The Extended Importance of the Social Creation of Value in Evolutionary Processes: A Proposed Model

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Abstract. In this paper I propose that the social creation of value is an important factor in the theoretical study of creativity, not only in cultural evolutionary processes but in the genetic evolution of specific creative domains, with particular attention to music. I consider the possibility that music emerged in an autopoietic manner from the basic conditions of the social creation of value and consider some of the properties of a model built on this perspective. Within this context I consider two hypothetical processes that could be tested through computer simulation; that novelty seeking behaviour leads to the evolution of increasing perceptual complexity, and that novelty seeking behaviour and the cultural clustering of styles stably reinforce each other.

1 Introduction

In many cases of human behaviour, the benefits gained by individuals for creative acts are generated *entirely through social action*. In other words, the artefacts resulting from these acts have no value other than that offered by other individuals. In this paper I consider the importance of this fact to the study of creativity from the perspective of the genetic evolution of innate human behavioural traits. I consider the possibility that the creation of social value played a significant role in the emergence of genetic aspects of human creative domains and propose a model for the evolutionary process that drove this emergence in the case of music. The focus of this work is less concerned with mechanisms relevant to individual creativity than with the process of evolution associated with creative domains; social contexts which can be seen as possible focal points for further evolution towards what we call creative ability.

Since at least the days of Darwin, evolutionary theory has been concerned with the economics of organic structure and behaviour. From an evolutionary perspective, creativity can be seen as the ability to define new possibilities (artefacts, concepts, behaviours) that are beneficial to the creator. If I can manipulate a piece of wood or stone to make a useful tool then my chances of survival are greater than if I didn't have that tool: individual creativity is functional. A sensible evolutionary approach to creativity therefore lies in understanding the kinds of cognitive developments that would grant individuals a better command of their environmental niches.

In the emerging story of human evolution, there is another important factor the explanation of certain particular human intellectual abilities: the complex demands of social life under the increasing external pressure to live in larger groups. Theories of Machiavellian intelligence [11, 12, 24] propose that human intelligence increased in a positive feedback cycle of according to a cognitive capacity known as theory of mind (ToM); the ability to infer mental states in others and subsequently predict their behaviour. ToM informs individuals in making decisions about possible alliances, which can dramatically affect their physical survival and sexual success. According to this theory, intraspecies competition is as much a driver for evolution as adaptation to an external environment, and we should also expect to see the potential adaptive advantages of creativity in this social context.

However, looking more closely into the dynamics of social life, it may not only be ToM that evolves under these circumstances. There are many factors that influence social success in modern humans and an individual who is poor at ToM may still improve their ultimate physical and reproductive success by, in some other way, influencing those around them so as to gain favour. In modern Western society this is particularly apparent in the set of activities that we classify as artistic, such as drawing, sculpting, acting and music-making. These activities typify the social creation of value; the artefacts resulting from these acts have no value other than that offered by other individuals. Creativity is evidently a valuable tool in these contexts then; a creative individual can find ways to 'extract' more value from their neighbours and raise their social success. This is the area of behaviour that I am concerned with in this paper.

A popular explanation for the existence of these 'artistic' activities in human behaviour, or what Dissanayake [9] generalises cross-culturally as the act of *making special*, is that it creates strong social bonds within communities, that increase the overall fitness of these communities under exactly the same pressures proposed in theories of Machiavellian intelligence; because large cohesive societies are mutually beneficial. However, by comparison with notions of coevolution and positive feedback in other areas of evolutionary theory, it is possible that the social creation of value bestowed on individuals (rather than the fitness that emerges from a well-unified social group) is sufficient to explain the emergence of such behaviours in a population.

Such domains also exhibit a value system which is constantly shifting; creative individuals achieve success by finding novel artefacts of value, and as these artefacts are introduced, new requirements emerge for success in future generations. Individual value judgements shift according to a history of experience. It may be that this view is tinted by a degree of ethnocentricity and that the competitive, novelty seeking behaviour associated with artistic practice in the West is not universal. This is hard to determine empirically. However, in that this view of cultural change invites hypothetical processes which may have led to the evolution of creative domains, it is worth considering the possibility that it is a long-standing universal behaviour.

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2 Creativity, Culture and Genetic Evolution

Sosa and Gero [23], focusing on modern design practice, provide a treatment of creativity situated in social contexts, following the systems theoretic view proposed by Csikszentmihalyi [8]. The approach replaces notions of *creative individuals* with *change agents* and locates creativity in *situations* (combinations of a *field*, a *domain* and a *person*) rather than solely in individuals. Within this framework Sosa and Gero are able to specify dynamics of social change that depend only on "group convergence and occasional individual disagreement" ([23] p.30), thus explicating general processes of creativity in design. The social dynamics that Sosa and Gero develop influence the present work, in particular in that creative domains and creative acts engage in a coevolutionary process, but in this paper I differ from their focus on design. Whilst, for the purposes of their design context, Sosa and Gero differentiate between the quality of an artefact and its 'creativity', the former residing "within the internal charachteristics of a design artefact" ([23] p.31), I consider instead those contexts in which quality is entirely socially ascribed, which is epitomised by the domain of music. Furthermore, the focus of this paper is on the evolutionary principles by which innate human perceptual mechanisms evolved. These mechanisms define boundaries for creative domains such as music, in the sense that music is primarily a perceptual fact, rather than a physical one. The introduction of a genetic component to a cultural evolutionary model, to complete a biocultural coevolutionary view, is also likely to produce very different dynamics.

A commonly cited explanation [19] for the existence of musical behaviour in humans is that it simply brings together sets of cognitive capacities from other domains, such as an aesthetic sense which derives from the need to find an appropriate habitat, and a desire for novelty (a capacity for boredom) which serves our creative needs in more obviously useful domains such as tool-making. Creative domains such as music therefore satisfy what Pinker describes as maladaptive [19]. This view is in keeping with the notion that cultural evolution is the sole process in the formation of these creative domains, and is amenable to models of social dynamics with no genetic component. However, the increasingly popular notion that culturally constructed contexts feed back into genetic processes of natural selection (see for example, [13, 17]), has the potential to apply in this case: socially generated value can ultimately influence individual success, providing an immediate selection pressure for the evolution of appropriate aesthetic perceptual mechanisms.

Dissanayake [10], Cross [5, 7, 6] and Mithen [16] all argue for a biocultural coevolutionary view of music for which the roles of music in establishing and maintaining social cohesion, and possibly in facilitating a certain cognitive flexibility, are both potentially critical evolutionary driving forces. I do not intend to present an argument against these well developed theories, but with respect to them the present work serves specifically to establish whether it is possible to model the basic process of an evolution of musical behaviour without these hypothesised driving forces of social cohesion and cognitive flexibility. In other words I consider whether artistic activities such as music have emerged simply because of an immediate structural role in allowing individuals to gain favour with other individuals: this would allow us to describe them as self-creating and self-maintaining domains of activity, or autopoietic systems. This is a contentious proposal but not, as it may appear, because it makes a circular argument out of evolutionary theory. A notion of positive feedback is common in explanations of evolutionary processes, examples of which include the evolution of sexually selected traits (typified by the peacock's tail feather), the characteristics of predator-prey pairs, and the evolution of ToM discussed above. The emergence of such creative domains is proposed as one more such process. The difficulty with the argument comes more from the poverty of evidence associated with the evolution of our cultural behaviour, especially in domains that do not associate themselves clearly with adaptive function. It is further confounded by the complexity of cultural behaviour in general.

In such cases broad evolutionary arguments play an important role. In recent years, *niche constructionism* [13, 17] has emerged as a theoretical framework which places the inheritance of modified environmental conditions on a par with the inheritance of genetic information, not only in the very visible activities of humans, but across all of organic life. From a niche constructionist point of view human cultural activity is suitably 'potent' in its niche construction to have had far reaching implications for subsequent genetic evolution. This perspective has the effect of drawing our explanatory focus away from adaptation-centred arguments [13] due to the effects of basic feedback processes. This lightens the necessity to ultimately attribute a functional role to musical behaviour.

Computational modelling also becomes an increasingly significant approach in contexts where such broad theoretical notions are at issue. As Di Paolo *et al* [18] argue, computer simulation models allow researchers to extend the notion of the *thought experiment* into situations which are beyond the capacity to be thought through – situations that are *opaque*. In the spirit of Artificial Life, such modelling is not expected to act as a simulation of the unique sequence of events that took place (*e.g.* in human evolutionary history), but as a conceptual tool that allows us to critically consider our theoretical understanding of possible processes in a way that informs a theoretical approach to this real evolutionary history. Di Paolo *et al* propose that complex simulation models can be iteratively developed through the formulation of hypotheses from initial exploratory models that implement the researcher's basic theoretical notions. In [3] I presented exploratory work aimed at developing a modelling context for biocultural coevolutionary processes, from which the present theoretical perspective and hypotheses have been extended and developed.

3 Towards a Modelling Context for the Evolution of Music

Saunders and Gero [20, 21, 22] developed a model of *curious behaviour* and explored the social dynamics that emerge from interactions between curious agents. The basic design of a curious agent is that it evaluates the novelty of incoming design artefacts with respect to a set of existing reference points, and this novelty measurement drives a *hedonic* response based on a mapping from novelty to value known as the Wundt Curve [1]. This mapping outputs low value for both very low and very high levels of novelty, with a single peak of value for some optimum level of novelty (see inset in figure 1). Curious agents also generate their own artefacts, based on their own preferences, which they then share with others.

In order to model the consequences of the social generation of value for genetic evolutionary processes, the value generated by such a function after each interaction (*i.e.*, each time one agent evaluates an artefact produced by another agent) can be awarded to the producer of the artefact, contributing to a cumulative fitness score. This fitness score embodies the notion that, in the context we are modelling, *the benefits gained by individuals for creative acts are generated entirely through social action*. Although, in reality, individuals are aware of their fitness and can adapt their behaviour in response to it, for simplicity's sake I consider only the case in which this fit-

ness score influences relative survival and reproduction chances, as in a genetic algorithm. I do not include any additional notion of fitness with respect to an external (non-social) environment. In this general framework the value-generating function needn't be that used by Saunders and Gero, although in the following section I will propose possible interesting consequences of pursuing this model.

Of greatest concern to theorists wishing to model the evolution of music is how to represent this physically, physiologically and socially complex activity in a simple computer model, and subsequently how to determine what should emerge out of what throughout the duration of the model. I approach these questions with the assumption that we can define music in its weakest and most broad sense as a communicative act that, if nothing else, generates and is subject to the generation of social value. This is a strong claim and a deliberate choice of perspective on the evolution of music. This weak notion of music can be ascribed to any acoustic (or even non-acoustic) communication between animals in the trivial sense that, within this modelling framework, the strength of value judgements, or the importance of status values for survival, can be defined to be negligible. This may be the default setting for most animal communication, including that of our hominid ancestors at some point along our evolutionary history. The important point in setting things up in this way is that the potential is then there for other features that are associated with music to emerge.

What, then, are the features that would be interesting to see evolve within this framework? We can expect to see changes in three major domains: in the structure of the patterns (artefacts) being shared; in the behaviour of individuals (for example in their evaluation strategies); and in the social organisation and cultural dynamics that emerge in the whole population (for example in the clustering of individuals and of the structure of patterns into groups, in the distribution of fitness within groups and in the cultural dynamics of the system).

4 Hypothetical Processes

The main result that might convince us that such a model successfully exhibited a plausible scenario for the evolution of human musical behaviour would be the emergence of some kind of structure in the patterns being exchanged. However, since structure emerges in quite arbitrary complex systems, the designers of such a model may need to justify exactly in what sense this structure is equivalent to that in human music.

A recent popular suggestion is that the most significant feature that sets human musical behaviour apart from animal music-like communication is rhythmic entrainment: the ability to find the beat in a rhythmic pattern and, perhaps additionally to structure perception of that pattern according to this beat. Humans are capable of robust entrainment across a broad range of tempi, unlike other animals who can at best entrain within a limited tempo range using only phase correction (Bispham [2] provides a detailed analysis of potential rhythmic behaviours that are specifically human and specifically musical, centred on this period correcting ability). However, existing models of rhythmic perception in musical contexts (*e.g.* [15, 14]) highlight the fact that there is more happening than just determining a period. Rhythmic perception also includes the perception of metrical structures: as listeners we infer beats and a meter on the music that we listen to and this provides a temporal framework within which we interpret musical information [4]. Admittedly these more complex aspects may not be innate, or may be insignificant consequences of the more fundamental evolved mechanism. But whilst basic timing mechanisms may have evolved under the pressures of social cohesion, could structuring aspects of rhythmic perception also have emerge directly out of the context of the social generation of value? The first hypothetical process I propose is that an increasing complexity of perceptual mechanisms could be a natural consequence of the social value framework, assuming the existence of novelty-seeking behaviour.

This hypothetical process begins by assuming that individuals perceive music by transforming an auditory stimulus into an internal perceptual space. We also assume that this perceptual space acts as the metric space in which individuals measure novelty, using the Wundt Curve, which we assume remains invariant. Finally, we assume that each individual's perceptual space is partly genetically determined and, in particular, the dimensionality of that space is specified in the genotype. Then the proposed principle is that, in a situation where individuals exchange artefacts with equal uniform frequencies throughout a population, individuals possessing higher-dimensional perceptual spaces will turn out fitter than those with lower dimensional perceptual spaces. This is because individuals with lower dimensional perceptual spaces will reward more artefacts with greater fitness values, whilst individuals with higher dimensional perceptual spaces will be more discriminatory.

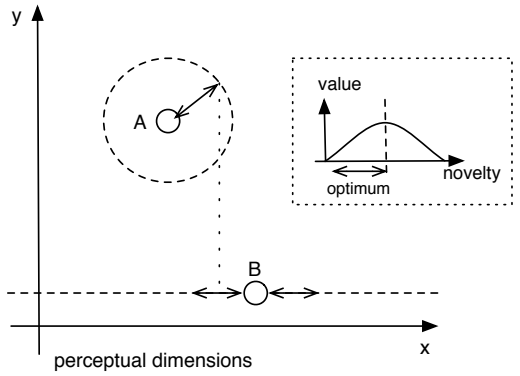

Figure 1. Agents with different perceptual spaces

Figure 1 provides an elementary representation of this relationship. A's perceptual space is two dimensional. A's position represents a reference point in that space from which novelty can be measured, and the dotted circle indicates percepts that generate the highest value in A's perceptual space. B's perceptual space is one dimensional, existing on the horizontal dotted line. When B produces artefacts that are optimal as measured in his own perceptual space, they could appear anywhere in the dimension perpendicular to B's space, when perceived by A. But when A produces artefacts that are optimal as measured in his own perceptual space, they are collapsed onto B's single dimension. Thus in many cases A will be more likely to produce artefacts that B values, but not vice versa.

It does not immediately follow that perceptual spaces will increase in dimension over evolutionary time. Implementing novelty-seeking behaviour implies that individual artefacts will be constantly changing within generations. Thus the proposed feedback necessarily relies on a dynamic cultural process rather than on a static cultural state, and only in simulation will it be really clear how the cultural process and genetic state will interact.

Continuing this discussion it becomes clearer that the questions of what music actually is and how it evolved are actually closely related.

The proposal that rhythmic entrainment is crucial to the evolution of human musical behaviour implies that temporal structuring is crucial in the definition of human music, and vice versa.

Given the assumption that by its weakest definition music is a mode of communication that results in the generation of value, what positive results could we expect a model to produce with respect to the other emergent possibilities in the model: individual behavioural strategies and social and cultural organisation? If the relationship between novelty and value were also to become a genetically determined variable of a model, could the particular relationship defined by the Wundt Curve emerge and/or sustain itself throughout the evolution of the model, through its interaction with other aspects of the model?

Novelty-value relationships have the potential to reinforce social structural organisations by, in the case of the Wundt Curve, promoting loose local cohesion and global separation. But, equally, consistent social structures may also influence the emergence of specific novelty value relations over genetic evolutionary time by creating a context in which it is beneficial to have such patterns of behaviour. This provokes a second extremely tentative hypothetical process in which social structures and innate novelty-value mappings coevolve into a mutually reinforcing stable state.

5 Conclusion

In this paper I have proposed a model associated with the evolution of musical behaviour in humans, based on the social generation of value, which I argue is increasingly relevant to human genetic evolution in light of the theory of niche construction. Like any artificial social system it is a weak representation of the real process it aims to investigate. However, its aim is to throw up hypothetical processes that can be investigated in greater detail because they can be implemented and tested as a computer simulation. The two hypothetical processes considered in this paper are; that complexity of perceptual systems emerges from the interaction of novelty seeking agents in systems of socially generated value, and that novelty-seeking behaviour and the clustering of cultural styles potentially mutually reinforce each other in such systems. This work is of little practical value in the creation of artificial creative systems but extends the theory of coevolving systems of production and evaluation to incorporate processes of human genetic evolution that are ultimately important in the understanding of human creativity.

ACKNOWLEDGEMENTS

This research is supported by a grant from the Department of Computing, Goldsmiths College. I would like to thank Geraint Wiggins for his significant contribution to the ideas discussed in this paper, and two anonymous reviewers for their comments.

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