A Communal Exchange-based Framework for Cultural Evolution

Liane Gabora (liane.gabora@ubc.ca)
Department of Psychology, University of British Columbia, Kelowna BC, V1V 1V7, CANADA

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Introduction

The overarching goal of my research program is to develop a scientific framework for cultural evolution that is as clear as our scientific framework for biological evolution. Such a framework can provide us with a better understanding of our origins and possibly improve the accuracy of predictions concerning future cultural scenarios. This presentation will begin by motivating the theoretical framework for cultural evolution that my group has been developing, and then summarize key sources of empirical support for it, with the bulk of the presentation focusing on new results.

A Scientific Framework for Cultural Evolution

The ideas, artifacts, and technology that constitute human culture become more complex and varied with time, leading to the suggestion that culture evolves through *Darwinian selection*. However, a Darwinian explanation is only appropriate when *acquired* change (e.g., a scar, or knowledge of peoples' names) is negligible relative to *inherited* change (e.g., eye color). Otherwise the first, which can operate over minutes, overwhelms the second, which requires generations. Moreover, to the extent that the *generation* of novelty deviates from random, change is due to whatever is causing that deviation in the first place, rather than to *selection* of fitter variants.

I have shown that in cultural evolution change is acquired, not inherited, and it is generated not randomly but through strategy and intuition; therefore a Darwinian theory of cultural evolution is inappropriate (Gabora, 2004, 2008, 2011, 2013). Even in the biological realm we are only just starting to appreciate the key role played by non-Darwinian epigenetic processes. It is widely believed that the earliest forms of life evolved through *communal exchange*, with evolution by natural selection coming substantially later (e.g., Gabora, 2006; Vetsigian, Woese, & Goldenfeld, 2006). Communal exchange is more haphazard than selection and does not require a self-assembly code (such as the genetic code). What it requires is structure that is (1) *self-organizing:* its components generate new components through their interactions, (2) *self-replicating:* through duplication of components it can reconstitute an entity like itself, and (3) *interactive:* entities exchange components. I have proposed that culture similarly evolves through a communal exchange process (Gabora, 2013). Adults share ideas with children such that eventually they develop their own self-organized network of understandings, at which point they can adapt ideas to their own needs and perspectives, and thereby contribute creatively to culture.

Evolution of Capacity for Cross-Domain Thinking

For minds to evolve through communal exchange they must be organized such that for any given representation there exists *some* pathway (e.g., a chain of associations or deductive reasoning) by which it could potentially interact with and modify any given other representation. To evolve through communal exchange, representations must be able to interact not just with others in the same local cluster but across clusters (as in cross-domain analogy). Thus, another question guiding this research program is: How did the human mind acquire this kind of structure?

I propose that two key steps toward cognitive modernity were (1) onset of representational redescription (e.g., "chaining") with the appearance of *Homo erectus* 1.7 MYA, and (2) onset in the Middle/Upper Paleolithic of *contextual focus* (CF): the ability to shift between different modes of thought: an explicit mode conducive to logical problem solving, and an implicit mode conducive to free-association, insight, and breaking out of a rut (Gabora, 2003). While dual processing theories generally attribute abstract, hypothetical thinking solely to the more recently evolved "deliberate" mode (e.g., Evans, 2003), according to the CF hypothesis it is possible in either mode but differs in character in the two modes (flights of fancy versus logically constructed arguments) (Sowden, Pringle, & Gabora, 2014). A neural basis for this was proposed (Gabora, 2000, 2010).

An agent based model showed that both chaining and CF increase the mean fitness and diversity of cultural outputs (Gabora, Chia, & Firouzi, 2013). Chaining was necessary for the space of outputs to be open-ended. CF was particularly effective when the fitness function (environment) changed, which supports its hypothesized role in facilitating insightful problem solving. Building on a related research program in concept combination (e.g., Aerts, Gabora, & Sozzo, 2013), models of concepts provide further support, showing that CF is conducive to making creative connections by placing concepts in new contexts (Gabora & Aerts 2009; Gabora & Kitto, 2012; Veloz, Gabora, Eyjolfson, & Aerts, 2011).

Potential Genetic Basis

It was proposed that CF was made possible by mutation of the FOXP2 gene, which is known to have undergone human-specific mutations in the Paleolithic (Chrusch & Gabora, 2014). FOXP2, once thought to be the "language gene", is not uniquely associated with language. In its modern form FOXP2 enabled fine-tuning of the neurological mechanisms underlying the capacity to shift between processing modes by varying the size of the activated region of memory.

Implications and Applications

Modeling Material Cultural History

The application of phylogenetic techniques derived from Darwinian approaches to culture present a distorted picture of cultural history as branching rather than network-like, because they do not incorporate horizontal transmission and blending. Moreover, because they incorporate only measurable attributes, they do not capture relatedness that resides at the conceptual level (e.g., mortars and pestles are highly related despite little similarity at the attribute level). The communal exchange theory of culture inspired a new technique for chronicling material cultural history which, using multiple data sets, has been shown to generate a pattern of cultural ancestry that is more congruent with geographical distribution and temporal data than that obtained with phylogenetic approaches (Gabora, Leijnen, Veloz, & Lipo, 2011; Veloz, Tempkin, & Gabora, 2012).

Cross-Domain Influences on Innovation

Because Darwinian theories assume strictly vertical transmission and do not allow different "species" of cultural artifacts to "mate", they are incompatible with *cross-domain influence,* wherein a creator in one domain (e.g., artist) is influenced by another domain (e.g., music). Communal exchange theory predicts that cross-domain influence is not just present but fuels cultural innovation. I will report on a new project designed to test between these predictions by collecting data on the frequency of cross-domain influence. 66 creative individuals in a variety of disciplines were asked to list as many influences on their creative work as they could. Results suggest that cross-domain influences are in fact more widespread than within-domain influences, even when broad within-domain influences (e.g., technology influenced by music) as well as narrow within-domain influences (e.g., music influenced by other music). I will discuss these findings and other studies that explore cognitive implications of the communal exchange theory (e.g., Gabora, O'Connor, & Ranjan, 2012).

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