

# The evolution of preferences Why ‘sovereign’ preferences may not lead to sustainable policies and what to do about it

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## Abstract

The conventional economic paradigm assumes that tastes and preferences are exogenous to the economic system, and that the economic problem consists of optimally satisfying those preferences. Tastes and preferences usually do not change rapidly and, in the short term, this assumption makes sense. Sustainability is an inherently long-term problem and in the long run it does not make sense to assume tastes and preferences are fixed and given. If preferences are expected to change over time and under the influence of education, advertising, changing cultural assumptions, etc., the old assumption of ‘consumer sovereignty’ is not adequate. Different criteria of optimality are needed. How preferences change, how they relate to the goal of sustainability, and how they can or should be actively influenced to satisfy the new criteria needs to be determined. Ecological economics has emphasized the three rank ordered goals of ecological sustainability, fair distribution, and allocative efficiency. This paper examines how preferences evolve and change over time and the implications of this for developing policies that meet these three goals in democratic societies. © 1998 Elsevier Science B.V.

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## 1. Introduction

Conventional, neoclassical economics is based on assumptions that, while yielding useful models

for understanding the problems of efficient allocation of resources in the short term, are misleading and potentially dangerous in dealing with the long term consequences of economic choices. This problem arises more specifically in evaluating the impacts of various policies that are proposed to promote ‘sustainable development’, because the temporal horizon of sustainability analysis is

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multi-generational. Sustainable development involves three hierarchically inter-related problems. These are maintaining: (1) a sustainable scale of the economy relative to its ecological life support system; (2) a fair distribution of resources and opportunities, not only among members of the current generation of humans, but also among present and future generations (and even in some formulations among humans and other species); and (3) an efficient allocation of resources over time that adequately accounts for natural capital (Daly, 1990).

Over generations, the economy is expected to grow significantly in its material scale as a result of population growth and probably also as a result of the increasing expectations of consumers. As the scale of economic activity increases there is also, in general, an increase in the impacts of economic activity on the environment<sup>1</sup>. This focuses attention on both population growth and on the material consumption levels of advanced societies. In this paper the focus is on the material consumption vector, questioning whether there may be a social interest in influencing individual preferences toward less material consumption-oriented forms of satisfaction. Any comprehensive effort to address problems of the scale of the economy and per capita consumption of resources must somehow address this fundamental problem of preference formation.

Neoclassical economists have largely ignored scalar problems and intertemporal distribution issues as being 'outside the domain' of economics, because they have assumed infinite substitution possibilities among resources and unlimited technological change. Economics is, on these assumptions, limited to solving the technical issues surrounding the efficient allocation problem. The problem is that optimal allocation does not guarantee sustainability. Mainstream economics has assumed that the goal is to manage environmental resources as efficiently as possible over time. It has largely ignored the theoretical principle that

there are an infinite number of time paths for resource use and preservation that would satisfy Pareto efficiency criteria. It is a relatively easy step to show that not all efficient time paths are sustainable. Additional criteria beyond Pareto efficiency will be needed if the dual goals of efficiency and sustainability are to be recognized in environmental policies (Bishop, 1993).

If economics is defined more broadly as the 'management of the household', as the Greek root of the word implies, then it must address all the problems attendant on that management, including scale and distribution problems, even if those problems do not submit to the mathematical models and prescriptions that have been used to solve the allocation problem.

The management of a household has both internal and external relations. One way of addressing the relationship of ecology to economics is to consider economics as the analysis of decisions within the 'closed' internal system of the family/household, while ecology provides tools for analyzing the inter-relations of the family to the outside world. Imagine the problems with a household that operates under the assumption that its members' preferences will be 'taken as given' and 'unlimited' for the purposes of setting each successive family budget. Limits imposed by the ecophysical system producing resources may impose limits on the scale of an economy, just as the income limits of a family inevitably force family members to reduce their demands for consumption.

In this paper, the conventional assumption that individual preferences can be accepted as given and stable for the purposes, and for the duration, of an economic study, and how the usefulness of this assumption changes as the time frame of the study increases, is addressed. The range of policy options which are deemed 'acceptable' is dependent on this assumption, so it has a large impact on long-term ecological and socioeconomic sustainability. The objectives of this paper are: (1) to examine the assumption of consumer sovereignty and the role of this principle in the analysis of environmental values; (2) to enhance the understanding of how values change over time in a society; and (3) to suggest some new directions for

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<sup>1</sup> Although there is evidence that some environmental impacts can decrease with increasing economic activity beyond a threshold, this effect is limited and does not outweigh the larger trend (Arrow et al., 1995).

analysis and modeling that may enhance the understanding of the social changes necessary to achieve a social commitment to sustainability in democratically organized societies.

## 2. Fixed tastes, preferences and consumer sovereignty

Conventional economic methodology is based on consumer sovereignty, the assumption that tastes and preferences are givens and that the economic problem consists of optimally satisfying those preferences (Silberberg, 1978). Tastes and preferences usually do not change rapidly so, in the short term at least, this assumption makes sense. But tastes and preferences do change, especially in the longer term. Therefore, economists' models, which treat preferences as exogenous, cannot be expected to correctly characterize or guide decisions that have potential impacts over decades, centuries, and longer.

Insisting that preference formation must be endogenous to models of resource decision making presents a very disturbing prospect for economists because it blocks easy definition of what is 'optimal.' If tastes and preferences are fixed and given, one can adopt a stance of consumer sovereignty and just 'give the people what they want'. There is no need to know or care why consumers want what they want; their preferences just have to be satisfied as efficiently as possible. However, if preferences are expected to change over time and under the influence of education, advertising, changing cultural assumptions, etc., a different criterion for what is 'optimal' is needed; and how preferences change, how much they are a function of 'nature' and how much of 'nurture,' how they relate to this new criterion, and how they can or should be actively influenced to satisfy the new criterion need to be figured out.

One alternative for this new criterion is sustainability itself, or, more completely, sustainable scale, efficient allocation of resources in the short term, and a reasonably fair distribution of nature's assets over multiple generations. This model implies a two-tiered decision process (Page, 1977; Norton, 1992, 1995; Norton and Toman, 1997),

with interactive tiers (Fig. 1). The search for improved policies is assumed to be an iterative process, with the model cycling through both tiers many times. In one tier, the 'reflective' tier, the central objective is to characterize and categorize environmental 'problems' by building models of human communities and their ecological, contextual physical system. These focus attention on physical dynamics that are socially valued or are associated with important economic or cultural values (such as salmon runs or forest regeneration). The goal of the first tier is to identify measurable physical processes that are relevant to locally defined goals for environmental management. One cannot discuss goals without discussing social values, so this reflective tier of the model must connect policies with impacts on social values. And while individual preferences of consumers may be a starting point for determining what ecophysical processes have social value, the model also contains a set of democratic processes for discussion and re-evaluation of preferences (see, Sagoff, 1998; Slovic, 1995). The output of this reflective tier is a determination of the type of environmental problem that is faced, an analysis of the social values at risk, a set of goals in dealing with that problem, and a proposal that one or more of the available 'action criteria' be applied. The second tier, the 'action' tier, generates policy guidance by applying one or more of

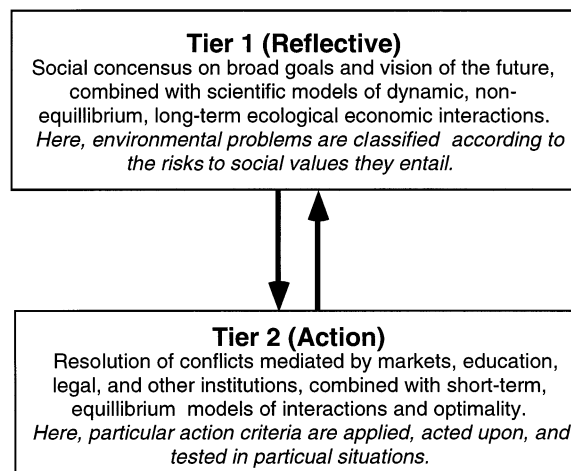


Fig. 1. Two-tiered decision structure.

several action-level criteria, such as cost benefit analysis (CBA) or the safe minimum standard of conservation criterion (SMS) within a scale-sensitive model. In the action tier, appropriate action criteria, given the classification of the risk or problem to be addressed, are applied to specific management situations. This two-tier, iterative model integrates the processes of social valuation, environmental science, and environmental monitoring and management in a more comprehensive way.

Besides threatening the theoretical and computational elegance of economists' welfare models, questioning consumer sovereignty also raises legitimate concerns regarding the possible manipulation of preferences. If tastes and preferences can change, then who is going to decide how to change them? There is a fear that a 'totalitarian' government or narrow special interests might be employed to manipulate preferences to conform to the desires of a select elite rather than the society as a whole. Two points need to be kept in mind however: (1) preferences are already being manipulated every day; and (2) we can just as easily apply open democratic principles to the problem as hidden or totalitarian principles in deciding how to influence preferences. So the question becomes whether it is better for preferences to be determined behind the scenes, either by a dictatorial government, by big business acting through advertising, or in some other way? Or do we want to explore and shape them openly, based on social dialogue and consensus, with a higher goal in mind? Either way, this is an issue that can no longer be avoided, and one which is best handled using democratic principles and innovative thinking.

Another way of looking at this issue is to draw a distinction between 'positive' and 'normative' analysis. 'Positive' refers to the way things are, while 'normative' refers to the way we would like things to be. Economists have attempted to make this a clear-cut distinction, and have often tried to confine their work to 'positive' analysis. However, like the mind-body distinction, the positive–normative distinction is not clear-cut. Our vision of how we would like things to be influences how things are and *visa versa*. Therefore, purely 'posi-

tive' analysis is impossible. A two-tier process allows us to move back and forth between an examination of social values and likely impacts of acting on those values, which points toward appropriate criteria for judging policies with varying potential impacts (in the Reflective Tier), and applications of those criteria in actual situations (in the Action Tier). When actions guided by a chosen action criterion lead to unwelcome consequences in a particular situation, it is possible to return to the Reflective Tier and re-examine the choice of an action criterion on the basis of new evidence. This re-examination may result in a re-classification of the problem and choice of a new criterion and, at least in some cases, further reflection on the appropriateness of social values as stated. In this way, experimental models and management experiments undertaken in the Action Tier provide a sort of laboratory for testing both management techniques and goals. When viewed in this way, management experiments may provide information that will provoke public discussion of community norms and social values.

### **3. Four degrees of consumer sovereignty**

Due to the fact that the principle of consumer sovereignty is so intimately entwined, theoretically and methodologically, with other constitutive elements of the mainstream economic paradigm, economists have often accepted the principle without providing it the intellectual scrutiny it deserves, especially given its decisive impact on the scope of questions addressed in 'economic' analyses (Norton, 1991, 1994). In fact, consumer sovereignty should not be thought of as an all-or-nothing state of reality or of policy, but rather as a continuum of possible assumptions regarding the extent to which questions regarding preference formation are held to be endogenous to the system of analysis of environmental values. Indeed, it has been shown that the various arguments to defend consumer sovereignty as a basic assumption of economics would support quite different interpretations of the principle in theory and practice (Norton, 1994). The survey of several possible interpretations, and the apparent policy

implications, of four ‘degrees’ of the consumer sovereignty principle follow. While these four degrees of consumer sovereignty do not exhaust the plausible positions on this continuum, they are useful because they each require somewhat different assumptions about the boundaries between economics and other traditional academic disciplines.

### 3.1. Degree 1: unchanging preferences

Some economists (Stigler and Becker, 1977), argue that individual preferences are not susceptible to rational analysis and that they should be considered both (a) given and (b) fixed for the purposes of analysis. To say that preferences are given is to say that, for the purposes of any analysis, preferences of individuals will be accepted, at face value, as indicative of the individual’s actual ‘good’ or welfare. This implication will be discussed in more detail in connection with degree 2. To say that preferences are fixed is to make a much stronger claim, that, at least from the viewpoint of economics, preferences of individuals do not change through time. According to this view, preferences are best thought of as tastes that, by the onset of adulthood, are locked in, at least in the sense that they are impossible to change through rational considerations (Stigler and Becker, 1977).

If it were to be assumed that this is a correct empirical generalization about human preference development (the point will be disputed below), it still would not follow that preferences are in fact fixed over time. They might, consistent with the hypothesis that there is no rational route to preference change, change in response to non-rational factors such as subliminal advertising or other forms of ‘propaganda’. Also, it seems obvious that the preferences of individuals do, in fact, change over time in response to some variables, e.g. witness changing attitudes toward smoking and sexual freedom. Whether such a process is rational is perhaps debatable, but the phenomenon of preference change is itself not in serious doubt.

Sympathetic interpretation of Stigler and Becker’s claim, then, requires that they are not taken

to be making the apparently false empirical claim that individuals never change their preferences, but rather the claim that, since preference change is not susceptible to rational analysis, it makes methodological sense to decide to treat preferences as fixed because this brings all consumer behavior under the explanatory scope of conventional economics, treating all such behavior as a function of opportunities. As Stigler and Becker (1977) say: “the great advantage...of relying only on changes in the arguments entering household production functions is that all changes in behavior are explained by changes in prices and incomes, precisely the variables that organize and give power to economic analysis”. However, this argument rests on the crucial assumption that there cannot be alternative ways to rationally understand or evaluate processes of preference change. And these are exactly the assumptions that are addressed in this paper. In fairness to Stigler and Becker, it should be said that they might have appealed more explicitly for justification of their premise that preferences are unresponsive to rational argument to the philosophical, ethical theory of emotivism. According to the logical positivists, a philosophical movement that had some currency between 1920 and 1950, evaluative utterances are simply expressions of emotion; their linguistic import and meaning is not cognitive, but emotive. Despite the usefulness of this theory in reminding us, as Hume (1888) had demonstrated two centuries ago, that the logic of descriptive and prescriptive sentences differ importantly, emotivism as a theory of ethics has been thoroughly discredited on the grounds that it misses most of what is important in processes of moral justification (Feigl, 1952; Williams, 1985).

Since it is obviously true that preferences do in fact change, it must be remembered that this strongest form of sovereignty for consumers is purely a methodological commitment having as its justification the expansion of the explanatory strength of economic theory; it does not have any implications whatsoever for the nature of preferences as psychological states of individuals or as tendencies to actually behave in specific ways in specific situations (Silberberg, 1978). Preferences,

interpreted as both given and fixed, are, however useful, highly theoretical entities that cannot be regarded as anything more than hypothetical constructs. It is asserted, then, that preferences interpreted in this manner, however useful they are in unifying disparate elements of theory in economics and in simplifying aggregations, are not useful at all in creating an economics that is truly explanatory of behavior in the long run.

### 3.2. Degree 2: preferences as given

A majority of economists adopt a somewhat weaker version of consumer sovereignty according to which preferences are assumed to be given and fixed only in the methodological sense, but not necessarily in the ontological sense. By this is meant that, other things being equal, individual choice is the best available measure of what is good for a person. Economists find it reasonable to assume that individual preferences are fixed for the duration of the analysis or experiment. Preferences are aggregated from 'snapshots', not as dynamic processes. The analysis abstracts from the question of changing preferences because of the advantages afforded in the ability to aggregate. If preferences are given and fixed for the duration of the analysis then they are not influenced by changes in other people's behavior (and preferences) and can easily be aggregated. This represents an acknowledged trade-off of reality for mathematical elegance and explanatory power. As noted in Section 1, analysis of policies to promote sustainable development must necessarily involve very long time horizons. Strict adherence to consumer sovereignty thus makes economic analysis less relevant to the evaluation of such policies.

Many economists who are advocates of methodologically supported consumer sovereignty, would (and have) stated that they of course recognize that preferences do in fact change, and that, (speaking non-economically) the question of preference change is an important one. Their point is only that, for disciplinary comparative advantage, given economists' expertise in modeling and aggregation of welfare, they are choosing to define their disciplinary

boundaries to exclude questions of preference change (Silberberg, 1978). Their argument, essentially, is that preferences are exogenous to economics, but endogenous to social science in the broader sense. On this view, it is logical for economists to seek interdisciplinary contact, to undertake interdisciplinary studies, and to seek broader theories of value that might unify their data and theory with data and theory from psychology, anthropology, and sociology. Consumer sovereignty in this form is simply a methodological assumption in economics and, so understood, it decisively supports our goal of addressing individual preferences in ways that incorporate the insights of economists who aggregate preferences-as-given into a broader understanding of value.

### 3.3. Degree 3: consumer sovereignty as commitment to democracy

If most mainstream economists accept the importance of preference formation and reformation, then what is the issue? Why not just plunge into interdisciplinary dialogue, and see what implications for social science theory emerge? But mainstream economists have shown reluctance to engage in this broader dialogue. We believe, however, that this reluctance rests mainly on a misunderstanding. A third degree of consumer sovereignty admits that preferences change, takes given-ness as an expression of a methodological decision, but nevertheless expresses skepticism regarding the evaluation of preferences and with attempts to change preferences in an explicit or systematic manner. This position, which is not inconsistent with degree 2, insists that there are dangers involved in evaluation and criticism of individual preferences. Such economists express fear that, if we set out to evaluate preferences, we have taken a giant step down the road toward paternalism, expertism, and perhaps even totalitarianism (Randall, 1988). According to this version of consumer sovereignty, it is recognized that individual preferences in fact change, but changes in preferences are highly individual, and nobody, not politicians, not philosophers, not social scientists, and certainly not environmental activists, is justified in telling individuals what their prefer-

ences should be. A commitment to democracy, and a rejection of any role for philosopher kings, scientific experts or, especially, for totalitarian manipulators of opinion, demands that preference formation be a highly individual, non-coercive process, according to this view. In this sense the individual consumer is sovereign, even as his or her preferences change, because the process of preference change is directed by the individual, rather than by an outside agent (this, of course, flies in the face of the fact that preferences are being manipulated by outside agents every day).

Note that this position has both methodological and evaluative elements. The argument is that the aggregation of revealed and expressed preferences should be interpreted methodologically, as given, because this strengthens the role of the public, taken as individuals whose preferences are sometimes stable and sometimes changing, and hence reinforces democratic trends in policy formation and implementation. Consumer sovereignty in this sense is a methodological stipulation in service of a commitment to the moral ideal of democracy. We feel great sympathy with the intent of this position, but we also think that it is essential to examine several of its underlying assumptions, because we doubt that, properly understood, a commitment to democracy requires rejection of rational analysis of individual preference change, or that a careful examination of reasons individuals should change their preferences must lead to elitism or totalitarianism.

Consider an example: imagine we live in a nation, the vast majority of the population of which are members of a particular religious sect, but that we are members of the minority. Surely, a commitment to democracy demands that we respect each of these individuals' right to their own belief as an element of their right to freedom of belief and of speech. But what if one of the majority's beliefs becomes the basis of an onerous policy? Suppose, to take an extreme case, that it is firmly believed by a majority (the believers) that the world, as we know it, will end in a final Armageddon in exactly 10 years, and that this holocaust can be averted only by the sacrifice of the first-born of every nonbelieving family in the nation. While in this case we might, along with

economists, be uncomfortable with 'expertism' and 'totalitarianism' in dismissing the majority's religious beliefs, and even if we would respect their right to their beliefs, we would also be opposed to taking the 'obligation' felt by the majority for human sacrifice as a given, and the obviously (on their empirical hypothesis) welfare-maximizing policy of mass human sacrifice, as a fait accompli.

This (hopefully implausible) scenario helps us to make a distinction between this third degree of sovereignty, expressed by economists who wish to guard the individual right to choose one's own preferences, and a fourth degree, which recognizes a stronger role for public discussion, expert input, and leadership, but does not run rough-shod over individual preferences. If we were a member of the nonbelieving minority in the fictional scenario, we surely would not accept the policy as a fait accompli, nor would we 'accept' the current preferences of the majority for mass human sacrifice as a preventive for Armageddon. We would surely try, by scientific, rational, and whatever other means necessary, to establish that there exists no plausible scientific evidence to support either the hypothesis of coming cataclysm or for the suggestion that human sacrifice would avert the cataclysm. Respecting the right of persons to their own beliefs and preferences does not preclude judgments that these beliefs lack sufficient support to justify policy actions, or that the public would be better off if the preferences of many of its citizens were to change.

#### *3.4. Degree 4: democratic preference change*

It is now possible to address the crux of the issue regarding preference formation and reformation. How is it possible to respect individual self-determination of preferences and at the same time to address the possibility that sincerely felt preferences of many individuals in a society, if pursued as a public policy, will nevertheless be extremely detrimental to the public interest or to the rights of a minority? In particular, since our concern is with considering what would be necessary and permissible to promote a sustainability ethic, an ethic that attempts to articulate and defend the

interests of generations yet unborn (and consequently unable to reveal or express their own preferences), it is asked whether is it possible in a democratic society to bring scientific, rational, moral arguments to bear on the question of whether some preference sets are more defensible than other preference sets?

It is possible to retain a commitment to democracy and to discuss the appropriateness of values because the democratic commitment is mainly procedural, while assertions of appropriateness are put forward as empirically and morally supportable theses regarding what our obligations to the future are. Hoping we will never face a situation so dire as to live in a society solemnly and with due legislative process committed to human sacrifice (as in our hypothetical example above), one hopes that policy will be set in a situation of open debate, with experts weighing in, and with interactions between the public, experts, and political decision makers. If a democratic process, including safeguards for individual rights of present people, is in place, then surely it makes sense to inject into the debate moral concerns about the well-being of future generations, even if these arguments require questioning and criticizing individuals' sincerely felt preferences.

We suspect, then, that a combination of commitments, to mathematical and methodological simplicity, and to democracy as noted, has inclined mainstream economists to favor consumer sovereignty of degree 1, 2, or 3 to degree 4. Once questions regarding the decision process are addressed, and allowing that in particular cases there may be real reasons to doubt the likelihood of predictions of dire consequences of current activities, there is in principle no reason why democratically inclined policy analysts cannot conclude that it would be better in the long run if certain, current preferences of individuals were to be reconsidered and amended. Advocacy of such criticism and education programs to change preferences need not be coercive; criticism of particular preference sets, based on the implications for those preference sets for the welfare of under-represented individuals such as future persons, may rather be in the form of rational suasion, of pointing out to people the consequences of their

desires, and showing to them alternative paths to personal satisfaction that have less severe impacts on the future of society.

We can also think of the democratic process as a multilevel one, rather than as flat and monolithic. Evidence that current behavior has negative impacts on other individuals, other species, or the future may require re-consideration of that behavior and the preferences that generate it. We can come to a democratic consensus about our shared preferences for a sustainable society through a process of discussion and debate, and then use these principles as guides to encourage people to see the inappropriateness of some preferences, given the scientifically demonstrable impacts of acting on those preferences (Fig. 1).

In the remainder of this paper, how preferences of individuals change through time, and the means available to criticize, and perhaps encourage change in, patterns of current individual preference will be examined. Only after such a discussion will it be possible to assess the prospects for advocates of sustainability to advocate and effect changes in attitudes and preferences of citizens in a democratic society.

#### **4. How preferences change**

To summarize the arguments so far: preferences change and the questions are, how? why? and does any subgroup within society have any business consciously participating in the process? In this section we concentrate on how and why preferences change (since these seem to be inextricably interlinked). In the following section the more difficult question of society's role in changing preferences is addressed. To address the how and why questions, we refer to research from three areas: (1) psychology and economics, in particular recent research on revealed preferences and preference reversals (Tversky et al., 1988, 1990; Fischhoff, 1991; Irwin et al., 1993; Knetch, 1994), constructed preferences (Gregory et al., 1993; Slovic, 1995), and decision making under uncertainty (Heiner, 1983); (2) social psychology and sociology, in particular research on social traps (Platt, 1973; Cross and Guyer, 1980); and



(3) anthropology, especially research on coevolutionary adaptation of cultures and ecosystems, or ecological anthropology (Harris, 1979).

From these sources we conclude that preferences are formed in humans (and many other animal species) by selection acting on traits that are transmitted both genetically and (in the case of humans) culturally, in a coevolutionary way. Preferences are but one more in a long list of traits that are ‘formed’ in this way. Preferences, as expressed, for example, in the economist’s indifference map, are determined by the combination of forces that are often summarized under the headings of ‘nature’ and ‘nurture’. That is to say, each human being enters life with a certain genetic makeup. Encoded there are certain basic needs and drives, including food, shelter, clothing, the sex drive, and the need for interaction with other people. These needs and drives are fundamental to our make-up as human beings. They are not now, and may never be fully understood. Furthermore, they play themselves out in our daily lives in ways that are profoundly influenced by the social and natural systems we live in. Our preferences for food, for example, are influenced in some ways by our genetic make up, but are also determined by our social groups (e.g. Jews and Muslims have an aversion to pork which they learn through their religious education) and by the alternative foods that their social and natural systems have in combination made available to them. Thus, over time, preferences may be affected by human genetic evolution, education, technological change, the evolution of social systems, and the changing availability of environmental and other natural resources.

A large and growing literature in cognitive psychology and related fields highlights the ‘lability’ of preferences, which refers to the variability of expressions of preference under varied contextual conditions. The findings of this research challenge any interpretation of actual preferences as fixed or invariant, and therefore calls into question economists’ conceptual model of preference formation. Summarizing evidence that preferences are often “constructed, not merely revealed, in the elicitation process”, Slovic (1995) says: “psychologists, claims that people do not behave according

to the dictates of utility theory are particularly troubling to economists, whose theories assume that people are rational in the sense of having preferences that are complete and transitive and in the sense that they choose what they most prefer”. While Slovic and his colleagues have mostly concentrated on preference variance under different conditions of elicitation, their conclusions, by inference, suggest that preferences are very unlikely to remain constant over time, and that it is misleading even to suggest that preferences exist independent of the occasions of their elicitation and/or expression in a specific context. Although, again the economist need not consider the news to be bad news, it turns out that psychologists have already learned a great deal about how preferences are constructed. If economists simply accept that consumer sovereignty is only a methodological consequence of their chosen models, a whole new field of study opens up at the edge of economics and psychology, e.g. the study of how preferences vary according to context and how they change across time and circumstances.

Further understanding of preference formation can be gained by examining the role of preferences in the larger human decision process. To again quote Slovic (1995), actual human decision making is not an exercise in the rational calculation of utilities, but is better understood as a form of ‘mental gymnastics’ (a highly contingent form of information processing), and sensitive to all sorts of contextual pressures. Empirical evidence from the social sciences thus supports our introduction of a two-tier and iterative decision model. Meanwhile, data regarding preferences as described in fixed-preference models can still provide snapshots of opinion, and this information provides one important input into the larger process of measuring, examining, and re-examining preferences and social values. What is gained by economists is many interdisciplinary opportunities to study preferences, their formation, and their relationship to behavior, and to embed this information into a more realistic model of decisions involving public values associated with the environment.

## 5. A coevolutionary explanation for preference formation

In modeling the dynamics of complex systems it is impossible to ignore the discontinuities and surprises that often characterize these systems and the fact that they operate far from equilibrium in a state of constant adaptation to changing conditions (Lines, 1989; Rosser, 1991, 1992; Holland and Miller, 1991; Kay, 1991). The paradigm of evolution has been broadly applied to both ecological and economic systems (Boulding, 1981; Arthur, 1988; Lindgren, 1991; Maxwell and Costanza, 1993; Norgaard, 1994) as a way of formalizing understanding of adaptation and learning behaviors in non-equilibrium, dynamic, complex systems. The general evolutionary paradigm posits a mechanism for adaptation and learning in complex systems at any scale using three basic interacting processes: (1) information storage and transmission; (2) generation of new alternatives; and (3) selection of superior alternatives according to some performance criteria.

The evolutionary paradigm is different from the conventional optimization paradigm popular in economics in at least four important respects (Arthur, 1988): (1) evolution is path dependent, meaning that the detailed history and dynamics of the system are important; (2) evolution can achieve multiple equilibria; (3) there is no guarantee that optimal efficiency or any other optimal performance will be achieved, due in part to path dependence and sensitivity to perturbations; and (4) 'lock-in' (survival of the first rather than survival of the fittest) is possible under conditions of increasing returns. While, as Arthur (1988) notes "conventional economic theory is built largely on the assumption of diminishing returns on the margin (local negative feedbacks)" life itself can be characterized as a positive feedback, self-reinforcing, autocatalytic process (Kay, 1991; Günther and Folke, 1997) and increasing returns, lock-in, path dependence, multiple equilibria and sub-optimal efficiency are the rule rather than the exception in economic and ecological systems should be expected.

## 6. Cultural versus genetic evolution

In biological evolution, the information storage medium is the gene, the generation of new alternatives is by sexual recombination or genetic mutation, and selection is performed by nature according to a criterion of 'fitness' based on reproductive success. The same process of change occurs in ecological, economic, and cultural systems, but the elements on which the process works are different (Toulmin, 1972). For example, in cultural evolution: (1) the storage medium is the culture, e.g. the oral tradition, books, film or other storage medium for passing on behavioral norms, and belief systems; (2) the generation of new alternatives is through innovation by individual members or groups in the culture; and (3) selection is again based on the reproductive success of the alternatives generated, but reproduction is carried out by the spread and copying of the behavior or ideas through learning and imitation rather than biological reproduction. One may also talk of 'economic' evolution, a subset of cultural evolution dealing with the generation, storage, and selection of alternative ways of producing things and allocating that which is produced. The field of 'evolutionary economics' has grown up in the last few decades based on these ideas (cf. Day and Groves, 1975; Day, 1989). Evolutionary theories in economics have already been successfully applied to problems of technical change, to the development of new institutions, and to the evolution of means of payment.

For large, slow-growing animals like humans, genetic evolution has a built-in bias towards the long run. Changing the genetic structure of a species requires that characteristics (phenotypes) be selected and accumulated by differential reproductive success. Behaviors learned or acquired during the lifetime of an individual cannot be passed on genetically. Genetic evolution in humans is therefore a relatively slow process requiring many generations to significantly alter the species' physical and biological characteristics.

Cultural evolution is potentially much faster. Technical change is perhaps the most important and fastest evolving cultural process. Learned behaviors that are successful, at least in the short

term, can be almost immediately spread to other members of the culture and passed on in the oral, written, or video record. The increased speed of adaptation that this process allows has been largely responsible for the amazing success of *Homo sapiens* at appropriating the resources of the planet. Vitousek et al. (1986) estimate that humans now directly control 40% of the planet's terrestrial primary production, and this is beginning to have significant effects on the biosphere, including changes in global climate and in the planet's protective ozone shield.

Thus, while the benefits of this rapid cultural evolution are significant, the costs are also potentially significant. Like a car that has increased speed, humans are in more danger of running off the road or over a cliff. Cultural evolution lacks the built-in long-run bias of genetic evolution and is susceptible to being led by its hyper-efficient short-run adaptability over a cliff into the abyss.

Another major difference between cultural and genetic evolution may serve as a countervailing force, however. As Arrow (1962) has pointed out, cultural and economic evolution, unlike genetic evolution, can at least to some extent employ foresight. If society can see the cliff, perhaps it can be avoided.

While market forces drive adaptive mechanisms (Kaitala and Pohjola, 1988), the systems which evolve are not necessarily optimal, so the question remains as to what external influences are needed and when should they be applied in order to achieve an optimum economic system via evolutionary adaptation? The challenge is to first gain foresight, and then to respond to and manage the system feedbacks in such a way as to avoid any foreseen problems (Berkes and Folke, 1994). Devising policy instruments and identifying incentives that can translate this foresight into effective modifications of the short-run evolutionary dynamics is the challenge (Costanza, 1987).

One of the possible modifications is to the preferences of individuals, which drive short term dynamics in economic systems. Individual preferences can have a huge impact on ecological resources. In one particularly dramatic example, the rapid spread of popularity of New Orleans Chef Paul Prudhomme's blackened redfish dish caused

a rapid expansion in demand, and threatened to destroy the redfish fishery in the Gulf of Mexico. Less dramatically, but perhaps more importantly, the preference of consumers for pre-packaging and small, individual containers has a very large impact on landfills throughout the United States; similarly, a taste for expanses of green lawns in the suburbs affects water quality and water availability for natural systems in arid areas. Looked at physically, these are problems of scale, e.g. human impacts on natural systems increase as a function of population and consumption, with the volume and type of consumption being a function of preferences. Market forces, supplemented with concerted attempts to internalize environmental costs can, of course, have an effect on consumption. If, for example, the full costs of irrigated lawns, including damage to wildlife, stream-water quality, etc., were paid by customers, they might turn off the spigot and 'suffer' with a brown lawn. The difference between charging full costs and changing preferences is that in the former case, consumers end up feeling deprived and unhappy, whereas they may feel enlightened and happy after being educated into the joys of a xeriscaped lawn. Given that populations in many areas of the world will continue to increase for at least decades, any attempt to address the problem of the scale of an economy vis-a-vis its limiting ecological factors must be addressed through reducing the impacts of per capita material consumption.

Fortunately, once the possibility of encouraging more appropriate preferences is introduced, there need be no necessary link between impacts of consumption on the environment and the levels of welfare experienced in a society. The good news is that, in evolutionary modeling, it may be possible to make small social investments that will affect which types of consumption bring enjoyment to consumers, reducing the scale of human impacts without decreasing, perhaps even increasing, levels of welfare of consumers. To continue with the xeriscaping example, a desert city with a shrinking aquifer might rationally consider a program to increase the number of residents who enjoy xeriscaping and use of native plants. They might, for example, establish a center for xeriscaping

with a botanical garden of native plants, encourage courses on xeriscaping as a part of the agricultural extension service, or help to establish a program in xeriscaping in the state university's landscape architecture department. These might be wise public investments that realize increasing returns as 'trends' are created toward lower-impact consumption patterns as a result of neighbors teaching neighbors the beauty and enjoyment, and lower maintenance costs, of native-plant landscaping. Once xeriscaping becomes an element of the community's identity, and citizens encourage a change in the tastes of their neighbors, a trend toward less water use and more native habitat might build on itself, providing increasing returns on a small investment. Investments such as this could pay increasing returns in lowering per capita demand for scarce resources and buffer the economy against shortages and rising prices.

And who is to say, to the gardener proud of his or her xeriscaping and its appropriateness to the surroundings, that a low-impact yard/garden yields less satisfaction than the currently prized lawns or tropical gardens with plants from rainforests and other ecologically inappropriate sources? But here, again, concerns about manipulation are encountered. The response, once again, is that there is no inconsistency with democracy if the goals chosen to guide preference reformation were arrived at through a democratic process such as a well-run ecosystem management plan, a community project on xeriscaping, or some other process that includes public input and free exchange of information.

## **7. Prospective: values and the future**

In the last part, we emphasized that preferences, especially preferences that affect the community and long-term public goods such as environmental protection, are best not thought of as fixed, or even necessarily stable, over years, decades, or generations. Community processes that encourage articulation of values and associated management goals therefore may need to be iterative and political in nature (Fig. 1). Snapshot

views of individual preferences understood as market behavior or shadow prices can yield important aggregations that are useful in analyses of policies with predictably limited long-term impacts. But we have advocated an analysis of policies, especially policies with long-term or irreversible impacts, that allows for a process of public articulation, discussion, and evaluation of public values. It has been shown above that there are interesting research and policy questions surrounding public processes of value articulation and management participation. The question of whether some of the currently felt preferences of individuals in industrial and post-industrial societies would be better changed is now addressed. In other words, is it possible to develop, within democratic institutions, a set of processes that would encourage the reconsideration and reformation of the preference sets of individuals? Again, a question that makes economists very concerned, and not without reason, as noted above, is faced. So far these concerns have been lumped under several types, e.g. concerns about 'manipulation' of preferences, about totalitarianism, etc., but what all of these concerns have in common is a suspicion that 'paternalism' regarding preferences is itself unacceptable. In this part, it is analyzed in more detail whether, and under what circumstances, a judgmental attitude regarding preferences is appropriate, and whether a certain form of paternalism might represent an important tool for developing and implementing sustainable institutions and policies.

As noted above, economists have generally favored self-determination of preferences because they see free preference formation as an important element in democracy. Solow (1993), for example, dismisses any attempt to affect the preferences of the future in one sentence (the preferences expressed by members of future generations 'is none of our business'). But we think that, if we leave theoretical assumptions and definitions of economics aside, most of us would admit that there are some situations which attempts to shape future preferences both make sense and are defensible. For example, consider wilderness preservation, historic preservation, and other attempts to protect important features of our land-

scape. Solow acknowledges that our generation may want to set aside particular ‘places’ or scenes because they are intrinsically valuable to us because of their beauty, historical significance, etc. But decisions such as this are more complex than the analysis suggests because if we assume we know nothing, and care nothing, about what future generations will want, we would be unlikely to invest in preservation. For example, would our generation be willing to set aside wilderness, or to forgo consumption that threatens species such as whales, if we believed that the next generation will not value these things for themselves and would destroy them whenever it is profitable? No, the decision to invest in protecting a wilderness area carries with it a commitment, or at least a desire, to influence the future to continue to value wild places and naturally evolved species. While we may share Solow’s distaste for some forms of paternalism, it also seems inevitable that huge investments to save natural or historical landmarks must be viewed as a part of a cultural dynamic in which the choices of one generation affect both the choices available to individuals in the future (maintaining or expanding their options), and the set of preferences that will be expressed by individuals in the future. In a very important sense, the preferences of future generations cannot be independent from current preferences. We pass on preferences to our children and we must in some cases decide which preferences to pass on in a very literal, paternalistic sense.

Consider again the example of wilderness protection. Suppose we choose in the present to alter all wilderness areas and use them for commodity production and apply a multiple use policy everywhere. Would future people retain or develop a taste for wilderness hiking, would they experience ‘existence values’ for such areas (values attributed to feelings that, even if the wilderness area is not visited or used, express a preference that it continue to exist)? Or would they never miss these lost opportunities to value wild things and, perhaps, be happy with theme parks and virtual reality wildernesses? The *laissez-faire* attitude of Solow (1993) toward future preferences now seems disingenuous. Either future individuals will desire to experience real wilderness or they will

not. If they do value it and wish to experience it, but cannot because we developed it, they would have reason to fault us for our choice. In this case it is at least important that we ascertain to the extent possible what preferences the future will in fact have so that we can take this into account in our computations of intergenerational fairness and in related decisions (Bromley, 1997). However, consider the case in which all wilderness is compromised irreversibly, and the more likely outcome that all future people have as a result lost the ability to value wilderness. In this case, the current decisions in fact have had a huge impact on the future and its range of options for enjoyment, whether future people recognize this impact or not. Solow’s remark that the preferences expressed by members of future generations are ‘none of our business’ seems in either case to ignore issues of considerable importance and complexity, and to naively favor policies likely to reduce cultural continuity and social meaning over time.

We suspect that Solow has arrived at his attitude because of a professional commitment to ‘positive’ economics and a form of methodological individualism involving a commitment to analyze decisions as faced by individualistic, ‘*homo economicus*’. His viewpoint on the intergenerational dynamic of preference formation might change if he were to treat at least some decisions from the viewpoint of the community. While the search for cultural continuity may become more and more difficult in a highly mobile society, it may still be important to build a sense of shared community values, both for the fulfillment of the aspirations of present people and also for the options available to members of future generations. The geographer, Tuan (1974, 1977) has developed a powerful case that all people exhibit ‘*topophilia*’, a commitment to a given geographical place, even if that place is seen as economically challenging, and a worse choice than other places to live by usual economic criteria.

Let us return to the case of attitudes toward, and preferences regarding, smoking. Since scientific evidence is now overwhelming that smoking increases risk of morbidity and mortality, and that smoking-caused illnesses have large social, as

well as personal consequences, this is an area where the Surgeon General's office accepts a public duty to affect behavior. Leaving aside for the moment that smoking is addictive, it still seems rational for a society to take steps to discourage young people from acquiring a preference for smoking cigarettes. If one believed, analogously, that individual preferences for more consumable goods has high social costs, it would by analogy make sense to invest society's resources in discouraging such preferences. The economist, at this point, might invoke a distinction between presenting consumers information regarding risks and influencing the values or preferences of individuals, and then argue that presenting information is appropriate, but that neither the government nor anybody else should attempt to influence preferences. According to this version of consumer sovereignty, preferences are sacrosanct and, while the government can justifiably dispense information, they ought to leave the 'final decision' regarding what to purchase and use to the consumer. The problem is that such an insulation of information from influence on preferences is impossible in practice. The choice of information dispensed must be designed to be effective in changing behavior—it would be silly and counter-productive if the Surgeon General were required only to present information in a way that would never affect youngsters' preferences, but only give them information about what might happen if they act on those preferences. On the contrary, a successful campaign to reduce the number of teenagers who smoke must, ultimately, mark its success in the loss of, or failure to develop, a taste for smoking. Even if a public service announcement never mentions, in addition to the fact that smoking causes cancer, that 'smoking isn't cool, anyway,' the factual content of the public service message is nevertheless chosen for presentation because of its likely direct and indirect impacts on the future preferences of prospective smokers. The idea of a public campaign to reduce smoking among teenagers is necessarily, even if implicitly, expressive of a commitment to alter consumption patterns in service of the social goal of having a healthy population.

By analogy, a public campaign to reduce lawn-watering in desert areas, based on scientific information regarding the negative impacts of irrigated lawns on the aquifer and surface water quality, and praising xeriscaping as a satisfying option, cannot be represented as simply an 'information campaign'. The fact that it is undertaken as a 'campaign' to change behavior already belies value neutrality; the insistence on presenting facts only, and leaving the decision up to consumers, cannot alter the value-ladenness of the enterprise. Nor can such a campaign proceed intelligently without adopting the goal of affecting the preferences that are finally held by individuals in the society in the future. So we are led back to the empirical question, beyond the scope of this paper, whether the preference for irrigated lawns in the desert is, like smoking, a preference that is sufficiently destructive of public goods to warrant 'information' campaigns to alter those preferences.

It is suspected that the case for a suggested campaign to reduce irrigated lawns seems weaker compared to the justification for an anti-teenage-smoking campaign because, in the latter case, health risks to the individual are involved, whereas in the case of lawns, the impacts are on more diffuse public goods such as clean and plentiful water. However, this difference is actually irrelevant in this case. To see this, suppose that it is scientifically established that second-hand smoke is actually worse for nonsmokers than first-hand smoke is to smokers. This change in the understanding of the facts would strengthen, not weaken, the case for a campaign to change behavior and preferences of smokers. The point of these examples, then, is that there are possible cases in the area of public health, and in the area of protection of environmental public goods such as clean water, in which there could be a legitimate public interest in affecting individual behavior and the preferences associated with it. In such cases, a democratic process could lead to a legitimate public-spirited decision to alter, through information and rational suasion, individual preferences and behaviors in the service of a social good.

Having argued that such situations are possible, even plausible, we must hasten to add that, sharing economists' worries about the potential dangers of preference manipulation, we believe claims that the public interest demands 'campaigns' of this sort must be submitted to the most disciplined analysis and that they must be considered carefully on their merits. In many cases, we suspect that calls for such public campaigns to affect public values and change individual behaviors in service of a social agenda may be thinly veiled attempts to manipulate opinion in service of narrower-than-public interests. Nor is there a foolproof way of separating justified cases of public examination of values and unjustified ones. Having said this, however, it is nevertheless recognized that a major part of the sustainability platform rests on the existence of such cases, and we therefore proceed to discuss how these cases might be addressed, provided it is established that preference change is truly in the public interest.

In what remains, we will continue to elaborate a general model for understanding situations such as these in an environmental policy context. This model makes value formation and reformation an endogenous element in the search for a rational policy for managing the impacts of human economic activities on the ecological and physical systems of nature (Fig. 1). The model will appear rather simple, abstract, and conceptual, but this generality signifies how much of the specification of a sustainability metric must be accomplished on a local, place-based level. The goal is merely to provide the general outlines of a sustainability policy that fulfills a minimal moral requirement of intergenerational equity. The details of such a policy must in all cases be worked out from a local perspective, with special attention to details that make local places distinctive, and with local issues that seem very important from a given perspective in space and time.

The model proposed is more comprehensive than either economic or ecological models of the relationship, but it should not be thought that it merely places economics and ecology side-by-side, in an attempt to integrate normative elements and descriptive elements in an iterative process. The model is also more comprehensive in that it is an

action-based model that includes economic models and ecological models in a larger, iterative system of monitoring, analysis, and action, followed by continued monitoring, etc. This larger system operates by assuming 'working hypotheses' relating social values with ecophysical processes, states goals, and engages in experiments and pilot projects in pursuit of those goals, monitors progress toward those goals scientifically, and then factors scientific results back into an ongoing public process. The important point is that preferences, values, and goals are open to revision, just as scientific hypotheses are. Economic models represent large subsystems that are embedded in larger-scale models of ecological and physical systems, and this structure is embodied in the two tiers of our model. Economic behavior is modeled in an equilibrium system, while ecological models, which encompass multiple equilibrium points, apply at larger scales (Common and Perrings, 1992; Holling, 1995). A two-tier system of analysis therefore sorts possible environmental problems and risks according to the likely temporal and spatial scale of their impacts in the first tier, and applies an appropriate action criterion, such as a cost-benefit criterion or a safe minimum standard criterion, given the scope and scale of possible risks of a policy in the second tier.

The two levels are interactive in social processes because we hypothesize that certain features of ecological communities support various social values, and we invite the public to specify goals for environmental management. Scientists, preferably local scientists, should also be involved to encourage the development of realistic, observable measures that can be hypothesized to track values that have been articulated by the community. Once goals, however tentative and difficult to measure, are set, the iterative process can be begun. It is expected to result in improved approximations of sustainability, because each experiment will be designed as a 'pilot' solution to a particular, local problem, and also designed so as to increase our knowledge in some way that improves future management, and our ability to measure its successes and failures.

If we are correct that re-examination of individual preferences will be an important part of any

model that represents a socio-physical dialectic capable of attaining sustainable institutions and sustainable policies, its role in a general model such as this would be represented as the interplay of scientific findings with the ongoing social dynamic as particular communities attempt to specify social goals, enlist scientists in an 'epistemological community' and set about a process of scientific inquiry and social learning (Lee, 1993). This process could submit policies to rigorous re-examination both with regard to progress toward stated goals, and also with regard to the 'appropriateness' of preferences under various models.

Unlike most models for evaluating environmental policies, our conceptual model embeds both economic and ecological models in a larger social process. The first step in that process, however, is political, not scientific. It is necessary for the various elements of a community, perhaps through representatives of stakeholder groups prominent in the community, to propose and discuss various visions, or scenarios, that they would set as positive outcomes of a process of economic development over generations. An important part of this will be the ranking of risks, and attempts to set some kind of priorities in addressing risk problems. But comparative risk processes are not as important as public discussions of their positive, long-term aspirations for their region. As Sagoff (1994) has noted, development of a deep sense of place has been interrupted by the tremendous mobility of populations in the United States. It is suggested that using ecosystem management plans and other public processes to build concern and responsibility for resources, and that one important role of public agencies and private environmental groups is to build a place-based sense of responsibility for sustainable management. Pilot projects and management experiments can play an important role in these public political processes, and the articulation and questioning of social values must be an important part of them.

One advantage of this approach is that, ideally, it may be possible through experimentation and scientific testing to find policies that have positive impacts on both the short term economic dynam-

ics and on the longer term social and ecological dynamics that affect longer-term goals. For example, tree planting programs in deforested areas may contribute to local economic goals (by reducing fuel wood shortages as planted areas are pruned), while simultaneously reducing erosion and improving stream water quality, and even contributing to slowing global climate change. While such policies cannot cure all ills, the important message is that, with an experimental spirit and involvement of a committed public, it may be possible to encourage development that is consistent with longer-term, as well as shorter-term, criteria. If such a positive development were to begin, it may be possible to intertwine the processes of monitoring and measuring impacts of human economic and protective efforts on physical systems with the more social process of developing a nature-based community identity in various regions. Such a system will not optimize one variable on any particular scale, but it will seek policies that are robust and effective on many scales. It will seek them by building community support at multiple levels, and joining in a cooperative venture with local physical and social scientists to describe and evaluate both the means to the goals and the goals themselves.

## **8. Conclusions**

The search for new, sustainable policies must, in addition to finding ways to internalize market externalities in economic activity, also address the question of the over-all scale of economic activity. It is difficult to see how this question can be addressed within a value system, such as that exemplified in neoclassical economics, that (a) does not allow the rational questioning of individual's value sets, and also (b) makes the assumption that, whatever people will prefer, their desires are unlimited. If individual preferences change (in response to education, advertising, peer pressure, etc.) then value cannot completely originate with preferences. We need to distinguish at least two kinds of value within this context: (1) short-term or current value based on current individual preferences; and (2) long-term or sustainable value



that emerges from a community process and encourages preferences that promote long-term sustainability (sustainable scale, fair distribution, and efficient allocation). Instead of being merely an expression of current individual preferences, sustainable value (at least in the mid- to long-term) becomes a system characteristic related the item's evolutionary contribution to the survival of the linked ecological economic system. Current value is the expression of individual preferences in the short term and locally, while sustainable value is the expression of community preferences, in the long term and globally. Achievement of clearly articulated and intergenerationally equitable goals that are in fact the expression of values experienced in local communities, their aspirations as well as their preferences, will require an iterative, democratic, and public process in which those communities develop goals and community values that are valid expressions of their ongoing culture. In this paper it has been argued that it is a legitimate activity of the policy community to encourage and participate in such an iterative process, which will require development of analytic tools that go beyond registering and aggregating currently expressed preferences. This change would bring policy analysis and discussion more into line with the constructivist approach to values and environmental valuation discussed above.

Preference change can be thought of in this context as an alternative to price change. Both influence behavior, and both are subject to imperfections. We may wish to (and need to) influence both prices and preferences in order to achieve our long-term social goals. To go back to our example of lawn watering in arid regions, both higher prices on water and public campaigns to encourage preferences for xeriscaping are potentially important ways to change behavior. An important distinction between these two policies is that reduced water consumption due to higher prices would lead to people feeling worse-off, while reduced water consumption due to changed preferences would lead to people feeling better off, as they experienced pride at behaving in a more environmentally appropriate way. Thus, reduced consumption can lead to either a decrease

(through price increases) or an increase (through preference change) in welfare, depending on the method by which we achieve the desired result.

Actively seeking to influence preferences is not inconsistent with a democratic society. Quite the contrary, in order to operationalize real democracy, a two tiered decision structure must be used (Fig. 1). This is necessary in order to eliminate 'preference inconsistencies' between the short term and the long term and between local and global goals, a phenomenon described in the social psychology literature as a 'social trap' (Platt, 1973; Cross and Guyer, 1980). There must first be general, democratic consensus on the broad, long-term goals of society. At this level 'individual sovereignty' holds, in the sense that the rights and goals of all individuals in society must be taken into account, but in the context of a shared dialogue aimed at achieving broad consensus. Once these broad goals are democratically arrived at, they can be used to limit and direct preferences at lower levels. For example, once there is general consensus on the goal of sustainability, with agreement by all the major stakeholders in society, then society is justified in taking action to change local behaviors that are inconsistent with this goal. It may be justified, for example, to attempt to change either people's preferences for driving automobiles or the price of doing so (or both) in order to change behavior to be more consistent with the longer term sustainability goals. In this way the foresight that we do possess in order to modify short-term cultural evolutionary forces toward achieving our shared long-term goals is utilized. If economics and other social sciences are to adequately address problems of sustainability, it will be necessary to develop evolutionary models that make preference formation and reformation an endogenous part of the analysis, and to develop mechanisms to modify short term cultural evolutionary forces in the direction of long term sustainability goals.

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## References

- Arrow, K., 1962. The economic implications of learning by doing. *Rev. Econ. Stud.* 29, 155–173.
- Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Holling, C.S., Jansson, B.-O., Levin, S., Maler, K.-G., Perrings, C., Pimentel, D., 1995. Economic growth, carrying capacity, and the environment. *Science* 268, 520–521.
- Arthur, W.B., 1988. Self-reinforcing mechanisms in economics. In: Anderson, P.W., Arrow, K.J., Pines, D. (Eds.), *The Economy as an Evolving Complex System*. Addison Wesley, Redwood City, pp. 9–31.
- Berkes, F., Folke, C., 1994. Investing in cultural capital for sustainable use of natural capital. In: Jansson, A.M., Hammer, M., Folke, C., Costanza, R. (Eds.), *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*. Island Press, Washington, DC, pp. 128–149.
- Bishop, R.C., 1993. Economic efficiency, sustainability, and biodiversity. *Ambio* 22, 69–73.
- Boulding, K.E., 1981. *Evolutionary economics*. Sage, Beverly Hills, CA.
- Bromley, 1997. *Ecol. Econ.* 00, 00–00.
- Common, M., Perrings, C., 1992. Towards an ecological economics of sustainability. *Ecol. Econ.* 6, 7–34.
- Costanza, R., 1987. Social traps and environmental policy. *BioScience* 37, 407–412.
- Cross, J.G., Guyer, M.J., 1980. *Social traps*. University of Michigan Press, Ann Arbor.
- Daly, H.E., 1990. Toward some operational principles of sustainable development. *Ecol. Econ.* 2, 1–6.
- Day, R.H., 1989. *Dynamical Systems, Adaptation and Economic Evolution*. MRG Working Paper No. M8908, University of Southern California, CA.
- Day, R.H., Groves, T. (Eds.), 1975. *Adaptive Economic Models*. Academic Press, New York.
- Feigl, H., 1952. Validation and vindication: an analysis of the nature of ethical arguments. In: Sellars, W., Hospers, J. (Eds.), *Readings in Ethical Theory*. Appleton, Century, Crofts, New York.
- Fischhoff, B., 1991. Value elicitation: is there anything in there? *Am. Psychol.* 46, 835–847.
- Gregory, R., Lichtenstein, S., Slovic, P., 1993. Valuing environmental resources: a constructive approach. *J. Risk Uncertain.* 7, 177–197.
- Günther, F., Folke, C., 1997. Characteristics of nested living systems. *J. Biol. Syst.* (in press).
- Harris, M., 1979. *Cultural Materialism: The Struggle for a Science of Culture*. Random House, New York.
- Heiner, R.A., 1983. The origin of predictable behavior. *Am. Econ. Rev.* 75, 565–601.
- Holland, J.H., Miller, J.H., 1991. Artificial adaptive agents in economic theory. *Am. Econ. Rev.* 81, 365–370.
- Holling, C.S., 1995. Engineering resilience versus ecological resilience. In: Schulze, P.C. (Ed.), *Engineering within Ecological Constraints*. National Academy Press, Washington, DC, pp. 31–43.
- Hume, D., 1888 (1776). *A Treatise on Human Nature*. Selby-Bigge, L.A. (Ed.). Clarendon Press, Oxford.
- Irwin, J.R., Slovic, P., Lichtenstein, S., McClelland, G.H., 1993. Preference reversals and the measurement of environmental values. *J. Risk Uncertain.* 6, 5–18.
- Kaitala, V., Pohjola, M., 1988. Optimal recovery of a shared resource stock: a differential game model with efficient memory equilibria. *Nat. Resour. Model.* 3, 91–119.
- Kay, J.J., 1991. A nonequilibrium thermodynamic framework for discussing ecosystem integrity. *Environ. Manag.* 15, 483–495.
- Knetch, J.L., 1994. Environmental valuation: some problems of wrong questions and misleading answers. *Environ. Values* 3, 351–368.
- Lee, K., 1993. *Compass and Gyroscope*. Island Press, Covelo.
- Lindgren, K., 1991. Evolutionary phenomena in simple dynamics. In: Langton, C.G., Taylor, C., Farmer, J.D., Rasmussen, S. (Eds.), *Artificial Life, SFI Studies in the Sciences of Complexity*, vol. X. Addison-Wesley, Reading, MA, pp. 295–312.
- Lines, M., 1989. Environmental noise and nonlinear models: a simple macroeconomic example. *Econ. Notes* 19, 376–394.
- Maxwell, T., Costanza, R., 1993. An approach to modelling the dynamics of evolutionary self-organization. *Ecol. Model.* 69, 149–161.
- Norgaard, R.B., 1994. *Development Betrayed: The End of Progress and a Coevolutionary Revisioning of the Future*. Routledge, London.
- Norton, B.G., 1991. Thoreau's insect analogies: or, why environmentalists hate mainstream economists. *Environ. Ethics* 13, 235–251.
- Norton, B.G., 1992. Sustainability, human welfare, and ecosystem health. *Environ. Values* 2, 97–111.
- Norton, B.G., 1994. Economists' preferences and the preferences of economists. *Environ. Values* 3, 311–332.
- Norton, B.G., 1995. Evaluating ecosystem states: two competing paradigms. *Ecol. Econ.* 14, 113–127.
- Norton, B.G., Toman, M.A., 1997. Sustainability: ecological and economic perspectives. *Land Econ.* (in press).
- Page, T., 1977. *Conservation and Economic Efficiency*. Johns Hopkins Press, Baltimore, MD.
- Platt, J., 1973. Social traps. *Am. Psychol.* 28, 642–651.
- Randall, A., 1988. What mainstream economists have to say about the value of biodiversity. In: Wilson, E.O. (Ed.), *Biodiversity National Academy Press*, Washington, DC.

- Rosser, J.B., 1991. From Catastrophe to Chaos: a General Theory of Economic Discontinuities. Kluwer, Amsterdam.
- Rosser, J.B., 1992. The dialogue between the economic and ecologic theories of evolution. *J. Econ. Behav. Organ.* 17, 195–215.
- Sagoff, M., 1994. Settling America: the concept of place in environmental ethics. *J. Energy, Nat. Resour. Environ. Law* 12, 351–418.
- Sagoff, M., 1998. Aggregation and deliberation in valuing environmental public goods: a look beyond contingent pricing. *Ecol. Econ.* 24, 213–230.
- Silberberg, E., 1978. *The Structure of Economics: A Mathematical Analysis*. McGraw-Hill, New York.
- Slovic, P., 1995. The construction of preference. *Am. Psychol.* 50, 364–371.
- Solow, R.M., 1993. Sustainability: an economist's perspective. In: Dorfman, R., Dorfman, N. (Eds.), *Economics of the Environment: Selected Readings*. Norton and Company, New York, pp. 179–187.
- Stigler, G.J., Becker, G.S., 1977. De Gustibus Non Est Disputandum. *Am. Econ. Rev.* 67 (March), 76–90.
- Toulmin, S.J., 1972. *Human Understanding*, vol. I. Princeton University Press, Princeton, NJ.
- Tuan, Y.-F., 1974. *Topophilia: A Study of Environmental Perception, Attitudes, and Values*. Prentice-Hall, Englewood Cliffs, NJ.
- Tuan, Y.-F., 1977. *Space and Place: The Perspective of Experience*. University of Minnesota Press, Minneapolis.
- Tversky, A., Sattath, S., Slovic, P., 1988. Contingent weighting in judgement and choice. *Psychol. Rev.* 85, 371–384.
- Tversky, A., Slovic, P., Kahneman, D., 1990. The causes of preference reversal. *Am. Econ. Rev.* 80, 204–217.
- Vitousek, P.M., Ehrlich, P.R., Ehrlich, A.H., Matson, P.A., 1986. Human appropriation of the products of photosynthesis. *BioScience* 36, 368–373.
- Williams, B.A.O., 1985. *Ethics and the Limits of Philosophy*. Harvard University Press, Cambridge, MA.