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RATIONAL CHOICE VS. PROGRAM-BASED BEHAVIOR: ALTERNATIVE THEORETICAL APPROACHES AND THEIR RELEVANCE FOR THE STUDY OF INSTITUTIONS

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Prepared for Workshop "The Nature and Evolution of Institutions," Max-Planck-Institute for Research into Economic Systems, Jena, January 11-13, 2001.

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Rational Choice vs. Program-based Behavior: Alternative Theoretical Approaches and their Relevance for the Study of Institutions[•]

by

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1. Introduction

Rational choice theory or the "economic model of man" has long been, and continues to be, a target of criticism from heterodox quarters within economics as well as from other social and behavioral sciences. Notwithstanding such enduring criticism most economists appear to be unshaken in their belief that, for their explanatory purposes, the rational choice model offers the best analytical tool available. Even if they are willing to concede that the model may not account for all varieties of observed human behavior, they remain convinced that its overall analytical power is superior to potential alternative models of man that other behavioral sciences have to offer. To be sure, such conviction may often reflect no more than a desire to defend one's acquired intellectual capital and is, presumably, rarely informed by a thorough review of the current state of knowledge in other sciences of human behavior. Yet, it is

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apparent that only by being offered an appealing alternative perspective, and not by continued reminders of the defects of their traditional model of man, that economists may be moved to consider building their theoretical edifice on a different behavioral foundation than their accustomed model of "homo oeconomicus."[1] It is the purpose of this paper to propose such an alternative theoretical outlook at human behavior, an outlook that, as I suppose, captures much of what makes rational choice theory intuitively appealing, that has, however, more explanatory power and is more in line with theoretical contributions from other behavioral sciences.

The theoretical perspective that I want to suggest here as an alternative to rational choice theory is based, in particular, on arguments developed by biologist Ernst Mayr and by philosopher Karl Popper. Independently, but in perfectly compatible ways, they have argued that intentional, problem-solving behavior can be understood as behavior that is governed by "programs" or "conjectures," and that, in this regard, there is a continuum from the behavior of primitive organisms, governed entirely by genetically coded programs, to the sophisticated, deliberated actions of "rational man" governed by conjectures that are stored in memory. And both equally stress that the "wisdom," i.e. the knowledge of the world, embodied in such programs or conjectures is nothing but the product of evolutionary learning by trial and error-elimination.

To be sure, Mayr and Popper are not alone in taking such an outlook at human behavior. Not only are there many other authors who have developed more or less similar ideas. Their overall approach to the study of purposeful, problem-solving behavior is compatible with, and supported by, a variety of theoretical approaches in modern behavioral science. In fact, not the least advantage of adopting the kind of perspective that Mayr and Popper suggest can be seen in the fact, that it would provide economics with a behavioral foundation that is embedded in the ongoing discourse of modern behavioral research, putting an end to the isolationist attitude with which economists have cherished their self-fabricated model of man.

The paper is organized as follows. Section 2 offers a review of the basic thrust and alternative interpretations of rational choice theory. Sections 3 and 4 summarise the central arguments of the respective approaches of E. Mayr and K.R. Popper. Section 5 looks at the applicability of the notion of program-based behaviour to conscious choice. Section 6 draws a

[1] As Herbert A. Simon, the most well-known critic of the standard use of rational choice theory in economics, has put is: "There is a saying in politics that 'You can't beat something with nothing.' You can't defeat a measure or a candidate simply by pointing to defects and inadequacies. You must offer an alternative.

The same applies to scientific theory. Once a theory is well entrenched, it will survive many assaults of empirical evidence that purports to refute it unless an alternative consistent with the evidence, stands ready to replace it" (Simon 1979a: 490).

brief comparison between the rational choice outlook and the notion of program-based behaviour. Section 7 looks at the relation between the latter notion and Herbert A. Simon's concept of "bounded rationality." The final section 8 discusses implications for the study of institutions.

2. Rational Choice: A Theory of Purposeful Human Action

To be sure, there is no general agreement among self-confessed advocates of rational choice theory as to what the specific content of that theory is. Yet, there appears to be a "basic model of rational behavior" that can be considered the common denominator of the many versions of rational choice models to be found in the literature. According to Herbert A. Simon, models of rational behavior "employ as their central concepts the notions of: (1) a set of alternative courses of action presented to the individual's choice; (2) knowledge and information that permit the individual to predict the consequences of choosing any alternative; and (3) a criterion for determining which set of consequences he prefers. In these theories rationality consists in selecting that course of action which leads to the set of consequences most preferred" (Simon 1965: 84).

Rational choice theory is meant to provide an explanatory account of purposeful human action. Its intuitive appeal surely lies in the fact that it appears to capture what, introspection and everyday experience tell us, are essential features of human behavior: Its intentional, purposeful, goal-seeking or forward-looking nature and its instrumental adaptedness to the problem-environment in which actors operate. Introspection tells us that our own behavior is purposefully aimed at solving problems we encounter and we make sense of other persons' behavior by employing a folk version of rational choice theory,[2] interpreting what others do as a - from their perspective - reasonable response to whatever choice problems they face. Successful interaction with others would not be possible without it.

The very fact that intuitive support for rational choice theory can easily be found in appealing to its folk version may have been one of the major obstacles to its progressive development. It appears to have prevented its advocates from asking questions that could have made them much more interested in the findings of other behavioral sciences than rational choice theorists have traditionally been. To ask how the intentionality of human action can be theoretically accounted for and how its adaptedness can be explained seems silly from a

[2] J. Ferejohn and D. Satz (1996: 79) speak of "folk intentionalism" and argue "that successful intentional scientific accounts must 'track' folk intentionalism." As they note: "Social-science explanations must, we claim, be compatible with intentional descriptions of human agents" (ibid.: 74).

rational choice perspective if the very notion of "*rational* action" is meant to imply that the behavior is intentional and adapted. From such perspective these features are treated as definitional attributes of rationality rather than contingent facts in need of explanation. That human action is intentional and adapted is "explained" by ascribing the capacity of "rationality" to humans, without any apparent need for further reasoning. In other words, it is not explained, but taken for granted.

It is my principal claim that the alternative outlook at purposeful action that I describe below can provide a more satisfactory behavioral foundation to economics exactly because it does not take the intentionality and adaptedness of human conduct for granted but accounts for them in a systematic theoretical manner. Thereby it allows one, in particular, to avoid ambiguities that have notoriously plagued a rational choice theory that oscillates between a subjective and an objective concept of rationality.

The concepts of subjective and objective (or "perfect") rationality can be used to describe two paradigmatically different rational choice perspectives that can be identified in the economics literature. An economic theory that starts from the concept of *objective* rationality puts its emphasis on the *adaptedness* of human behavior, its factual problem-solving capacity. It implies that there is no relevant difference between the 'objective data' and the 'subjective knowledge' that economic agents act upon. Economic actors are assumed to possess the knowledge that they need to make optimal choices, to effectively deal with the problems they face. The task that remains for economic theory to solve is to work out the logical implications that can be derived for a world that is populated by agents who are endowed with the capacity to perfectly pre-adapt to the problem-situations that they encounter.

The subjectivist version of rational choice theory puts its emphasis on the *intentionality* of human behavior. It merely claims that human agents are rational in a *subjective* sense, i.e. relative to what they actually know about the world. To such a theory what agents subjectively know about the world need not correspond to the 'objective data', nor need it be the same across economic actors or between them and the observing analyst. A theory of subjectivist rationality has to allow for the fact that knowledge may differ among different persons, or change over time for the same persons, and that, therefore, differences and changes in knowledge become relevant for any effort in explaining observed behavior. If persons act on the basis of subjective models of the world and on fallible conjectures about what are successful strategies to employ in problem-situations that they encounter, then their

behavior cannot be explained in terms of what is "objectively rational" but only in terms of what is rational in light of the theories that they happen to hold.

The notion that human behavior is "subjectively rational" does per se impose no restrictions on what one may assume about the content of an actor's preferences and beliefs except that they are consistent. By contrast, the notion that human behavior is "objectively rational" implies that an actor's preferences and beliefs must themselves be "rational" in the sense of allowing him successfully to operate in the world as it is. The virtue of a theory of objective (or perfect) rationality is that it is falsifiable. The problem with it is that it is amply falsified by every mistake that real human beings make in their attempts to cope successfully with the problems they face. An economic theory that is based on such a concept of rationality is not descriptive of the "real world," populated by imperfectly rational human beings. To be sure, it may be said to inform us about what would be the case if the world were populated by perfectly rational agents. Yet, whatever useful information it may provide in doing so, as a theory about an imagined world it definitely does not produce empirically testable conjectures about real human action in the world as it is.

The problem with the subjectivist counterpart is a matter of testability. Because as observers we do not have any direct access to persons' subjective beliefs, allowing assumptions about such beliefs to play an explanatory role appears to invite arbitrariness. It is not least for this reason that economists have been reluctant consistently to embrace the concept of subjective rationality and have, instead, explicitly or tacitly tended to adopt the objectivist version, thereby bypassing the problems that arise if we acknowledge the possibility of inter-subjective differences in beliefs. Yet, such strategy amounts to ignoring a fact that is hard to deny, simply because one does not know how to deal with it. Since choices are based on preferences over *anticipated* consequences, and since anticipation is possible only on the basis of theories or mental constructs, all purposeful action is *theory-guided*, and an actor's theories are necessarily his *subjective* theories. A theory that aims at explaining behavioral choices can ill afford to abstract from this fact.[3] As K. J. Arrow (1996: xiii) has noted: “Choice is over sets of actions, but preference orderings are over consequences.” A choice therefore reflects the actor’s beliefs about, or his “knowledge of the relation between actions and consequences” (ibid.).

That choices are about selecting among potential alternative courses of action while preferences are about evaluating the *expected outcomes* of actions should be an elementary and obvious insight, yet it does not seem to be always fully appreciated in economic

discourse. In fact, the common distinction between *preferences* and *constraints*, and the common notion that economic explanations take differences and changes in constraints as their central explanatory variable in accounting for differences and changes in behavior, while treating preferences as 'given,' is ambiguous in this regard. As they are typically understood, they hide the role that in any explanation of purposeful action the actor's "knowledge of the relation between actions and consequences," i.e. his subjective beliefs about the world, must necessarily play, if outcomes, as the objects of evaluation, cannot themselves be directly chosen, but only actions that are expected to bring about certain outcomes. The role that not only preferences but also subjective theories play in human choice must even be acknowledged for such trivial choices as the choice among different flavors in an ice-cream parlor, a choice that is necessarily based on conjectural expectations about the enjoyment to be derived from different ice-cream varieties, i.e. on expectations that are themselves derived from past experiences with similarly looking or labeled flavors, and that may turn out to be mistaken, causing a modification in the actor's "theories" about ice-cream flavors. Yet, the role that a person's subjective views of the world play in her choices becomes clearly more significant as the tasks of predicting the relevant future consequences of potential alternative actions, and of comparing the desirability of the respective expected consequences, become more demanding, as, for instance, in the case of choices among alternative job offers or the choice among alternative constitutional regimes under which she wishes to live.[4] If, however, choices are inevitably based on conjectural knowledge of the world this raises the question of where such knowledge comes from. The theory of perfect rationality has essentially ignored this issue by definitionally ascribing to "rational actors" the knowledge that they need to behave in ways adapted to their problem environment.[5] By assuming that their rationality endows humans with the capacity in every problem-situation to identify reliably all factually available courses of action, to accurately predict all their relevant (short- and long-term) consequences, and to select consistently the most preferred alternative, such a theory relieves itself of the need to deal with the complications that are introduced once we acknowledge the role of subjective beliefs. A theory of subjective rationality cannot afford to do so.

What is at issue here has been pointed out by F.A. Hayek in his seminal 1937 article on "Economics and Knowledge."[6] An economic theory, Hayek argued there, that takes its

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[3] R. Boyd and P.J. Richerson (1993: 133): “Everyone must acquire beliefs about the world before they can optimize."

[4] See Vanberg and Buchanan (1994).

[5] As H.A. Simon (1981: 60) has put it: "The artifice of economic man enables him to make the very best adaptation, in the environment in which he finds himself, to his wants and needs."

[6] Originally published in Economica (Vol. 4, new series, 33-54), reprinted in F. A. Hayek (1948: 33-56).

departure from a notion of *objective* rationality bypasses a fundamental question that cannot be avoided if one starts from a notion of subjective rationality, namely how people acquire knowledge of the world, and how their subjective pieces of knowledge are adapted to each other and socially coordinated.[7] The problem of how people learn about the world becomes paramount as soon as one acknowledges that "the analysis of what people will do can start only from what is known to them" (Hayek 1948: 44). Only by incorporating conjectures "about how experience creates knowledge," Hayek (ibid.: 47) concluded, can economists give their theories empirical content.[8]

As noted before, economists' reluctance to allow subjective variables to play an explanatory role in their models is often justified with the argument that such variables, since they are not directly observable, may become an entry door for arbitrary assumptions. Between allowing non-testable assumptions about subjective beliefs to introduce arbitrariness in our explanations of human action and simply ignoring the subjectivity of human rationality there is, however, a third possibility, namely to employ theories that allow one to arrive at testable conjectures about subjective variables that are not directly accessible in an inter-subjective manner.[9] The alternative outlook at purposeful human action that I shall describe in more detail below (sections 3 and 4) takes an evolutionary outlook at human behavior. By contrast to the rational choice paradigm, it interprets purposeful human action as *rule-based*

[7] H.A. Simon has similarly emphasized the need to include in our analysis of human behavior the perceptual and cognitive processes by which subjective knowledge of the world is formed. As soon as we recognize, Simon (1982a: 342) argues, that a distinction must be made "between the objective environment in which the economic actor 'really' lives and the subjective environment that he perceives and to which he responds ..., we can no longer predict his behavior – even if he behaves rationally – from the characteristics of the objective environment: we also need to know something about his perceptual and cognitive processes." - On Simon's critique of the standard economic model of rational choice see also below, pp. xx, and Vanberg (1993: 178ff.).

[8] It is interesting that K.J. Arrow (1994: 8) recognizes a systematic connection between methodological individualism and the need for a behavioral theory that accounts for human learning: "Methodological individualism has indeed one major implication for information acquisition, ironically one not very compatible with neo-classical paradigms, particularly not with rational choice. Information may be supplied socially, but to be used, it has to be absorbed individually. The limits on the ability to acquire information are a major barrier to its diffusion. This line of argument leads to Herbert Simon's concept of bounded rationality and to the emphasis on learning as a process in time."

[9] The discussion in this paper focuses on the role of subjective theories, leaving aside the issue of subjectivity of preferences. If the assumption of "given preferences" is meant to dispense economists from the need to account for inter-personal differences and intra-personal changes in preferences, this applies only to the kind of "ultimate preferences" that Becker (1976: 145) contrasts to preferences for "ordinary goods" such as ice-cream, caviar or mountain-bikes (see Vanberg 1994: 46ff.). While the latter, they may be called secondary or learned preferences, are clearly malleable, one may well argue that there are certain genetically rooted "ultimate preferences" that humans share as members of their species. In the formation of secondary preferences an actor's past experience, whether direct or indirect, concerning the capacity of "ordinary goods" to contribute to a satisfaction of ultimate preferences will certainly be of foremost importance. This means, however, nothing other than that secondary preference are "theory-impregnated" and that they will differ among actors with different learning backgrounds. The explanatory problems that we have to solve if we want to account for subjective (secondary) preferences are similar to those that we have solve in order to account for the role of subjective theories. The theoretical perspective outlined below can, therefore, be equally applied to the issue of the learning of (secondary) preferences.

behavior, as *program-based* behavior in Ernst Mayr's terms or as conjecture-based problem-solving in Karl R. Popper's terms. Human problem-solving capacity that rational choice theory attributes to "rationality" is explained here in terms of the knowledge of the world that is incorporated in rules or programs that guide behavior, knowledge that has been accumulated, through trial and error, in the process of human evolution and individual learning.

As I shall seek to show, such an evolutionary outlook at human behavior can provide a coherent account of the very features of human action that make the rational choice model so intuitively plausible without inviting the kind of criticisms that have been raised against rational choice accounts. Furthermore, it offers the advantage of providing economics with a behavioral foundation that is embedded in, and can be related to, a number of theoretical approaches to the study of human behavior in various other disciplines, approaches that all appear to converge towards a unified evolutionary outlook at what rational choice theory claims as its genuine domain: intentional or purposeful human behavior.

3. E. Mayr: Purposeful Action as Program-Based Behavior

In order to avoid, on the one side, the notorious ambiguities that arise when teleological concepts are invoked in accounts of goal-directed behavior, but to do justice, on the other side, to the purposefulness of human action, Mayr has proposed to look at such action as a special case of what he calls *teleonomic* or *program-based* behavior. As he explains: "*A teleonomic process or behavior is one that owes its goal-directedness to the operation of a program*" (Mayr 1992: 127). What is essential for teleonomic behavior is not simply that it leads to some end-point or "goal," but that in doing so it is governed by a *program*.[10]

To characterize purposeful human action as "teleonomic behavior" means to place it into a much broader class of phenomena. As Mayr (1988: 60) notes: "Teleonomic (that is, programmed) behavior occurs only in organisms (and man-made machines) and constitutes a clear-cut difference between the levels of complexity in living and in inanimate nature." To look at human purposeful action as an instance of a much more inclusive class of teleonomic behavior does, of course, not require one at all to deny that there are differences between the operation of a programmed machine, such as a computer, animal behavior and consciously pre-meditated human action. It is meant to suggest that the purposefulness or goal-

[10] E. Mayr (1992: 127): "Truly teleonomic activities depend on the possession of a program." – Mayr (ibid.: 126) distinguishes in this regard between *teleonomic* and *teleomatic* processes, noting that, for instance, "radioactive decay is a teleomatic process, it is not controlled by a program."

directedness of human behavior can be understood in terms of the operation of a program, not entirely different from the ways in which we can explain the behavior of animals or the program-governed operations of a computer.[11] And it requires us to specify in terms of the nature and operation of the respective program whatever distinctions between these different sub-classes of teleonomic behavior we may want to draw.

Mayr expressly adopts the concept of a *program* from information theory. A program is "a set of instructions" (Mayr 1992: 128), it can "be defined as coded or prearranged information that controls a process (or behavior) leading toward a goal" (ibid.: 127f.) As Mayr (ibid.: 129) suggests, there "is a strict equivalence of the 'program' of the information theorists, and the genetic and somatic programs of the biologist," notwithstanding significant differences in the nature and the origin of the programs that they respectively study.[12] The programs or sets of instructions of which Mayr speaks incorporate conjectural knowledge about the world, knowledge about potential strategies for responding to encountered problem-situations, and knowledge about the likely consequences that can be expected to result from alternative actions under prevailing circumstances. Such programs or conjectural instructions constitute rules of action that can, in principle, be stated in the form of "If ..., then ..." - rules: If a problem of type P is encountered, an action of type A is an appropriate response. The if-component and the then-component of such rules need, of course, not be as simple as the example suggests, but may reach considerable degrees of complexity.

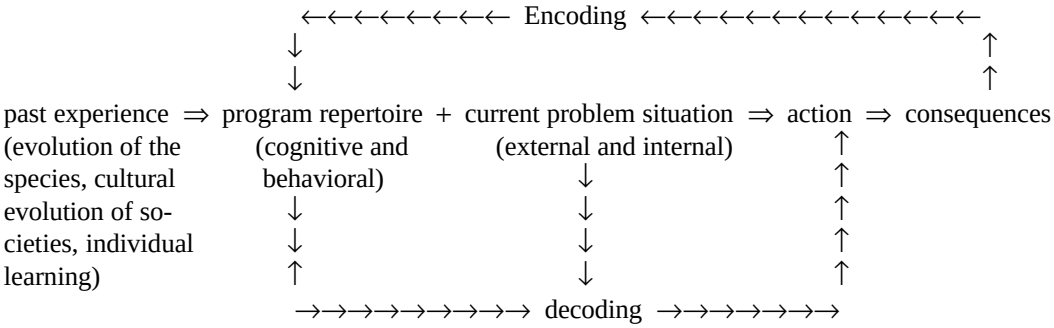
Significant about Mayr's proposal to look at purposeful behavior as program-based behavior is its shift of focus, compared to the rational choice perspective. The adaptedness that we find in purposeful human action is not simply derived from an unexamined capacity "rationality," but is attributed to the adaptedness of the *programs* or rules of action that guide human behavior. This interpretation directs our attention to the issue of how the adaptedness of these programs can be explained, and how the ways in which behavior is guided by such programs can be understood. Or, in Mayr's terms, it draws attention to the questions of how the *encoding* and the *decoding* of programs is to be understood.

Encoding is about the processes through which programs are "recorded" in an organism. It is about the manner in which programs are stored, and about the ways in which

[11] In answer to the question of where it is "legitimate to speak of purpose and purposiveness in nature" Mayr (1988: 30) notes: "An individual who – to use the language of the computer – has been 'programmed' can act purposefully. Historical processes, however, *cannot* act purposefully. A bird that starts its migration, an insect that selects its host plant, an animal that avoids a predator, a male that displays to a female – they all act purposefully because they have been programmed to do so."

[12] Mayr (1988: 31): "The purposive action of an individual, insofar as it is based on the properties of its genetic code, therefore is no more nor less purposive than the actions of a computer that has been programmed to respond appropriately to various inputs. It is, if I may say so, a purely mechanical purposiveness."

they become adapted to the kind of problem environment in which the individual operates. Decoding is about how programs are implemented in, or applied to, particular choice situations. The scheme below serves to illustrate general aspects of the interrelation between the two processes.



- *Encoding* as "selection by consequences": Programs that lead to successful (problem-solving) actions are reinforced, programs that fail to lead to successful action are weakened.
- *Decoding* as application of programs to current choice situations.

The encoding is governed by feed-back processes that establish a link between the effects of programs and their future role in guiding behavior. Since programs can be viewed as stored knowledge of the world, encoding can be seen as a process of learning: Experience is used to "improve" the program-repertoire, i.e. to make it a more suitable guide to successful problem-solving. Decoding is about how a repertoire of programs, i.e. of encoded instructions, is to be "applied" to newly encountered problem-situations. Decoding is a matter of information processing: Information retrieved from the current (internal and external) situation and information stored in the program-repertoire is processed and translated into action.[13]

The encoding that the evolutionary biologist studies is the feed-back process built into the population dynamics of genetic evolution, a process based on natural selection. But not just the process of genetic evolution but all encoding processes can be said to be based on "natural selection" in the sense that all programs, genetically encoded as well as memory-encoded learned programs, are selected by their consequences.[14] Programs that generate

[13] Mayr (1988: 51): "The translation of programs into teleonomic behavior is greatly affected both by sensory inputs and by internal physiological (largely hormonal) states."
[14] Mayr (1988: 45): "Each particular program is the result of natural selection, constantly adjusted by the selective value of the achieved end point, ... (whether) through a slow process of gradual selection, or even through individual learning or conditioning ... ."

"successful," problem-solving behavior are reinforced and retained, those that systematically lead to less conducive outcomes loose strength and are eventually abandoned. The feed-back mechanisms that implement such "natural selection" are, of course, different in genetic evolution and in individual learning, but the general principle, "selection by consequences" (B. F. Skinner 1988), is the same. It is this principle that results in the encoding of programs that enable organisms to behave in an forward-looking, purposeful manner, adapted to the kind of problem-environment in which the encoding occurred.

The decoding aspect of Mayr's concept of program-based behavior corresponds in part to what rational choice theory is about, namely the issue of how purpose-seeking agents go about solving the problems they face. There is, however, a critical difference between the two perspectives. Rational choice theory simply appeals to the capacity, called "rationality," in order to "explain" the observable adaptedness of human behavior. How this capacity actually allows human beings to solve problems, and where it comes from, are questions that remain unexamined. The concept of program-based behavior, by contrast, alerts one to the fact that whatever "adaptedness" or problem-solving capacity human beings exhibit, it must be due to the adaptedness of the programs that guide their behavior, programs that reflect past experience, the "experience" of the species, as encoded in hard-wired genetic programs, and the experience of the individual as stored in soft-wired learned programs.

The distinction between encoding and decoding draws attention to the fact that, in our efforts at explaining the adaptedness or problem-solving nature of observed behavior, we need to distinguish between two kinds of causes that tend to be blended into each other when such adaptedness is simply attributed to the human capacity of "rationality." Mayr refers to these two kinds of causes as *proximate* and *ultimate* causes of behavior. The proximate cause for a particular behavioral response to be adapted or problem-solving is that it is governed by an adapted program, and that the decoding is appropriate to the situation faced. The ultimate cause of its adaptedness lies in the selection process that has shaped the program. Other than by sheer accident, behavior cannot be more adapted to current problem-environments than the programs on which it is based. In terms of Mayr's distinction rational choice theory can be said to be about the proximate causes of adapted human behavior. Yet, lacking a theory of what the ultimate causes of human rationality or adaptedness are, it has no ground on which to build a empirically contentful theory of how the proximate causes operate.

4. K. R. Popper: The Concept of Conjecture-Based Problem-Solving Behavior

In Karl Popper's work one can find two sets of arguments that are relevant to the theme of this paper. In those parts of his work that explicitly address issues of the methodology of the social sciences he argues that the "rationality principle" constitutes the central explanatory tool not only of economics but of other social sciences as well. In other parts of his work, Popper outlines an explanatory approach to human behavior that does not rely at all on the "rationality principle," but suggests an outlook at purposeful action that is, indeed, very similar to E. Mayr's notion of program-based behavior. Popper suggests there to look at the behavior of all organisms – including human purposeful action - as *conjecture-based problem-solving behavior*.

Clearly, with his concept of conjecture-based problem-solving behavior Popper suggests a potential alternative to the "rationality principle," yet, surprisingly, he nowhere addresses the obvious question of whether this outlook at purposeful action may not provide a more attractive behavioral foundation to the social sciences than the rationality principle. This is particularly surprising because, as has been pointed out (Vanberg 1975: 109-120; Koertge 1979), the role Popper assigns to the "rationality principle" appears to be incompatible with his general falsificationist methodology,[15] while his alternative outlook is, in this regard, much more congenial. - In any case, the following discussion concentrates exclusively on Popper's empirical behavioral model, leaving aside his methodological arguments on the rationality principle.

Like Mayr's concept of program-based behavior, Popper's suggestion to "look upon organisms as problem-solving rather than end-pursuing" (Popper 1976: 178) immediately draws attention to the fact that the capacity to solve problems presupposes problem-solving knowledge of some kind. How an agent behaves in a given problem-situation will depend on two things: on his perception or interpretation of what kind of problem he faces, and on his conjectures about what promises to be a successful strategy for solving the problem. His problem-solving capacity will depend on the adequacy of his problem-perception and the adequacy of his conjectures about appropriate behavioral strategies. This concerns, in Mayr's terms, the issues of *decoding* and *encoding*, namely the question of how agents come to arrive at adequate interpretations of the problems they face, and the question of what allows them to form adequate conjectures about how these problems can be solved.

[15] Popper (1994b: 171) insists that the "rationality principle does not play the role of an empirical or psychological proposition."

Problem-solving, Popper (1982: 150) argues, is what all behavior – in fact, all live – is about.[16] As he puts it: "All living things are engaged constantly in problem-solving" (Popper 1994c: 79). Furthermore, they are *active* problem-solving agents, always actively attempting to control their environment (Popper and Eccles 1990: 128). They not simply respond to external conditions, but act from endogenous reasons in an explorative manner (Popper 1976: 48; 1994a: 13). Their attempts at coping with the problems they face – from the most elementary problems of survival to their "countless concrete problems"[17] – are informed by, or guided by, pre-existing expectations or conjectures about the world around them. These expectations or conjectures constitute what he organism "knows" about the world. And they provide the basis for the organism's repertoire of behavioral dispositions, i.e. its repertoire of problem-solving strategies.[18]

It is only in the light of its repertoire of conjectural expectations that an organism can perceive and identify problems, i.e. perception is always a theory-impregnated act of interpretation.[19] This is no less true for our most elementary, subconscious sensory experience, than for our most conscious scientific observations (Popper 1972: 345). We are born with theories built into our sense organs that make us selectively perceive our environment (ibid.: 72), and the theories that our mind develops focus our attention to selected aspects only of what we might perceive.[20] Using a language similar to Mayr's, Popper (1976: 139) states: "Our sense organs have many subtle decoding and interpretative devices built into them – that is adaptations, or theories. ... A consequence of this is that here are no uninterpreted visual sense data ...: whatever is 'given' to us is already interpreted, decoded."

Just as we can only perceive our environment in light of pre-existing conjectural expectations, it is only on the basis of our conjectural knowledge that we can respond to the problems we face. Again in a language similar to Mayr's Popper points to the fact that these

[16] Popper (1976: 178): "I conjecture that the origin of *life* and the origin of *problems* coincide."
[17] Popper (1994a: 13): "All organisms are fully occupied with problem-solving. Their first problem is survival. But there are countless concrete problems that arise in the most diverse situations. And one of the most important problems is the search for better living conditions."
[18] Popper (1972: 239f.): "We solve our problems by tentatively proposing various competing theories and hypotheses ... and by submitting them ... to empirical tests, for the purpose of error-elimination."
[19] Popper (1994b: 86): "There is no such thing as a 'pure' observation, that is to say, an observation without a theoretical component. All observation ... in an interpretation of facts in the light of some theory or other." - Popper (1972: 343): "Every observation is preceded by a problem, a hypothesis ..., by something theoretical or speculative. This is why observations are always selective, and why they presuppose something like a principle of selection."
[20] Popper and Eccles (1990: 130): "At any given moment what is selected, filtered, and admitted to full consciousness, is only a small fraction of all that which we act upon and which acts upon us."

conjectural expectations can be regarded as "action programmes" (Popper and Eccles 1990: 134),[21] as "dispositions to act, or to behave" (ibid.: 130).

If all perception and action occurs on the basis of pre-existing conjectural knowledge or behavioral dispositions, an organism's *acquisition of knowledge* or *learning* can never proceed from an non-expectational, non-theoretical "empty slate." It can only consist in the modification or correction of expectations or dispositions that went before. In Popper's (1972: 71) terms: "All acquired knowledge, all learning, consists of the modification ... of some form of knowledge, or disposition, which was there previously, and in the last instance of inborn expectations."[22] And the principal mechanism that governs this process of learning is the disappointment of expectations, i.e. the failure of tentative conjectures to solve the problems faced by the organism. "Disappointments force us to correct our system of expectations. The process of learning consists largely in such corrections; that is, in the elimination of certain (disappointed) expectations" (Popper 1972: 344). Learning consists in the "tentative variation of theories or action programmes and their critical testing, by using them in our actions" (Popper and Eccles 1990: 134).

As Popper emphasizes, his suggested outlook at the acquisition of knowledge as a "process of actively learning by trial and error, or by problem solving, or by action and selection" (Popper and Eccles 1990: 142), can be viewed as a "Darwinian theory of the growth of knowledge" (Popper 1972: 262), as an approach that looks "at the growth of knowledge as if it were a struggle for survival between the competing theories" (Popper 1994c: 12).[23] It is an approach that, according to Popper (1972: 261) is equally applicable "to animal knowledge, pre-scientific knowledge, and to scientific knowledge," notwithstanding the obvious differences that may otherwise set these quite distinct levels of knowledge apart: "Problem-solving always proceeds by the method of trial and error: new reactions, nor forms, new organs, new modes of behavior, new hypotheses, are tentatively put forward and controlled by error-elimination" (ibid.: 242). Stressing, in a deliberately provocative manner, the fundamental commonality across levels, Popper (ibid.: 261) submits: "From the amoiba to Einstein, the growth of knowledge is always the same: we try to solve our problems, and to

[21] In fact, Popper explicitly – and approvingly – refers to Mayr's concept of program-based behavior (Popper 1987:151).

[22] This is, as Popper notes, not only true for the process of individual learning, but also for the "growth of knowledge" that occurs in the evolution of life: "At every stage of the evolution of life and of the development of an organism, we have to assume the existence of some knowledge in the form of dispositions and expectations. Accordingly, the growth of all knowledge consists in the modification of previous knowledge" (Popper 1972: 71).

[23] Popper (1972: 142): "Epistemology becomes ... the theory of the growth of knowledge. It becomes the theory of problem-solving or, in other words, of the construction ... and critical testing of competing conjectural theories."

obtain, by a process of elimination something approaching adequacy in our tentative solutions." - What is different, of course, is the particular nature of the method of adaptation at each level. At the level of genetic adaptation, the process of variation through crossover and mutation as well as the process of natural selection proceed without any interfering consciousness, except, of course, in the human enterprise of breeding where natural selection is replaced by *purposeful* selection in the service of human needs (Vanberg 1997). At the level of human adaptive learning, even though most of the processes that shape a persons behavioral repertoire must be assumed to occur without any involvement of consciousness, premeditated experimenting and deliberate selection clearly play a significant role. At the level of scientific discovery the process of trial and error-elimination is obviously a most conscious enterprise.

5. Behavioral Programs, Conjectures and Conscious Choice

Like Mayr's notion of program-based behavior, Popper's notion of conjecture-based problem-solving avoids drawing a categorical dividing line between the kind of deliberate, calculated choice-behavior that is the principal subject of rational choice theory and other, less "rational" forms of human behavior. It avoids, thereby, the problems that the rational choice paradigm faces in dealing with forms of behavior that do not involve deliberate calculation, such as non-conscious routine behavior. While the rational choice approach is forced, either to adopt the ad hoc solution of treating such behavior *as if* it where based on rational calculation, or to regard it as falling outside of its explanatory domain, the notion of program- or conjecture-based behavior allows one to include the study of conscious rational choices in a broader theoretical framework. It can treat as an open question whether or not agents are conscious of the programs on which their actions are based, and it also allows for the possibility that an agent's own "rationale" for his behavior may be different from the program that actually governs it. On the other hand, the notion of program-based behavior does not require one at all to disregard any of the specific characteristics that distinguish consciously premeditated actions from, for instance, subconscious routine behavior. By including rational choice behavior in a more encompassing theoretical framework it requires us, however, to specify the presumed distinctiveness of such behavior in analytical terms.

What is important to realize is that even the most deliberate and conscious instances of problem-solving are no less "program-based" than any sub- or unconscious routine behavior, in the sense that they, too, have nothing other to rely on than *conjectures*, hypothetical

knowledge of potential problem-solving strategies and their likely consequences. The lessons of past processes of trial and error-elimination that are the basis of any knowledge concerning potential solutions to encountered problems cannot be stored in any other form than in the form of conjectural expectations, behavioral dispositions or programs of action that incorporate information about what kinds of strategies promise to be successful in certain types of problem-situations. The very process of pre-choice deliberation consists in nothing other than in thought-experiments or mental trials, and in selection based on expected consequences. For obvious reasons, a systematic prediction of the likely consequences of contemplated alternatives is, however, possible only on the basis of conjectures that incorporate knowledge accumulated by past adaptations.

If, however, choices must be based on recipes, rules or programs for action that are informed by past experience, 'rational' action can mean no more than to base one's actions or choices on rules that are found to have worked in the past in similar problem-situations. Such rules may be invoked sub-consciously, habitually or deliberately. The deliberate, calculating nature of choice does not make it any less 'rule-based' than habitual routine action. Saying this is not to deny in any way the special role that conscious deliberation and premeditation play in human problem-solving. It only points to the structural similarities between non-conscious routine behavior and rationally deliberated choice.

To the question of what "are the biological achievements that are helped by consciousness" (Popper and Eccles 1990: 125), Popper answers: "I suggest as a first reply: the solution of problems of a non-routine kind" (ibid.). The role of consciousness is clearest, he notes, "where an aim or purpose ... can be achieved by alternative means, and when two or more means are tried out, after deliberation. It is the case of making a new decision ... the choice of a non-routine programme" (ibid.: 126).[24] Stated differently, "consciousness assists the organism in its voyages of discovery, and in its learning processes" (Popper 1994a: 18), in particular through "linguistic formulations of expectations, that is, of *theories*," (ibid.) performed by the cognitive apparatus.[25]

By contrast to the traditional rational choice perspective, the emphasis on the role of conjectures and programs in deliberate choice behavior draws our attention to the fact that "human rationality" is not an unconditional capacity that permits persons to pre-determine the

[24] Popper (1994a: 17): "My hypothesis is that the original task of consciousness was to anticipate success and failure in problem-solving and to signal to the organism in the form of pleasure and pain whether it was on the right or wrong path to the solution of the problem."

[25] H. Plotkin (1994: 154): "The ability to manipulate stored knowledge – that is, reasoning and thought – is a form of intelligence most probably restricted to a small number of species. *Homo sapiens* is especially adept at this form of intelligence. We are also particularly good at sharing learned knowledge, which introduces a special dynamics into human intelligence."

most appropriate solution to any problem they encounter, but that, instead, it is a problem-solving capacity that is always based on a person's repertoire of conjectures, dispositions or programs, a repertoire that cannot reflect more wisdom than was accumulated by past adaptive learning.[26] Human rationality, in other words, cannot guarantee pre-adaptedness, it is, instead, a matter of the backward-looking adaptedness of behavioral programs that allow for a tentative, forward-looking response to current problem-situations. The wisdom of past experience is applied to current problems, and it cannot provide better guidance than the continuity of present to past problem-environments permits. This does not mean at all that humans are not imaginative and inventive in their problem-solving efforts. Instead, it means that in their intendedly rational innovative exploration human beings cannot benefit from pre-adapted insight. "Rationality" can do no more than to rely on the lessons of past adaptations, it can mean no more than experimenting at the margins of previously successful programs or conjectures. To the extent that experimentation goes beyond what can be learned from past experience, it cannot be but "blind" in the same sense that mutations in genetic evolution are blind experiments, explorations in unknown territory where success cannot be guaranteed in advance.

As Popper emphasizes, even if trials at the behavioral level – by contrast to the level of genetic adaptation – "are no longer completely 'blind'" (Popper 1994b: 5), because they are informed by the "background knowledge" embodied in the organisms repertoire of programs or conjectures, "a certain degree of 'blindness' is inherent in all trials" (ibid.:).[27] We must not overlook, he argues, "that even a discovery accompanied by 'insight' may be mistaken: every trial, even one with 'insight', is of the nature of a conjecture or a hypothesis. ... And even great mathematicians are sometimes misled by intuition. Thus animals and men have to try out their hypotheses. They have to use the method of trial and error elimination" (ibid.).[28]

[26] Albert (1979: 22) contrasts the orthodox rational choice model to "a more *activist* conception of man as a hypothetico-imaginative organism," a conception that emphasizes "the fact that man is a 'theoretical animal,' an animal fabricating, adopting, and using 'theories' that are effective in action" (ibid.: 23).

[27] It should be noted that in genetic adaptation only *mutations* are a completely 'blind' source of variation and innovation. The other, more important, method for generating novel programs, namely cross-over, is in similar ways influenced by the "background knowledge" of past adaptations as are 'inventions' of new programs at the behavioral level through combinations of components drawn from the existing program repertoire. This aspect is emphasized by J.H. Holland (1995) in his theory of adaptive systems.

6. Rational Choice vs. Program-Based Behavior: A Comparison

The amazing adaptedness that we observe in living nature has surely been the reason for man to conjecture that the world we live in must be the product of a creator's mind whose foresight endowed the organisms he created with the capacity to deal successfully with the kinds of problems they face in their respective environments. Such conjecture explains adaptedness by deriving it from a source to which the capacity for *pre*-adaptedness is definitionally ascribed. To "explain" adaptedness in such fashion precludes any further search for a naturalistic account of the phenomenon. The important contribution that Charles Darwin has made to our understanding of the world around us is to have shown that in order to explain adaptedness in nature we need not suppose pre-adaptedness.[29] He was able to show how adaptedness can be explained in terms of the nature of the process by which it is produced, a process of trial and error that builds on past success but operates without foresight.

As noted before, the apparent adaptedness of human behavior is surely a principal reason for the intuitive appeal of rational choice theory. Rational choice model explains adaptedness in human behavior by deriving it from a source, called rationality, to which the capacity for *pre*-adaptedness is definitionally ascribed. Different versions of rational choice theory may differ in regard to the ways in which they specify what it means to be rational, but to all of them adaptedness in human behavior is implied in whatever rational capacity they ascribe to human beings. To explain adaptedness in such manner as the product of *rationality* means to simply ascribe to humans the capacity of predetermining their best response to problems that they face,[30] and it precludes any further search for a genuine explanation of man's problem-solving capacity.

In a sense it can be said that, in its explanatory logic, rational choice theory is *pre-Darwinian,* and that the argument presented in this paper is a plea to adopt a "*Darwinian perspective*" in our account of adaptedness in human behavior. This does not mean at all that we ought to focus primarily on man's genetic endowment as a product of the evolutionary history of the human species. It means that, in a general sense, we ought to pay attention to the processes of evolution and learning through which adaptedness in human behavior is brought about. A Darwinian approach aims at explaining adaptedness in human behavior by examining how human actors acquire the knowledge on which they act in their attempts to

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[28] Trials at solving a newly encountered problem cannot, Popper (1976: 46) notes, "anticipate its (unknown) solution otherwise than by a fortunate accident. ... It is not from the trial but only from the ... method of error elimination, that we find, *after* the trial ... whether or not it was a lucky guess."

[29] Mayr (1992: 134): "There is adaptedness (Kant's Zweckmässigkeit) in living nature but Darwin showed that is origin can be explained materialistically."

[30] As M. Macy (1977: 435) puts it, rational choice theories "posit the analytical ability of purposive actors to accurately predict the outcomes of alternative choices based on knowledge of causal processes."

deal with the problem-situations that they encounter. Adaptedness in current behavior is explained in a backward-looking manner, as a product of past experience. That is, adaptedness is always seen as adaptedness to past environments, not as something that guarantees success in current choice situations. An important implication of this is that the types of behaviour that standard rational choice theory can only look at as "anomalies" may be systematically accounted for as behaviour guided by programs that may have well worked in their proper context, but that are misapplied in the current problem-situation.

In this context a brief comment may be in order on the "evolutionary" defence of the traditional paradigm of rational, maximising behaviour that was advanced by Armen A. Alchian's in his famous 1950 article on "Uncertainty, Evolution, and Economic Theory" and followed up by Milton Friedman (1953, chpt. 1). Without going into a detailed discussion of their argument,[31] it suffices to point out here that their "evolutionary account" is critically different from the explanatory use of an evolutionary perspective as it appears in the theoretical approaches proposed by Mayr and Popper. In Alchian' and Friedman's account the evolutionary argument is used essentially for the purpose only to legitimise the use of the rational maximisation assumption in explaining market behaviour, namely on the ground that competition will tend to select against non-optimal behavioural strategies, such that optimal behaviour will necessarily become the dominant type, i.e. the behaviour that perfectly rational actors will exhibit. After it has served its justificatory purpose, the evolutionary perspective has no further role to play in Alchian's and Friedman's scheme.

By contrast, in any approach that, like Mayr's or Popper's, takes the evolutionary perspective seriously the point of the exercise is not simply to presume that evolution selects in favour of "optimal solutions,"[32] it is, instead, to show how the characteristics of the "evolutionary outcome" that we want to explain can be accounted for in terms of the specific nature of the evolutionary processes that generated the outcome. In this sense, to provide an evolutionary account of human problem-solving capacity would mean to show how the adaptedness of the hard- and soft-wired programs that guide actual human behaviour can be explained in terms of what we know about the "selection by consequences" that actually occurred in the relevant processes of genetic evolution, cultural evolution and individual learning. Such an evolutionary account can ascribe to humans no problem-solving capacity other than what can reasonably be assumed to have been generated under the kind of conditions that, as far as we know, have actually characterised the relevant evolutionary

[31] For a detailed review see J.J. Vromen (1995: 21ff.).
[32] In relation to Alchian's and Friedman's account H.A. Simon (1981: 53ff.) discusses the issue of "whether the evolutionary argument implies optimization" (ibid.: 53).

processes (Cosmides and Tooby 1994). It is hard to see how such an evolutionary account could be provided for the kind of capacity that the model of perfect rationality ascribes to human beings.

7. Program-Based Behavior and "Bounded Rationality"

In economics, the controversy over the explanatory role of the rational choice model is, of course, most prominently associated with the name of Herbert A. Simon. Since the 1950s Simon has persistently argued in numerous contributions that, if it is to gain explanatory power as an empirical science, economics must replace its model of “Olympian rationality” by a theory of “imperfect” or “bounded” rationality,[33] that provides a more adequate account of how real people go about solving the choice-problems they face. Since Simon's critique has become the standard reference in discussions on the merits of rational choice theory it is instructive to compare, at least briefly, the concept of program-based behavior described here with Simon's concept of bounded rationality.

The first thing to note is that the term "bounded rationality" may not have been the most fortunate choice to label Simon's "alternative notion of rationality" (Simon 1965: 89). It seems to have drawn too much attention to the sterile issue of "how much rationality," away from the relevant issue of the nature of "rationality." Putting the matter in terms of the contrast between “bounded” and “perfect” rationality easily invites the misguided perception that it is well understood what kind of capacity we mean by "rationality," and that the controversy is only about the issue of “how much” of that capacity we may ascribe to human beings. To a considerable extent the debate on Simon's argument has, indeed, proceeded as if the "how much"-issue were at stake, neglecting the substantive things that Simon had to say on the more relevant issue of how the nature of the capacity "rationality" can be analytically specified and how its operation can be explained.

To be sure, the concept of "bounded rationality" is meant to stress the "limitations upon the capacity of human beings to behave in a 'perfectly' rational fashion" (Simon 1965: 90), i.e. to point to the fact that the knowledge and computing power of human agents is limited and falls far short of what a model of perfect rationality supposes. Yet the point of Simon's contribution is not simply to argue that humans possess the capacity "rationality" in lesser quantities than standard rational choice theory assumes, leaving unexamined the issue

[33] In his critique H. A. Simon has targeted “the discrepancy between the perfect human rationality that is assumed in classical and neoclassical economic theory and the reality of human life” (Simon 1992: 3), arguing

of what we actually mean by the capacity so called. Instead, his essential argument is that as soon as the assumption of "perfect" or "objective" rationality is given up and the subjectivity of human rationality is acknowledged, we can no longer pretend to be able to explain human purposeful behavior without an empirically contentful theory of how humans acquire knowledge about the world and how they employ such knowledge in their efforts at solving the problems they face. In other words, Simon's contribution is about "accounting for human rationality" (Simon 1996: 370) and about "explaining human rationality" (ibid.: 116).[34] What is of particular interest in the present context is that the "theory of bounded rationality" that Simon has "proposed as an alternative to classical omniscient rationality" (Simon 1979a: 503) is very much compatible with the concept of program- or conjecture-based problem-solving behavior described above.

"The human mind," Simon (1998: 15) notes, "is an adaptive system. It chooses behaviors in the light of its goals, and as appropriate to the particular context in which it is working." This capacity of the mind has, so Simon argues, inspired "rational adaptation models" (ibid.) that suppose there is a simple method for explaining human action: "Analyze the environment in which the behavior is to take place and the goals of the actor, and from these deduce ... what the optimal behavior (and hence the actual behavior) must be" (ibid.: 15f.). As Simon adds, "nowhere has this method of explaining human behavior been carried further than in modern neoclassical economics. The neoclassical theories also show the severe limits of the approach" (ibid.: 16). In Simon's view these limits are due to the fact that it is a gross oversimplification of real human choice problems to suppose, as rational choice accounts to, that "the actor's goals and the alternative behaviors available for choice are known in advance" (ibid.) so that the only problem is to identify from a given set of alternatives the one that serves a given goal best.[35] In reality matters are significantly more complex because of a multitude of partly conflicting and even incommensurable goals, and

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that neither people's "knowledge nor their power of calculation allow them to achieve the high level of optimal adaptation of means to end that is posited in economics" (ibid.).

[34] On the problem of "understanding the nature of the mind" that he wants to address Simon (1996: 366) notes: "Economics dodged the problem for two centuries with its *a priori* assumption of human rationality." - It was, Simon (1979b: 67) notes, "the assumption of substantive rationality ... [that] freed economics from any dependence on psychology." According to Simon (1982b: 341), "economics got along almost without psychological hypotheses about man's intellectual qualities by assuming him to be 'objectively' rational - that is rational in dealing with a given external environment as viewed by an omniscient being gifted with unlimited powers of computation."

[35] Simon (1987: 26f.): "If we accept values as given and consistent, if we postulate an objective description of the world as it really is, and if we assume that the decision maker's computational powers are unlimited, then two important consequences follow. First, we do not need to distinguish between the real world and the decision maker's perception of it: he or she perceives the world as it really is. Second, we can predict the choices that will be made by a rational decision maker entirely from our knowledge of the real world and without a knowledge of the decision maker's perception or modes of calculation. (We do, of course, have to know his or her utility function.)"

because the alternatives from which the actor might choose are usually not known in advance (ibid.). Instead, "human beings spend much of their time inventing or discovering actions that fit the circumstances" (ibid.).

Most importantly, Simon argues, "in complex adaptive behavior, the link between goals and environment is mediated by strategies and knowledge discovered and learned by the actor" (ibid.: 17). What counts as "available alternative" on what consequences are predicted to result from alternative actions depends on the capabilities and knowledge of the actor, capabilities and knowledge that may differ among persons and change over time as persons learn.[36] Accordingly, "we should not presume to predict how a human being will solve a problem ... without knowing what that human being already has stored in memory by way of relevant information and skills" (ibid.: 18).[37] How human beings behave in a given situation depends on "the actor's subjective representation of the decision problem" (Simon 1987: 27). That is, we cannot explain behavior without accounting for the actor's "internal constitution" (Simon 1990: 2),[38]

In regard to the "internal constitution," Simon assumes, like Mayr, that knowledge about the world is stored in the form of "programs." As he puts it: "The human mind is programmable: it can acquire an enormous variety of different skills, behavioral patterns, problem-solving repertoires, and perceptual habits. Which of these it will acquire in any particular case is a function of what it has been taught and what it has experienced" (Simon 1979b: 81). Problem-solving in a highly complex world can, as Simon reasons, proceed in no other way than on the basis of simplified models that incorporate experience-derived knowledge of relevant contingencies.[39] The fact that he draws a distinction between "programmed" decisions[40] and "non-programmed" decisions (Simon 1982a: 380) is, therefore, not incompatible with the notion that all decisions are based on "internal models"

[36] In his work Simon has pointed again and again to "the discrepancy between the perfect human rationality that is assumed in classical and neoclassical economic theory and the reality of human life" (Simon 1992: 3), arguing that neither people's "knowledge nor their power of calculation allow them to achieve the high level of optimal adaptation of means to ends that is posited in economics" (ibid.).

[37] Simon (1998: 25): "Behavior cannot be predicted from optimality criteria without information about the strategies and knowledge agents possess or acquire."

[38] Simon (1978: 8): "In complex situations there is likely to be a considerable gap between the real environment of a decision (the world as God or some other omniscient observer sees it) and the environment as the actor perceives it." - See also Simon (1982b: 342).

[39] Simon (1984: 47f.): "In any realistic description of the environment of a human decision maker, the variables and information to which he might attend … are innumerable. The hypothesis of bounded rationality claims that human beings handle this difficulty by attending to only a small part of the complexity about them. They make a highly simplified model of the world, and they make their decisions in terms of that model and the subset of variables that enter into it."

[40] Simon (1982: 389): "We should view programmed decision-making as a process for making choices within the framework set by highly simplified models of real-world problems."

and, in this sense, program-based.[41] It is meant to suggest that decisions can be arranged along a continuum, from habitual routine behavior to tentative exploration into new territory (ibid.: 382).[42] At the "non-programmed" end Simon locates "processes of innovation" (ibid.: 393) that are initiated when current programs fail to lead to successful problem-solving and that he describes as "the construction of new programs" (ibid.: 396).[43]

An explanatory account of human behavior that acknowledges the role of the "internal constitution" must pay attention to the process of experience-guided learning in which a person's repertoire of problem-solving routines or behavioral programs is shaped, and to "the processes that generate the actor's subjective representations of the decision problem" (Simon 1987: 27). In other words, it must pay attention to what Mayr calls "encoding" and "decoding." While Simon's focus is more on the latter aspects, his understanding of the process of encoding is clearly compatible with Mayr's and Popper's evolutionary outlook. In fact, Simon (1996: 166) describes his theory of bounded rationality as "a sort of Darwinian model of rationality," and he explicitly speaks of the explanation of human problem-solving as a sub-case of the explanation of adaptive systems, noting: "Adaptation may be quite conscious and unintended, as in Darwinian evolution, or it may contain large components of conscious intention, as in much human learning and problem-solving" (Simon 1990: 2).[44]

The issue of decoding is addressed when Simon (1979b: 73) says about the procedures men use to deal with decision problems: "In all these situations, they use selective heuristics and means-end analysis to explore a small number of promising alternatives. They draw heavily upon past experience to detect important features of the situation before them, features which are associated in memory with possibly relevant actions." Decoding is, in Simon's account, a matter of "recognition of relevant cues in problem situations" (Simon 1992: 109), cues that allow the actor to retrieve knowledge about potential problem-solving strategies from memory.[45] What we call "insight" or "intuition" are, according to Simon

[41] Simon (1982a: 380): "Are there any decisions, then, that are *not* programmed? If we want to be literal, … any sequence of events in which each event is determined in some way by the whole collection of its antecedents is 'programmed.' In these terms, even searching through a haystack for a needle is programmed choice – and perhaps it is. Nevertheless it is useful to classify or arrange decisions according to the following criteria, and to call decisions at one end of the range 'nonprogrammed,' those at the other end of the range 'programmed.' The criteria are these: (a) To what extent are *search processes* … involved … . (b) To what extent is the process characterized by sudden *switches from one frame of reference … to another*."

[42] Simon (1982a: 393): "Nonprogrammed decisions were defined earlier as those in which relatively unsystematic search processes and relatively unsystematic shift in frames of references are prominent."

[43] Simon (1982a: 399): "[T]he failures of existing programs indicate the need for innovation. The innovation process then requires the discovery and elaboration of new programs."

[44] See also Simon (1979a: 510f.).

[45] Simon (1982a: 116): "The ability to recognize particular symptoms, or stimuli, depends on their familiarity from previous experience and learning."

(ibid.) "simply acts of recognition, based on stored knowledge of the domain."[46] Where actors encounter problems "whose solutions are not provided by immediate recognition" (Simon 1990: 9), their search for potential problem-solving strategies "is then guided by various rules of thumb, or heuristics, some of which are specific to particular tasks, but some of which are more general" (ibid.). Such explorative problem-solving behaviour can be "rational," in the sense of being "pre-adapted," only to the extent that the programs ("rules of thumb, or heuristics") by which it is guided are themselves adapted to the current problem-environment. Whatever goes beyond the knowledge embodied in backward-looking adaptedness can be no more than "undirected, trial-and-error search" (Simon 1992: 108).

8. Implications for the Study of Institutions

In the most general sense institutions can be defined as sets of rules that allow a plurality of persons to coordinate their behavior and to routinely solve typical problems that arise in social interaction and cooperation. Private property, representative democracy, or the rules of the road can all be considered institutions in this sense, and they all have in common that they consist of rules or social norms that are meant to guide the behavior of participating agents. In other words, rule-guided or norm-following behavior is the very essence of social institutions. Institutions can be said to exist only to the extent that the persons involved actually comply with the relevant rules. In terms of the theoretical perspective described above, explaining institutions, therefore, requires to explain how the persons involved come to adopt the respective mutually compatible and mutually reinforcing behavioural programs.[47]

The study of institutions has been traditionally a blind spot of rational choice theory, and there is a systematic reason for this. Rational choice accounts face an inherent difficulty when it comes to explaining *rule-following* or *norm-guided* behavior in the sense of a person's general compliance with the rule or norm in question. The logic of the rational choice approach induces us to focus our explanatory efforts on *single* actions. It is *particular choices* that we seek to explain as "rational" response to the contingencies of the specific choice

[46] It is the ability, founded in familiarity with the relevant problem-environment, to recognise key cues and "to retrieve directly from memory information for dealing with the situation that the cues identify" (Simon 1990: 9) that distinguishes "expert from novice behaviour" (Simon 1992: 109). Taking the expert chess-player as an example Simon (ibid.: 82) notes "that his perceptual experience enables him to detect familiar patterns in the situations that confront him, and by recognizing these patterns, to retrieve speedily a considerable amount of relevant information from long-term memory."

[47] Simon (1982a: 384) points to the systematic connection between "programmed behaviour" and institutions when he speaks of "the role of institutions in creating for the individual a 'simple' world within which his programmed decisions-making can take place," and when he notes: "The sociological terms 'institution' and

situation, given the actor's preferences and beliefs. A person's behavior over time is, from this perspective, viewed as a sequence of separable choices, each of which can be accounted for in terms of the relevant situational circumstances. If, from such perspective, one is to account for rule-following behavior in the above sense, one would need to show that in each particular instance in which a person confronts a relevant choice situation, the respective situational circumstances make compliance the rational, utility-maximizing response. Since it is easy to imagine that persons will, at least occasionally, confront situations in which rule-violation would generate a higher payoff than compliance (e.g. because the risk that the violation will be detected by third parties is negligible), a rational choice approach that explains human choices in a case-by-case manner would seem to suggest that genuine norm-guided behavior is a rather unlikely phenomenon.[48] Truly general rule-compliance would require that, in each and every case in which a person encounters a relevant choice problem, the situational balance of advantage is in favor of compliance. This would seem to make genuine rule-guided behavior an extremely rare phenomenon, much less common, indeed, than sociologists and common sense suggest.

Not all economists have been willing to conclude that their rational choice approach requires them to deny the factual relevance of rule-following behavior. Some of those who wish to reconcile the logic of a rational choice perspective with the recognition that genuine rule-following is a relevant social phenomenon have adopted a version of the traditional sociological account. Sociologists have traditionally based their explanatory account on the concept of the "internalization of norms," and some economists have adopted this concept, arguing that a person's *general* rule compliance, even in cases in which the situational incentives seem to suggest otherwise, can be explained in rational choice terms if we assume that the person has developed a preference for following the norm, due to "internalization." The problem with such strategy is that it is obviously ad hoc. Without an explicit theoretical argument for how the emergence of such a "preference for norm-compliance" can be explained, in a manner that is consistent with a rational choice approach, the reference to "internalization" offers little more than an empty formula.[49]

The concept of program- or conjecture-based behavior, while - as noted - capturing much of what makes the rational choice paradigm appealing to economists, allows one to account in a systematic manner for norm-following behavior, without any need to take recourse to ad hoc assumptions. Like the rational choice approach, Mayr's approach to

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'role' refer to these mosaics of programmed behavior that constitute social systems" (ibid.: 390). – On the issue of the mutually reinforcing character of established routines in institutional settings see ibid.: 391.

[48] For a more detailed discussion see Vanberg 1994: 15ff., 30ff.

program-based behavior as well as Popper's concept of conjecture-based problem-solving insist that *payoffs* are essential in explaining behavior. The essential difference lies in the fact that Mayr's and Popper's approaches focus on the level of behavioral programs, rather than the level of particular actions, as the level where the relevant, payoff-oriented "calculus of advantage" takes place. What is assumed is that humans (like all organisms) tend to adopt programs that generate "beneficial" payoff-patterns over time, and to replace programs that turn out to generate undesirable outcome-patterns. From such a perspective, the fact that compliance with certain rules or social norms may generate, in particular instances, lesser payoffs than could be realized by deviant behavior, does not imply at all that a "compliance program" may not be the best option compared to potential alternative *programs*. While it is extremely unlikely that in any social group conditions prevail that make it "rational" for a case-by-case maximiser always to comply with certain norms, it is much less unlikely that conditions prevail that make general norm-following a beneficial program, compared to feasible alternatives. The relevant comparison here is not with regard to the payoffs that alternative programs would generate *in specific instances*, but between the *overall payoff-patterns* that alternative programs tend to generate in the kind of social environment in which actors operate.

Mayr's and Popper's perpective even allows one to make sense of the much abused notion of "internalization." In their theoretical framework, internalization can be related to the process of encoding, i.e. to the feedback process in which a person's repertoire of behavioral programs is shaped. In this perspective, internalization has nothing to do with a person learning to disregard its own payoff-interest in favor of a separate preference for norm-compliance. Instead, internalization concerns the process of - largely implicit - "accounting" in which a person's program-repertoire responds to the payoff-contingencies in its environment, payoff-contingencies, to be sure, that are measured in terms of the overall outcome-patterns that behavioral programs generate over relevant periods of time. How such largely implicit "accounting" of payoffs at the level of behavioral programs is actually accomplished, and how it can be modeled in a theoretically concise manner, is, of course, a question with no easy answer. But that it induces us to ask such questions, and to direct our research interests in this direction, is exactly what makes the concept of program-based behavior a fruitful heuristic.[50]

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[49] For a more detailed discussion see Vanberg 1994: 56ff.

[50] To these questions J.H. Holland's (1995) theory of adaptive systems seeks to give an answer.

References

Albert, Hans, 1979: "The economic tradition - economics as a research programme for theoretical social science," in K. Brunner (ed.), *Economics and Social Institutions - Insights from the Conferences on Analysis and Ideology*, Boston, The Hague, London: Martinus Nijhoff Publishing, 1-27.

Alchian, Armen A. 1950: Uncertainty, Evolution, and Economic Theory, *Journal of Political Economy*, 58, 211-21.

Arrow, Kenneth J. 1994: "Methodological Individualism and Social Knowledge," *American Economic Review, Papers and Proceedings*, 84, 1-9.

Arrow, Kenneth J. 1996: "Preface," in K.J. Arrow, E. Colombatto, M. Perlman and C. Schmidt (eds.), *The Rational Foundations of Economic Behavior*, Proceedings of the IEA Conference held in Turin, Italy, New York: St. Martin's Press, xiii-xvii.

Becker, Gary S. 1976: *The Economic Approach to Human Behavior*, Chicago: University of Chicago Press.

Boyd, Robert and Peter J. Richerson 1993: "Rationality, Imitation, and Tradition," in: R.H. Day and P. Chen (eds.), *Nonlinear Dynamics and Evolutionary Economics*, New York and Oxford: Oxford University Press, 131-149.

Cosmides, Leda and John Tooby 1994: "Better than Rational: Evolutionary Psychology and the Invisible Hand," *American Economic Review, Papers and Proceedings*, 84, 327-332.

Ferejohn, John and Debra Satz 1996: "Unification, Universalism, and Rational Choice Theory," in J. Friedman (ed.), *The Rational Choice Controversy - Economic Models of Politics Reconsidered*, New Haven and London: Yale University Press, 71-84

Friedman, Milton 1953: *Essays in Positive Economics*, Chicago: University of Chicago Press.

Hayek, F.A. 1948: *Individualism and Economic Order*, Chicago: The University of Chicago Press, 33-56.

Holland, John H. 1995: *Hidden Order – How Adaptation Builds Complexity*, Reading, Mass.: Addison-Wesley.

Koertge, Noretta 1979: "The Methodological Statue of Popper's Rationality Principle," *Theory and Decision*, 10, 83-95.

Macy, Michael W. 1997: "Identity, Interest and Emergent Rationality," *Rationality and Society*, 9, 427-448.

Mayr, Ernst 1988: *Toward a New Philosophy of Biology – Observations of an Evolutionist*, Cambridge, Mass., and London: Harvard University Press.

Mayr, Ernst 1992: "The Idea of Teleology," *Journal of the History of Ideas*, 53, 117-135.

Plotkin, Henry 1994: *Darwin Machines and the Nature of Knowledge*, Cambridge, Mass.: Harvard University Press.

Popper, Karl R. 1972: *Objective Knowledge - An Evolutionary Approach*, Oxford: At the Clarendon Press.

Popper, Karl R. 1976: *Unended Quest – An Intellectual Biography*, La Salle, Ill.: Open Court.

Popper, Karl R. 1982: *The Open Universe – An Argument for Indeterminism*, London: Routledge.

Popper, Karl R. 1987: "Natural Selection and the Emergence of Mind," in G. Radnitzky and W.W. Bartley, eds., 139-155.

Popper, Karl R. 1994a: *In Search of a Better World – Lectures and Essays from Thirty Years*, London and New York: Routledge.

Popper, Karl R. 1994b: *The Myth of the Framework – In Defence of Science and Rationality*, London and New York: Routledge.

Popper, Karl R. 1994c: *Knowledge and the Body-Mind Problem – In Defence of Interaction*, London and New York: Routledge.

Popper, Karl R. and John C. Eccles 1990: *The Self and Its Brain – An Argument for Interactionism*, London and New York: Routledge.

Simon, Herbert A. 1965: Mathematical Constructions in Social Science, in: D. Braybrooke, ed., *Philosophical Problems of the Social Sciences*, New York: MacMillan, 83-98.

Simon, Herbert A. 1978: Rationality as Process and as Product of Thought, *American Economic Review, Papers and Proceedings*, 68, 1-16.

Simon, Herbert A. 1979a: Rational Decision Making in Business Organizations, *American Economic Review*, 69: 493-513.

Simon, Herbert A. 1979b: From Substantive to Procedural Rationality, in: F. Hahn and M. Hollis, eds., *Philosophy and Economic Theory*, Oxford: Oxford University Press, 65-86.

Simon, Herbert A. 1981: *The Sciences of the Artificial*, 2nd ed., Cambridge, Mass., London: The MIT Press.

Simon, Herbert A. 1982a: Economics and Psychology, in: Idem, *Models of Bounded Rationality*, Vol. 2, *Behavioral Economics and Business Organization*, Cambridge, Mass., and London: The MIT Press, 318-355.

Simon, Herbert A. 1982b: The Role of Expectations in an Adaptive or Behavioral Model, in: Idem, *Models of Bounded Rationality*, op. cit., 380-399.

Simon, Herbert A. 1984: On the Behavioral and Rational Foundations of Economic Dynamics, *Journal of Economic Behavior and Organization*, 5, 35-55.

Simon, Herbert A., 1987: "Rationality in Psychology and Economics," in: R. M. Hogarth and M. W. Reder (eds.), *Rational Choice - The Contrast between Economics and Psychology*, Chicago and London: The University of Chicago Press, 25-40.

Simon, Herbert A. 1990: Invariants of Human Behavior, *Annual Review of Psychology*, 41: 1-19.

Simon, Herbert A. 1992: *Bounded Rationality and the Cognitive Revolution*, Aldershot: Edward Elgar.

Simon, Herbert A. 1996: *Models of My Life*, Cambridge, Mass., and London: The MIT Press.

Simon, Herbert A., 1998: "What is an 'Explanation' of Behavior?" in P. Thagard (ed.), *Mind Readings – Introductory Selections on Cognitive Science*, Cambridge, Mass., and London: The MIT Press, 1-28.

Skinner, B.F. 1988: "Selection by Consequences," in C. Catania and S. Harnard (eds.), *The Selection of Behavior. The Operant Behaviorism of B.F. Skinner*, Cambridge: Cambridge University Press, 218-236).

Vanberg, Viktor 1975: *Die zwei Soziologien – Individualismus und Kollektivismus in der Sozialtheorie*, Tübingen: J.C.B. Mohr (Paul Siebeck).

Vanberg, Viktor 1993: Rational Choice, Rule-Following and Institutions, in: U. Mäki, Bo Gustafsson and Ch. Knudsen, eds., *Rationality, Institutions and Economic Methodology*, London and New York: Routledge, 171-200.

Vanberg, Viktor J. 1994: *Rules and Choice in Economics*, London and New York: Routledge.

Vanberg, Viktor J. 1997: "Institutional Evolution through Purposeful Selection. The Constitutional Economics of John R. Commons," *Constitutional Political Economy*, 8, 105-122.

Vanberg, Viktor J. and James M. Buchanan 1994: Interests and Theories in Constitutional Choice, in V. J. Vanberg 1994, xxx

Vromen, Jack J. 1995: *Economic Evolution - An Enquiry into the Foundations of New Institutional Economics*, London and New York: Routledge.

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