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**Abstract**

Complexity economics is a promising theory for consumer education that aspires to be focused on global justice and sustainability in a profoundly complex consumer marketplace. This paper first discusses the basic tenets of complexity theory, the foundations of complexity economics, followed by an overview of normal versus post-normal science, including tame and wicked problems. The third part of the paper positions consumer education within normal science, explicating the assumptions of conventional neoliberal economic theory. The final part discusses the assumptions of complexity economics, and how it challenges traditional economic theory. A case is made for augmenting 21st century consumer education with complexity economics, anticipating a companion paper with pedagogical details.

The management of consumer economics within households is a very complex process (Hira, 2009), unfolding in an incredibly complex global market. No less than 20 dimensions of daily family life require astute and careful management to ensure stability and viability of both the family’s finances and of the relationships associated with the management of finances within a home and with the external environment (see Figure 1). In attempts to deal with the complex dynamics of consumer economics, management and decision making, consumer education has evolved over the past 50 years (McGregor, 2010a,d). She identified 25 different consumer education initiatives in Canada, United States and Europe. Although not expressly articulated, most of these pedagogical innovations were predicated on conventional economic theory, a form of normal science (to be discussed shortly).

![Figure 1 Dimensions of Complex Consumer Management](image)
Recently, consumer educators have become more concerned with issues of global justice and sustainability as parlayed through consumption decisions. However, architects of these consumer education innovations seldom identify which economic theoretical perspectives underpin their pedagogical approaches, despite that many frameworks now focus on citizen-consumers striving for citizenship, justice, solidarity and sustainability, acting from a site of political resistance (McGregor, 2010a,d). New approaches to consumer education appear to be intimating a different economic theory, one that respects complexity, relationships, and constant change and fluctuation instead of equilibrium, individuality, rationality and optimization. In light of the biggest economic meltdown of all time, the 2008 global economic recession, conventional economic theory is being challenged, with complexity economics emerging as a strong contender (McKie & Ławniczak, 2009). This paper proposes that 21st century consumer education can augment its focus on neoclassical economic theory (focused on tame problems) with complexity economics (a strand of post-normal science focused on wicked problems, to be discussed shortly). Succinctly, wicked problems have no obvious solution, are interpreted differently by different stakeholders and any efforts to solve them almost always cause other problems (e.g., climate change).

To develop this idea, the paper first discusses the general concept of complexity theory, from which complexity economics draws its tenets and assumptions. This is followed by an overview of normal versus post-normal science, including tame and wicked problems. Complexity theory is an aspect of post-normal science, while conventional economic theory stems from normal science. The third part of the paper positions consumer education within normal science, explicating the assumptions of conventional economic theory. The fourth part discusses the assumptions of complexity economics, and how it challenges the assumptions of traditional economic theory. The case is made for augmenting 21st century consumer education with complexity economics theory, anticipating a companion paper with pedagogical details.

**Basic Tenets of Complexity Theory**

Complexity economics stems from complexity theory. As a brief primer, complexity is derived from the Latin verb *complecti* (to twine together) and the noun *complexus* (network). The word system is derived from Greek *systema*, meaning a whole composed of many parts (Gummesson, 2009). Complexity theory assumes a system can comprise living parts that are intelligent and capable of adapting to their environment through interactions, communication and coordinated activities. Parts that have the ability to process information and adapt their behaviour are called *agents* (including consumers, firms, governments and civil society organizations). The system within which these agents interact is called an *intelligent complex, adaptive system* (Beinhocker, 2007; Yang & Shan, 2008). Examples of complex adaptive systems include the ecosystem, the brain, the human immune system, the stock market, political parties, ant colonies, communities and economic systems.

In a complex system, the agents constantly act and react to what other agents are doing. The overall behaviour of the complex adaptive system is the result of a huge number of decisions made *every moment* by many individual agents (Holland, 1999). Complex behaviour of the whole system (aggregate behaviour) is the result of loosely coupled agents behaving in simple ways, acting on local information (Dooley, 2002). Complexity theory assumes micro-level interactions of the parts (the agents) of a system lead to the emergence of macro-level patterns of behaviour (Beinhocker, 2007; Yang and Shan, 2008). Business people, consumers and others make millions of decisions each day that comprise the evolving form, structure and character of
the economy (Innes & Booher, 2000). Complexity theory is concerned with how this complex behaviour evolves or emerges from relatively simple local interactions between system components over time (Manson, 2001).

Complexity theory describes how people and organizations respond to the chaos around them; hence, one of the main tenets of complexity theory is chaos. Chaos is Greek khaos for emptiness, gaping void, abyss, formless state, wide openness. Re-conceiving what constitutes order is a cornerstone of complexity theory (Whitt & Schultze, 2009). Within complexity theory, chaos does not mean disarray or being out of order; rather, it means order emerging. In fact, chaos means order with no predictability. Events appear to be random; hence, confusion is erroneously inferred. Order is created through chaos; as a result of fluctuation, change and disturbances, order emerges from within the emptiness. From a complexity mind set, people would accept that constant flux, tension and change create chaos and that chaos is not a bad thing. Unpredictability helps create complexity (Whitt & Schultze).

Complexity theory assumes people will self-organize (reorganize) and seek solutions to the perceived lack of order. Self-organization is defined as the process by which the internal organization of a system increases in complexity without being guided or managed from an outside source (Heylighen, 2008). By accepting the idea that chaos (an unpredictable, seemingly empty space) is a recognizable step towards new situations, people can appreciate the merit of standing back and watching the system over time. This way, people are not surprised when disorder and perceived emptiness emerge - they expect it and embrace it. They know they have to let go of their need for order and to pass through the darkness of chaos - knowing in their hearts that chaos is order, with no predictability (McGregor, 2010c; Wheatley, 1994).

Chaos theory looks at how very simple things can generate very complex outcomes, which could not be predicted by looking at the parts themselves. An example of chaos theory is the flight pattern of a flock of birds. Conversely, complexity theory looks at how very complex systems can generate very simple outcomes when a large number of individual agents come together and interact intensely with each other. An example of complexity theory is cells in the human body (MacGill, 2007). Complexity theory is concerned with how a distributed network of agents, each with little knowledge individually, can produce outcomes that are coordinated and that demonstrate more intelligence collectively than any individual (Innes & Booher, 2000). Patterns and structures seem to emerge out of nowhere because the parts of the system are able to self-(re)organize as a result of the parts interacting. The results are complex, adaptive systems, which are capable of changing and learning from experiences - evolving (MacGill).

Complexity theory is increasingly being brought to bear on business management, economic systems and on education (David & Sumara, 2008; Dooley, 2002; McKie & Ławniczak, 2009). Its main concepts include chaos, emergence, adaptation, self-organization, patterns, agents, networks, wholeness, and interdependent interactions among divergent yet connected parts. Other concepts include learning and memory, change and evolution, surrounding environments, relationships between entities, internal system substructures, and holism and synergy (Manson, 2001). This paper makes the case that complexity theory can inform consumer education with a resultant deeper focus on complex, emergent interactions among consumers, marketplace firms, government agencies, institutions, and civil society organizations.
Normal versus Post-normal Science

As noted, most consumer education initiatives of the past appeared to be predicated on neoclassical economic theory, a form of normal science (a term coined by Thomas Kuhn in 1962). Complexity economics, on the other hand, is a strand of post-normal science (Batie, 2008), a term coined by Funtowicz and Ravetz (1991). This section differentiates between these two forms of science, and also discusses tame and wicked problems (see Figures 2 and 3). Normal science also is called positivistic science; the only way to be positive that research has produced truth is if the scientific method was employed. Anything that challenges the tenets of positivistic science is called post-positivistic science (McGregor & Murnane, 2010), of which post-normal science is an example.¹

![Figure 2 - Comparison of Normal and Post-Normal Science](image)

Normal Science

Normal science is what most scientists do all of the time and what all scientists do most of the time. They use agreed-upon rules (proper scientific methods and axioms) in order to solve puzzles, striving to produce new knowledge for the sake of having the knowledge (Kuhn, 1962). Normal science strives to figure out how the world works, using knowledge generated from the scientific method to inform judgements (Hulme, 2007). Normal science adds to the details of an established theory, but does not challenge or test its assumptions. It assumes that scientific
progress leads to societal progress (Turnpenny, Jones & Lorenzoni, 2011).

The knowledge that normal science creates flows into and is stored in a knowledge reservoir that can then be drawn upon by society. Normal science (including economics) is isolated from society; there is a clear division between who does the science and who uses it. Normal science assumes no responsibility for how the knowledge in the reservoir is put to use by members of society; instead, it is the responsibility of normal science to ensure that it gets the science right using the linear model of cause and effect. The right science increases the certainty that society will progress if it uses the knowledge generated from rigorous scientific scholarship (Turnpenny et al., 2011).

Normal science consists of puzzle solving within an unquestioned theoretical framework and an unquestionable paradigm ((International Society for Ecological Economics, Funtowicz & Ravetz, 2008; Kuhn, 1962). Normal science (positivistic research) is criticized as being incapable of understanding the bigger picture in planning for the future. Those who embrace normal science trust in the inviolability of its objective representation of the facts and truth, which can never be infringed upon or dishonoured. As well, normal science relies heavily on quantitative assessments and on falsifiability of data; that is, data are irrefutable if discovered using the scientific method (International Society for Ecological Economics et al., 2008; Turnpenny et al., 2011). Hulme (2007) asserted that normal science is a privileged enterprise and that society normally affords it high status relative to other forms of inquiry.

**Tame Problems.** Most especially, normal science focuses on tame problems that are complex and difficult yet can be solved by disciplinary experts with little or no involvement with societal stakeholders (Batie, 2008), see Figure 3. Examples of tame problems include identifying the cost effectiveness of different crop practices, determining the costs and benefits of expanding an irrigation project, or determining the source of a food contamination outbreak (Batie). Conklin (2006) suggested that finding the shortest route from A to B, raising $10,000 or selecting a new doctor in a new city are examples of tame problems, some of which can be very technically complex.

These problems can be clearly delineated, precisely described and these definitions do not change a lot over time. In the process of defining the problem, potential solutions tend to emerge due to clear cause and effect mechanisms. The more a tame problem is studied, the more various answers sooner or later converge. Everyone tends to agree on why something needs to be done, and on the right way to go about doing it. Tame problems tend to enjoy consensus. Everyone agrees that the problem does have a solution (Conklin, 2006; Hancock, 2004), and there tends to be little conflict over the desirability of potential solutions (Batie).

Tame problems can be solved in relative isolation from one another. Those involved break things down into parts and fix any broken components, without examining any patterns or connections between the parts. Many tame problems are not simple, are not easily understood or solved, but everyone involved does assume that a solution is possible. And, the problem solvers know when the job is done because there are criteria that tell when the solution or a solution has been found. Solutions can be tried and abandoned and they come from a limited set of alternative solutions (Conklin, 2006; Ritchey, 2010). A tame problem belongs to a class of problems that can be solved in a similar way. There is little danger of solving the wrong problem or causing other problems (Hancock, 2004).
Post-normal Science

Post-normal science (PNS) rejects the assumptions of normal science (see Figure 3), presuming instead that “facts are uncertain, values in dispute, stakes high, and decisions urgent” (Ravetz, 1999, p.649). In these conditions, science can be anything but normal. Normalcy cannot address the reality that today’s problems “have more than one plausible answer, and many have no answer at all” (p.649). Post-normal science is seen as the key to achieving more sustainable futures because it provides an alternative approach to dealing with highly complicated and complex global problems (Turnpenny et al., 2011).

The *science* in PNS refers to both (a) normal, conventional notions of science and understandings of the world and (b) knowledge of the world that stems beyond the formal scientific community, mainly from extended peer communities (beyond the specialist science peer group) (Healy, 1999). Whereas normal science generates knowledge that is stored in a reservoir accessible by society, post-normal science relies on normal science knowledge as well as that generated by members of civil society. The extended peer community constitutes all of those affected by an issue who are prepared to enter a dialogue about it (Turnpenny, Lorenzoni &
Jones, 2009). The peer community brings an extension of facts to the table, beyond the facts generated using normal science (Healy). Extended is Latin *extendere*, stretched out. Extended facts comprise those beyond the materials provided by the experts, and include wisdom, local and community knowledge, anecdotal evidence, neighbourhood surveys, investigative journalism and leaked or private documents (International Society for Ecological Economics et al., 2008; Ravetz, 1999).

Post-normal science also is deeply concerned with a plurality of multiple, legitimate perspectives, due to its concomitant appreciation for the complexity and uncertainty of systems (natural, social, economic and political) and the relevance of human commitments and values (International Society for Ecological Economics, et al., 2008; Ravetz, 1999). Post-normal science “focuses on aspects of problem solving that tend to be neglected in traditional accounts of [normal] scientific practice: uncertainty, value loading, and a plurality of legitimate perspectives. PNS considers these elements as integral to science... and the framing of complex issues” (International Society for Ecological Economics, et al., p. 1).

**Wicked Problems.** Normal science “smoothed over (tamed) its wicked, rough edges with abstracting assumptions” (Batie, 2008, p.1180) (see following section on assumptions of neo-liberal economic theory). To address this practice, post-normal science evolved as a way for people to deal with wicked problems that cannot be, or have not been, tamed by normal science. Examples of wicked problems include global environmental issues (climate change), health pandemics, water resource management, poverty and energy issues (e.g., what to do when oil resources run out). Other wicked problems are how to deal with crime and violence in schools and how to deal with consumerism as a source of structural violence. Turnpenny et al. (2009) asserted the world is permeated by wicked issues.

Wicked is Latin *prav* for vicious, crooked and perverted. Rittel and Webber (1973), who coined the term wicked problems, felt wicked was akin to malignant (in contrast to tame or benign), vicious (as in vicious circle), tricky (like a leprechaun) or aggressive (like a lion). Wicked problems are characterized by (a) uncertainty; (b) inconsistency of needs, preferences and values; (c) an unclear sense of all consequences and/or the cumulative impact of collective action; and, (d) fluid, heterogeneous, pluralistic participation in problem definition and solution (Carley & Christie, 2000). A wicked issue is incomplete, contradictory and it has changing requirements. There are complex interdependencies, and it is often difficult to reach consensus (Turnpenny et al., 2009). One cannot understand a wicked problem until one has developed a solution; that is the *Catch 22* (Conklin, 2006).

Batie (2008) called wicked problems “social messes” (p. 1176) that are never solved; they just become better or worse, or the solution is deemed good enough. Rittel and Weber (1973) characterized wicked problems as ill-structured issues that have human relationships and social interactions at their center. What the problem is depends upon whom is asked - different stakeholders have radically different views and understandings of the complex issue with no correct view, and they have different views of what constitutes an acceptable solution. There are no given alternative solutions because there is an immense space for options. Within that space, those involved have to negotiate and collectively exercise judgements, all the while juggling conflicting interests and priorities (Conklin, 2006).

It is no surprise then that wicked problems are ripe with attendant value conflicts, further exacerbated by widely varying goals, perspectives, ideologies and interests. These highly uncertain issues are especially difficult to solve because each attempt to create a solution changes
the problem. And, every solution that is offered exposes new aspects of the problem, requiring further adjustments of potential solutions. This process is provoked because of the inherent uncertainty in system components and outcomes. Furthermore, there are no classes of wicked problems that can be solved using overarching principles; each wicked problem is unique because of (a) the nature and properties of the presenting problem and (b) the configuration of related issues, of stakeholders and the context. And, many aspects of a particular wicked problem can be considered symptoms of other problems, necessitating a lot of circular causality (one thing is caused by and causes another) (Conklin, 2006; Ritchey, 2010; Rittel & Weber, 1973).

Wicked problem solving ends when people run out of resources (time, money, energy) or when a solution is reached that is good enough (satisficing). More significantly, the aim is not to find the truth (as with normal science) but to improve some aspect of the world where people live; hence, the problem solvers cannot afford to be wrong. Too much is at stake. Every attempt to solve a wicked problem has lasting, often unintended, consequences, which have the potential to spawn new wicked problems. One cannot build a nuclear plant or a power project dam just to see if it works (Conklin, 2006; Ritchey, 2010; Rittel & Weber, 1973). “Over time one acquires wisdom and experience about the approach to wicked problems, but one is always a beginner in the specifics of a new wicked problem” (Conklin, p. 7).

Consumer Education, Neoliberal Economics and Normal Science

Conventional consumer education has been traditionally informed by neoclassical, neoliberal economic theory, a key component of normal science. This is evident in attempts to teach rational decision making, information processing, choice maximization, optimal management of scarce resources to ensure efficiency, and consumer rights to protect the individual’s economic interests (Bannister & Monsma, 1982; McGregor, 2010d).

Assumptions of Neoliberal Economic Theory

Neoliberal economic theory assumes individuals are rational optimizers and maximizers, working in a stable environment where perfect information is available. Using formal decision logic, consumers and producers are assumed to achieve equilibrium and optimal outcomes. Consumers are assumed to have unlimited cognitive resources and they enter purchase situations with complete and unbiased knowledge about their environment. Consumers are assumed to be sovereigns of the marketplace and are not affected or influenced by their values, beliefs or perceptions. This theory assumes that because consumers cannot improve their behaviour, they must act rationally, be well informed and use that information (Arthur, 2009; Pavard & Dugdale, 2001).

Neoclassical economic theory also assumes homogeneity, meaning it assumes “the economic man” is essentially the same. The economic man principle symbolizes every individual in society. The theory assumes that by always thinking rationally, everyone can maximize their economic welfare and achieve consumer equilibrium because they are capable of maximizing any situation that involves choice. Neoclassical economic theory further assumes there is a lack of distinction between the individual agent and the aggregate level (Arthur, 2009; Pavard & Dugdale, 2001).

As well, this theory embraces the linear assumption; that is, more normal economic science leads to less certainty, which leads to improved decisions. It further assumes that the market is the right mechanism for social choices, that prices equate to valuation (estimation of something’s worth), and that economic valuation (assigning monetary value to non-economic factors) can be mapped into what is socially preferred (Batie, 2008). Rosser, Cramer, Holt and
Colander (2010) explained that standard economics textbooks focus on efficiency and optimization, all the while assuming that consumers are rational, selfish and operating in an environment that arrives at a unique equilibrium through supply and demand functions. As will be further illustrated, this economic model is hypothetical. The assumptions on which it is built deviate from real-world conditions, replete with complex relationships and wicked problems.

**Consumer Issues as Tame Problems**

Within the normal science approach to consumer education, conventional consumer issues can be described as tame problems. Examples of traditional consumer issues are anti-trust (monopolies and cartels), unfair competition, credit and debt mismanagement, unfair consumer contracts, unsafe products and service delivery, inadequate or unsymmetrical information, and misleading and fraudulent sales practices. If a consumer issue is left unresolved, some aspect of the consumers’ self or economic interest will be negatively affected (e.g., their safety, redress, voice, choice) leading to personal or financial harm or disadvantage.

These long standing consumer issues can be framed as tame problems because, through a neoliberal economic lens, consumer educators assume consumer issues are characterized by clear definitions, which tend not to change over time, although the issues can manifest in various ways from one situation to another. Basically, though, anti-trust is anti-trust. Misleading advertising is misleading advertising. These tame problems are readily recognizable when they manifest in the marketplace, and everyone assumes there is a solution to remedy the negative fallout.

Through a linear, cause-and-effect mechanism, the process of clearly defining a consumer issue reveals or unveils potential solutions, usually in the form of (a) government intervention (via laws regulating market structures and business and consumer behaviours) and (b) consumer education and information. (c) Some consumer issues are dealt with through soft-law and firms’ self-regulation. With tame problems, there is widespread agreement that protecting consumers from the aggressive and/or illegal actions of firms is desirable. There tends to be little conflict about the desirability of the proposed solution(s) for the issue at hand. What worked in one situation (country, state) may well work in another, and often does.

**Consumer Education, Complexity Economics and Post-normal Science**

Consumer education predicated on normal science is no longer adequate because consumption is no longer business-as-usual (pun intended) - it is no longer normal. The assumptions of neoliberal economics, that smooth out the rough edges of the untamed, wicked side effects of normal consumption, should no longer be the sole foundation of consumer education curriculum. In more detail, people are making consumer choices within a sophisticated and fast-changing world. Decisions made by consumers have a profound impact on themselves, the next generation, those not born, those living elsewhere, the Earth’s ecosystem and other species. Consumption is integrally intertwined with global justice, sustainability and the human condition (McGregor, 2007). Twenty-first century consumption results in unintended contributions to the perpetuation of wicked issues because consumption contributes to the perpetuation of complex late-industrial problems (e.g., genetically modified foods, climate change, desertification and water depletion, and poverty). Innocuous purchases (unethical, immoral and amoral) are causing irreparable harm to the environment, other species and to those who labour to make goods and services (McGregor, 2010b).

Continuing to use traditional economic principles (normal science) to explain the nuances of consumer decisions with global implications does not allow consumer educators to adequately capture the reality of today's global consumption decisions (McGregor, 1998). Post-normal
science is concerned with how science needs to be done in the cause of global justice and sustainability. It is focused on how people might “achieve a better balance between environmental and social priorities with a view to channeling societies to a path of sustainable development (Turnpenny et al., 2011, p.9). PNS is further concerned with the development of new research methods and theories that “include ethical and social considerations to assist with the management of uncertainty for the common good” (p.5).

Consumer educators adhering to normal science may, by instinct, unwittingly hide behind neoliberal economic experts when confronted with wicked consumer issues (see Hulme, 2007; Ravetz, 1999). This paper proposes that consumer educators can use post-normal science as one way to understand the limits of economic models and conventional approaches to consumer behaviour; in particular, they can turn to complexity economics and post-normal science’s focus on wicked problems. Changing one’s perspective changes what one perceives as being important (Colander, 2008). In order to respect the complexity of modern day consumption, consumer educators have to take normal science off center stage, give it less importance. That means foregoing their heavy reliance on neoliberal economic theory (see Hulme, 2007), or at least becoming cognizant of its basic assumptions.

Assumptions of Complexity Economic Theory

Consumer educators wishing to address wicked consumer issues can learn lessons from post-normal science by turning to complexity economics, a 21st century intellectual movement that is profoundly altering the views of economists (Rosser, 2004). Batie (2008) identified complexity economics as a key post-normal science. As a field of study, complexity economics is only at its beginning stages, but it is anticipated to be the wave of the future (Rosser et al., 2010). Complexity economics traces its roots to the Sante Fe Institute’s (SFI) exploration of the relationship between economics and physics, achieved by fostering multidisciplinary collaborations in the physical, biological, computational and social sciences in order to understand complex adaptive systems, including the economy (Arthur, 2010; Rosenhead, 1998).

Complexity economics strives to see the economy as a complex system that follows the same laws as all complex, dynamic systems (see earlier discussion). Complexity economics eschews the far-sighted rationality assumed of individuals because if the economy is truly complex, then individuals cannot rationally deal with every part of it (Colander, 2008). The economy is assumed to be an evolving complex system, which has competing forces operating all the time. It is in constant change and flux (Rosser et al., 2010). Full rationality as optimization will not suffice anymore because economic reality is rife with uncertainty, nonlinearity, discontinuity and a variety of phenomena and actors that are not easily predicted or understood (chaos). Nonlinear movement refers to that which does not progress or develop smoothly from one stage to the next in a logical way; instead, it makes sudden changes, or seems to develop in different directions at the same time, exhibiting discontinuity, uncertainty and emergence (Whitt & Schultze, 2009). Today’s modern economy achieves its order (indeed its disorder) from the complex interactions that constitute an evolutionary process, which defies far-sighted rationality and linear thinking (Rosser, 2004).

Complexity economics calls into question the entire premise of equilibrium (a balanced state), which is the centerpiece of conventional economics; instead, it assumes emergence, tension and chaos are key characteristics of economic systems and processes (Colander, 2008). Arthur (2010) explained that whereas conventional economics asks how the economy would behave if it were in a steady state (equilibrium), complexity economics wants to know how the
economy would behave if it were not in a steady state - out of equilibrium. Conventional economics assumes that economic patterns settle down over sufficient time to a simple, homogeneous equilibrium that requires no further behavioural adjustments. Complexity economics assumes that economic patterns are always emerging, are seldom in a steady state and are ever-changing, exhibiting perpetually novel behaviour - multiple equilibria (see also Rosser et al., 2010). “It’s really an economics of things coming into being and it focuses on patterns forming, structures [emerging] and changing, innovation, and the consequences of permanent disruption. … As the elements react, the aggregate changes, as the aggregate changes, elements react anew” (Arthur, 2010, p. 1).

Arthur (2010) labelled this new notion of economics nonequilibrium economics, explaining that he originally coined the term complexity economics in 1999 for an article in Science. Both concepts convey the essence of constant disruption that comes about from agents (including consumers) adjusting to situations that are always changing. Complexity economics emphasizes market agents reacting to changes made by other market agents. It looks at structures forming in the economy and the consequences of attendant disruptions. Conventional economics studies consistent patterns that comprise a stable economy. Complexity economics assumes the economy (and its attendant agents) is a complex system that is in process, constantly evolving and unfolding over time, shaped by interdependent individual and aggregate behaviours. Patterns of economic behaviour inherently induce further economic behaviour of other economic agents, meaning the economic patterns are organic, process-dependent and emergent (always coming into existence), not consistent (Arthur, 1999). Complexity economics assumes that economic activity is fundamentally about order creation through an appreciation of the linkages and resultant patterns of behaviour among all agents and networks (Whitt & Schultze, 2009).

Rosser et al. (2010) clarified that complexity economics moves us (a) from rationality to purposeful behaviour, (b) from selfishness to enlightened self-interest as a social being in interaction with others, and (c) from unique states of equilibrium to multiple equilibria, with some situations or states more sustainable than others. Arthur, Darlauf and Lane (1997) shared six characteristics of a complex economic system. First, it comprises dispersed interaction among heterogeneous market agents acting locally, in parallel, on each other in some space resulting in aggregate changes. The action of any given agent (e.g., consumer, firm, government) depends upon the anticipated actions of other agents and on the aggregate state they co-create. Second, there is no global controller of the economy; instead, economic actions are mediated by legal institutions, assigned roles and shifting associations. Third, cross-cutting hierarchical organizations exist with tangled interactions (e.g, associations, channels of communication, strategies, behaviours).

Fourth, marketplace agents are continually adapting, learning and evolving. As individual agents accumulate experience, the system constantly adapts. Fifth, economies experience perpetual novelty as new markets, technologies, agent behaviours and institutions create new niches in the system. Finally, the economy exhibits out-of-equilibrium dynamics with no presumption of optimality. Because new niches, new potentials and new possibilities are continually being created, global equilibrium is not likely, meaning the economy operates far from any optimum state. Economies that exhibit these characteristics of complexity do not act in terms of stimulus and response; instead, they anticipate, form expectations and function as adaptive, non-linear networks of interdependent actors, systems and processes. The emphasis is on the discovery of patterns and structures and the processes through which these emerge across
different levels of the economic network (Arthur, Darlauf & Lane, 1997).

**Discussion and Conclusions**

McGregor (2010 a,d) identified recent efforts to frame consumer education as a vehicle to teach consumers about global justice and sustainability. This pedagogical development intimates that a growing complement of consumer educators may be receptive to the idea of complexity economics, and of the deep paradigm shift involved in moving from neoclassicalism to complexity. In anticipation of this intellectual and paradigmatic readiness, this paper provided primers on each of complexity theory, normal and post-normal science, tame and wicked problems, neoclassical economic theory and complexity economics.

This paper further developed the idea that architects of 21st century consumer education initiatives have much to learn from complexity economics. However, they are and will be challenged in their efforts to shift from conventional neoliberal economics to an approach that respects complexity and change. “The world seems to be caught up with the current capitalistic economic system. In fact, even the recent economic and financial crisis has not led to a fundamental revision of mainstream economics” (Lessem & Schieffer, 2010, p. xx).

Despite this system-wide resistance to post-normal science, it is necessary for consumer educators to rise to the challenge. McGregor (2007) made a case for perceiving individual consumer behaviour in relation to the conditions of the shared commons and humanity. While not referencing wicked problems, she did couch her comments within complexity theory. She suggested complexity, emergence, chaos, evolution and patterns as tools to reframe consumerism so it can be seen as interconnected with the common good and the human condition. Other consumer educators are encouraged to follow her lead.

Consumer educators now have the opportunity to gain deep insights from recent efforts to reconceptualize economics so that it moves away from the basic neoclassical principles of individualism, reductionism, rationality (reason), homogeneity, linearity, equilibrium (balance), maximization of utility and optimization (Arnsperger, 2010). Complexity economics introduces a new set of assumptions that can underpin consumer education initiatives: complexity, change and evolution, adaptation, self-organization, emergence, nonequilibrium, chaos and tensions, patterns and networks, and holistic, synergistic interconnections and relations between individual and aggregate agents (Manson, 2001), see Figure 3.

Turnpenny et al. (2011) called for new strands of post-normal science that focus on ethical and social considerations to assist with the management of uncertainty for the common good. Complexity economics is one such approach (Batie, 2008). Consumer educators can apply complexity economics as a way to teach people how to recognize wicked problems and how consumption contributes to their perpetuation (e.g., climate change, oppression of off shore labourers and producers, unequal wealth and income distribution, and consumerism as structural violence).

Given the nature of wicked problems and the impact of modern consumption, complexity economics is a promising theory for consumer education that aspires to focus on global justice and sustainability in a profoundly complex consumer marketplace. Moving from neoliberal economic theory (normal science), with its penchant to focus on tame problems or to tame wicked problems, towards complexity economics (post-normal science) with its focus on wicked problems, is a viable new direction for consumer education in the 21st century.
References

There is no agreement among scientists and lay people about the merit of post-normal science. As an example, refer to Anthony Watt’s moderated blog (the world’s most viewed climate website), where entrants discuss Hulme’s (2007) paper and work by Dr. Jerome Ravetz (36 pages over 37 hours, March 2010), http://wattsupwiththat.com/2010/03/15/response-to-ravetz-and-post-normal-science/ (archived at http://www.webcitation.org/5vXmsc4Ho).

Endnote

1. There is no agreement among scientists and lay people about the merit of post-normal science. As an example, refer to Anthony Watt’s moderated blog (the world’s most viewed climate website), where entrants discuss Hulme’s (2007) paper and work by Dr. Jerome Ravetz (36 pages over 37 hours, March 2010), http://wattsupwiththat.com/2010/03/15/response-to-ravetz-and-post-normal-science/ (archived at http://www.webcitation.org/5vXmsc4Ho).