Towards a Generalized Darwinist view of Sustainability

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Introduction

The issue of sustainability has been tackled from a wide range of perspectives within the social sciences and beyond. Sustainability might be interpreted as the capacity to endure over time, involving the reconciliation of environmental, social and economic demands. In this sense, sustainable development should both foster adaptive capabilities and maintain prosperous social, economic and ecological systems (Holling, 2001; Folke et al., 2002). Given its multi-dimensional nature, with a dynamic inter-relationship between environmental, social and economic spheres of influence, one might wonder whether the issue might be examined through a co-evolutionary lens. With a view towards shedding new light on this phenomenon, this chapter explores evolutionary foundations of sustainability, putting forward a Generalized Darwinist view on the field of study. The chapter therefore begins with a review of the Generalized Darwinist approach, and its use in sustainability research. In brief, this approach examines the co-evolution of cultural practices across groups, communities and societies through the evolutionary mechanisms of variation-selection-retention. Drawing on Breslin (2011a), it is argued that three tensions underpin co-evolutionary change in socio-cultural systems, which rest at the core of the sustainability question. These tensions reflect communities in which cultural practices become path-dependant over time, with local- and group-level behaviors tending to dominate the evolutionary process and constrain deviations from this path.

To explore these tensions and how they might impact upon sustainability, a historical re-examination of the Norse settlements in Greenland between the 10th and 15th centuries is presented. It was seen that Euro-Centric practices dominated the behaviors of the settling Norse, despite the maladaptive nature of these practices for the marginal environment in Greenland. These dominant cultural practices continued to reflect the past, and failed to adapt to changing challenges faced in the local environment tying the fate of the Norse community to a past world that was no longer relevant. The community thus became trapped by the interpretation of the past (first tension), by the collective interpretation of the wider group (second tension) and the dominance of local evolutionary pressures (third tension). The net effect of these tensions resulted in the suppression of the mechanism of variation, as the interpretation of the need for change and/or the ability to then enact this change was reduced. The chapter

concludes with a discussion on co-evolutionary implications for sustainability, and implications for individuals at all levels of society. It is argued that:

- Community members need to develop anticipatory systems based on the co-evolutionary account presented, and so consider the broader multi-level and community-wide implications of choices made at a local behavior. In this way, individuals can also use a co-evolutionary approach as an anticipatory system to interpret future events, and in so doing create new interpretations, worldviews and futures.
- Community leaders need to manage the higher level process through which local knowledge evolves through the management of people and processes (without becoming directly involved in the evolutionary process itself), in much the same manner as Darwin's pigeon fanciers selected and pruned key desired characteristics in their prize pigeons (Darwin, 1859).
- Community elders finally need to focus on the management of the wider co-evolutionary process through the interaction of levels within society. In this sense community elders need to consider the competitive selection environment at each level of the community hierarchy. Managing this broader process and the competing needs for exploitation and exploration, thus involves balancing the interaction between the evolutionary systems of the different hierarchical levels within the community, from individual to group and community.

What is Generalized Darwinism

Since the publication of Darwin's Origin of the Species (Darwin, 1859) 150 years ago, scholars have explored the possibility of developing an evolutionary approach beyond the domain of biology to fields of study as diverse as language, psychology, economics, behaviour and culture (Breslin, 2010; Breslin, 2011b). As with the publication of Darwin's original work, these moves have been met with much criticism within these respective scientific communities (Breslin, 2011b), and a misunderstanding that generalising Darwinism to study society, culture and economics implies a commitment to genetic determinism. Whilst some have clearly taken this approach viewing socio-cultural change as a product of biological and genetic evolution, others have treated cultural evolution as a distinct and separate, yet parallel process of information inheritance (Durham, 1991). These cultural evolutionists maintain that once humans had evolved brains big enough to generate collective knowledge, then this knowledge itself began to evolve over time largely independent of any underlying inherited instructional processes (Blackmore, 1999; Dawkins, 1982; Dennett, 1995; Durham, 1991; Plotkin, 1994; Richerson and Boyd, 2005).

Plotkin (1994) argues that if humans had not evolved this capability to generate knowledge and if behaviour were purely the result of inherited instincts, then the resultant behaviour might be 'explained entirely by a reductionist genetical account' (Plotkin, 1994, p.176). At a broader cultural level, Richerson and Boyd (2005, p.45) argue that whilst an individual's innate psychology shapes culture, culture itself evolves through gradual, cumulative adaptations over many generations that 'no single individual could evoke on his or her own'. As a result they conclude that cultural evolution 'cannot be based directly or in detail, on innate, genetically encoded information' (Richerson and Boyd, 2005, p.45). Whilst these authors believe that the leash between socio-cultural and biological evolution is weak, they still argue that socio-cultural change can therefore be described in evolutionary terms (Breslin, 2010).

In sum, these researchers seek to abstract from the domain-specific details of genetic evolution to a higher-level set of Darwinian principles which might apply to other 'evolving systems'. Indeed, the question relating to whether these systems evolve separately, and whether more abstract Darwinian principles might have relevance for developing theory in these different domains, dates back to Darwin himself (1871), who argued that the spread of languages parallels the evolution of species, for example in terms of its variability, its crossing or blending together and its extinction. Darwin (1871, p.139) remarked that 'the survival or preservation of certain favoured words in the struggle for existence is natural selection'. In this way, he tries to conceptualise the development of languages in evolutionary terms without spelling out the details of the mechanisms involved. Dennett (1995, p.345) argues that 'cultural evolution recapitulates all the features of genetic evolution', as 'the whole edifice of biological theory is perfectly mirrored in the medium of culture'. Drawing on this stance, Generalized Darwinists maintain that Darwinian concepts can be broadened from the domain of biology (Lewontin, 1970) and applied to all forms and levels of life (Hodgson, 2002). In the biological world evolution occurs over time through the key Darwinian mechanisms of variation (of genotypes), selection (of the consequent phenotype) and retention (of the underlying genotype), where the genotype is defined as the material inherited by an individual from its parents (i.e. genes), which has the potential to be transmitted to future generations. The phenotype on the other hand represents the manifestation of the genotype in the physical characteristics of the organism. Generalized Darwinists argue that at a sufficiently general level of abstraction this core set of general Darwinian principles of variation, selection and retention can be used to describe evolution within a variety of domains (Campbell, 1965; Hodgson and Knudsen, 2004; Hodgson, 2003), including biology, psychology, culture and economics. In this manner, whilst the details of socio-cultural

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evolution may be different from biological evolution, the concept of Generalized Darwinism can nonetheless be used as a starting point for the development of theory in both (Breslin, 2010; Breslin, 2011b).

In addition to the evolutionary concepts of variation-selection-retention, the question of what evolves, or the unit of evolution remains a thorny one. In biology the mechanisms of variation-selection-retention act on the genotype-phenotype as outlined above. In socio-cultural evolution, however the concepts of the 'replicator' and 'interactor' are put forward (Dawkins, 1976; Hull, 1988), where the replicator is defined as anything in the universe of which copies are made such as genes in the biological world. The interactor on the other hand is the development expression of the replicator in a particular environment. A number of different definitions of the replicator and interactor have been put forward to describe socio-cultural evolution. Cloak (1975) differentiated between the concept of the i-culture which represents the cultural instructions individuals carry in their heads, and the m-culture which includes features of an individual's behaviour, technology and social organisation. Whilst elements of i-culture are 'tiny, unrelated snippets, acquired and stored in a rather helter-skelter fashion like a genotype, the behavioural outcomes of those elements, the features of m-culture, often exhibit a high level of orderliness, pattern, functional integration etc like a phenotype' (Cloak, 1975, p.168). A number of researchers identify the meme as the replicator (Blackmore, 1999; Dawkins 1976; Dennett, 1995; Distin, 2011) in socio-cultural evolution, where a meme is defined as a self-replicating element of culture, passed on by imitation, such as behaviors or skills (Dawkins, 1976). The corresponding interactor is the 'outward and visible' manifestations of the meme in the outside world through words, music, visual images, gestures and skills (Dawkins, 1982), or the behaviours (Blackmore, 1999; Dennett, 1995). Durham (1991) differentiated between cultural units of information such as ideas, values and beliefs, and the associated behaviour which results from enacting this information, as he stressed these units of information were distinct from the resultant actions themselves. He argued that if research focused on traits or artefacts as units of analysis, it would be unclear whether that trait represented a cultural unit of analysis or was the phenotypic expressions of underlying genetic units of analysis (Durham, 1991).

Generalized Darwinism and Sustainability

Developing this Generalized Darwinist approach, recently a number of scholars have put forward a co-evolutionary framework for studying sustainability, by analyzing the mutual interrelationship between ecological and

socio-economic systems (Foxon, 2011; Hodgson, 2010; Kallis and Norgaard, 2010; Norgaard, 1984; Gowdy, 1994; van den Bergh and Gowdy, 2003). Foxon (2011) for instance examines the multi-level co-evolution of institutional frameworks, technologies and user practices. Similarly Simmie and Martin (2010) put forward a Generalized Darwinist approach to study the related phenomena of resilience, in which economic organizations *vary* behaviors which are subsequently *selectively retained* within the wider system. The notion of sustainability has been related to that of resilience (Levin, 1993), where the latter refers to a systems ability to recover from a severe shock or stress. In addition to absorbing shocks resilience also deals with the capacity for renewal and development, which is key to the sustainability discourse (Folke, 2006). Adapting a co-evolutionary framework these evolutionary economic geographers conceptualize how socio-cultural rules might emerge and become institutionalized within regions (Martin and Sunley, 2007). In this way the structures and features of an economic landscape would be viewed as the manifestations of systems of rules or knowledge (Boschma and Martin, 2007). In this sense social rules are seen as the units that evolve in the complex system. 'The economic landscape is the product of knowledge, and the evolution of that landscape is shaped by changes in knowledge' (Boschma and Martin, 2007, p.544). Likewise Simmie and Martin (2010) explore the adaptive ability of resilient systems, as regions adapt to socio-economic and political shocks and changes. They argue against the notion that resilient systems respond to shocks by returning to or retaining some previous equilibrium points. *Selection* however is a mechanism which occurs at multiple levels spanning local, regional, national and global spaces (Essletzbichler and Rigby, 2005). Clearly, the more *variations* put forward, the more opportunities exist in finding solutions to unexpected shocks from the wider environment.

In sum, what is emerging within this community of scholars is an evolutionary narrative in which cultural units are seen to co-evolve through the Generalized Darwinist mechanisms of variation-selection-retention. However, as noted above, what remains to be resolved is the question of what is evolving, and how the mechanisms of variation-selection-retention operate on these phenomena (Waring, 2010). Addressing this question, Foxon (2011) identifies these cultural entities as institutional frameworks, technologies and user practices. Others have pointed to socio-cultural rules, as noted above (Martin and Sunley, 2007), systems of rules or knowledge (Boschma and Martin, 2007), and simple rules and heuristics (Waring, 2010). Drawing on these works and the wider literature on cultural evolution summarized above, it is argued here that cultural practices, norms and routines evolve overtime at multiple levels within a society. These practices are represented by a duality of tacit, cognitive knowledge and

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expressed, situated behaviors (Bourdieu, 1990; Orlikowski, 2002). In the account that follows these cultural practices are put forward as the units that evolve over time through the mechanisms of variation-selection-retention. It is argued below that understanding the dynamics of evolutionary change at multiple levels can thus shed light on the competing tensions which lie at the core of the sustainability question.

Co-Evolutionary Tensions

Breslin (2011a) outlined three core tensions which define multi-level co-evolutionary social systems. These include;

- Temporal tension: where the past is reflected in the present through the practices of individuals and how this impacts on the anticipation of futures;
- Tension between levels: where the more established a collective cultural practice becomes then the more they 'police' individual variations, and;
- Tension with localism: where the more local the interpretations made by the group, the more these may diverge from wider communal and societal considerations.

Using an evolutionary approach, Breslin (2011a) develops a co-evolutionary conceptualization of a changing social system. In this manner, units of culture are seen to evolve at multiple levels, through the mechanisms of variation-selection-retention. So at the level of the individual, each person use and participates in a series of cultural practices. Some of these practices might be shared with others within the person's peer group or community, whereas others might be more idiosyncratic and unique to their own past or life path. So for instance, the individual might drive a gas-fueled car, and regularly fill up the tank of the vehicle with gas. This practice is clearly shared within the wider community of car drivers. However, the same individual may choose to adopt practices on their own, which they believe make a contribution towards lowering their carbon footprint. For instance, individual may 'free-wheel' down hills (a practice I observed my uncle continue throughout his life to save on fuel costs). So while the former practice is collective, the latter is more individual. Taking an evolutionary perspective, these practices change over time through the mechanisms of variation-selection-retention. So the individual might experiment and *vary* the free-wheeling practice by for instance varying the start point at which he releases his foot on the accelerator, or by even deciding to turn off the car engine during downhill runs. These experimental variations are first *pre-selected* in thought based on the individual's anticipation of expected benefits (Dewey, 1922). However, ultimately *selection* involves enacting the behaviors

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and interpreting feedback based on resultant performances (Breslin, 2011a). So our free-wheeler turns off the car engine on approaching the descent of a steep hill, and assesses the performance based on the resultant maneuverability of the vehicle without power. If the result is interpreted as positive, then the individual *retains* that variant practice for future use (i.e. he switches off the engine every time, until future performances give evidence to the contrary). In this manner the *selection* and *retention* of practices becomes path-dependant, as individuals choose to enact behaviors which they believe are suited to the task in hand, based on past experience.

However in addition to this path-dependency individuals are also forward-looking as they anticipate reactions from the external world, based on expected responses following the enactment of a practice (Dewey, 1922). In this way individuals anticipate future events based on cognitive representations they hold of those 'expected futures'. Such anticipatory systems incorporate models of themselves and their environment, allowing individuals to anticipate future events and adapt their behavior in response (Rosen, 1985). So the individual might anticipate positive feedback on expected performances of switching the car engine off. This expectation might be based on previous experiences in using the same free-wheeling practice. In this sense, the associated interpretative system acts as a vicarious selector, anticipating higher-level selection from the external world, and providing guidance to the localized selection and emergence of practices over time. The worldviews represented by these interpretations are then used to interpret and make sense of actual feedback received following the enactment of these behaviors. In this way, if unexpected feedback is received based on the use of the practice, the individual might dismiss this if it does not fit with the worldview built up over time. So if our free-wheeler has one negative experience after months of fuel savings, he may dismiss this event as a one-off. Established practices thus have a strong influence on choices made, both through the anticipation of the future and through the interpretation of the present and past. This represents the *temporal tension* in the anticipation and interpretation of futures outlined by Breslin (2011a).

A fuller understanding of the evolutionary process at the level of the individual can be gained by examining the process at the level of the collective. As noted above, some cultural practices used by individuals are shared within peer-groups, organizations, communities and wider societies. For instance communities might share practices regarding the filling of car tanks. Recently in the UK, industrial action resulted in fuel supply being limited, with long queues forming at gas stations. As a result a collective practice emerged in which drivers chose to keep tanks full, as opposed to empty, topping up each time they passed

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a gas station. Both the behaviors and the reasoning behind them emerged as a shared cultural practice amongst a large group of drivers. Examining the evolutionary process behind this emergence, drivers first *vary* their previous practice of filling up tanks. This variant is *pre-selected* first in thought, so the individuals concerned might perceive the expected benefits of having a full tank in the event of industrial action. Drivers then carry out the practice, and *select* behaviors based on actual performances. This feedback is received from others within the group and beyond. Some might react positively and endorse the risk-reducing nature of this behavior. Others however might react negatively to such 'selfish' practices, which they might argue lead to panic buying and long un-necessary queues forming at gas stations. Given the complexity of this feedback, and the possibility of different interpretations of the same being made by other individuals, the process will inevitably involve interaction between individuals through communication, dialogue and negotiation, as individual choices are reconciled within a *collective selection* mechanism. For instance, our individual might interpret the 'full tank' practice positively. However this interpretation may not be shared by others. In this way, competing interpretations are resolved through dialogue, interaction and even negotiation as collective practices emerge. With this emergence, individuals even develop expectations of the behavior and understandings of others (Mead, 1934). As a result the development of collective practices includes a socio-political dimension, as competing interpretations of futures are resolved through dialogue, communication and negotiation. The resultant truce can act to constrain future interpretations within the group, and indeed police 'variations' as it reinforces the collective status quo. This represents the second *tension between levels* outlined by Breslin (2011a).

Finally in addition to different interpretations being made by individuals, the 'importance' or strength of the various feedback signals received by the group from the 'external world' might differ, and over time some signals may be given more 'importance' than others. For instance, more importance may be given to local actors and neighbors, as opposed to more distance thought leaders. In this way, our tank-filling individual might be swayed to abandon such behaviors if local residents continually disapprove of such actions. On the other hand, our same individual might travel to a more distant gas station outside the local community to continue the practice, given that local opinions are less significant there. As a result, interpretative systems can become increasingly focused on localized issues over time as behavioral and socio-political factors act to strengthen local feedback signals (i.e. those local to the group) as opposed to wider external factors. Rosen (1975) argued that this can result in 'inappropriate' behaviors which ultimately might detrimentally affect the longer term survival of

the community. Depending on the strength of feedback signals received by the individual or group from the outside world, practices can tend towards reflecting the future of a local world, and local actors within that world. So whilst individuals and groups make local choices which they believe offer local improvement, the resultant behavior may detrimentally affect the wider community's longer term evolution and survival. These local world views can act to downplay signals from outside the local environment, and as a result can result in resistance to change and evolutionary drift. This trend represents the third and final *tension with localism* put forward by Breslin (2011a).

In sum, the tensions put forward by Breslin (2011a) reflect a socio-cultural system in which practices become path-dependant over time, with local- and group-level behaviors tending to dominate the evolutionary process and constrain deviations from this path.

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The Multi-Level Co-Evolution of Cultural Practices among the Greenland Norse

Breslin (2011a) argued that these tensions might develop within any co-evolving, socio-cultural system. In this way, they might be further developed to shed light on the issue of sustainability, given the complex co-evolutionary nature of the phenomenon. Reexamining the case of the Greenland Norse, who established settlements in that remote part of Europe between the 10th and 15th centuries, one can draw out how these tensions underpinned the key challenges facing this community during that period. These following accounts are drawn from Jared Diamond's (2005) seminal work 'Collapse: How Societies Choose to Fail or Survive'. The case of the Greenland Norse is an interesting one, as the community clung on to survival for several centuries. Given the marginal nature of the settlement, even the smallest variation, such as a change in the summer temperature, or failure of migratory harp and hooded seal, might have spelt disaster for the community. This marginal, knife-edge existence was exacerbated over the centuries, as Greenland's climate changed from mild to cold, with the *Little Ice Age* beginning around 1300.

Temporal tension

Diamond (2005) argued that Viking Greenland was very conservative and Euro-centric in its outlook, despite the very different sets of challenges facing them in their new home and the hundreds of years of occupation of this land. As a result, they tended to continue to adopt the same cultural practices used by the first settlers in the 10th century. Indeed, they used the same tools, produced the same carvings, and crucially failed to learn new practices needed for survival in Greenland's harsh climate (such as the Inuit (Eskimos) practices of hunting for ringed seal or whale). The Norse survived on a combination of pastoralism and hunting wild animals. In the European tradition they kept goats, sheep and cows, with the latter being kept in barns during the winter. Milk produced in the summer months was turned into dairy products which they ate during the winter, such as cheese, butter and a yoghurt-like product known as *skyr*. Wool was also taken from the sheep and goats. To support the feeding of livestock during the winter months, hay was produced on the narrow pasturelands bordering the fjords. So despite the very different climate and geographic challenges facing them, the Norse adopted practices better adapted to life in Norway. To

supplement their marginal existence, the Greenland Norse also hunted. Caribou were hunted in the fall, and common, harp and hooded seal were hunted in the spring, when food reserves would be running low. Occasionally trips might be carried out towards the North of the country during the summer to hunt for walrus and polar bears. Despite an abundance of fish in the lakes and rives, the Greenland Norse did not eat fish. Diamond (2005) posits the idea that perhaps a taboo against fish-eating emerged during the early stages of the Norse settlements in Greenland, perhaps as a result of food poisoning. This taboo became so ingrained that latter inhabitants continued to avoid fish.

The Euro-centric and Christian nature of the Greenland Norse further resulted in other maladaptive practices becoming established. For example they followed European fashions despite the much colder climate. And while imports from Norway were rare, and confined to essentials such as iron, lumber, tar, luxury items for high-status individuals and the church were highly sought after. These high-value goods were exchanged for animal skins, wool and rarities such as walrus tusks and polar bears. However to obtain these latter items, resources had to be diverted from the important summer hay harvest to risky hunting expeditions to the north. So while their Christian identity may have helped maintain a functioning, integrated society (see below), it also resulted in key maladaptive practices which may have threatened the Norse's ultimate survival in Greenland (Diamond, 2005). Such maladaptive practices including 'stubbornly maintaining cows in Greenland's climate, diverting manpower from the summer hay harvest to the Nordrseta hunt, refusing to adopt useful features of Inuit technology and starving to death as a result' (Diamond, 2005, p.247). However, as Greenland's climate began to got cooler around 1300, the marginal existence of the community was doomed given the ill suited nature of the cultural practices being used. 'The values to which people cling most stubbornly under inappropriate conditions are those values that were previously the source of their greatest triumphs over adversity' (Diamond, 2005, p.275). In summary, what emerges is a story in which dominant cultural practices continued to reflect the past, and failed to adapt to changing challenges faced in the local environment. This temporal tension tied the fate of the Norse community to a past world that was no longer relevant.

Tension between levels

Breslin (2011a) argued that the more established a collective practice becomes, then the more they 'police' individual interpretations, representing a tension between levels which rests at the core of social systems. A total of 5000 Norse

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lived in Greenland, with 4000 of these living in the more southerly (and therefore milder) fjord. These inhabitants were settled into 250 farms, of about 20 people per farm. Farms were further organized around churches, with about 20 farms per church. The local economy was tightly integrated and controlled, with the rearing of livestock, production of hay and hunting for seals and caribou tightly coordinated within the community. As a result of this, and as a consequence of the Euro-centric Norse culture noted above, the society was sharply stratified and hierarchical, with most of the power resting in the hands of a few rich farms. Therefore, cultural practices were designed to fit within the tightly integrated system, with little opportunity for variation. In addition, maintaining the system and the practices that went with that, acted to maintain the status quo and power relations between different farms and communities. So while some innovations may have improved the survival chances of the settlements, 'those innovations could have threatened the power, prestige and narrow interests of the chiefs. In the tightly controlled, interdependent society of Norse Greenland, the chiefs were in a position to prevent others from trying out such innovations. Thus the Norse society's structure created a conflict between short-term interests of those in power, and the long-term interests of the society as a whole' (Diamond, 2005, p.276). Those socio-political factors thus acted to suppress variations from individuals or sub-groups of settlers. Say for instance one farmer decides to divert hay production and try a new crop one year. As a result, less hay is produced within the local collective, with fewer heads of cattle being fed over the winter, less dairy products being produced, and so less food to see the community through the lean winter months. Or say a small group of farmers decide to go on a hunt to Nordrseta for Walrus tusks, in the hope of exchanging these with Norwegian traders for jewellery. By diverting resources to the hunt, less time would be devoted to hay production, resulted in less hay, livestock and so forth. In this manner, the wider community acts to restrain these individual and sub-group decisions to deviate from collective practices. As a result collective practices acted to constrain and indeed police the practices of individuals over time, leading to a tension between levels.

Tension with Localism

Finally, the tension with localism outlined by Breslin (2011a) refers to the divergence of practices between local groups from those of the wider community and environment. It was noted above, that the Greenland Norse were characterized by an inwardly-focused, past-orientated, Eurocentric culture, which was organized in a rigidly, hierarchical and integrated community. Despite the 'cultural baggage', surely this community was aware of the

challenges facing it in Greenland and able to adapt to them? After all the Norse had shown incredible resilience and adaptability as they moved to conquer and settle lands across the North Atlantic, from Britain and Ireland to Iceland and Newfoundland. However Diamond (2005) points to a number of irreversible actions taken by the Greenland Norse on the local habitat, including destroying the natural vegetation, causing soil erosion and cutting turf. On arrival the Norse cleared woodlands for pasture. These trees were later prevented from regrowing by grazing animals. As a result of this deforestation, the Norse had a very limited supply of lumber. Furthermore, the Norse needed wood to extract iron from local bog iron. Despite the scarcity they also continue to use willow and alder wood for heating, unlike the Inuit who used animal blubber. They further resorted to using turf to make walls for buildings and heating. As a result of this deforestation, the Norse were short of lumber, fuel and iron. Finally, the loss of plant cover resulted in topsoil erosion due to wind and rain.

Most of these actions were taken as a result of using maladaptive practices adapted to a very different environment in Europe. For example, while the clearing of forests and digging of turf might have been suited in areas of Britain and Ireland, with greater resources and milder climates, it was clearly ill-suited in the much more marginal and resource-limited fjords of Greenland. As a result, the settlers adopted established practices to meet the local and immediate needs of the local community (e.g. to clear land, make hay, or produce heat). The tension towards localism resulted in the community failing to adapt to wider environmental changes (both as a result of their own actions and wider climate change). Furthermore, they failed to learn from the Inuit, who also inhabited Greenland during the same period. Unlike the Norse, the Inuit predominantly relied on hunting for survival. However they had developed a number of practices uniquely suited to the environment of Greenland. First they did not rely of lumber, using ice to build homes, animal skins to make canoes and blubber for heating. Second, in addition to caribou, they had learned how to hunt whale, and ringed seal, using harpoons from canoes and blow holes respectively. These practices allowed them to take advantage of food resources available throughout the year. Despite these innovations, the Norse failed to learn from the Inuit, either in terms of making and heating their homes and hunting. As a result when the climate got cooler, and hay production was severely reduced, the Norse could no longer rely on their livestock to provide food.

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Co-Evolutionary Implications for Sustainability

The above co-evolutionary narrative might have some interesting implications for the issue of sustainability. While cultural practices are altered based on the interpretation of past events through a post hoc sense-making process (Daft and Weick, 1984), they influence the anticipation of futures, resulting in the selection and retention of practices in anticipation of feedback from others within the group and beyond. Crucially this process is played out within the socio-political dynamics of the group, community and wider society, with an ecology of cultural practices competing for dominance. As these practices become more collective in nature, the resultant socio-political truces and coalitions (Cyert and March, 1963) established within groups can act to constrain deviations from this accepted view of the world. This biased interpretation and anticipation of futures is further compounded when the strength of local feedback signals overpowers those received from other sources, including the wider environment. As noted above, in some cases these practices can tend to reflect the world and actors local to them (Breslin, 2011a; Rosen, 1975), and not that which is representative of the selection environment external to the community as a whole. Indeed, Sober and Wilson (1999) argue that humans have evolved altruistic and cooperative behaviors towards other members of their group, where 'group selection favors within group niceness and between group nastiness'. However, this between group competition can hinder wider, even global-level cooperation needed for sustainability. Therefore, whilst individuals make local choices which they believe offer local improvement, the resultant behavior may detrimentally affect the group and community's longer term evolution and survival, as seen with the Greenland Norse. The net effect of these tensions might result in the suppression of the mechanism of variation, as the interpretation of the need for change and/or the ability to then enact this change is reduced. As a result variation and with it the continued evolution of the system can be either encouraged or suppressed.

Some authors have commented on how the establishment of collective practices over time can result in taken-for-granted ways of viewing the external world, and indeed interpreting feedback from that world (Aldrich, 1999). Given that collective interpretive systems are used to anticipate responses from the external world following the enactment of practices, it is importance that these can also adapt to reflect changing worlds. However, clearly the 'accuracy' of these 'anticipatory vicarious selectors' is based on the interpretation of prior feedback from the external world, and following previous success it can be seen how this could lead to the entrenchment of established practices, resulting in

competency traps (Miller, 1999). As Diamond (2005, p.275) noted 'the values to which people cling most stubbornly under inappropriate conditions are those values that were previously the source of their greatest triumphs over adversity'. In this way, feedback might be interpreted in a manner which is consistent with the view of the world held by the existing interpretive system. This might result in the anticipation of futures becoming trapped by the interpretation of the past (first tension), by the collective interpretation of the wider group (second tension) or the dominance of local evolutionary pressures (third tension). In this extreme account it might even be argued that the community becomes tied to historical, collective and localized cultural practices as exploration, and indeed continuing evolution through variation is suppressed. As a result, a mismatch can exist between cultural practices which were evolved for a different world, than the wider ecological challenges faced by societies today (Waring, 2010). However, communities can and do overcome inertia, break with past interpretations, un-tap variations from individuals and broaden their understandings of the external challenges they face. In this manner, communities can explore new futures through variation. This involves un-tapping the sources of variation from individuals within the community itself or introducing it through new arrivals (Breslin, 2011a). Exploration of new practices can also be initiated from higher levels within the community including political, and community leaders. In this way, communities are not inextricably linked to the past through certain cultural practices.

One might argue that by sitting together and working through future scenarios, community leaders can identify and thereby overcome some of the constraining effects of these tensions. For example, new narratives that challenge past worldviews could be put forward. Or different 'voices' from across levels or sections of the community could be encouraged in open brainstorming sessions. However many of these approaches do not specifically explore the multi-level complexity of changing practices within communities, and how choices made at the level of the individual and collective can over time influence the survival of the wider community. In addition while these approaches challenge the constraining effects of the past and the collective on anticipatory frameworks, the potential of such approaches are themselves constrained to a certain degree by focusing on a limited number of possible futures or scenarios. The problem we are dealing with is multi-level and complex, and it is argued here that it requires a multi-level, complex and co-evolving solution. In essence, the net effect of the tensions outlined above is to constrain variation and innovation emerging from within levels of the community. Variations are the fuel of any evolutionary system, and novelty must be nurtured in order to guarantee the longer term survival of the system. Examining the evolutionary process at

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different levels in the community, a number of evolutionary solutions might be put forward.

'Learning to Evolve'

Each member of the Greenland Norse community were at the 'frontline' living on the very edge of survival. As noted above, they relied on practices which were inherited from the past, and maintained by local, and collective pressures. However, these same practices became increasingly maladaptive for the challenges they faced. One might argue that had individuals within those communities developed anticipatory systems based on the evolutionary account given above, broader multi-level and community-wide implications of evolving local behavior would have been considered in the choices that they made. For instance, they would have seen that the continuation of local practices was preventing the community for innovating and learning from the Inuit. Or they would have become more aware of the detrimental affects of continuing to use practices adapted for milder climates in Europe. In effect, by understanding how our cultural practices evolve over time, we can better learn to evolve (Breslin and Jones, 2012). This involves members of the community asking themselves a number of questions. Is *variation* and innovation encouraged within the community? After all this is the fuel of further evolution. How are choices made regarding the *selection* of practices? Are these adversely affected by socio-political differences, or are choices made based on a clear, and accurate understanding of the wider challenges facing the community? Finally, are systems in places to ensure the *retention* of good practices, and the discontinuation of maladaptive ones? In this manner individuals might interpret their behavior and those of others in terms of the broader hierarchy of evolutionary systems which ultimately influence the survival of the community. In this way, individuals can also use an evolutionary approach as an anticipatory system to interpret future events, and in so doing create new interpretations, worldviews and futures. Such anticipatory systems or 'mind tools' (Dennett, 1995, p.378) allow individuals to learn how to 'think better about what they should think about next'.

	Community members 'Learning to Evolve'
Variation	Nurturing novelty through variation and innovation.
Selection	Clear and accurate understanding of wider challenges faced.
	Overcoming historical and socio-political resistance.
Retention	Retaining practices through new competences and skills.

Following this argument it is seen that practices evolve through the mechanisms of *variation*, *selection* and *retention*, however this process occurs through the behaviors of individuals and groups. Therefore one cannot separate the process from the individual. For instance, how do individuals in frontline groups facilitate or hinder the process of *variation, selection* and *retention*? Are the right individuals put together in the right way to facilitate or constrain the resulting evolution of knowledge? While existing practices can provide stability, they can also act to resist change, and in this sense the exploration of new practices might be resisted by the experiences and socio-political status quo directly associated with key individuals within the community. In this sense, while the focus of our evolutionary story shifts towards evolving knowledge, individuals and groups also matter and cannot be divorced from the evolutionary processes which define the development of that knowledge over time. It then becomes the job of community leaders to manage the higher level process through which local knowledge evolves (without becoming directly involved in the evolutionary process itself), in much the same manner as Darwin's pigeon fanciers selected and pruned key desired characteristics in their prize pigeons (Darwin, 1859). In the case of the Greenland Norse, these community leaders might include the most powerful farms around whom other families were organized, as noted above. It then becomes the job of these separate settlement leaders to manage the process of evolution through the management of the broader process and people involved, in a sense acting as 'artificial breeders' controlling the means through which knowledge evolves within groups.

	Community Leaders as 'Artificial Breeders'
Process	Managing the processes through which knowledge evolves.
People	Identifying people who enable/constrain this process.

Managing the Co-Evolutionary System

While one might argue that individuals can 'learn to evolve' (Breslin and Jones, 2012), by considering the wider implications of their decisions in terms of the broader co-evolutionary process, clearly a coordination of the resultant multitude of voices might be needed. This might involve a number of measures in which the co-evolutionary system is managed at a higher level.

The wider co-evolutionary process can also be managed through the interaction of levels. In this sense community elders need to consider the competitive *selection* environment at each level of the community hierarchy. The greater the number of levels within this hierarchy, then the greater the

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complexity involved in managing this process. Balancing the need for both the exploitation and exploration of knowledge, involves on the one hand communities breaking down the invisible barriers within the hierarchy of evolving systems and unlocking creativity and *variations* from all levels, and on the other hand allowing enough stability to become established within the various levels to ensure this knowledge is then *retained* and exploited within these same groups. When the community's behavior is dominated by the exploitation of existing practices (as in the case of the Greenland Norse), the resultant socio-political situation can lead to *variations* coming from lower levels within the community being suppressed. So for example, lower level *variations* introduced by individuals or other groups are inhibited because they disagree with the established practices and/or because they challenge the existing status quo. Whilst exploitation involves bringing individuals into the collective fold and modifying their individual behavior to that of the group, exploration involves unlocking the sources of *variation* from lower levels through individual creativity and learning. In particular this involves un-tapping sources of *variation* from individuals within the group, and as well as exploring different practices used by other groups and individuals both within the community and beyond.

	Community Elders managing the Co-Evolutionary Process
Systems	Managing the hierarchy of co-evolving systems
Multi-Level	Managing the interaction and competitive selection environments at different hierarchical levels
Culture	Cultivating a Co-Evolutionary Language within the community

From the community elders' perspective, managing this broader process and the competing needs for exploitation and exploration, thus involves balancing the interaction between the evolutionary systems of the different hierarchical levels within the community, from individual to group and community. This involves taken a wider perspective on the co-evolution of separate local communities and examining the interaction between them. For instance, increasing the interaction can be achieved by increasing the competitive *selection* pressures at lower levels within communities, as community elders act to encourage diversity and competition amongst individuals and groups (Breslin, 2011a). This might involve the strengthening of key feedback signals from sources external to the group, with a view towards increasing the influence of key sources at different levels on choices made within the group (Waring, 2010). Crucially the separation of roles and responsibilities between community leaders and elders, allows the former to focus on managing the evolution of specific communities, while the

latter direct their attention towards the interaction and co-evolution of these separate processes to ensure competing short-term and long-term needs are balanced.

Conclusion

The world around us shows evidence of nature's survivors who have adapted to changing environments, whilst other species have become extinct. Whilst clearly the detailed mechanisms between biological and cultural evolution differ, we can nonetheless learn from these broader principles of evolution. Reinterpreting the challenges faced by communities in this manner shifts the focus of attention onto co-evolving cultural practices. Examining this multi-level process, it is argued in this chapter than three key tensions can develop within such communities, in which practices become backward-looked, collective and increasingly local in focus. In the case of the Greenland Norse the development of these tensions had disastrous consequences for the sustainability of the community in that marginal environment. However, it is further argued that communities can break free from this cycle, and each member of the community has a role to play in managing and leading this evolution. By developing an evolutionary language in this way, broader multi-level and community-wide implications of evolving local behavior can be considered in the development of sustainable communities and societies. In this manner community members, leaders and elders might interpret their behavior and those of others in terms of the broader hierarchy of evolutionary systems which ultimately influence the survival of the community, and longer-term sustainability of cultural practices.

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