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Six choice metaphors and their social implications

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Abstract: The six metaphors analyzed in this paper unfold stepwise into an interdisciplinary systems framework based on planning horizons. The notion of planning horizons serves as an ordinal measure of rationality and organization, in a social systemic context of ecological interdependence. Each metaphor opens into the next to extend our understanding.

The *neighborhood store* is where almost all neoclassical choices are made, with visible options spread on shelves and a budget allocated among them, maximizing its worth. The *chessboard* demands strategic contingency planning in an evolving context of incompletely projectable outcomes. A *transportation network* combines substitutes and complements into a static complex system, intertwined and non-decomposable, leaving economists with a problem of institutional choice. *Love* is a complementary good – virtually costless to produce and distribute, always in demand – that should be abundant, though it is scarce. The *educational system* brings inter-horizonal complementarities into our field of view, where contagion effects of longer horizons enhance complementarity at the expense of substitution, shifting the mix of interdependence away from conflicts to concerts of interest. *Human ecology* is a dynamic complex system of interactive phenomena opening into time, evolving constantly in its structure, relationships and diversity and demanding ethics in our relations.

These six metaphors raise some pressing questions on the invisible limits of models standing on substitution applied where they have no place. Symptoms of failure reveal themselves in myopia, ecological loss and the rise of violence in society. Economic implications of these metaphors are reviewed to illustrate the basis for an interdisciplinary approach to social scientific constructions.

Keywords: metaphors, complementarity, planning horizons, cooperation, systems theory

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Introduction

The aim of this paper is to unfold – stepwise – a model of planning horizons and how they affect economics. The planning horizon, in this sense, is an index of bounded rationality; one can think of it as a 'measure of fit' between theory and fact – or reason and truth – to which we have no direct access. But the more we understand, the better suited to its application will be the model of how things work underlying all our decisions. We do not choose among outcomes but from imagined projections thereof. Framing matters, in its selection of fundamentals and theories on which all these subjective fancies are based. The range of awareness from which they emerge – as bounded by where reality opens in unexpected directions ("Surprise!") – is our index of planning horizons. The more rational we can become, the longer the planning horizon for a given amount of attention and effort; longer planning horizons are related to understanding, appropriate theoretical applications and intelligent choices suggesting efficient use of resources. So every decision is based on a model of how the world works with respect to that choice, sketching our options and their results in a spray of imagined projections. Thus do we choose, for better or worse, our horizons scored and defined by surprise. (We may think our horizons are long when surprises show them as short.)

These models we use, selectively blind to all we leave out of focus, steer our choices and their results. Such theoretical lenses stand on a metaphorical base. How we think about all we do is metaphorically founded. Metaphors are frameworks of thought; they avert the need for a lengthy explication of grounds. Metaphors serve to enrich a model of thought beyond its articulate core. As theory involves selective focus on self-asserted essentials, the context of any particular outlook – the background against which its figures are cast – is left inarticulate and undescribed. As Polanyi (1958, pp. 55-57; 1969, pp. 128-29, 192-96) made so clear, focal awareness occurs against an implicit contextual field. The background must remain tacit, for the focus to hold our attention. The pianist, suddenly thinking of fingers, loses the thread of the song.

The role and function of metaphor has been explored by Deirdre McCloskey (1985, 1990) and others (cf. Klamer et al. 1988). Economics – indeed, all theory – is metaphorically bound. The relation of theory and metaphor is often misconstrued, however, to mean that metaphors illustrate theories, or that they offer convenient insight to applications thereof. Such a view misses the point. The analytical role

of metaphor is primary and not derivative. Theories stem from, illustrate and reflect metaphors, not the reverse. That focal awareness is shaped by theory arising from metaphor is the main insight brought to us by McCloskey.

The six choice metaphors to be explored are: (1) the neighborhood store, where almost all neoclassical choices are made; (2) the chessboard, where the emphasis is on boundedly rational strategic complexity and horizon effects; (3) the transportation network, where systemic interdependencies are of both substitution (negative feedback) and complementarity (positive feedback); (4) love, where human relations are complementary, free of physical scarcities; (5) the educational system, with a focus on organizational learning through interhorizonal complementarity; and (6) human ecology, in a system of vital living consciousness integrated with all existence. Each metaphor rises from those prior, redefining them as special cases in a wider frame. But all have value when applied to where their assumptions pertain. The key is to learn the limits of each by understanding them all.

Choice in the neighborhood store

The neighborhood store is where almost all neoclassical choices are made. The options sit on shelves – be they consumer goods, production technologies, contingent outcomes, etc. – with their features known and accounted for, and a budget allotted among them maximizing its value when turned into goods. What each outcome will feel like to wear, pursue or consume is already known; neighborhood stores are familiar and such choices are made every day. The details shift – e.g., from consumption as an end in itself to production as a means to profit – but the pattern of action is standard. Choice in the store is an orderly process: stable, static, controlled and known.

The pricing decision in the world of the neighborhood store is simple: maximize profit at some price (**P***) as a markup on cost. The growth of output at **P*** is zero or at some expected rate, where output alters through time at a pace set by that price. In this scheme, short-run decreasing returns (or rising unit costs) shift downward through time into long-run increasing returns, strengthened as well by any technical, learning or systems improvements.

But choices in neighborhood stores are familiar because we enter them every day; there is no need for rational long-term plans, strategic concerns, etc. Objective

functions are met through profit, undisturbed by others save via prices (set by supply and demand in an impersonal market). The neighborhood store is a package of features simply taken for granted as the fundamentals of choice: knowledge and full control of effects; independence of wants between neighbors through time; material goods; substitute tradeoffs; stable preferences; etc. The framework of interdependence in neighborhood store economics is schematized thus: the paradigmatic core of the theory is centered on substitution/diminishing returns in short-term micro theory, and then extended to long-term macro growth theory via increasing returns and technical change.

Although uncertainty and dynamic constructions append to this schema, it is in essence static and certain. This will limit its application to anything other than short-term phenomena, where unexpected change and complexity are at minimal levels. The neoclassical view applies smoothly to the neighborhood store, in all its simplistic conditions. The chessboard depicts a different domain of unpredictable outcomes, in which a neighborhood store economics says little of value to guide choice.

Choice on the chessboard

Herbert Simon (1976; 1978; 1981, pp. 105-8) and others said choice on the chessboard is the issue. When Mitchell Waldrop (1992, pp. 150-51) asked Brian Arthur "What is the ... problem with economics?" he readily answered "Chess!" Orthodox statics are wrongly fit to strategic games such as chess, as standard neighborhood store assumptions – of free and independent agents, known outcomes, stable preferences – shall not apply to chess. Even game-theoretic conceptions are too rigidly structured to embrace the essence of chess in all its strategic contingent decisions. One must abstract from moves and details to address the problem meaningfully. Instead of muzak in neighborhood stores, chess is more like jazz. Chess is a process of planning in the face of strategic contingencies shifting with each turn. Outcomes must be projected uncertainly, and the purpose – to win – neither defines nor requires action sufficiently to identify moves. The field of chess is as much an opponent's style of play as the board. The chessboard demands a different approach to understanding choice than that designed for a neighborhood store.

One must step back from positions on the chessboard to analyze its economics. The emphasis here is on planning in unpredictable, changing environs. The better that

tradeoffs are understood and near-move contingencies culled, the more moves ahead can a player project. The move horizon in chess is analogous to the time horizon in choice. The contribution to economics of chess is the notion of planning horizons (which is seen as an ordinal index of our projective range of vision). Choices in chess are path-dependent in time and spatially interdependent. They are also irreversible, as in real life, unlike in a store. Indeed, the ecological view – that every action we take creates effects spreading outward forever – invites attention to the relative boundedness of our rational limits (Simon 1982-97). This is the notion of planning horizons.

In neighborhood stores outcomes stop with consumption of physical goods. On chessboards, choices are linked through time and spill out across every agent; they must be structured together into an organizational pattern to see. Each move is strategically placed in the context of all prior play and based on opponents' expected responses. How one does in the game is a function of planning horizons in chess. The move horizon in chess extends by understanding the rules of the game along with its pattern of play. This 'savvy' is a result of repeated experience more than of study. Entrepreneurial learning is similar: it is more a skill from practice than transmissible knowledge. The better one apprehends the world – and the more stable environments are – the further ahead and around decisions can their effects be seen. Indeed, all outcomes are imagined at the time of decision: the process of choice is a normative process of multidimensional causal projection. The range of valid projection in any act is its planning horizon, set both by internal understanding and external conditions. As Herbert Simon (1981, p. 180) noted: "Our myopia is not adaptive, but symptomatic of the limits of our adaptability. It is one of the constraints on adaptation belonging to the inner environment." The planning horizon (**H***) emerges from the balance of short and long term inducements seen by the agent in choice. Simon (1983, p. 107) called for longer horizons, suggesting that an "enlightened self-interest" would "broaden human horizons so that people will take into account, in deciding what is to their interest, a wider range of consequences" within a horizonal frame (Jennings 2007a, 2008a, 2009).

A static view of the pricing decision in neighborhood stores was shown above: that price is a markup over costs at some level of output. What chess shows is that both the markup (based on demand elasticity) and the measure of cost per unit of output decline with longer planning horizons. This finding can be derived – if done properly – from Alchian's (1959) nine propositions on cost, despite the

erroneous effort by Hirshleifer (1962) and its acceptance by Oi (1967) and Alchian (1968) (cf. Jennings (1985, ch. 5; 2008a,b). Margolis (1960, pp. 531-32) stated the basic point thus:

"... The greater the uncertainty ... the shorter will be the planning horizon and the greater will be the ... costs... The implications ... are that the greater the ignorance of the market the higher will be the estimate of the costs and the more inelastic the estimate of demand. What price should a firm charge if it has hopes of later expanding its market? The higher the price the greater the expected short-run profits and the greater the sacrifice of expected information about the mass market. The lower the price the more information it gains about the future market possibilities."

All this implies that pricing and growth are related to planning horizons, where longer horizons in choice reduce the former (**P***) and raise the latter (**g***). If so, the static model of pricing in neighborhood stores is incomplete: without defining horizonal limits, economists' story of pricing is undefined and indeterminate. Chess has something important to offer that we cannot otherwise see in the complexity of its options. The 'move horizon' in chess is simply the 'planning horizon' in choice: both are reflections of agents' skills, 'savvy' and experiential learning. Chess introduces another realm – beyond discrete decisions – such as in complex systemic contexts.

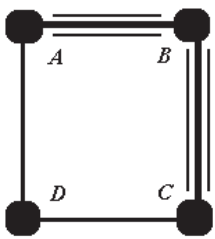
The neighborhood store is static, closed to interdependent decisions. Chess is strategic, competitive, and encompasses interdependent decisions in rivalrous situations, showing how planning horizons relate through choices to pricing behavior and growth. The pattern of feedback through planning horizons in chess is similar to that of falling cost (increasing returns), save for learning curve phenomena (Jennings 2008b). But these two metaphors stress substitution and individual action, not the full linkage of agents in time.

The neoclassical view of the chessboard is about oligopoly outcomes, including game theoretic constructions sensitive to their assumptions. There is no 'rule' for this situation, as Herbert Simon (1976, pp. 140-41) has said, describing oligopoly and models of imperfect competition as "the permanent and ineradicable scandal of economic theory" due to economists' "...lingering reluctance to acknowledge the impossibility of discovering at last 'The Rule' of substantively rational behavior for the oligopolist. Only when the hope of that discovery has been finally

extinguished will it be admitted that understanding imperfect competition means understanding procedural rationality" (also cf. Jennings 1985, 2008a). Horizon effects step back from positions in chess to analyze understanding and its sequential effects. Orthodox statics say little to guide decisions set on a chessboard. But chessboards still are rivalrous settings, where agents play to win. The transportation network captures substitution and complementarity in a nondecomposable mix of fully interactive agents with common as well as conflicting intentions.

Choice in a transportation network

Choices in transportation networks spill their effects on others: externalities spread throughout the system without any end. The boundedness here is horizonal, in the range of projected effects internalized into the process of choice. The transportation network characterizes interlinked agents setting prices alone or in concert. Their pricing effects supply a language of interdependence stretching beyond the ranges of neighborhood stores and chessboards.



Imagine four rural towns in a square, linked by four rail lines. Counting clockwise from the NW corner, the towns are **A,B,C,D**. Now imagine collusion between lines **AB** (north) and **BC** (east), and ask the question of whether **AB** and **BC** are parallel or end-to-end (substitutes or complements). This is the very same question of comparing beer vs. wine to beer and pretzels in a consumer economy, except that here we have falling cost.

For parallel lines – substitute goods – standard models apply. Any collusion increases the markup, due to external effects. End-to-end mergers among complements cut markups so raise growth through internalizing positive feedback. Growth also reduces cost due to increasing returns, another reinforcing effect.

Complementarity inverts the welfare impact of collusion vs. rivalry here. The question turns to one about the nature of interdependent relations.

Whether **AB** and **BC** are rival or joined depends on direction of travel: between **B** and **D** they are parallel routes, but between **A** and **C** they have end-to-end ties. If traffic goes in both directions, substitution and complementarity are entwined in a nondecomposable mix in need of a systems approach (Jennings 2006).

Here the importance of substitution (negative feedback) and complementarity (positive feedback) is not a priori, as in neighborhood stores or the chessboard. This is especially so in a complexly interdependent open economy. What we need is a composition rule for individual agents, with respect to their externalities. Sherman R. Krupp (1963, p. 223) explained the relation of composition rules to externalities:

"The problem of externalities concerns the interdependence that emerges when individual units are aggregated with consequences not predictable under theorems derived from the individual units. ... The failure of the main theorems to resolve important problems requires at a minimum either the introduction of new variables or the incorporation of new composition laws into the axioms of the theory."

The nature of interdependence for any good with respect to a group of products can be insightfully framed in terms of a quantified divergence between its own-profit-maximizing price and that which is best for group profits: that difference serves as a gauge of net interdependence within that particular group with respect to one member. This can be done, for example, by comparing the noncollusive maximum profit price of beer (P_j^*) with the joint-profit-maximizing price (P_j'). The difference between these two prices should be seen as a 'feedback term' expressing the net interdependence within a group with respect to one member. A positive feedback term – where $P_j^* = P_j' + S_I$ with the latter representing S_I as more or less than zero – implies a net complementarity in which group pressures through cooperation will lead to reductions of price. A negative feedback term, on the other hand – where $S_I < 0$ – will lead to an economic case for independence of functions, separation and competition.

Where substitution prevails – with negative feedbacks – prices are lower and output higher with competition, but the inverse applies to complementarity. The question is how collusion brings external profit effects into pricing decisions in a

balance of feedbacks to raise or reduce sales. The efficiency and social welfare impact depend on net interdependence (substitution or complementarity). Any such composition rule transcends our industry model, which is defined as substitution, with a more general frame embracing them both. The method displays why complementarity yields a case for cooperation as a means to efficiency in an internalization of positive feedbacks. Indeed, the main contribution of the transportation network metaphor is to replace the industry concept. As psychologists and philosophers say, our representations matter (Arrow 1982).

The transportation network metaphor opens a question about the balance of substitution (negative feedback) and complementarity (positive feedback) in a systemic context. The simplest way to address their relative weight in any group is to look beyond pricing to welfare effects. The issue is whether my own gain reduces or adds to yours. Substitution poses a conflict, while complementarity yields a concert of interest in social relations.

Defining S_I as a balance of substitution and complementarity opens an issue of fundamentality. Stores and chessboards are rivalrous settings, supporting a view of opposition as a motivation to effort. The transportation network captures complementarity in a dynamic balance (S_I) with substitution. Are there realms where complementarity overrides substitution? If our successes are aligned, dividing us through a competitive frame undermines efficiency. Here we become more effective (we encourage each other) by working together. Collusion in the presence of complementarity increases social welfare. In this respect, cooperation activates synergies in production, organization and education. Competition is self-defeating among complementary goods, such as love for one example.

Choices in love and other purely complementary goods

Love is as close to a purely complementary good as we get. There are many other examples: information; ecological health; ethics; joy; etc. The question needing attention is: What does an economics of complementarity entail? Where we find a concert of interests, such as with beer and pretzels or wine and cheese, instead of a conflict of value as with beer vs. wine, how do we analyze this situation? Note, too, all four of these goods are complements for a party versus some other entertainment: tradeoffs and values are context- and purpose-specific in economic decisions. Defining goods as public or even nonrival – as special exceptions in a

world of substitute tradeoffs – is insufficient in a systemic context. That tactic casts substitution as our primary form of relation, with complementarity second in rank. Kaldor (1975, p. 348) asserted that complementarity "is far more important for an understanding ... of the economy than the substitution aspect..." So what would an economics of complementarity actually be?

Richard Nelson (1981, pp. 1053-55) noted the nonconvexity of reciprocal inputs: "If factors are complements, growth is superadditive... The growth of one input augments the marginal contribution of others." In this setting, marginal analyses do not apply: "there are not neatly separable sources of growth, but rather a package of elements all of which need to be there." In other words, partial approaches don't work: holistic constructions are needed. This systemic conception is found in transportation networks, where rival and nonrival goods are entangled together in some balance (S_I). The economics of love forces substitution out of the picture, replacing it with pure reciprocity in human relations.

So what is an economics of love? First, there is a puzzle here for rational economics: love, virtually costless to produce and distribute though always sought, is scarce in modern society. Why? We ought to be awash in love! How is this not the case? Deirdre McCloskey (1990, pp. 142-43) offered a hint, observing that "there is an ethical problem in the theory and practice of economics... Economics was once described as the science of conserving love... The problem is that conserving on love, treating it as ... scarce ... may be a bad way to encourage its growth." This is a key to the answer. Love is a complementary good, much like information; 'what goes around, comes around' here. As Boulding (1962, p. 133) said, teaching "is the one clearly observable process in the universe where the strict laws of conservation do not hold. Energy and matter can only be exchanged: knowledge can be produced... Teaching is in no sense an exchange, in which what the student gets the teacher loses." There are no tradeoffs here, or at least not those we analyze in economics.

Substitution assumptions and the conflict mentality on which they stand do not apply to love – or to any complementary good. This is why "conserving on love" is such "a bad way to encourage its growth." The best strategy among complements is to give them away if 'what goes around, comes around' holds. It is like squandering smiles on the street: the more you offer, the more you get and the better you are at production (as your output capacity grows with practice through a process of habit formation), and thus the more reinforcement you receive for

additional output. This is the economics of complementarity as a guide to choice in its contagious system effects. Smiles and love are reciprocal sources of pleasure that ought to be openly shared and not treated as scarce. An economics of substitution does not apply among complements; indeed, to employ it in this setting will frustrate the outcomes sought: competition creates scarcity in the presence of complementarity.

A transportation network captures the point truly and well: among complements, $S_I > 0$, making the maximum-own-profit price (P_j^*) exceed the maximum-joint-profit price ($P_j^{'}$). If so, then collaboration is a means to improvement here, restoring consonance between efficiency, equity and ecological health (Jennings 2003, 2005). Competition in this setting will lead to restriction of output; here reciprocal goods should be shared to actuate their potential. Losses occur in 'positive feedback' contexts subject to rivalrous structures: so are complements – starved by competition – encouraged through cooperation. An economics of scarcity offers precisely the wrong guidance to choice among complementary outputs. Love and smiles should be openly shared to maximize social well-being.

The main question remaining concerns the relative weight of complementarity and substitution in human affairs. If rivalry yields the organizational form best suited to scarcity problems, while cooperation is much preferred in the presence of complementarity, our optimal institutional choice stands on their relative balance. Substitution is not our only form of interdependence, but how important is complementarity? Is Kaldor right that complementarity is our general case? Or is the commitment to substitution in neoclassical theory correct? The question needs an answer in the absence of industry-based aggregation. The composition rule based on own and joint profit comparisons shows that complementarity calls for some major reforms in how we do economics. Another realm of complementarity is teaching and learning, calling for study of our educational system. A closer review of information transactions in education will lead to insight on the relative weight of negative vs. positive feedbacks (substitution and complementarity) in economic analysis.

Choice in the educational system

Neighborhood stores are wholly focused on physical sources of value, emphasizing consumable goods. Scarcity under a budget constraint defines the maximization

problem essential to orthodox economics. Complementarity says something else, as shown by love and the transportation network model of human relations. Love and information do not suffer from material scarcity (although attention certainly does if faced with floods of data); as Simon (1981, p. 167) said: "A design representation suitable to a world in which the scarce factor is information may be exactly the wrong one for a world in which the scarce factor is attention." This is the very core of the case supporting horizonal theory and justifying the economic efficiency of cooperation in a world of bounded attention or for all intangible goods: in this setting, constraints are imposed and not relieved by rivalrous systems. Emotional and informational outputs act like complementary goods. So we turn to educational (learning) systems as a paradigm for economic conceptions.

The educational system metaphor opens to learning effects through an interdependence of planning horizons (**H***s) and horizon effects. Its implications strongly favor complementarity, not substitution, in our relations of interdependence. If substitution is special – not general – then the case for competition must cede to one for cooperation in social organization. The argument goes as follows. The neighborhood store reduces pricing to profit maximization such that prices maximize own-profits exclusively as defined above. The chessboard inserts the planning horizon (**H***), so prices are also influenced by an ongoing horizonal balance in individual choice. The transportation network captures the external impact of pricing decisions, by adding a feedback term ($\mathbf{S_I}$) of spillover profit effects from $\mathbf{P_j}$* on any group **I**. An economics of love frames an example of complementarity in a case for efficient cooperation among intangible goods, where $\mathbf{S_I} > \mathbf{0}$ means that integrated organization works better than fragmentation of effort.

The educational system opens the orthodox treatment of interdependence (static cross-elasticities) into dynamic horizonal realms. The interhorizonal interdependence of economic decisions strengthens the case for complementarity as our essential human relation, and so demotes substitution to a narrow, auxiliary role. The question is focused thus: what is the likely impact of horizon effects on $\mathbf{S_I}$, the balance of substitution with complementary interdependence? A shift in **H***s – outward or inward – will change **P***s (as already shown), but also alters the feedback term ($\mathbf{S_I}$) of static interdependence. Such effects are predictable under extremely general assumptions: horizonal lengthening moves our interrelations away from substitution toward more complementarity and a horizonal shortening

does the reverse. Threatened people get selfish. Likewise, as we become mature, our generosity grows. If so, then competition in complementary settings shortens horizons as well as subverting output directly. The implications are outlined below as a generalized tragedy of the commons.

What is the influence on $\mathbf{S_I}$ of a change in planning horizons? The direct dependence of prices, sales and growth on horizons was seen, as well as the impact of static interdependence ($\mathbf{S_I}$) on $\mathbf{P_j^*}$ with external profit effects internalized through a compensation process (Hicks 1939, Kaldor 1939). The interhorizonal interdependence of individual planning horizons is the focus here. The question turns on how a change in one person's planning horizons will likely affect others' horizons: not at all; in opposition; or reciprocally. In other words, do planning horizons (horizon effects) show independence, substitution, or complementarity? How do horizon effects spread from private to social domains? That is the critical issue.

The independence of planning horizons is easily dismissed. Our influence on each others' mental states – self-confidence, ethics, motivation, reliability, etc. – is observable and well-established. So the question distills to the actual linkage of horizon effects, to their social interdependence. Do planning horizons show interpersonal substitution or complementarity: are there negative or positive feedbacks among horizon effects? If planning horizons are inter-reactive, what is their proper relational form? If the essence of interhorizonal interdependence is substitution, then when one horizon extends, all others simply retract. In a competitive market, this suggests a takeover by one firm whose efficiency grows unmatched as short horizons select themselves out. This does not reflect general experience. Most entrepreneurial learning appears to be imitation of winning organizational management strategies rather than any reaction against them. Horizonal substitution, where it occurs, is like a defensive threat response to another's success: such a reaction is maladaptive and thus self-extinguishing. This leaves one remaining case.

The nature of interhorizonal interdependence stands on positive feedback, a process of interhorizonal complementarity not substitution. If my neighbor improves her reliability in my decision environment, I am more likely to react by extending and not retracting horizons. Interhorizonal complementarity means that planning horizons shift in concert and not in opposition. Horizon effects spread like contagion among individual agents. Interhorizonal complementarity means

that we change our horizons together. The patterns of interhorizonal interdependence are also dynamic, unlike static cross-elasticity feedbacks in transportation networks. Indeed, the interpersonal spread of horizon effects shifts static interdependencies in predictable ways and, by transforming, transcends them. The clearest way to express such effects is through their overall impact on the feedback term ($\mathbf{S_I}$).

$\mathbf{S_I}$ was defined above as the joint effect on $\mathbf{P_j^*}$ of internalizing its external profit effects on others in any group **I**, expressing a net balance therein of substitution and complementarity. Each entity yields to the impact of selling one unit of output on the profits of proximal firms in group **I**. The question turns on the influence of (both private and social) horizon effects on net interdependence ($\mathbf{S_I}$) in any group with respect to one member with interhorizonal complementarity (Jennings 2008a,b). We reach a general conclusion that horizonal lengthening alters social relations away from substitution in favor of complementarity, transforming conflicts to concerts of value at the margins of interdependence.

This important finding can be expressed in numerous ways, as an improved alignment of personal values when ethics and conscience spread, since longer-range thinking and greater perspectives salve violence, stress and discord through recognition of others' concerns. Here an expansion of planning horizons augments static complementarities at the expense of substitute tradeoffs: 'a rising tide lifts all boats' through synergistic cumulative feedback (Myrdal 1978). Interhorizonal complementarities stimulate positive feedbacks: everyone's social welfare responds to contagiously spreading horizon effects, for better or for worse. (If so, a short-term motive for private gain imposes – at social levels – a generalized tragedy of the commons.)

Such a finding gives support to increasing returns and complementarity in our relations of interdependence. Interhorizonal complementarity means all learning activity in and out of educational institutions is complementary. Competition only applies to substitution and tradeoffs; among complementarities, social cooperation is sought. This has sweeping economic and organizational implications for the design of social incentives in our institutions.

If learning and economic development involve reciprocal outputs, then our rivalrous systems are not advancing but retarding growth (Jennings 2007b, c). The elevation of competition as an efficiency standard only applies to an economics of

substitution, tradeoffs and scarcity; in the presence of complementarity, namely in positive feedback systems, cooperation – not competition – is our route to efficiency. Indeed, the failure of competition to reduce scarcity problems pertains to all intangible goods, such as information, knowledge, ethics, smiles, social conscience, ecological health, horizonal learning, art and community cultures. Substitution assumptions do not reflect the general form of social relations in a modern economy based on knowledge and information.

The five choice metaphors stated so far can be summarized thus. The neighborhood store reflects the realm of neoclassical economics, where no horizon effects occur. The chessboard introduces the role of planning horizons in choice, in a rivalrous zero-sum game. The transportation network opens substitution assumptions into realms of fully interdependent domains where rivalry is combined with synergistic complementarity in a nondecomposable mix. So will love (along with smiles, learning, teaching and other intangibles) show in abundance – shared openly – yet degrade to rarity if framed in rivalrous systems. Static interdependencies in a transportation network adjust – due to horizonal learning effects in an educational system – in the direction of complementarity and away from substitution in a manner that mimics increasing returns (Kaldor 1972, 1975) as civilizations mature. Interdependence is not just static; it is interhorizonal and dynamically balanced as well. The whole systemic configuration is best seen as a human ecology through a horizonal lens, since the organizational structure of our relations stretches beyond the mere aggregation of physical elements here.

This last point is important. The methodological habits of thought (Veblen 1898) among modern economists stop at the aggregation of units into macroeconomic composites, with little attention afforded to organizational issues. Systems – such as in transportation networks – seem more recognizable in neoclassical terms if framed as sums through aggregation than as positions in a structure. Ecological, social, feminist and institutional economists seem more ready to overcome methodological limits than neoclassical advocates; organizational management theorists, psychologists and other systems analysts speak to the problem more articulately than most economists. Some meaningful lessons emerge from methodological laws shunned by economists as outside their realm. These concerns cannot be avoided when dealing with complex systems such as found in human ecology, as we move further into realms of fully interdependent decisions.

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Choice in a holistic human ecology

What is human ecology? Paul Shepard (1969, pp. 131-35), considered its founder, described human ecology thus:

"Ecology deals with organisms in an environment and with the processes that link organism and place. But ecology as such cannot be studied... It is not a discipline... It must be therefore a scope or a way of seeing. Ecological thinking ... requires a kind of vision across boundaries.

And so ecology as applied to man faces the task of renewing a balanced view... It further implies exploration and openness... This idea of natural complexity as a counterpart to human intricacy is central to an ecology of man... Although ecology may be treated as a science, its greater ... wisdom is universal."

A. Toward an economics of human ecology

The sense of engagement that Shepard (1969, p. 135) depicts was lost due to academic conceptions severing us from our studies (Jennings 2007c). Positivism excludes human awareness from its science, so abandoning culture for rigor. As Nicholas Georgescu-Roegen (1967, p. 104) explained:

"From time indefinite, the natural sciences have cherished a positivist epistemology... [in which] objectivity ... requires ... that a proper scientific description should not include man in any capacity whatsoever... For a science of man to exclude altogether man from the picture is a patent incongruity. Nevertheless, standard economics takes special pride in operating with a man-less picture."

Michael Polanyi (1958, pp. 139-42) argued that an impersonal view of knowledge poses a threat to science and culture:

"The ideal of strictly objective knowledge, paradigmatically formulated by LaPlace, continues to sustain a universal tendency to enhance the observational accuracy and systematic precision of science, at the expense of its bearing on its subject matter. This issue [is part of] ... a wider intellectual disorder: namely the menace to all cultural values, including those of science, by an acceptance of a conception of man derived from a Laplacean ideal of knowledge and by the conduct of human affairs in the light of such a conception."

When we become part of our understanding, systems subsume mechanistic constructions within network models. So how we analyze social and natural systems from 'inside' then demands some more reflection. Nicholas Rescher (1979, pp. 46-49) observed that "the network model of cognitive systematization," as distinct from "its Euclidean counterpart ... dispenses altogether with ... axiomatic supports" and it replaces

"stratification of theses into levels of ... fundamentality by a conception of enmeshment... The network appeal is unreductive... [It] shifts the perspective from unidirectional dependency to reciprocal interconnection... A heavy charge can be laid against the Euclidean model on grounds of the enormous hold it has established on philosophical and scientific thought in the West. Its exclusion of circles and cycles on grounds of their violating ... Aristotelian logic against 'circular' ... reasonings impeded the conceptualization of reciprocal causal models in science for over two thousand years."

As Ludwig von Bertalanffy (1968, p. 45), a founder of systems theory, expressed it: "In the world-view called mechanistic ... causality was essentially one-way... This scheme of isolable units acting in one-way causality has proved to be insufficient... We must think in terms of systems of elements in mutual interaction." Bertalanffy (1968, pp. 87-88) added that:

"The mechanistic world-view found its ideal in the Laplacean spirit – i.e., in the conception that all phenomena are ultimately aggregates of fortuitous actions of elementary physical units. Theoretically, this conception does not lead to exact sciences outside the field of physics... Practically, its consequences have been fatal for our civilization. The attitude that considers physical phenomena as the sole standard of reality has led to the mechanization of mankind and to the devaluation of higher values. The unregulated domination of physical technology finally ushered the world in to the catastrophical crises of our time... We believe that ... general system theory ... may be destined ... to play a role similar to that of Aristotelian logic in the science of antiquity. The Greek conception of the world was static... In modern science, dynamic interaction appears to be the central problem in all fields of reality. Its general principles are to be defined by system theory."

B. The methodological implications of fully interdependent domains

A systems theory is needed to address human ecology, emphasizing interdependence, feedbacks, homeostasis, ethics, community values, organizational learning and cohesion in society. Institutional, ecological and cultural economic approaches stress systems analysis in various forms. Systems theory emerged out of fields so diverse as psychology, sociological theory and biology; as R.L. Ackoff (1960, p. 332) said: "Initially we can define a system broadly ... as any entity, conceptual or physical, which consists of interdependent parts."

Systems approaches emphasize interdependence, with externalities seen as a failure not of markets but theory. A paper by Walter P. Heller and David A. Starrett (1976, p. 10) describes the neoclassical theory of externalities thus: "One of the prime attributes of the market system is that it isolates one individual from the influence of others' behavior... Viewed in this light, one can think of externalities as nearly synonymous with nonexistence of markets." So in this system of thought, the market internalizes 'externalities.' A contrasting conception is offered by Sherman R. Krupp (1963, p. 223) in an elegant explanation of why systems theories are needed, due to ubiquitous interdependence:

"Externalities involve statements about the properties of aggregates, when these properties are not wholly deducible from their atomic elements. It is a difficulty which lies at the boundaries of microeconomic price analysis and which concerns the scope of ... deductive economic theory... In deductive systems, combinations of units obey the same laws as individual units. Theorems governing the operation of aggregates are deduced from laws operating in the smaller units and their combinations.

Externalities ... reflect conceptual difficulties at the boundaries of microeconomic theory... Externalities are introduced at the point in theory where deductive explanation becomes unsatisfactory... The application of microeconomic theory to instances of externality constitutes a challenge to the scope of existing theory... At present, the difficulty of adapting theorems drawn from axioms about independent units to permit handling phenomena of common interdependence must be recognized as a major structural problem in microtheory."

Where orthodox standards see market failure, systems approaches find theory failure; Bertalanffy (1968, pp. 18-19) observed that systems address "the

limitations of analytical procedures in science... 'Analytical procedure' means that an entity investigated be resolved into, and hence can be constituted or reconstituted from, the parts put together... These conditions are not fulfilled in the entities called systems." The problem is well defined by Krupp (1963), that externalities so infuse the actions of individuals, any partial analysis of decisions sunders any chance of apprehending their total effect. "Reasoning which abstracts from externalities cannot be applied to a situation in which they are present" (Nove 1969, p. 852), because: "Market information ... is inaccurate when interdependent activities are decentralized" (Malmgren 1961, p. 419).

As Bertalanffy (1968, p. 5) explained: "In one way or another, we are forced to deal with complexities, with 'wholes' or 'systems,' in all fields of knowledge. This implies a basic reorientation in scientific thinking." "Systems approaches ... are ... holistic" according to Fred Massarik, Newton Margulies and Robert Tannenbaum (1985, pp. 10-11): "the more appropriate metaphor is closer to organism than machine, and the more suitable conceptual base is closer to Gestalt theory and field theory (...) than it is to particularism or reductionism." Motivated by concern over ecological loss, for example, "deep ecologists are desperately trying to replace ... the mechanical model of the world with ... an organic model" (Turner 1991, p. 336).

C. The positional nature of systems

The difficulty arises with the positional nature of organization because "the structure of wholes cannot be described in terms of relationships" but only under a different "logical genus" of "system" (Angyal 1941, p. 17). C. West Churchman (1971, p. 62) put it succinctly: "all systems are design nonseparable." Addressing an issue of when systems thinking – originating with Aristotle and culminating with Kant – got derailed in the 19th and 20th centuries by "those who believed that the road to comprehensiveness is through greater and greater precision" with a "model building" approach, Churchman (1979, p. 44) explained that "the use of 'precision' began with Cournot's work on the economics of the firm in the 1830s." Indeed, the initial emergence of organizational theory in economics stemmed from Edward H. Chamberlin's (1933) work on the same problem addressed by Cournot on the interdependence of firms (Jennings 1968).

The urge for rigor in economics set the focus on partial analysis and optimality, to the exclusion of interdependence and externality problems. Substitution implies

that externalities shall damp out as they spread in 'negative feedback' contexts, so they can just be ignored. When complementarities are introduced, then a more integral view reveals the weakness of orthodox separability and substitution assumptions. Churchman (1979, pp. 45-46) noted, against such claims, that "all so-called subsystems ... are strongly nonseparable from the whole system," and that "it is remarkable how intuition and common sense cooperate to convince the mind that success in being precise about one sector of reality implies that one is becoming more precise about the reality of the whole system." The problem appears in the linkage of elements, showing "why the intuitive, commonsense belief that precision about the description of a structure leads to precision about the larger system may be seriously wrong."

Angyal (1941, pp. 20-27) examined one of the issues, showing how the "members of a system" become "constituents" through their positioning or "arrangement." The dimensionality of any system makes it inherently nondecomposable. Here economic and social relations are "explained" by "direct connexion," whereas systems must be "understood" with reference to members' positions in a "superordinate" dimensional domain. Thus "wholes" are not derived by "additive aggregation" in systems, but are arranged therein: "aggregation and whole formation are processes of an entirely different order." As Angyal puts it: "If we recall that [a] system is a kind of arrangement in which the parts do not participate by means of their inherent characteristics but by means of their positional values [like a song in different keys], the above-mentioned relative independence of the whole from the nature of the individual parts will be understandable." D.L. Katz and R.L. Kahn (1969, pp. 90-91) described it thus:

"Systems theory is basically concerned with problems of relationships, of structure, and of interdependence rather than with the constant attributes of objects. In general approach it resembles field theory except that its dynamics deal with temporal as well as spatial patterns. Older formulations ... dealt with the closed systems of the physical sciences... But living systems, whether biological organisms or social organizations, are acutely dependent upon their external environment and so must be conceived of as open systems."

D. Ecological interdependence and a human sense of connection

A knowledge of and involvement with one's environs seems central to the notion of human ecology. The "universal ... wisdom" of ecology "is a deep sense of

engagement with the landscape, with profound connections to surroundings and to natural processes central to all life," which is "difficult ... even to describe" (Shepard 1969, p. 135). Philosopher Thomas Birch (1990, pp. 342-52) offered an insight to the problem:

"At the center of Western culture ... are faulty presuppositions about otherness... Mainstream Western culture views ... otherness ... as adversarial. It presupposes that opposition is fundamentally conflictive, rather than complementary... The essence of otherness is wildness ... [whose] maintenance ... requires ... spontaneity and ... novelty... The fundamental human relationship with nature, and with wildness itself, is participatory, cooperative, and complementary, rather than conflictive... Wildness is logically intractable to systematization. There can be no natural laws of wildness... The realization of this vision would mean recovering the ... relation between humans and others, including human others ... as complementary to us, as we all live together in the wild and continuous composition of the world."

Thomas Berry (1999, pp. 61-62) explored the legal implications of this, suggesting that:

"To achieve a viable human-Earth situation a new jurisprudence must envisage its primary task as that of articulating the conditions for the integral functioning of the Earth process, with special reference to a mutually enhancing human-Earth relationship... In this context each individual being is supported by every other being in the Earth community. In turn, each being contributes to the well-being of every other being in the community. Justice could consist in carrying out this complex of creative relationships."

As Edward Grumbine (1994, p. 381) observed, after referring to Birch and others: "the Western concept of people being separated from nature ... does not allow us to erect a sustainable, cooperative relationship with it... Old worldviews do not dissipate quickly and ... new ways of being take even longer to become established as we feel our way from conflict toward complementarity."

But the sense of engagement described by these authors appears in a contrast, according to Wolfgang Sachs (1993, p. 436), of two alternative frames for apprehending global ecology, as "either a technocratic effort to keep development afloat against the drift of plunder and pollution, or [as] a cultural effort to shake off the hegemony of aging Western values and gradually retire from the

development race. These two ways may not be exclusive ... but they differ deeply in perspective," where the latter entails "designing cultural/political limits to development" within an ethical framework (also cf. Jennings 2007a, 2008a, 2009). As Sachs (1993, p. 442) said of the first approach: "the language of global ecology ... offers data, but no context; it shows diagrams, but no actors; it gives calculations, but no notions of morality; it seeks stability, but disregards beauty." The primary aim of human ecology is to integrate people and nature in a complementary way. In sum, a broader approach is needed for an economics of human ecology.

E. The cognitive fabric of systems theory

A systems theory must be cultural, ethical and ecological; Massarik, Margulies and Tannenbaum (1985, p. 15) call it "human systems development." A key aspect is an orientation toward the design of processes over control of outcomes; Herbert Simon (1981, pp. 115, 223, 228) said that "the proper study of mankind is the science of design" which entails a knowledge of process:

"Given a desired state of affairs and an existing state of affairs, the task of an adaptive organism is to find the difference between these two states and then to find the correlating process that will erase the difference... Human problem solving is basically a form of means-ends analysis that aims at discovering a process description of the path that leads to a desired goal... The notion of substituting a process description for a state description of nature has played a central role in the development of modern science."

As Kenneth Boulding (1956, p. 92) explained: "a new process always starts as a new image, as a new idea. The process itself is merely a form of transcription of the new image." Simon (1981, p. 104) noted that: "Long-term memory operates like a second environment, parallel to the environment sensed through eyes and ears, through which the problem solver can search and to whose contents he can respond." Zenon Pylyshyn (1984, p. 251) put it thus: "It is my view that there is only one empirical hypothesis responsible for the productive success of the entire range of imagery models...: When people imagine a scene or an event, what occurs in their minds is, in many ways, similar to what happens when they observe the corresponding event actually happening." Boulding (1956, pp. 25-26) explained the relevance of fitting images to reality as a horizonal process:

"It is the capacity for organizing information into large and complex images which is the chief glory of our species... Our image of time ... goes far beyond that of the ... lower animals ... because of our capacity for language and for record... The human being ... is firmly located in a temporal process... Because we are aware of time, we are also aware of cause and effect, of contiguity and succession, of cycles and repetition... Because of the extended time image and the extended relationship images, man is capable of 'rational behavior,' that is to say, his response is not to an immediate stimulus but to an image of the future filtered through an elaborate value system. His image contains not only what is but what might be. It is full of potentialities as yet unrealized... Because of his extended image, he is also capable of organizing his own experience in ways that will extend the image further. This is the essence of science and the scientific method... It has led ... to an enormous extension of [man's] image both in time and space and in relationships in the course of the past two hundred years."

Simon (1981, p. 181) also remarked that: "One of the noteworthy characteristics of our century is the shift that appears to be taking place ... in our time perspectives." He assigned this shift to interdependence through communication and transport, and to progress in human knowledge. He closed his Stanford lectures on "Reason in Human Affairs" (Simon 1983, p. 107) thus:

"Reason ... can't select our final goals... It would be quite enough to keep open for our descendants as wide a range of alternatives as our ancestors left for us... Success depends on our ability to broaden human horizons so that people will take into account ... a wider range of consequences. It depends on whether all of us come to recognize that our fate is bound up with the fate of the whole world, that there is no ... self-interest that does not look to our living in a harmonious way with our total environment."

F. Some methodological limitations of orthodox social theory

But successful process design entails a fit between theory and application denied by many economists in neoclassical circles. Milton Friedman (1953, p. 14) even exalted unrealism as a virtue: "in general, the more significant the theory, the more unrealistic the assumptions" (also cf. Jennings 1968). Lawrence Boland (1984, p. 174) lamented that "most practicing economists believe in [Friedman's] methodological tenets." The horizonal answer to Friedman is that the closer the fit of theoretical image to factual application (with respect to realistic assumptions),

the longer our planning horizons, so the better our choices will be (cf., e.g., Lincoln 1985, pp. 31-32). Peter Senge (1990, p. 294) cautioned that, "in the absence of systems thinking, local decision making can become myopic and short-term. This happens because local decision makers fail to see the interdependence by which their actions affect others outside their local sphere."

The planning horizon can be seen to reflect the 'fit' between image and truth throughout human decision. Furthermore, if longer horizons shift our relations away from opposition toward harmony – away from conflicts to concerts of interest – a key issue in social design is how we foster horizonal growth through understanding, greater reliability and more sense of engagement. Competition is not the answer, unless substitution shapes our relations: systems analysis shows – and deep ecology also confirms – that 'otherness' is not adversarial but aligned with human needs. How we design social systems for learning and democratic empowerment has been examined in management theory, ignored by most economists.

Peter Selznick (1948, pp. 261-73) claimed, in a classic organizational paper, that the wide range of systems theory was due to "structural-functional homologies" in which "it is the logic, the type of analysis, which is pertinent," taking "formal organization" as "the structural expression of rational action" within "cooperative systems" which operate as "an economy" and as "an adaptive social structure." Organizations engage people in commitments to wider goals than their own immediate needs, suggesting a tension between the aims of a system and individual wants. As Herbert Simon (1960, p. 204) said: "organizational form must be a joint function of human characteristics and the nature of the task environment" where: "Hierarchy is the adaptive form for finite intelligence to assume in the face of complexity." But the emphasis here is on teamwork: cooperation, not competition, allows systems to function, grow, and thrive in changing contexts. As Simon (1960, p. 210) put it: "Man does not generally work well with his fellow man in relations saturated with authority and dependence, with control and subordination... He works much better when he is teamed with his fellow man in coping with an objective, understandable, external environment."

G. The role of environmental awareness

The focus on environments, central to organizational theory, arises from open systems. As D.L. Katz and R.L. Kahn (1969, pp. 100-102) noted: "Thinking of the

organization as a closed system ... results in a failure to develop the intelligence or feedback function of obtaining adequate information about the changes in environmental forces." Indeed, the whole apparatus suggests a different way of thinking about the world in which we live, on how we tie individual actions into an ecological whole as we move through space and time. Flexibility and diversity allow us to cope with evolving complexity, as Eric Trist (1985, p. 171) explained: "when a system's response repertoire cannot match increases in variety emanating from the environment, that system's survival is endangered." Yet as S. Terreberry (1968, p. 144) observed: "Sociological, social psychological, and business management theorists often still treat formal organizations as closed systems," which should be seen as unscientific if firms and life forms are open systems, as Katz and Kahn (1969, p. 91) maintain: "living systems, whether biological organisms or social organizations, are acutely dependent upon their external environment and so must be conceived of as open systems."

If so, environments should be studied. F.E. Emery and E.L. Trist (1965, pp. 243, 253) defined four ideal types of causal texture related to systems' settings: "the placid, randomized environment" of a competitive market; the imperfect competitive form of a "placid, clustered environment"; "the disturbed-reactive environment" of oligopoly; and a "turbulent field" that has no clear analogue in economics:

"Turbulent fields demand some overall form of organization that is essentially different from the hierarchically structured forms to which we are accustomed. Whereas type 3 [i.e., disturbed-reactive oligopoly] environments require ... competitive organizations ... turbulent environments require ... relationships that will maximize cooperation... We are inclined to speak of this type of relationship as an organizational matrix."

These "matrix organizations" then transform into institutions in turbulent environments "through the embodiment of organizational values which relate them to the wider society." Terreberry (1968, p. 144) described the rejection of optimization by many economists for alternative forms of organization involving greater regard to cooperation – not competition – especially in dynamic uncertain domains where learning and change are important. Eric Trist (1985, pp. 167-73) developed this schema into an "organizational ecology in the general systems sense" by means of a matrix of stakeholder-run interindustry associations that transcend turbulence by adopting an "overriding purpose that emerges from ... shared understanding" achieved through "democratic" community:

"Facing a future of increasing complexity means trying self-regulation within interdependence, learning how to cultivate the new logical type...A negotiated order will need to be founded on collaboration rather than competition, collaboration being the value base appropriate for the adaptive cultivation of interdependence... This change to a new logical type ... requires a reversal of the customary relations between competition and collaboration."

H. The elements of systems theory

There are several themes woven throughout the fabric of systems theory, emerging from its three essential elements which can be defined as substitution (negative feedbacks), complementarity (positive feedbacks) and time horizons (or lags), at least according to Peter Senge (1990, pp. 79-80). Senge identified three essential elements in any system: the first is substitution, normally called 'negative feedback'. The second type, 'positive' or "reinforcing (or amplifying) feedback processes are the engines of growth," equivalent to institutional notions of "cumulative causality" (Myrdal 1978): in the theory of interdependence, this is the concept of complementarity. Finally: "In addition, many feedback processes contain 'delays,' interruptions in the flow of influence which make the consequences of actions occur gradually."

These three aspects of systems theory, according to Senge, are its central concepts. Delays in feedback control loops are of particular relevance to a system's stability and dynamics, such as for efficient performance and subsystem integrity (as seen in terms of the whole). How well organizations survive in the presence of unexpected disturbance is affected by lags in response, not only due to adjustment delays but also rising from uncertainty. As Senge (1990, pp. 89-92) put it:

"Delays between actions and consequences are everywhere in human systems... But delays are often unappreciated and lead to instability... Virtually all feedback processes have some form of delay... Unrecognized delays can also lead to instability and breakdown, especially when they are long. That's one of the lessons of balancing loops with delays: that aggressive action often produces exactly the opposite of what is intended. It produces instability and oscillation, instead of moving you quickly toward your goal."

The systems viewpoint is generally oriented toward the long-term view. That's why delays and feedback loops are so important. In the short term you can often ignore

them; they're inconsequential. They only come back to haunt you in the long term. Reinforcing feedback, balancing feedback, and delays are all fairly simple. They come into their own as building blocks for the "systems archetypes" – more elaborate structures that recur in our personal and work lives again and again.

I. Feedback loops and organizations' stability and cohesion

The notion of feedback control loops and their 'tightness' is important for the integrity – thus the efficiency – and the stability of any system. If forces (effort and tradeoffs) become misaligned, then energies shift from production of value to resolving conflict: this is a waste of vital resources if viable, more cohesive frameworks exist for incentive alignment (that will lengthen planning horizons). This is a matter of flexible linkages and the strength of feedback loops: weak connections stem from doubt about underlying causality and from "managerial self-interest" developing inappropriate choices. Karl Weick (**1985, pp. 120-21, 127-28**) counts "four general features of organizations that directly affect the strength of connections: (1) rules... (2) agreement on rules... (3) feedback... [and] (4) attention" but warns that every organization differs in its design such that the notion of loose coupling in systems is mostly "a way to think" and not a precise structural description: "presumptions, expectations, justifications and commitments ... span the breaks in a loosely coupled system and ... tighten settings. The conditions of order and tightness in organizations exist as much in the mind as they do in the field of action." Senge (**1990, pp. 287-88**) answers the question of how we "achieve control without controlling" with the notion of "localness", which entails "moving decisions down the organizational hierarchy" thereby "unleashing people's commitment by giving them ... freedom to act ... and be responsible for results... Localness is especially vital in times of rapid change."

The tightness of feedback control loops stands on incentive alignment, on how well agents' and group plans mesh. Samuel A. Culbert and John J. McDonough (**1985, pp. 138-39**) opined that: "The concept alignment provides management with a model for understanding how individuals attempt to fuse and integrate their personal needs with the needs of the organization." To summarize Selznick's (**1948, pp. 272-73**) seminal view: organizations engage people in making commitments to wider aims than their own immediate needs, suggesting a tension between the goals of a system and individual wants (**Jennings 1999, p. 58**). The magic of cooperation turns on the delicacy of trust: that each member is loyal to everyone

else and not just out for themselves, so private and social intentions align. No opposition exists between them in healthy organizations, so all effort directly addresses shared ambitions smoothly and freely. In this setting, cooperation operates as it should, through willingly-shared common goals, full engagement and tight devotion.

J. The organizational learning case for cooperation and complementarity

Cooperation also enhances social learning endeavors, so will tighten feedback control loops by increasing consistency of beliefs in organizational systems. Culbert and McDonough (1985, pp. 125-26) add that, in business, "the biggest impediment to ... integration of personal needs and organizational considerations lies in managers' lack of understanding about ... the ways self-interests shape ... personal realities." The timing and tightness of feedbacks show our awareness of the environment and the impact thereon of our actions. If feedback connections are loose, we may not trace an effect to its causal origin or relate them properly. Our planning horizons are extended through knowledge of feedback causality. Understanding our radiant impact tightens feedback control loops since we incorporate these effects into our rational apprehension of how the world responds to us. As Senge (1990, p. 170) said, "a neglected dimension of personal growth lies in 'closing the loops' – in continually discovering how appropriate external forces are actually interrelated with our own actions." As V.I. Kremyanskiy (1960, p. 134) observed: "Self-awareness in living systems is based ... on ... feedback."

Organizational learning comes from understanding causal loops of feedback in dynamic contexts. Thus "a deepening interdependence among the economic and other facets of society" yields an implication "that maximizing cooperation, rather than competition between firms – particularly if their fates are correlated – may become a strong possibility" (Bennis 1966, pp. 221-22). So what does organizational learning mean in systems analysis? For one, it denotes an increase in the "comprehensiveness" (Churchman 1979, pp. 65-66) of views, beyond self-interest to an expansive vision of social ethics, as in Simon's (1983, p. 107) statement above. As Churchman put it, "we must continually think of ourselves as in a whole stream or process, constantly trying to become more ... comprehensive in our perspective." Elsewhere, Churchman (1971, p. 276) noted that: "Inquiry ... is a reaching out of a human being beyond himself to ... what he ... or ... the world could be." In discussing Carl Jung's belief that individual ethics are required for social morality, Churchman (1979, p. 133) wondered "whether the opposite of

Jung's thesis is not more correct; individual morality presupposes the solution of social morality." The meaning of interhorizonal complementarity is that both interact together reciprocally in their private and social effects.

K. The efficiency of cooperation

Social leadership patterns showing group participatory engagement do work more efficiently. Rensis Likert (1961, pp. 280-83, 293) traced productivity to cooperation thus: "Widespread use of participation is one of the more important approaches employed by high-producing managers" to block "competition, hostility and conflict" in the firm. Participatory cooperation is also the route to learning activity, at least according to Churchman (1979, p. 200): "the environment which the inquiring system critically needs is a cooperative environment ... because inquiry is evidently needed to create cooperation and cooperation to create inquiry." In this economic context, dominated by complementarity and a systemic concert of interest, the optimal organizational form is cooperation, not competition, as shown by the transportation network and educational system metaphors (e.g., cf. Johnson and Johnson 1994). Alfie Kohn (1986, pp. 55, 61-65, 108, 110, 113, 123, 129-31, 143), in a remarkable book called *No Contest: The Case Against Competition*, opined that:

"The simplest way to understand why competition generally does not promote excellence is to realize that trying to do well and trying to beat others are two different things... Competition ... precludes the more efficient use of resources that cooperation allows... Beyond the greater efficiency of cooperation, it is also true that competition's unpleasantness diminishes performance... At best, the stressfulness of a competitive situation causes us to try to avoid failure. And trying to avoid failure is not at all the same thing as trying to succeed... Competition does not promote excellence... Whereas cooperation apparently contributes to high self-esteem, competition often seems to have the opposite effect... Psychological health requires unconditionality... In competition, by contrast, self-esteem is conditional... Something very like an addiction is at work here...: the more we compete, the more we need to compete... In sum, the security that is so vital to healthy human development is precisely what competition inhibits... Competition does not promote ... substantial and authentic ... individualism. On the contrary, it encourages rank conformity [and] ... dampens creativity... Creativity is anticonformist at its core; it is ... a process of idiosyncratic thinking and risk-taking. Competition inhibits this process ... [and] affects the personality.

Turning life into a series of contests turns us into cautious, obedient people... The chief result of competition ... is strife."

So organizational learning is a process stemming from cooperation, not an individual outcome of effort devoted to understanding (although the latter is also important in both its private and social effects). Indeed, the glue that holds systems together is shared values and trust in relations standing on common knowledge. L.E. Davis (1985, p. 151) offered a "crucial learning ... that neither organizational design nor technical design can proceed without agreement on ... social values." Agreement on ethics and goals serves to guide decisions toward the results seen as their ultimate destination. No planning process is possible in the absence of values.

L. The role of values in organization

"Values are central to human endeavor" according to Massarik, Margulies and Tannenbaum (1985, pp. 5-7) with three aspects of special importance: authenticity (genuineness); intentionality (purposive action); and personal self-identity (as a balance between integration and distinction in a system): "As human beings all we have is experience flowing through time." But integrating individuals into an interdependent domain within a cohesive framework is the organizational challenge of the 21st century's social thought. This should demand alignment of private tradeoffs with their social effects by means of an ethical linkage of views along with a sense of engagement: the integration of organizational function is a matter of normative values shared through cooperation. D.L. Katz and B. Georgopoulos (1971, pp. 136-38) explain the role of social values and the importance of cooperation in organization thus:

"The great need of our time is a reformulation of social values... In the first place, research and observation show that the norm of reciprocity, of cooperation, of mutual helpfulness, runs wide and deep. Organizations could not exist without many uncounted acts of cooperation which we take for granted... In the second place, justice and fairness are not outmoded values... It is important to emphasize the importance of justice and fairness in the operation of an organization and to introduce reforms where inequity is the practice. In the third place, social responsibility ... has a potential that remains to be developed... All of these values are related to ... the democratic ethic which is still our basic creed...

Organizational reform needs such a value base both as a set of social principles and as guidelines for action."

Competition, alternatively, yields the organizational fragmentation into incommensurate disciplines seen in academe. If knowledge brings integration through a broader understanding, then the failures of competition are revealed by patterns of conflict in economic and social affairs. As Peter Vaill (1985, pp. 572-73) noted: "It is the historical mission of the applied behavioral sciences that gives rise to the imperative of community as an organizing and integrating principle." He developed this important point thus: "A conclusive case can be made ... for a very different mode of inquiry from that developed in the physical sciences" by academics. Indeed, we must redefine the notion of "field" in our research institutions:

"The field is a human enterprise and a system of social processes among academics, professionals, practicing managers, students, and program administrators... It is a community of inquiry and planned change ... not an abstract collection of theories and research findings. It is a community of ideas and meanings. Without the sense of community and the system of practices that sustain and develop it, the theories and research findings indeed do fragment in all directions. Various persons do become radically cut off from each other, both in modes of practice and, more importantly, in values."

M. The humanity of organizational theory

Indeed, the process of organizational learning, communication and integration is often taken as statically given in economics, so its structural aspects are ignored. As Kenneth E. Boulding (1966, p. 29) put it in his honorary Richard T. Ely lecture before the American Economic Association on "The Economics of Knowledge and the Knowledge of Economics": "A substantial monkey wrench is thrown into dynamic economics by the fact that the price system itself may operate as a teacher, and preferences may change in response to the price structure just as the price structure changes in response to preferences."

Such feedbacks are essential in any systems theory although they conflict with the one-way causality often dominant in neoclassical theory, as Rescher (1979, pp. 46-49) and Bertalanffy (1968, pp. 45, 87-88) have noted. Any more realistic concept of growth is thereby excluded in neighborhood stores, on chessboards and

throughout transportation networks; the process of learning avoids substitution in favor of complementarity in undeniably open systems characterized by positive feedbacks (Jennings 2007b). Indeed, "teaching ... is the one clearly observable process in the universe where the strict laws of conservation do not hold," as Boulding (1962, p. 133) has explained. The complementarity of information – indeed, of any intangible goods, such as love and honor – reinforces the case for cooperation. The impact of substitution assumptions on our economic and social understanding of organizational process has been disastrous, imposing very high costs upon our understanding and actions. As Abraham Kaplan (1985, p. 478; also cf. Polanyi 1958, pp. 139-42) noted:

"Here is the shortcoming of applying to interpersonal communication the depersonalized model so useful in the mathematical theory of information. In that model, coding by the transmitter and decoding by the receiver are separable and independent processes. In the life of dialogue, however, there is a continuous interaction between them. What is happening is not transmission ... but the emergence of a shared meaning... The interchange is not just communication but a species of communion by which alone ... each participant in the dialogue first becomes a person."

N. The organizational implications of a humane economics

Chris Argyris (1960, pp. 262-63, 268-69; also cf. Maslow 1954, 1968; Wachtel 1989; Kohn 1986; Scitovsky 1976; McGregor 1960), a well-known organizational theorist, declared that conventional management treats organizational members like children rather than as adults: mature people in these settings show symptoms of ill health, including "frustration, failure, short time perspective and conflict." He voiced concern about organizational fragmentation thus: "The nature of the formal principles of organization causes the subordinates, at any given level, to experience competition, rivalry, intersubordinate hostility and to develop a focus toward the parts rather than the whole." Douglas McGregor (1960, p. 310-11) long ago warned in an often noted paper on organizational management that:

"The deprivation of needs has behavioral consequences... The man whose needs for safety, association, independence or status are thwarted is sick, just as surely as he who has rickets. We will be mistaken if we attribute ... passivity, or ... hostility, or ... refusal to accept responsibility to ... inherent 'human nature.' These forms of behavior are symptoms of illness – of deprivation of ... social and egoistic needs."

McGregor went on to explore the connection to rampant consumerism and materialism in modern cultures:

"The fact that management has provided for these physiological and safety needs has shifted the motivational emphasis to the social and egoistic needs. Unless there are opportunities at work to satisfy these higher-level needs, people will be deprived; and their behavior will reflect this deprivation... People will make insistent demands for more money under these conditions. It becomes more important than ever to buy the material goods and services which can provide limited satisfaction of the thwarted needs. Although money has only limited value in satisfying many higher-level needs, it can become the focus of interest if it is the only means available."

O. Toward an ecological understanding of economic society

The metaphor of human ecology opens economics into an unfamiliar realm of feedbacks, circular reasoning and dynamic complexity yielding a systems approach. The notion of planning horizons – specifically of horizon effects as an ordinal shift in our range of awareness (so of our rational bounds) – suggests an organizational principle for a new social science. Such a horizonal economics stands on an understanding of fields in diverse subject areas, all of which point to cooperation as a means to lengthen planning horizons and to restore ethics and civility in our relations. So we must talk of values and aesthetics as well as about economics. As Donald Worster (1993, p. 418) remarked about achieving sustainability in ecological systems: "My own preference is for an environmentalism that talks about earth ethics and aesthetics rather than about resources and economics, that places priority on the survival of the living world of plants and animals on which our own survival depends, and that focuses on what nature's priceless beauty can add to our emotional well-being."

Senge (1990, p. 274, quoting Badaracco and Ellsworth 1989) notes the "self-fulfilling" character of the belief "that people are motivated by self-interest and by ... power and wealth":

"If people are assumed to be motivated only by self-interest, then an organization automatically develops a highly political style, with the result that people must continually look out for their self-interest in order to survive. An alternative assumption is that, over and above self-interest, people truly want to be part of

something larger than themselves... When organizations foster shared visions, they draw forth this broader commitment and concern."

The ongoing neglect of positive feedbacks and humanity in economic and social theory has some meaningful lessons that only an emphasis on natural systems as a representation of human behavior can effectively bring to light. Thus will human ecology use systems theory as a means for reform of failed approaches in economics stemming from positivist depictions of learning in which humans are absent and/or invisible, as Georgescu-Roegen (1967, p. 104) noted. The social implications spread through all we know of ourselves and each other, recapturing cognitive factors and moving them into our center of focus. Indeed, the notion of planning horizons stems from an inductive frame of fully interdependent dynamic complexity in its assumptions. Systems seem to reflect the view of Polanyi (1958) and many others that the study of physics, social science and – especially – economics should be engaged with and not detached from values (Myrdal 1954, 1972) and personal growth (Boulding 1956). Thus will human ecology as a model of social analysis show where reciprocity overwhelms substitution, making cooperation our best means to organizational learning, economic growth and social welfare improvement (Jennings 2007b). The primary impact of competition has been destructive in the extreme, as Paul Hawken (1994, p. 3) disturbingly warned:

"Quite simply, our business practices are destroying life on earth. ... We know that every natural system on the planet is disintegrating. The land, water, air and sea have been functionally transformed from life-supporting systems into repositories for waste. There is no polite way to say that business is destroying the world."

As Hawken (1999, pp. 19-20) noted elsewhere, in attributing our rapacity to economists' stubborn denial of modern knowledge in other realms: "We are surrendering our living systems, social stability, fiscal soundness, and personal health to outmoded economic assumptions." Is it not time to revise our representations to fit what is known?

Summary and conclusions

The six choice metaphors in this paper reveal a pressing need for an economics of planning horizons. Standard textbook constructions see supply and demand as given and take all time horizons as fixed, distinguishing short from long term models without attending to run length itself. Choice in neighborhood stores is

simple, with no projection needed. The economics of neighborhood stores cannot be used to guide choice on a chessboard due to irreversible outcomes splayed across strategic contingencies (as in oligopoly). In chess, savvy counts: the better one apprehends the game – and an opponent's style of play – the further ahead are effects seen. The move horizon in chess is like the planning horizon in choice: the better we understand the world – in how it works as a complex system – the more efficient will be our use of resources in the pursuit of ends.

But substitution is not our only form of interdependence. Standard theory in economics studies the interaction of firms in industries at the cost of any attention to complementarity: conflict dominates concerts of interest in neoclassical theory. A transportation network captures the balance of substitution and complementarity in a compensated internalization of interfirm profit effects within any group. But reciprocity is not rivalry; any application of frames standing on substitution assumptions will lead us astray in this setting. As a result, we reap what we sow – as Badaracco and Ellsworth suggest (Senge 1990, p. 274) – through positive feedbacks shaping us, affecting all our beliefs and decisions. Ironically, policies aimed to improve efficiency under rivalry are creating crises among complements such as love and learning. Competition may encourage physical output (with rising cost), but starves intangibles in domains of far more importance to us, shortening our planning horizons, undermining cohesion and destabilizing organization throughout our social systems.

The educational system metaphor introduces another issue: with a nondecomposable mix of substitution and complementarity, how would horizon effects – changes in **H*** – rend this balance of feedbacks? This question has an answer: interhorizonal complementarity means that changes in **H*** mimic causal linkages under increasing returns and complementarity (Jennings 2008a). In sum, mainstream models are incomplete not just due to fixed horizons, but also because orthodox standards cede to horizon effects in economic importance. Incorporating contagious horizon effects shows some major revisions are needed toward complex system approaches in economics. Further ramifications will lead us well beyond the scope of this paper.

Under orthodox standards, interdependencies show as substitution, so competition is seen as the optimal organizational form: rivalry increases output and collusion does harm. This is a well-established part of the canon of economics and the rationale for social system design throughout the world. But a systems approach

embraces two alternative forms of interdependence: substitution (negative feedbacks or conflicts of interest) and complementarity (positive feedbacks or concerts of interest). Substitution demands competition for an efficient outcome. For similar reasons, complementarity calls for cooperation. Just as collusion of substitutes is said to be inefficient, competition among complements is self-defeating as well. Transportation networks show both substitution and complementarity in a nondecomposable mix, suggesting a more general question.

How do planning horizons affect the balance of interdependencies in educational systems? The answer relates to all economic contexts, so long as horizons move together (and not in opposition): longer planning horizons shift our relations toward a concert of interest away from rivalrous strife. But this sort of advance is stifled by a competitive frame of incentives: social institutions should thus evolve, favoring cooperation, to support the overall lengthening of planning horizons. If they do not, progress is slowed; horizonal growth is starved. In fact competition in complementary settings is counterproductive: here rivalry is keeping us stupid and immature, running on narcissistic concerns while in denial on ecological loss. Planning horizons serve as the engine of growth in a complex systems economy (Jennings 2007b). Horizonal learning is spread through cooperation and blocked by competition, as with all intangible goods. The failure of neighborhood store economics stems from increasing returns, complementarity and horizon effects being kept out of frame (Jennings 2008a).

This paper reveals a need for horizonal economics. Standard theory in economics is savaging all life on the earth, due to its strict doctrine of substitution applied where it has no place. Ecosystems are complementary in their relations as well, leaving economists with a heavy burden in our responsibility for the current deterioration of all life on the planet. The shift from competition to cooperation needed to extend planning horizons across society has not occurred due to economists' stubborn denial of falling cost (Jennings 2008a,b). A brief view of human ecology offers some meaningful lessons on how and why our system must change and embrace horizonal economics as a means to renewal (Gardner 1981). Whether economists will pay heed cannot be answered in the abstract. All one can do is point the way, and hope that colleagues will listen (Tannenbaum and Hanna 1985).

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