Creative Industries: fashion versus reason
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As the CCi-FEAST conference organisers have pointed out, an emerging, knowledge-based society creates demand for evolutionary economics that consider outputs, inputs and social networks wherein peoples' choices are dependent upon, and valuated by, the choices of others. How individuals behave within these contexts is fundamental to the nature of growth of creative industries, in whether they proceed in predictable directions, or drift upon the tides of fashion.

It is useful to model elements of creative industries as being positioned along a highly simplified spectrum, between ideas that are *copied randomly* among people as fashions, and ideas that are *selected* for inherent qualities. Characterizing innovation along this fashion-selection spectrum gives crucial insight to the dynamics of how certain behaviours increase or decline. As the spectrum becomes broadly defined, the approach can be made incrementally more complex through incorporating additional model parameters tested against industry-supplied empirical data (1).

Conceptualised this way, the study of creative industries can take advantage of sophisticated tools from epidemiology (2), population genetics (3) and other culture evolution models in all their variety (4). For the 'selection' end of the spectrum, we have a wealth of models of independent decision-makers who weigh the costs and benefits of their options, while subject to various biases of influence (5). This applies well to behaviours that serve some adaptive purpose, i.e., that *matter* to human values, or the spread of a useful idea (6). Even a display of fashion, if it carries some meaningful signal (e.g. mating potential), can be seen as subject to cost/benefit decisions (7).

At the other end of the spectrum are behaviours that do not inherently 'matter', in terms of human survival, and for which there is often a large variety of options – decorative designs, musical motifs, and word forms, for example. In analogy to population genetics, these choices can be considered 'neutral' traits, in that what is chosen has no *inherent* value relative to other options (8,9). The neutral model would assume that whether a mother names her girl "Jane" or "Jamelia" depends on who, and how many, already have the name, rather than any qualities of the name itself. This is formalised as the random copying or neutral model, akin to the neutral-trait model of population genetics, for popular culture change (3).

Practically speaking, the random copying model does not require that people make choices without any reasons at all, but rather that the statistics of all their idiosyncratic choices, at the *population* level, are comparable to random copying. The model simply allows us to ask, what if everyone simply copied each other, with occasional innovation? Against this background 'canvas', more interesting phenomena become visible. In one study, we used the expectations under random copying as the background on which to fit data on dog breed popularity in the 20th century. The rapid rise and fall of Dalmatians was then clearly visible just after 1984 (10). The reason for the spike in Dalmatian popularity was surely the re-release of the Disney movie *101 Damatians* during this year. However, not all movies have this 'celebrity

effect', and the point is that we were only able to identify the Dalmatians as a *special* case because we had the null model of random copying (drift) to test against.

Given the dichotomy – random copying versus selective decisions – often the question is where certain behaviours lie on the spectrum between them. For example, with independent, rational thinking, creative culture should converge upon the collective priorities of individuals, rather than drift constantly (11). On the other hand, random copying with occasional innovation leads our collective tastes to drift continually, in a direction that is unpredictable (12) but at a rate that is steady and predicted by the level of innovation (13). We are not meant to decide beforehand which aspects of the creative industries are subject to drift, as in fact this is what we can find out empirically, using these contrasting models for the patterns of change through time.

Academia as a creative industry

Academia is itself a creative industry, and academic publishing is very much subject to fashion. Ideally, science is the systematic process of testing multiple hypotheses, but in reality, it is practiced by real people, in social contexts. Academics do their research within complex collaboration networks (14), and are prone to copy ideas from one another. Indeed, new publishing pressures and the continual diversification of specialities have changed what once was a relatively compartmentalised, restricted enterprise into one where academics compete for citations and other forms of wide-reaching, academically-sanctioned 'publicity'. In the U.K, the incentive to disseminate research has become explicit under the R.A.E. system, which scores each academic's top four publications in terms of 'impact factor'. Databases like the ISI Web of Knowledge have turned citation analysis not only into a science, but into a universal valuation system with metrics such as the 'h-index' and comprehensive citation analyses that summarize an academic's career at the a single click. In essence, most academics are judged on the number of citations they have received. The competition now is becoming less for validity of research, and more for the volume of 'hits' that research receives (15), just like any other creative industry in the modern cyber-economy – how many comments a blog has received, how many tickets were sold, how many copies of a song/video were downloaded, or how many friends have linked to a MySpace page. Academic publications, as listed on journal citation databases with all the outgoing links (references cited) and incoming links ("cited by…"), are not so different from online social network pages in this respect.

Such competition for popularity drives diversification and the construction of new niches. As a result of the pressure to publish at all costs, there is now a proliferation of new journals on almost every conceivable topic (e.g. *Journal of Happiness Studies, Queueing Systems, Wear, World Pumps, Archaeoastronomy & Ethnoastronomy News*), so that an author can publish almost any article by moving down the journal ranking far enough (16). With the added stress on reviewers, and increasing stress on academics to publish in quantity (17), this has become a recognized practice (18). As the volume of writing grows geometrically, and the editorial control consequently decreases, academic writing is free to become more and more subject to fashion, with authors copying each other in an effort to stay on top of the latest ideas, and ultimately collect as many citations as possible.

As a consequence, trendy academic jargon tends to demonstrate the continual flux and empirical patterns of random copying (19), which implies that buzzwords do not actually matter in a meaningful, scientific sense. "Copying strips of words" was a part of human interaction that George Orwell (20) hated, but on the other hand our remarkable ability to imitate is a prerequisite for culture itself.

Diverse opinions exist as to what constitutes trendy ideas versus more meaningful research paradigms, yet there is little means of evaluating this objectively. Evolutionary theory is an ideal means to model these aspects of scientific process (21). By applying basic population genetic analogy to citations database research, we can characterize the use of modern scientific keywords in terms of a continuum between copying fashionable ideas at one extreme (akin to the neutral model of random genetic drift), and independent selective testing of hypotheses at the other (akin to selection, falsifying the neutral model).

A case study: academic vocabulary

Following the selection-random copying spectrum discussed above, we can propose two simple hypotheses for the evolution of academic vocabulary, which can be quantifiably tested for a given case study: (1) Vocabulary is *randomly copied* from one paper to another, with continual innovation, (2) Vocabulary is *selected* based on inherent meaningful value of the words. The question is one of degree, with variation expected along this basic continuum. Using random copying as the null hypothesis, we simply seek to identify selection against the null without characterizing it specifically; although the most obvious form would be selected for validity of the words that usefully describe something real and relevant to the topic. We consider selection versus random copying to be the primary axis on which to characterize the process; and here we explore predictable patterns in the data such that we can characterize their degree of importance for a given academic field of study. If this can be achieved, it would then be easier to identify secondary effects, such as a bias in favour of novelty, or bias towards conformity.

Of the two hypotheses, random copying serves as the null model against which selection might be identified by contrast. By 'random copying' we do not mean that the words themselves are random, as they obviously will be intelligible, but that they exist within a large set of possible keywords, none of which is inherently more useful than any other. In analogy with the neutral model of population genetics (9), randomly-copied keywords would be *value-neutral*.

The neutral model can be modelled as follows: We start with a set of N individuals, which are replaced by N new individuals in each generation. Over successive generations, each of the N new individuals copies its variant from a randomly-selected individual in the previous generation, with exception of a small fraction, μ ($< 5\%$), of the N new individuals who invent a new variant in the current generation. In applying this to keyword use, we consider N to represent the number of keywords in a given time period, rather than the number of article, which vary in their number of keywords. This ensures that each 'individual' corresponds with exactly one variant.

The neutral model is simple to simulate (3), yet provides richly complex results that produce at least three useful predictions relevant to cultural drift:

1) **Individual frequencies through time**. If we track individual variants through the generations, their frequencies (relative popularities) will change in a stochastic manner, as opposed to a directed manner or completely random manner. More specifically, the haploid neutral model predicts that the only source of change in variant frequencies over time is random sampling, such that:

$$V = \frac{v(1-v)}{N} \qquad (1)$$

where V is the variance in frequencies from one time step to the next, and $v \leq 1$ is the relative frequency of the variant as fraction of N, the maximum possible number of variant copies per generation. For small v, $v(1-v) \sim v$, which after rearranging eq. (2) indicates that $NV/v \sim 1$. This means that departures from the neutral model may be identified by values of NV/v substantially different than one. If it was much less than 1, there might be some stabilizing selective phenomenon reducing variability, whereas values much greater than 1 could occur for different reasons, such as a variant steadily rising or decreasing in frequency due to selection, or from fluctuating wildly – which can be assessed on a individual basis. The point is, the NV/v value provides a means to identify selection, such that when we apply 'reasons' for change that we can be confident the change is not just due to random drift.

2) **Frequency distributions.** Like many 'rich-get-richer' processes (under random copying the chance of being copied is proportional to current frequency), the variant frequencies exhibit a long-tailed distribution, which for small values of μ follows a power law form (3). This is one of the less diagnostic predictions, as a variety of mechanisms can generate power law and related distributions (22). With selective bias for novelty, for example, we would expect newly-invented variants to rise quickly from obscurity and fall precipitously after reaching some threshold of popularity, as well as a truncation of the tail of the variant frequency distribution, such that very-high frequencies are absent. Alternatively, there might be a conformist bias resulting in a "winner take all" distribution, whereby one word has a higher frequency than predicted by the power law for the rest of the words.

3) **Turnover**. There is continual turnover in the variant pool. If the variants are ranked in order of decreasing frequency, the turnover z in that list over successive generations (time) depends much more strongly on μ than on N (13), such that:

$$z \approx \sqrt{\mu} \qquad (2)$$

where z is measured as the fraction of turnover in the list (e.g., two items replaced in the Top 10 = 20% turnover). In contrast to random copying, under selection the population size N should correlate positively with the turnover rate in the ranked list of most popular variants.

Using these predictions as the null model, we can identify selection as departures from these patterns, dependent on the kind of selection operating. In my CCi-FEAST presentation, I will present the preliminary results of this analysis. Among several cases, I test differences between subfields older versus younger, and within the

physical sciences versus the social sciences. In doing so, I find some remarkable regularities.

Conclusion

Almost by definition, the creative industries involve the transmission of information between individuals, with the continual production of new inventions, some of which become innovations (i.e., rise to prominence). With the invention of new ideas analogous to 'mutations,' the process is almost ideally suited to evolutionary analysis, particularly one of evaluating the degree to which ideas are selected versus randomly copied.

The selection-fashion dichotomy is more generally acceptable in today's world than it was previous decades when labour unions were strong, the Internet was a novelty of the US government agencies and academic publication was still done on real paper. Now, however, after rapid rise and fall of dot-com equities, YouTube videos, MySpace personalities, and throwaway books, ideas of random copying and drift are almost unavoidable. The relationship between evolutionary theory and other disciplines has also changed. If we see economics as a historical science, rather than a law-like one like physics, then evolution may be the *only* theory to explain variation and culture change in a causal way.

Since the mid-1990s, physics has changed, and started explicitly applying analyses of dynamic, historical processes of change – such as network evolution, complex adaptive systems, information cascades, sudden state changes and extreme events – toward models of social change. In the last decade, the science of interacting particles (or network nodes) has provided significant insights into modeling collective interactions in social systems, from Internet communities to pedestrian and vehicle traffic, and economic markets (23).

Nevertheless, economic study needs to focus on the flux of variation in open systems, rather than the maintenance of equilibrium in closed systems ([24]). Whereas variation in physics is often treated as 'noise', it is the essence of an evolutionary approach. The direct analogy between people and particles (or network nodes) in "social atom" models (25) are crucially dependent on the assumed rules of interaction, which often strays too far from reality (26).

The best approach, then as now, is evolution, and the tools that come with over 100 years of studying change among entities that pass on their similarities to others through time. As Daniel Dennett argued in *Darwin's Dangerous Idea*, evolution applies to almost any process of change, rather than the just biology of nonhuman organisms. If evolutionary economists measure empirical variation - frequencies of discrete elements – then change is characterised in terms of drift versus selection of those discrete elements, rather than gradual transformation of forms. Hence, the unit of transmission continues to be a key concern cultural evolution studies (27). In going further, many have gone back, to Dawkins' (1976) meme concept to postulate that *culture itself* evolves within its environment of human minds (Shennan 2002, Lake 1997, 1998; Aunger 2000; Mesoudi et al. 2006) regardless of the difficulty of agreeing on definitions of culture or finding units to quantifying it, which are really just our problems as scientists to overcome.

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