slave as one who accepts from another the purposes which control his conduct."[273] There are unintended consequences of teaching teleological intentionality that are deleterious to democracy. Lave observes that in the practice of grocery shopping, "problem solving is viewed as the resolution of dilemmas through gap-closing activity . . . which seamlessly joins means and ends."[274] Grocery shopping involves a nonteleological intentionality in which what is means and what ends emerges in the effort of the agent to functionally coordinate her transactions while resolving the problems posed by value incommensurability to her satisfaction. One can easily see that Dewey is entirely committed to the kind of nonteleological intentionality needed to go grocery shopping satisfactorily.

VII. The Knew-It-All-Along Effect

It is a general finding in psychology that postoutcome estimates by subjects of their pre-outcome judgments are closer to the outcomes than their pre-outcome judgments were. The inability to ignore outcome knowledge is labeled the knew-it-all-along effect (KIAA hereafter). Wood (1978) reports "Fischhoff (1977) suggests that the KIAA effect is the result of the automatic assimilation of new and old information. Some of the present findings are consistent with this view, but others require a modest extension of a simple assimilation position."[275] For clarification, consider the following case, which is a simplified version of what can be found in the psychological experiment literature:

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[269] Ibid. Interestingly, Lave found "no significant statistical relationship between the gender of participants and any other variable" in her grocery shopping studies (p. 51).

[270] Ibid. p. 154

[271] Ibid. p. 127

[272] Ibid.

[273] Dewey, Democracy and Education, p. 90

[274] Lave, Cognition in practice, p. 167.

[275] Fischholf further states, "it seems necessary to recognize that instructions can influence what information subjects access when making postoutcome judgments. That is, instruction may influence the

Joe is asked to predict the result of the college football game that is scheduled for this weekend and his prediction is 40-10. The game outcome is 30-20. Next week he is asked to remember his prediction and his answer is 35-15. That is, he modifies his prediction according to the actual results of the game. This phenomenon happens even if Joe is truthful and even if he is provided with incentive to recall his own prediction. The irony is that the actual result of the game is irrelevant to the question he is asked, and nevertheless Joe seems to treat it as relevant information![276]

As we will see in the next chapter, Lipman, in his axiomatization of bounded rationality, cannot capture the phenomenon that the agent uses this (seemingly irrelevant) information in his inference. But Burke, who develops a formalization of Dewey's logic, can potentially avoid this shortcoming because he includes all items of information as elements of the information set. And the agent is using this domain of information, which includes seemingly irrelevant information while taking an action.

VIII. What Did We Learn?

We looked at the results of studies of the human behavior in markets and when faced with gambles and tried to learn something outside traditional economics. To demonstrate the wide spectrum of studies in the different fields, I chose supporting evidence from anthropology and psychology. It is amazing that behavior observed by the researchers in many different fields suggests a fundamental revision of the economic theory of choice, yet economists keep developing their ideas within the traditional framework. Mainstream economists are interested in "non-psychological" models of bounded rationality. Some of those have been formulated based on intuition, computer science, or artificial intelligence. These models are meant to capture cognitive limits of economic actors but do not invoke research on the specific patterns of errors that human beings make.

On a Deweyan account, in the wide and comprehensive deliberation among competing values, the self is in the making as the economic agent strives to functionally coordinate her transactions with the aisles, displays, employees of the market, etc. while striving to unify incommensurable values. This context of activities yields the real make-up, meaning, and value of economic activity. Having algorithms, machine programs, or a hand held calculator may help, but it is not the hub of human economic choice and deliberation. That involves embodied habits, action, passion, imagination, and creative transformation. One who knows how to calculate the price of everything, but cannot functionally coordinate incommensurable values makes poor choices in the market. Economic theories that can only calculate cannot comprehend economic deliberation; hence, they make poor predictors of economic decisions in the market.

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availability of information, and the information available determines the size of the knew-it-all-along effect…"

[276] One can argue that the phrasing matters and if he was asked on the second time just recall the results of the game then the actual result was relevant. But what I am looking for is a framework that is capable of accommodating both of these phrasings and sees the information which are used by the agent relevant. Because this is how Joe "actually" behaves.

Chapter Five: Using Logic as the Theory of Inquiry in the Axiomatization of Bounded Rationality

Abstract [277]

In this chapter, I use a theory of inquiry developed by analytical philosopher, Tom Burke, extending ideas of Dewey to show how the transactional view[278] can explain the relevance of inconsistent information to the making of final choices (phenomena like the knew-it-all-along effect, last chapter). So conceived, the exploration of a formal transactional structure is both possible and useful.

Lipman's work is based on Simon's methodology while Burke's system is built upon Dewey's concept of logic (the theory of inquiry.) To compare these formal systems, I will start with an introduction to both philosophies. Next comes a deconstruction of Lipman's axiomatic framework followed by characteristics of Burke's logical system. I argue that the deficiencies introduced into Lipman's structure by a Simon-like methodology can be cured by adopting a framework such as Dewey's conception of inquiry.

[277] A preliminary version of this work was presented at the *Dewey and Post Modernism Confernce*, July 2001, MA. And the complete work was presented at the Second *Annual Symposium on Behavioral Sciencse*, July 2002, BRC/AIER. I have benefited from the comments and suggestions of the participants in both events.

[278] The term transactional for Deweyan epistemology was proposed by Bentley and accepted by Dewey.

I. The State of the Art

Following Simon's line of thought, several efforts were undertaken to formally capture the idea of bounded rationality. These efforts extend from organizational behavior to psychological modeling. However, there are rare efforts toward axiomatizing the idea. Economics theorist, Barton Lipman, has developed an axiomatic framework for bounded rationality[279]. This axiomatization uses the standard probability and expected utility theory in an innovative way to modify the standard theory of choice such that it accounts for the cognitive limitations of the agent. Therefore, the descriptive power of this model exceeds that of subjective expected utility[280] (SEU). Noteworthy is that in Lipman's axiomatic framework, such as in SEU the inconsistent information, practically used by the agent, remains irrelevant to the final choice. That people hold inconsistent beliefs and that they condition on these beliefs when making a choice, is a confirmed observation in human behavior studies in many fields (we saw lots of examples in last chapter). Nevertheless, this phenomenon cannot be captured in the standard setting nor in its derivations because it necessitates conditioning on inconsistent beliefs.

II. Simon and Economic Methodology

Simon finds "methodological inquiry interesting and instructive to the extent to which it addresses itself to concrete problems of empirical science."[281] Where Nagel pointed out that whether a particular proposition is a fundamental assumption of a theory or one of its derived conclusions is relative to the formulation of the theory.[282] Which means that if this was the whole story, then what Paul Samuelson calls "F-twist" and Simon calls "principle of unreality" would be entirely arbitrary. Simon, instead, talks about theories of economic actors and theories of economic markets: define,

X- businessmen desire to maximize profit

Y- business man can and do make the calculation that identify the profit-maximizing course of action. Then market theory states,

prices and quantities are observed at those levels which maximize the profits of the firms in the market.

Nagel and Samuelson have exposed the logical fallacy in using the validity of Z to support X and Y or consequences of X and Y that do not follow from Z. Simon thinks that most critics have accepted Friedman's assumption that Z is the empirically tested one, while X and Y are not directly observable. He believes that this is nonsense. He asserts that the expressed purpose of Friedman's principle of unreality is to save classical theory in the face of the patent invalidity of Y (by several experiments and observations). He adds "The Alchian survival argument that "only profit-maximizers survive doesn't help, since that cannot be observed (like Z) either." Simon's remedy for this problem is "make[ing] the observations necessary to discover and test true propositions, call them X' and Y', then construct a new market theory."

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[279] To the best of my knowledge, it is still the only axiomatization of bounded rationality.

[280] See the appendix on SEU.

[281] Simon, Herbert A. (1962, AEA, a symposium on Milton Friedman's methodology) "Testability and Approximation."

[282] meaning we can deliberately change the place of assumptions and conclusions.

Another argument is that Friedman had as much right as physicists to make unreal assumptions. But, Simon asks: "Was Galileo guilty of using the invalid principle of unreality?" Simon thinks, no! He thinks that Galileo was interested in behavior in perfect vacuums not because there are not any in the real world, but because the real world sometimes sufficiently approximates them to make their postulation interesting. He states that "[the] principle of the real world approximation asserts: if the conditions of the real world approximate *sufficiently well* the assumptions of an ideal type, the derivations from these assumptions will be approximately correct." Unreality of premises is not a virtue in scientific theory; it is a necessary evil- a concession to the finite computing capacity of the scientist that is made tolerable by the principle of continuity of approximation.

Simon complains:

> Working scientists employ the principle of continuity all the time. Unfortunately, it has no place in modern statistical theory. The word "significant" has been appropriated by the statisticians to mean "unlikely to have arisen by chance." As a result in testing extreme hypotheses –ideal types- we do not primarily want to know whether there are derivations of observation from theory which are "significant" in this sense. It is far more important to know whether they are significant in the sense that the approximation of theory to reality is beyond the limits of our tolerance. Until this latter notion of significance has been properly formalized and incorporated in statistical methodology, we are not going to accord proper methodological treatment to extreme hypotheses.[283]

III. Dewey and Economic Theory

The American philosopher John Dewey developed a very interesting and influential theory of inquiry. In his view, inquiry occurs when a person needs a "recoordination" in the sense described bellow. *Equilibrium* is defined to as the state that exists when a person is adjusted his situation. In equilibrium there is no need to act because the person and the environment are coordinated. Now if something disrupts a person's feeling of happiness, he feels uncomfortable and seeks to restore his comfort. He does so through an active exchange with circumstances, which he is a part of. He starts to act, undertaking exchanges with his environment, which itself starts to change in response to the actions he takes. The goal of the person's effort is to restore equilibrium by creating a chain of new coordinations. Therefore, this procedure is not arbitrary. In this creation of new coordinations, feeling and thinking are equally important in guiding the person's actions, through *practical reasoning.*[284] This orientation leads to a different form of rationality than the one that is acknowledged in economic literature. Also, this orientation is capable of accommodating unintended consequences, thereby providing a better framework than logical non-omniscience for capturing limited cognition. Dewey denotes abstract ideas as *universals.* Furthermore, "universal propositions" are subject to standards of comprehensive systematic coherence, and are not necessarily subject to empirical or observational method. The function of universals in our inquiry goes back to the fact that

[283] Simon, Herbert A. (1962), "Testability and Approximation."

[284] Passionate desire, values, and discerning perception have been built into practical reasoning since Aristotle. Look at Garrison (1999) for practical rationality à la Dewey.

ideas do not arise in isolation but rather in *systematic*[285] "constellations of related meanings." Thus *inquiry* for Dewey is an existential process of transforming a situation, in a way that will achieve a satisfactory resolution of a given problem (e.g. choice situation). In this context "operationalism" means that ideas are operational, they direct further observations, they bring new facts to light. Thus *ways of acting* and *modes of being* are the same thing for Dewey; in either case one is undergoing a process. Dewey characterizes *universals* as abilities or possible modes of action; the ability to consider different options under given conditions rather than being constrained by established habits.[286]

The knowledge we rely on is in the form of habits. We form habits in order to avoid engagement in infinite inquiry about recurring subjects. We also categorize subjects and apply the same procedure to all items in each group. These procedures are inferred from our well-established habits. Thus we limit new situations and free our limited cognition for further explorations. But it is important to keep alive the creative feature of inquiry; otherwise our habits will cripple our ability to receive new knowledge. We can always improve our understanding of any situation by exchanging with the concerned society but we cannot be certain that there are no further relevant facts that can change our understanding. Society is continuously producing social intelligence. In my reading of Dewey, he introduces the concept of "social intelligence" as a substitute for the quest for certainty. Thus he replaces the question of "how to be more certain?" with the method of "let's gather and share our information and thoughts to improve a situation." By contrast, in the conventional "realism" view, truth-seeking leads to certainty.

My conjecture is that this view[287] teaches us a way to have an integrated framework that incorporates substantive and procedural rationality as a more complete picture of behavior. We can distinguish then between these two types of rationality based on their operationality in answering specific questions of a scientist who studies the behavior. Substantive rationality answers the question of outcomes while procedural rationality is concerned with how one gets at a certain end.

IV. Barton Lipman's Axiomatization of Bounded Rationality

Lipman (1999) suggests developing a decision theory that does not assume that agents are logically omniscient. To elaborate this, consider a person who knows all axioms of a theory and the rules of logical inference. Now consider all theorems that are

[285] Burke (2001) argues that a notion of ideology is needed to account for the systematicity of ideas: "When ideas are employed in an inquiry, that inquiry is ideological. Ideology refers to the abstract contexts of the systems of universals."

[286] This may sound very similar to Herbert A. Simon's saying, "[W]e employ our abilities as long as they perform 'good enough' and not 'best'… [W]e reflect upon ideationals in many ways among them, **mathematical** discourse." (emphasis added) But is fundamentally different as the nature and source of cognitive limits is not the same for Dewey and Simon.

[287] In a Deweyan sense, *kind* integrates existential and ideational contents. This view of *kinds* integrates operational and empirical meaningfulness into inquiry. It does so because operational contents are directly relatable to ideational matters while the empirical contents of kind are directly existential in nature.[287] This is the very interest of Tom Burke whose task is to formalize Dewey's logic.

logically inferable from the axioms. It is quite possible that this hypothetical person cannot derive some of the theorems, despite the fact that he is equipped with all the means required to accomplish this task. In other words, the fact that he knows the axioms and the inferential rules will not automatically lead to him knowing all the theorems. We can agree that a *real person* is obviously not logically omniscient. We formally define:

An agent is "logically omniscient" if he knows all logical implications of his knowledge.

A logically omniscient agent in philosophical logic is a globally rational agent in economics. He knows all the possible actions as well as the payoffs associated with each action and further, he orders these payoffs and chooses the action that leads to the maximum payoff. These payoffs could be considered as different states of the world; the actions are the axioms of a theory; and the rules, which assign a payoff to each action, are all known. Let us define *knowledge* of a fact to mean that it is true in every state of the world. Then the rational agent, who is capable of and willing to use all his knowledge, would choose the action that leads to the highest payoff. Notice that we are imposing a very strong condition, that is, all the states of the world are *consistent*. It is the consistency of the states of the world that implies the truth of theorems in all states, which then implies that the agent must know them thoroughly as well.

If we drop the logical omniscience of the agent we face a logical impossibility, namely that the theorems are not true in all states of the world (or, alternatively, not true in all possible worlds). Although it seems logically impossible, it seems to be what a *real* agent considers as possible. To capture this contradictory situation the model of impossible possible worlds has been developed (Hintikka, 1975). These are called minimal models in modal logic; the idea is to allow for A and not-A to be simultaneous obligations in a deontic logic; where A is a logical proposition.[288] Lipman calls this a *contradiction* and he allows it for *broad* sets; then he studies only the sets that are not broad.[289] He "hope[s] that it may prove more useful in applications than models of bounded rationality based on less familiar concepts" because, in his approach, he "uses familiar notions like probability, utility, and states of the world." I will argue in the next section that operationalizing bounded rationality seems to call for a departure from "familiar" notions.

I classify some basics to clarify different elements of decision for the economic agent as well as the philosophical agent, and go on with giving my decomposition of Lipman's idea.

Rational agent	Logically omniscient agent
Knows the actions	Knows the theory
Knows the behavioral rules	Knows the inferential rules
Knows the payoffs	Knows all the theorems

RESULT:

Rational agent aims for and earns the maximum payoff.

Logically omniscient agents enjoy the internal consistency of all states of the world.

[288] Developing this type of model was motivated by an interest in capturing moral obligations.

[289] In page 18, Remark 6 when he drops the assumption of non-broad information sets, he still says "…note that since contradictions cannot appear in any information set, they are **irrelevant** (emphasis added) to whether a given state set preserves the agent's recognized equivalences."

Note that the case of different outcomes, as it happens in bounded rationality, could be captured in this framework only if we allow for the case to contain several distinctive actualizations that do not make a difference for the agent.

Boundedly rational agent	Logically non-omniscient agent
Does not consider all the actions; or	Knows the theory; and
Does not use all the rules; or	Knows the rules of inference; and
Does not know all the possible payoffs	Does not know all the theorems

RESULT: A boundedly rational agent sets an aspiration level and earns the first payoff above that.

Lipman provides us with an example: An agent is asked to choose between $100 and f(1) dollars when f(x) is defined as,

f(x) = 0, if the 10000^{th} digit of ? 2 is x;
= 200, otherwise

It is easy to see that even if the agent is provided with all the necessary mathematical definitions. Still, the regular agent cannot be certain about his choice. The traditional approach treats the options the agent has as ACTs, which are functions from states to consequences. In this example, the options available to the agent are:

ACT1: Constant function that maps all states into $100

ACT2: F(x) for x=1 that gives 0 in any state in which f(1)=0 (set A) and $200 in any other state (set B)

The problem with this approach is that for logically consistent states either set A or set B is an empty set. Then ACT2 gives only one amount in every state. Thus the agent is assumed to be unable to distinguish the second choice from a sure receipt of 0 (if set A) or $200 (if set B). In other words, the traditional framework cannot include the obvious uncertainty in the model.

Lipman forms a model based on his axiomatization of bounded rationality for a logically non-omniscient agent as follows. For any set A and B, A^B is the set of all functions *f: A!B*, and 2^A is the set of all subsets of A. Φ is the set of pieces of information, and J is a nonempty collection of subsets of Φ such that it contains only "truly possible" states. *S*, the set of *possible worlds*, is the set of maximal elements of J, and $I \hat{I} J$ is an information set. In this model, Lipman aims to distinguish between different states which are logically equivalent. To do so, he treats pieces of information as points in a set Φ, including: logical propositions, statements in a language, or mathematical formulas. What he does next is very important. He defines "correct" logical deduction by J, which is a non-empty collection of subsets of Φ, where the sets in this collection; *I (an information set)* are internally consistent. Notice that the implication of this restriction is that the impossible states do not enter the information set: For $s \hat{I} F$, any state of the world, such that at *s* any piece of information in the set *s* is true (others are false).

Thereafter, Lipman starts treating the problem at hand:

Let *X* be set of *consequences*…Then $F=X^S$ denotes the set of *acts*…*Assume* that we, as modellers, know how the agent would respond to each possible information set, not that the agent himself knows this exante…Preferences are ONLY defined at information sets

Notice that the key ingredient of this framework is a collection of binary relations on the set of acts *F*, which enables Lipman to uncovers a representation of the agent's information processing from his different preference relations *F*.[290] However, the problem with his model, as with other existing frameworks is that he can only explain the agent's action using his advantage as the logically omniscient modeler.[291] The main shortcomings of his model are: a) He needs the full knowledge of the modeler to identify *S*, b) In actual situations nobody knows I, and c) His agent treats the impossible worlds as source of irrelevant information, while people act based on this seemingly irrelevant information in actual daily decision-makings. To resolve this deficiency it is required that information could be derived from all members of a set of states that holds non-mutually consistent states of belief. But existing subjective state spaces defined and used by economists cannot have this characteristic.

V. Burke's formalization of Dewey's Logic

Burke emphasizes Dewey's conception of experience, experimental theory of inquiry, and theory of propositions. Then he goes on to employ a mathematical concept that is capable of accommodating Dewey's theory of inquiry, while preserving the non-analytical aspects of it. He focuses on the idea that inquiry involves both existential and ideational contents and he seeks to distinguish between these two. This distinction is not made under Dewey's notion of universals.

For Burke, ordered relations are system-dependent and do not exist by them selves "there is no such thing as an isolated proposition; or, positively stated . . . propositions stand in ordered relations to one another." (emphasis added)[292] Thus preferences are formed qualitatively, "We *value* goods and form *qualitative preferences* for certain goods over others."[293] Two main type of ordered relations among propositions are as follows: one referring to the *factual* or *existential* material which determines the final subject of judgment, the other referring to the *ideational* material, the *conceptual* meaning, which determines the predicate of final judgment. For Burke, universals are social and cultural in their origins and are instrumental in laying out programs of action.[294]

He states beautifully: "So far as I know, there is no way to pre-specify anything like a domain of all possible situations or inquiries." This viewpoint seems, to me, analogous to the cognitive limits of the decision-maker in theories of bounded rationality, which account for the impossibility of considering *all* behavioral alternatives. We will see that there is more to it.

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[290] Act and consequence are defined as in Savage (1954): actions are relationships between states and consequences.

[291] Rubinstein (1998) acknowledges this deficiency of the existing frameworks.

[292] Interesting for economists is the analogy to the idea that there is no isolated behavioral rule, and hence we have not one theory but a group of theories of bounded rationality according to different environmental conditions.

[293] **Observational results-data are constituted by particular propositions,** where "particular proposition" is a proposition in which a quality is attributed to some discernible 'this' or 'that'.

[294] I assert that the origin of universals should be understood and learned empirically, and that these programs of action could be analogous to behavioral alternatives for (early) Simon's satisficing agent.

Primarily, he defines theories as systems of definitions and hypotheses and everything that follows from them by accepted proof rules. Then he improves this definition of theories to a coherent set of definitions, axioms or basic hypotheses, and their implications in a given world-view. For Burke, "When ideas are employed in an inquiry, that inquiry is ideological. Ideology refers to the abstract contexts of the systems of universals." A theory is a system of definitions and hypotheses and everything that follows from them by given proof rules. Therefore, not all ideas are theories. He defines the elements of his logical system as follows:

A world-view is a set of theories (Same as possible worlds in modal logic.) A Family of world-views is a set of systematically related world-views. Each inquiry involves different families of world-views. A predicate of final judgment is a fuzzy class or family of ideology-types, where

An ideology-type (V,R,T);

V = {fuzzy set of world-views; v}

$\wedge$ = a grammar for a language of abstract hypotheses

$T : \wedge \varnothing 2^V$;fuzzy function from abstract hypotheses to

Various world-views ;T being ontologies

Γ = a repertoire of possible forms of reasoning or discourse

$R : \Gamma \varnothing 2^{VxV}$ is a fuzzy function from methods of reasoning to mutually accessible world-views, R being accessibility relation

Theories could be shared among world-views. Each inquiry involves different families[295] of world-views, and a predicate[296] of final judgment is a fuzzy class or family of ideology-types. He defines R: $\Gamma \varnothing 2^{VxV}$ as a fuzzy function from methods of reasoning to mutually accessible world-views; R being an accessibility relation. The achievement of this framework is that a world-view can hold non-mutually-consistent theories. Note that this framework captures a real human being: one who is holding a view that consists of non-consistent obligations[297]. This is what I find important for boundedly rational behavior formalization: We saw that a main concern is the feature of consistency in each and every level of the framework that Lipman constructs. A Burke-like framework, on the other hand, allows for conditioning on the seemingly irrelevant information.

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[295] Each family shares a type of "similarity" in the sense of Wittgensteinian "resemblance".

[296] Burke(2000) defines three sorts of predicate. And gives an example for economists: capital.

- Capital in a qualitative sense of scarcity

- Capital as a universal or abstract idea. It's meaningful because it could be measured in relation to other universals like wealth and prosperity

- Capital as a kind is a general term applicable in certain 'existential' conditions- integrating abstract ideas and their relations to one another with a respective range of registerable 'qualities'.

Also he makes an important distinction "We need to distinguish the abstract ideas embodied in possible econometric methods, the potential qualitative data we get from accounting and statistical methods, and systematic pairings of these methods and their possible results in the constitution of kinds."

[297] Note that theories are systems of universal propositions. They don't need to be existentially applicable. (like mathematical theories)

VI. Lipman's Framework versus Burke's

Now we reread Lipman using Burke's framework. The unappealing structure of logical non-omniscience, in Lipman's form, could be avoided when the necessity of consistency is removed, by the new approach of Burke. To see if a boundedly rational agent could do better by being, realistically, creative, we reexamine bounded rationality in this section.

Let's rewrite the deconstruction of the axiomatization of bounded rationality. The idea of bounded rationality is appealing as a framework for studying human behavior because it is considerably closer to observations than the neoclassical abstract notion of substantive rationality. However, it has not successfully been axiomatized in a broadly accepted manner. Lipman wants to capture the idea of bounded rationality by borrowing the idea of logical non-omniscience from philosophy and building a useful analogy. A logically non-omniscient agent allows for internal inconsistency of some states of the world to capture contradictory situations such as moral obligations. He uses the familiar language of economists, such as probability theory, to incorporate a philosophical concept into economics. In section IV, I presented a deconstruction of his framework. The analogy he suggests provides a framework that necessitates the loss of consistency of world-views or states of worlds. Thereafter, when he formally states and proves the body of his system, he doesn't cover this characterization. He defines *broad views* to hold inconsistency, then he excludes those parts of the view sets and he continues with non-*broad* views. Burke's framework, by contrast, won't lead to this evasion because it doesn't necessitate consistency in any level of the system except the level of individual theories.

Although Lipman's suggestion of removing the internal consistency of the states of our world apears fine at first, he seems to seek to bring it back when he attempts to form a model that explains the agent's behavior. He attempts to manipulate the set of relevant information through a logically omniscient and hence superior modeler. I think that there should be something added to the system when we take away the perfect knowledge of the agent: a possibly fuzzy set of worldviews. Burke's system requires the necessity of ideology, and he uses fuzzy sets to formalize the inquiry procedure. He defines his notion of ideology to account for a coherent system that works independent of consistency[298]. I conjecture that Burke's framework is useful in forming an axiomatization of bounded rationality that is capable of capturing Lipman's framework without requiring the exclusion of broad views. This new system will enjoy higher operationality because this aspect was a consideration from first step. It will be more appealing to economists who work with data because the theory underlying this system, Dewey's theory of inquiry, is based on nothing but the essential importance of empirical, existential findings, whereas Lipman's work starts and ends with theoretical concerns. Consider the *knew-it-all-along* effect introduced in the previous chapter. Remember that in the mapping from information to action, Lipman excludes "seemingly irrelevant information" from the information set of the agent.[299] So, he cannot capture the fact that the agent uses this

[298] The relevant contexts with respect to which necessity is determined are possible concrete situations rather than abstract world-views and/or ideologies.

[299] He calls the state of the payoff that is associated with this view a strange state which is a member of subjective state space but will not produce any member of the information set.

information in his inference. Lipman clearly states "I only consider preferences conditional on consistent information. Because the impossible worlds are only part of the representation, preferences conditional on such worlds cannot be relevant." Also his framework necessitates the existence of the logically omniscient modeler who forms the domain of "correct" and therefore relevant information. But Burke doesn't make a partition of "correct" and "incorrect" states in his state space. Thus he includes all items of information as elements of the information set. And the agent is using this domain of information, which includes "incorrect states," while taking an action (here giving the answer).

VII. Concluding Remarks

In actual decision-making, people use information which are irrelevant to the rational economic agent. To capture this feature of behavior a structure is needed that goes beyond the regular probability theory. Burke develops a logical system that accepts mutually non-consistent states. I suggest that a formalization of Burke's system can be a foundation for theory of choice with a higher descriptive power and operationality. To do so, my conjecture is that we need to be able to condition on information from every state (including the "incorrect" ones) with a positive probability. Thus, all possible out comes set will be extended to account for the impossible worlds. Further, I argue that the underlying philosophy of this system cannot hold for objective reality. The transactional theory of inquiry holds that we are doubtful because the situation is inherently doubtful and that the situation cannot be straightened up by manipulation of our personal states of mind. Therefore, restoration of integration can be effected, in one case as in the other, ONLY by operations which actually modify existing condition, not by merely "mental" process. I suggest that Dewey's theory of inquiry should be adopted to achieve better models of decision-making. These models will be based on an axiomatic framework that does not need consistency. Remember, that consistency is the cornerstone of the current framework.

Mas-Colell and Whinston Microeconomic Theory text book teaches us:

When using choice structures to model individual behavior, we may want to impose some "reasonable" restrictions regarding an individual's choice behavior. An important assumption, the weak axiom of revealed preferences [first suggested by Samuelson (1947)], reflects the expectation that an individual's observed choices will display a certain amount of consistency. For example, if an individual chooses alternative x (and only that) when faced with a choice between x and y, we would be surprised to see her choose y when faced with a decision among x, y, and a third alternative z. The idea is that the choice of x when facing the alternatives $\{x, y\}$reveals a proclivity for choosing x over y that we should expect to see reflected in the individual's behavior when faced with the alternatives $\{x, y, z\}$. (p. 10.)

Burke's framework formalizes Dewey's theory of inquiry, hence provides the required tool. The new view point along with the formal tool will lead to a higher explanatory power, captures incommensurable valuation, and accounts for the change of agent after a choice.

When one believes in the existence of a unique truth independent of the truth-seeker, one utilizes optimization theory to formalize the procedure of inquiry. Alternatively, if the existence or the uniqueness of the optimum solution, or for that matter, the existence or uniqueness of the truth is doubted, another framework is required to capture this new approach. To the best of my knowledge, this alternative orientation has not been introduced into economics.

Inquiry has an uncertain nature. To capture this uncertainty we must introduce a non-analytical element into the system of inquiry. In Burke's system there are classes of theories in each class of world-views, which fall in classes of ideology-types. Consistency and analytical deductibility is found ONLY at the level of single theories not higher. Furthermore, ideologies provide a proper place for a non-analytical element. So, we don't sacrifice precise logical analysis. We do this by holding consistency ONLY at the level of single theory and not among all theories in a world-view.[300] "A given world-view in a given ideology-type corresponds to a class of (possibly incompatible) alternative theories each of which is based on its own system of universals. A world-view corresponds to some space of categories [not all] each consisting a system of universals in Dewey's sense, and each supporting the systematic formulation of abstract hypotheses."

To achieve the determinacy needed for concluding the inquiry, we want the suitable level of fuzziness that accommodates our problem under constraints imposed by ideologies. Note that although ideologies are social in nature, they are the constraint-producing element not the objective part. Furthermore, fuzziness represents formal analysis and consistency, not the lack of them. Finally, notice that we embody uncertainty as a part of the system; the nature of ideas is *functional* and *fallible.* To formalize Dewey's framework we need to account for the fundamental existence of uncertainty as a characteristic of every situation. It is true that minimizing the uncertainty is desirable, but eliminating it is not affordable.

I offer an adventurous journey to people who enjoy entertaining new ideas: take a step back and reexamine the behavior of human being from an alternative orientation. It may or may not change some of the findings in an outer shell of economic theory. However, I expect a change in a fundamental level, and my conjecture is that Dewey's orientation extends the verifiable area of human behavior for economists. It also sheds a light on some complexities by changing the nature of approaches: maybe they simply don't exist any more. These conjectures need to be explored in later investigations.

[300] To systematically compose the complex abilities, Burke considers lambda calculus and category theory.

Chapter Six: Concluding Remarks and Directions for Further Research

In this chapter, I highlight and shortly review the main idea of this dissertation. Also, I put this idea in the general context of issues that are of interest to economists. Then I present some outlines and brief descriptions for research projects that will follow the current one.

I. Philosophy of Decision Making

It is important to demonstrate to economists the relevance of the philosophies underlying economic frameworks, in particular those of the transactional behavior approach, positivism and realism, as counterparts for bounded rationality, positive economics, and optimization. My research agenda revolves around three analogies: positivism as a counterpart for behavioral models without preferences; representative realism as a philosophical reflection of desirability of optimization, and transactional logic as a formal framework that can capture the original idea of bounded rationality. The last analogy has been explored in this dissertation. The other two analogies are subjects to be elaborated as described in directions for further research, below.

The second chapter discussed the philosophical foundations of an alternative choice theory, based on the "transactional" view. I concentrated on Dewey and his influential student, Bentley. They consider behavior to be not different from inquiry per se. I extended Dewey's transactional view to shed light on behavior in general, and on decision-making under uncertainty in particular. In later chapters, I reviewed the neo-classical and other current models, with stress on their methodologies. Then I examined bounded rationality from Dewey's perspective and identified, in informal discussion as well as formally, the primary steps toward developing a transactional view.

Empirical studies of decision-making suggest that decision-making can be considered a set of related skills that depend on individual experiences, abilities and behaviors. My main concern was to show that real behavior could be best described using a transactional view, especially by adopting the concept of emerging goals and innocent uncertainty. The transactional framework has not been used previously as a foundation for supporting and clarifying empirical findings. Thus, formalizing this ability would be a unique contribution towards clarifying how people really behave, for example, how they choose where and how much to invest, and what factors affect their decisions. Ultimately, the transactional framework is an approach that *subjects actual rules of choice from daily life to scientific judgment.*

I investigated how Dewey's theory can be applied to current issues in decision theory. One major issue is how to model purposeful behavior characterized by the pursuit of goals rather than maximization. An implication would be the conceptual equivalence of rejecting "substantive rationality," which is the main feature in current

optimization theory, as a building block of decision theory, and Dewey's denial of the existence of any fixed and final law.

I showed that Dewey and Bentley's revised logic or theory of inquiry helps us to overcome some dilemmas. It does so because in a transactional process there is nothing exogenous to behavior: organism, environment and their relations are all parts of the ever evolving functioning of individuals. From this viewpoint, even the structure of social intelligence that forms the norms becomes a component of an indivisible totality. By clarifying these fundamental problems, I took the first step toward presenting a completely new approach to behavioral paradoxes, namely, a transactional approach.[301]

II. The Next Step: Formalization of Bounded Rationality

The next step after the current work is to construct an axiomatization and then a formal mathematical model based on Simon's bounded rationality idea, but treating bounded rationality as a primary framework rather than a deviation from standard rationality. I plan to show how such an approach can help us understand empirical regularities. This work will explore a new way of thinking about behavior, outside the paradigm of theories that assume any degree of economic rationality.

In this dissertation, I focused on creating clear, concise, and brief portraits of the status of each of the more popular decision-making models. I started with EUT and OT and continued by adding bounded rationality to the picture. We saw that the goal remained unchanged: an axiomatic framework for a rational agent. Up to this point, I presented a methodological argument for my claim, along with a categorization of current frameworks. The next steps in my research agenda are as follows:

First I will investigate how the rather informal ideas of Simon can be formalized and be put to use in economic applications by using the transactional approach.

Second, I will see whether the formal models attained in the first stage lead to a satisfactory formal definition of bounded rationality.

Third, I will demonstrate more generally how this formal definition of bounded rationality is possible and desirable within a transactional axiomatic framework.

Finally, I will survey existing models of decision-making under uncertainty and determine to what extent they constitute instances of bounded rationality and how my framework is advantageous in capturing the empirical and other incompatibilities in the so-called rational agent.

[301] Rationalists and empiricists stand at the opposite margins of subject-object duality. Rationalists convey that object must conform to mind, where empiricists believe in the opposite. The well known duality for economists is that of goals and means, namely objectives and constraints. I claim that neoclassical view point is limited to what could be named "function" in Dewey's philosophy and behavioral philosophy is laying under what is called "process". Furthermore, utilizing transactional inquiry we can build a bridge between function and process and by an active exchange from this two sides a new view will emerge that enjoys a great explanatory power over both approaches.

III. Directions for Further Research

- **An Index of Persistence**

In a given situation of choice, a decision-maker who encounters an unexpected obstacle (or opportunity) can either examine alternative ways to pursue his goal (look for novel or exclude some existing alternatives) or adjust his aspiration level, which is the tentative satisfying level that an agent sets before taking action. We can name these two ways of reacting to a problematic situation as "active reaction" and "passive reaction," respectively. Then a persistence index would be an index that measures the level of active creativity of an agent in resolving a given problem. The tendency toward adjusting "the set of behavioral alternatives" rather than adjusting the "aspiration level" under controlled situations is suggestive of creativity and of an active response to the conflictual situation. Such an index is potentially useful for screening applicants for managerial positions, as persistence is a characteristic of many successful managers. It is valuable to notice that an important factor in these evaluations is risk behavior. (Risk-takers are preferred for this kind of position.) The *persistence factor* may be a more accurate predictor of managerial success.

- **Positivism and Behavioral Models without Preference**

I see a conceptual relationship between philosophical schools of thought (like Hutchison's) and their counterparts in positive models of economic behavior (like Hildenbrand's). I will put the two together and see if I can observe any logical structural similarity. The main point is that both economic and philosophical perspectives of positivism share an important feature: deviation from the teleological assumption[302] of behavior, namely that every choice aims at a preexisting end, of course constrained by cognitive limitations.

Terrence W. Hutchison was the first person to approach economics positively in every aspect. He was deeply influenced by the Vienna Circle's *scientific method*, and tried to apply that to economic theories. In his 1938 book, *The Significance and Basic Postulates of Economic Theory*, he clearly states that the goal is not to get involved in old philosophical arguments about *method*, but rather to establish a clear basis for modern economic theory. The first step, he states, would be to establish economics as a "science". He categorizes economic theorems into two main groups: tautologies and positive statements. In his effort to fit economics into the family of "science," he requires all subject matter to be directly translatable to empirical statements. Thus he denies the validity of the normative part of economic theory and removes that from "scientific" economics. [303]

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[302] We discussed that Dewey has a non-teleological theory of behavior. It is important to distinguish between these two concepts: a non-teleological theory that allows for unexpected outcomes and a non-teleological assumption that leads to a certain prescription of behavior based on necessary market conditions.

[303] I should name other thinkers who have pointed out the main shortcomings of pure positivism and have made some progress in this direction including: Friedman and his "as if" instrumentalist approach; Keynes and his self-fulfilling prophecy; Knight with showing the inconsistency of Hutchison's perspective and the relevance of the Austrian's notion of "*Verstehen*".

In a preference-free approach to market demand, Hildenbrand treats a *representative* individual as an agent who consumes a portfolio of goods and services in a period of time. Individuals are treated *as if* they are acting in a certain way. As long as the concern is predicting the aggregate decision, the positivist models will work well. In a macro perspective, the individual cannot act against the aggregate because there are forces that require him to obey certain behavior rules. For example, an agent cannot afford a long-term deviation from the law of demand. However, when the subject matter is an individual who is playing a game against nature or another individual, then the aggregate models do not apply anymore. The individualistic methodology and game theory will be relevant when the economists desire more than mere explanation and predictions under the same circumstances as the ones observed, when they aim to extend their predictive power to new situations.

- **Realism and Maximization**

Realists, in general, believe a "truth" or essence exists "out there," independently of inquiry. They analyze all intentional behavior as attempts to converge to that reality, to the extent that constraints allow. I suggest that there is an analogy between this approach and that of maximizing behavior as introduced in economic decision-making. The appendix to the first chapter includes an introduction to this idea.

- **Capturing the Subjective Element of Decision Making**

The standard implications of the EUT-based theory of insurance are highly implausible. Walker, Thaler and Tversky (WTT) (1997) think that probabilistic insurance (PI) is intuitively unattractive. They conduct some surveys of various groups, with hypothetical big stakes, which they believe are more instructive in this domain than real pennies (small amount of real money). The subjects with a hypothetical fixed amount of total wealth were asked to reveal their prices for different kinds of insurance deals. Their results indicate that people demand about a one-third reduction in the premium to compensate them for a 1% chance that their claim will not be paid. This explains the lack of attraction for PI, while a risk-averse decision maker requires a substantial reduction in the premium (significantly more than 1%) to compensate for a 1% risk of not being reimbursed. While the majority of respondents were willing to pay more than an actuarially fair premium for standard insurance, the majority were not willing to pay the actuarially fair premium for probabilistic insurance. Doubling the replacement cost did not have much effect on the reservation price.

All the survey evidence shows a strong reluctance to purchase PI, which is not allowed by standard EUT. WTT demonstrate that the weighting function of prospect theory, or weighted utility theory, can explain this phenomenon. In classical economic analysis, insurance is explained by concavity of utility. In prospect theory, insurance is explained by subadditivity of decision weights. It seems that the purchase of insurance is driven by the over-weighting of small probabilities rather than diminishing marginal utility. Also, the finding that people value the elimination of risk disproportionately more than the reduction of risk represents a major departure of human behavior from canons of rational choice. Therefore, an adequate analysis of insurance should attend to the non-linearity of chance in addition to the non-linearity of value. Using a weighting function to explain behaviors like insurance purchasing would do so.

I will add two parts to their experiment, hoping to find some evidence for changes in decision behavior in going from a completely hypothetical case to a simulation of a "real" world with pennies. Also I will change the part that makes the problem dynamic in WTT, where they tell the subjects that they have a job that means a source of income, but bring another dimension of uncertainty involved with the job market into a person's mind. Instead, I will assign a certain amount of total wealth to each person and make the problem a one-shot (static) decision, by excluding all concepts of time that could be derived from earning money through a job, or making decisions about a yearly insurance plan.

- **Formally Stating the Methodological Argument in *Cost and Choice***

According to the preface of *Cost and Choice*, Buchanan claims to have two primary goals:

1) To use the theory of opportunity cost to demonstrate basic methodological distinctions that are often overlooked and to show that a consistent usage of this theory clarifies important areas of disagreement on policy issues.

2) To trace the evolution of ideas in the conception of cost; emphasizing the contributions that stem from the London School of Economics.

The book contains six chapters. The first chapter sketches out the doctrinal history of cost theory before the 1930's. In the second chapter he discusses the origins and development of the London Theory, and in chapter three summarizes the theory of opportunity cost in two contrasting analytical settings. He devotes the remaining chapters to applications: chapter four examines cost theory in public finance, an application that aroused the author's interest in the need for conceptual clarification; chapter five uses opportunity-cost logic as a means of looking again at the Pigouvian welfare norms, and chapter six demonstrates the relevance of basic cost theory in the overall domain of non-market decision-making.

Four topics intrigued me the most:

[1] The distinction between "a predictive or scientific theory" and a "logical theory of economic interaction" (p. 38). This methodological point is the source of pervasive error in applied economics.

[2] The possible relationship between taxes as the cost of public goods and taxes in choices for public goods (p. 52). A related question to think about is: does economic theory truly aim at locating the cost of public goods?

[3] Sophisticated cost-benefit analysts recognize the relevance of "the distribution of tax shares" (or benefit shares), while at the same time they fail to recognize "the relevance of the distribution of decision-making power" (p. 59). The oversight of this second distributional effect stems from the paradigm in which "costs" are presumed to exist as objectively quantifiable magnitudes, unrelated to the choice process.[304]

[4] The individual should be on a subjective margin of indifference between the two fiscal instruments. It is the differences among the subjective valuations of equal present

[304] However, some exceptional economists such as Roland N. McKean, seem to be aware of the magnitude of the problem that exists here.

value instruments with differing time dimensions that cause the individual to move toward full equilibrium. It is illegitimate to derive implications for choice among equal present value instruments, assets or liabilities, from the characteristics of the equilibrium towards which such choice behavior aims. The book elicited a question from me: what do fiscal theorists mean when they say that a tax may be fully capitalized under certain condition? (p. 67)

I want to emphasize the third chapter, with the same title as the book, because it discusses an economic issue in a methodological manner. I found the argument presented in this part—in principle—consistent with Lionel Robbins and Hans Mayor who stressed the distinction between technical and economical problems. The book offers several points about a conceptual confusion related to different types of cost, which leads to the misapplication of data analysis—stemming from methodological negligence—that require further consideration:

The actions of human beings are the basic elements of economic theory;

There should be no presumption that people should behave economically;

The "cost" consequent to "choice" creates a part of this confusion (p. 44).

There are costs that affect choice, like the opportunity cost (as referred to in chapter two). There are also choice-influenced costs, the term that Buchanan uses to point to the costs that emerge after a choice.

Due to the utility of this text and its methodological approach, I plan to translate this book into a formal theory. While some may consider this text dated, it addresses contemporary issues well. The incorporation of *Cost and Choice's* clarifications and illuminations would lead to economic advice to policy makers in the direction of less restrictive plans, by showing how unrealistic their forecasts are. Five-year plans and the influence that governments exert over the economy stifle development; consequently a drastic shift in economic methodology is in order.

The central idea of this book is that if you know what you want, there is no cost associated with your action. I generalize this argument to claim that if there is no uncertainty then there is no incentive. Ironically, economists create conditional situations to make choice possible and meaningful, and then spend all their time trying to overcome the problem of knowledge; how much the agent knows and how he acquires knowledge. Alternatively, by not assuming any final outcome (one or many) the problem is resolved once and for all. What needs to be adopted is a notion of permanent uncertainty that not only cannot be removed but is the source of actions.

IV. My Idea in Perspective

In order to make a clearer picture of my idea, I will compare my view on the appropriate method of capturing actual behavior, to some known views presented by other thinkers on this matter.

The notion of uncertainty I prefer among those suggested, has been introduced by Frank Knight. However, he considers neo-classical economics a necessary but not

sufficient tool to explain human behavior. I suspect the necessity of this account and suggest that we can put aside the whole neo-classical framework and consider an altogether new framework for analysis of actual behavior.

The way in which uncertainty is considered in quantum mechanics is appealing to me in the sense that the observer is part of the dynamic process, instead of standing out of it. To comment on this issue I shall need more study on this subject.

Finally, all the approaches toward modeling behavior, started formally after World War II, whether they use optimization theory or not, fall into the Humian paradigm, where uncertainty is an epistemologic notion. That is the existence of uncertainty is due to our cognitive (and other) limitations. I attempt to discover the advantages that could be brought to us by putting aside this paradigm and adopting an alternative one in which uncertainty is considered as an ontological notion. This means that uncertainty is not an undesirable characteristic of the situation to be overcome. Rather it is an ever existing characteristic of the situation and we will deal with it without trying to eliminate it, as we actually are doing so, in our every-day lives.

I admit that at present all I have is a plausible theory. This work has been the first step of a lifetime research agenda to develop an alternative way of formally modeling behavior. It contains an introduction to an appropriate philosophy for such endeavor, as well as the logical structure that stems from this philosophy and provides us with a ground to formalize rules of behavior without imposing consistency. In addition, this work clarifies the main challenge that we face in the current research programs: the necessity of consistency, which itself is a byproduct of epistemological considerations of uncertainty.

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Appendix A- Optimization satisfies our quest for certainty: an analogy between a theory of perception and the prominent decision-making model

1. The philosophical side: There are a group of philosophers who will only be happy if there is an unchangeable *thing* or essence beyond human thought wherefrom all the perceptions earn their validity. I refer to them as representative or metaphysical realists. In all these philosophies the cornerstone is the existence of the unapproachable and certain *reality* of fixed and immutable essences that play a vital role of being a reference point or telos (end or purpose) for all other elements in the construction of these frameworks. This ultimate *truth* keeps their activities and inferences meaningful and it provides the actors with incentives. It also serves as a guarantee that rescues their camp from drowning in the realm of relativism.

2. The economics side: there is also a prominent tradition in economics for the conceptualization of the procedure of decision-making. This tradition is based on the concept of "rationality". To formalize the notion of "rationality", economists have utilized the technical tool of optimization theory (OT). This method is based on expressing the activity of decision-making as the maximization of an objective function named *utility* function, and the environmental limits in terms of *constraints* for this maximizing behavior. A *rational* agent is aware of the outcomes associated with each action and so he will choose the action that provides him with the highest *utility* available under the *constraints*. This omniscient characteristic of the economic agent appears to me as a counterpart to the perfection of the ultimate being in the representative realism.

3. A comparison: It is noteworthy that these two concepts are both necessary to the formation of their corresponding frameworks as the main building block: the global rationality for decision-making models and the unapproachable reality for the realism.[306] My conjecture is that the absolutism underlying both approaches is the very property that they closely share. This common feature imposes a certain way of formalizing problems and of solving them, which is importantly restrictive. Therefore, if there is to be an alternative for these models it should stem from another philosophy. As long as the alternatives preserve the same basis they will not have the quality to capture behavioral phenomena. Further arguments are in order to clarify that the non-EU alternatives share the same characteristic with EU theory and so can not solve the problem of anomalies in a wide scope, beyond the special cases that they were designed to explain.[307]

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[306] Psychologists and behavioral economists attack the neoclassicals for being obsessed with this absolute utility measure and ignore the reference points that people consider when making actual decisions. This is not contradictory to what I am saying. What I claim is the similarity of posing an absolute task for the actions and claim that the "correct" road leads to that end.

[307] However, I claim that this task could be achieved within a fundamentally alternative approach that I call "transactional analysis" and will explore gradually.

4. Some clarifications: Here I state some instances of the analogy between philosophical absolutism and the postulate of subjective expected utility maximization in economics with reference to Immanuel Kant, the founder of phenomenalism[308]:

Kant's argument for the justification of the certitude of the foundation of the knowledge is couched at every point so as to indicate the necessity of a higher although intellectually unapproachable realm.(Dewey, *The Quest for Certainty*, p. 49)

This is just analogous to the assumptions that economists traditionally make for behavior, namely the unapproachable rationality.

> [I]n Kant's system…a perfect and unshakable adjustment of the certainty of intellectual beliefs…the point at the practical side that had to be protected at all hazards was that no concrete and empirical material be permitted to influence ultimate moral realities…(Dewey, *The Quest for Certainty*, p. 49)

A considerable proportion of economic theorists (neoclassical advocates) display an aggressive lack of curiosity towards behavioral research. When confronted, they argue that the framework of rational behavior was conceptualized to make a model that works in the domain of interest to economists. It was not designed to be tested in experimental labs and so it is essentially empirically non-refutable. The rationality assumptions are from the absolute and abstract world of theory and are not to be evaluated by observation. Does this sound along the same line with Kant's view above? To me, yes!

[308] Maybe the group that resemble the way economists approach the modeling of decision-making process, in philosophy is wider than realists?

Appendix B

- ## Subjective Expected Utility

Camerer and Weber (1992) explain:

SEU was first developed by Savage (1954) (inspired by Ramsey, 1931, and de Finetti, 1937), then derived by Anscombe and Aumann (1963) in an approach that essentially combined EU and SEU.

In SEU, a decision-maker must choose between "acts" denoted by uppercase letters (e.g., X). The consequences of an act X depend on which state s occurs, from the set S of possible states. (The consequence of X if s occurs is denoted by $x(s)$.) For simplicity …[if] the sets of acts and states are [assumed] finite. If we include subjective probabilities of the states, denoted by $p(s)$, then an act X will be described by a vector $(x(s_1), p(s_1);\ldots; x(s_n), p(s_n))$ (where states are indexed $s_1, s_2,\ldots, s_n$). Preferences between a pair of acts X and Y will be denoted by $X \sim Y$ (X is indifferent to Y) and $X \geq Y$ (X is weakly preferred–preferred or indifferent–to Y).

The mathematical goal of SEU is to represent preferences over acts by a numerical utility index u and a probability measure on the states, p, such that act X is preferred to act Y iff the… SEU of X is larger than the SEU of Y. The SEU of X is defined as

$$SEU(X) = \sum_{s\in S} p(s)u(x(s)).$$

If preferences satisfy certain axioms, then there are numerical utilities and probabilities that represent acts by their SEU. P. 327.

In the same survey, we read "These axioms [of SEU] yield a state-dependent SEU representation in which the utility of consequences depends on the state in which the consequences occur. Two other axioms restrict the utility function to be the same for all states. The SEU *representation theorem* states that preferences over lottery acts satisfy the five axioms iff there exists a unique additive *probability measure* (or distribution) for all states $p: S \rightarrow [0, 1]$ and a *utility function* on the lotteries $\alpha(s)$, $\beta(s)$, etc., unique up to a positive linear transformation, so that

$$X \geq Y \leftrightarrow \sum_{s\in S} p(s).\, u(\alpha(s)) \geq \sum_{s\in S} p(s).\, u(\beta(s)).$$

- ## Fuzzy sets and Fuzzy logic [309]

Let U be a collection of objects denoted originally by $\{u\}$, which could be discrete or continuous. U is called the universe of discourse and u represents the generic element of U.

Definition 1: Fuzzy Set: A fuzzy set F in a universe of discourse U is characterized by a membership function μ_F which takes values in the interval [0,1]. A fuzzy set may be viewed as a generalization of the concept of an ordinary set whose membership function only takes two values {0,1}. Thus a fuzzy set F in U may be represented as a set of ordered pairs of a generic element u and its grade of membership function: $F = \{(u, \mu_F)| u\in U\}$.

[309] This part is borrowed from Lee (1990).

Definition 2: Support, Crossover Point, and Fuzzy Singleton: The support of a fuzzy set F is the crisp set of all points u in U such that $\mu_F(u) > 0$. In particular, the element u in U at which $\mu_F = 0.5$, is called the crossover point and a fuzzy set whose support is a single point in U with $\mu_F = 1.0$ is referred to as fuzzy singleton.

Definition 3: Fuzzy Relation: An n-ary fuzzy relation is a fuzzy set in $U_1 \times \ldots \times U_n$ and is expressed as

$$R_{U_1 \times \ldots \times U_n} = \{((u_1, \ldots, u_n), \mu_R(u_1, \ldots, u_n)) | (u_1, \ldots, u_n) \in U_1 \times \ldots \times U_n \}$$

One exploration of fuzzy logic is the conception and design of fuzzy systems that have the capability to learn from experience. This type of system can emulate the remarkable human ability to learn and adapt to changes in environment. Fuzzy Logic may be viewed as a conceptual framework for modeling human decision making and approximate reasoning. In this context, the forward data-deriven inference (generalized modus ponens) plays an especially important role.

Fuzzy inference mechanisms related to the decision making logic:

The definition of a fuzzy implication may be expressed as a *fuzzy implication function.* We prefer to say that the inference (consequence) should be as close as possible to the input truth function value, rather than be equal to it. This gives us a more flexible criterion for choosing a fuzzy implication function. Furthermore in a chain of implications, it is necessary to consider the "fuzzy syllogism" associated with each fuzzy implication function before we can talk about the propagation of fuzziness.

There are two important fuzzy implication inference rules in approximate reasoning[310]. They are the generalized modus ponens (GMP) and the generalized modus tollens (GMT). Specifically,

Premise 1: *x* is *A'*
Premise 2: if *x* is *A* then *y* is *B* (GMP)
_____
consequence: *y* is *B'*

Premise 1: *y* is *B'*
Premise 2: if *x* is *A* then *y* is *B* (GMT)
_____
consequence: *x* is *A'*

in which *A*, *A'*, *B*, and *B'* are fuzzy predicates. The proposed criteria are summarized in tables I and II. We note that if a casual relation between "*x* is *A*" and "*y* is *B*" is not strong in a fuzzy implication, the satisfaction of criterion 2-2 and criterion 3-2 is allowed. Criterion 4-2 is interpreted as: if *x* is *A* then *y* is *B*, else *y* is not *B*. Although this relation is not valid in formal logic, we often make such an interpretation in everyday reasoning.

TABLE-I: Intuitive Criteria Relating Pre1 and Cons for Given Pre2 in GMP

x is *A'* (Pre1)	*y* is *B'* (Cons)

[310] It is fair to say that everyday reasoning is approximate reasoning and could be modeled using fuzzy inference.

Criterion 1	*x* is *A*	*y* is *B*
Criterion 2-1	*x* is very *A*	*y* is very *B*
Criterion 2-2	*x* is very *A*	*y* is *B*
Criterion 3-1	*x* is more or less *A*	*y* is more or less *B*
Criterion 3-2	*x* is more or less *A*	*y* is *B*
Criterion 4-1	*x* is not *A*	*y* is unknown
Criterion 4-2	*x* is not *A*	*y* is not *B*

TABLE-II: Intuitive Criteria Relating Pre1 and Cons for Given Pre2 in GMT

	y is *B'* (Pre1)	*x* is *A'* (Cons)
Criterion 5	*y* is not *B*	*x* is not *A*
Criterion 6	*y* is not very *B*	*x* is not very *A*
Criterion 7	*y* is not more or less *B*	*x* is not more or less *A*
Criterion 8-1	*y* is *B*	*x* is unknown
Criterion 8-2	*y* is *B*	*x* is not *A*

Appendix C: Are Methodological Concerns Important?

After having read *Cost and Choice*, I asked James Buchanan two primary questions:

[1] If you were to write about this same topic today, would you come to the same conclusions, or do you believe that economists have now overcome this negligence?

[2] What is the effect on empirical economists of their lack of concern for the methodological confusion that you addressed in this book?

He told me that his intention in writing this book was to make his subjectivist viewpoint clear. After his previous book, *Public Principles of Public Debt* (Homewood, I11.: Richard D. Irwin, 1958), in which he harshly criticized orthodox economists, he wanted to explain his viewpoint—in detail—and to address some underlying concepts and ideas, to clarify how he defines *cost* and *choice*.

He also mentioned the fact that this argument meant the most in its own time, when welfare economists criticized Von Hayek and Mises, and when the socialist viewpoint was so popular. This confirms the ongoing importance of such issues to all states with central planners.

He still believes that many economists do not take into account methodological considerations; moreover, they do not care to do so either. Consequently, he does not find the interpretations that come out of such work credible. He also considers such interpretations harmful when policy makers who consult this group of economists use their findings. In other words, as long as we economists model and calculate, the problem does not arise. However, when we use our analysis and data from statistics models to make policy prescriptions, we misapply the data. As Buchanan said, we are "passing the permitted border," methodologically speaking.

I close with the picture he gave me when I asked his idea about "economics as a science". Nominalism, by itself, does not lead to an outcome, but subjectivism will offer an economist findings, under certain assumptions. So, there is a bounded region in which the outcomes are located, and one should always be aware of how restricted one is in generating results from a framework, by understanding the assumptions one has started with. And never give in to the temptation to claim more from your findings than your assumptions permit.

Vita

Shabnam Modarres-Mousavi
355 New Kent Rd., Blacksburg, VA 24060, Tel: (540) 951-3713, E-mail:
smousavi@vt.edu
www.econ.vt.edu/~smousavi/welcome.htm

Education:

Ph.D., Economics, Virginia Polytechnic Institute and State University, Blacksburg, VA., 10/02.

Dissertation Title: "Methodological Foundations for Bounded Rationality as a Primary Framework"

Advisor : Nicolaus Tideman

Ph.D. Student, Statistics, Virginia Polytechnic Institute and State University, Blacksburg, VA. Expected date of completing M.A. 8/03.
M.A., Economics. Virginia Polytechnic Institute and State University, 5/00.
M.S., Economics and Social Systems Engineering, Institute for Research in Planning and Development
(IRPD), Tehran, Iran, 05/98.
Export Development Management Certificate , Industrial Management Organization (IMO), Tehran,
Iran. 1996.
B.Sc., Electrical Engineering, Sharif University of Technology (SUT), Tehran, Iran, 1995.

Publications:

"Toward a Transactional Theory of Decision Making: Creative Rationality as Functional Coordination in Context," with Jim Garrison, forthcoming, *Journal of Economic Methodology*. June 2003.

In Persian:

"Household Welfare and Income Distribution, Poverty Line, and Characteristics of the Poor Families 1989-1996," with Mohammad Tabibian et al., in Poverty and Income Distribution In Iran, IRPD, 2000.
"Role of Rural Women in Development in Korea, Indonesia, and Bangladesh: A Comparative Study," with Reza Kheirandish, Conference on Rural Women and Development, Tehran, Iran, July 1997. Papers and Proceedings.
"Drug Abuse among College Students: A Survey for National Plan to Confront Drug Abuse in Iran," with Amir H. Mehryar and Reza Kheirandish. Research Report, Institute for research in Planning and Development 1997.

Book Chapter under Review: "Substantive and Bounded Rationality Do Not Fit in the Same Paradigm"

Professional Presentations:

"How to Develop Bounded Rationality as a Primary Framework," Presented at the Second
Annual Symposium on the Foundation of the Behavioral Science, Behavioral Research Council
at AIER, MA. July 2002.

"Toward a Transactional Theory of Decision Making: Creative Rationality as Functional Coordination in Context," International Network of Economic Methodology at ASSA, Atlanta, GA. January 2002.

Working Papers:

"A Classroom Exercise: Voting by Ballots and Feet," with Roger Hewett, Charles A. Holt, Georgia Kosmopoulou, Christine Kymn, Cheryl X. Long and Sudipta Sarangi. Summer 2002.

"Uncertainty Improves Second Best," with Hans H. Haller. Department of Economics, Virginia Tech, May 2000.

Work in Progress: "Democracy as an Investment Behavior"

Research Experience:

Research Assistant, Catherine Eckel on Social Learning in Economical Behavior. 1999.
Research Assistant, Nancy Lutz and Catherine Eckel on a Risk Attitude Study at VT. Coded questionnaires for data analysis. Summer,1999.
Member of a research group, project on Development Planning in Iran, studied the two latest five-year development plans for Iran; primary responsibility for writing and directing six (out of thirteen) TV programs on the evaluation of those plans and the future perspectives for several fields, including: *Primary and Higher Education, Health, Income Distribution, Women, Social Participation, Industrial Structure.* The project goal was to provide insight into social situations by educating citizens in an easily comprehended medium. Three TV channels broadcast these programs. 1998.
Research Assistant, Mohammad Tabibian, project on the Profile of Poverty and Income Inequality in Iran. Conducted data analysis for Iran Budget Survey Data; analytical reports and made policy recommendations. 1998.
Research Assistant, Hossein Salehi, Economic Aspects in Service of Addiction, conducted visits to treatment centers to interview addicts; compiled and analyzed data. The purpose of the project was to find evidence in favor of the fact that drug addicts suffer from psychological disorders and should be treated as such instead of being treated as criminals. 1997.
Member of a research group, The Status of Rural Women in developing countries. 1997.

Teaching experience:

Teaching Assistant, Tina Baker, Undergraduate Biostatistics, two sections, 167 students, Fall 2002.
Instructor. **Primary responsibility for one section of Principles of Economics (Macroeconomics), 112 students, Virginia Tech, Spring, 2002.**

Instructor. Primary responsibility for one section of Principles of Economics (Microeconomics), 89 students, Virginia Tech, Spring, 2001.
Teaching Assistant, Catherine Eckel, Principles of Economics (Microeconomics), two sections, 280 students, Spring and Fall, 2000.
Teaching Assistant, Hans Haller, Graduate Microeconomics, Spring 1999.

Honors and Awards:

Outreach Conference, Public Choice Center, George Mason University, Fairfax, VA. June 2002.

Workshop on Dewey's Philosophy, American Institute for Economic Research(AIER), MA, May 2002.

Workshop on Experiments in Class, College of William and Mary, Williamstown, VA, May 2002.

Workshop on Experimental Economics, August 2001.

Summer Fellowship, AIER, MA. Six weeks of interactive research with weekly seminars on methodology of economics, and related topics. Summer, 2001. Followed by an In-absentia award.

Summer Fellowship, AIER, MA. Eight weeks workshop with weekly seminars on methodology of economics, money and banking, business cycle analysis. Summer, 2000. Followed by an In-absentia award.

Young Professional Program Candidate, UNESCO, Paris, France. Fall,1997.

Ranked 81 in special and 8 in general courses, Nation-Wide Entrance Exam for Colleges, Iran. 1987.

Campus Leadership Activities**:**

Public Relation Officer, Iranian Club at Virginia Tech. Fall 2002-
Elected Member at Large, Council for International Student Organization (CISO) Spring,1999.
Acting President, then President, Iranian Club at VPI. Cooperated with other associations at Virginia Tech in organizing various activities. Organized art exhibition and lecture for renowned Persian surrealist painter; Iran Darroudi. Fall, 1998-2000.

Languages: Persian, English, and familiar with French and Arabic.

Computer Skills**: Microsoft Office (Word, Excel, Power Point,…); SAS; Adobe Illustrator; Fortran.**

Academic References:

Buchanan, James M., Professor Emeritus, Economics, Virginia Tech (VPI). jmbuchanan@vt.edu

Eckel, Catherine, Professor of Economics, Virginia Tech (VPI). eckelc@vt.edu

Garrison, James, Professor of Teaching & Learning, Virginia Tech. wesley@vt.edu

Khalil, Elias, Director of Behavioral Council, American Institute for Economic Research, Gt. Barrington (AIER), MA. elk@aier.org

Ye, Keying, Associate Professor of Statistics, Virginia Tech (VPI). keying@vt.edu

Lutz, Nancy, Associate Professor, Economics, Virginia Tech (VPI). nlutz@vt.edu

Nakamoto, Kent, Department Head and Professor of Marketing, Virginia Tech (VPI). nakamoto@vt.edu

Tideman, Nicolaus, Professor of Economics, Virginia Tech (VPI). ntideman@vt.edu