TOPICS
TOPICS IN COGNITIVE SCIENCE

Topics in Cognitive Science 4 (2012) 678–684

ISSN: 1756-8757 print / 1756-8765 online
DOI: 10.1111/j.1756-8765.2012.01224.x

Two Challenges in Cognitive Musicology

David Huron

Center for Cognitive Science, Ohio State University

Received 10 April 2012; received in revised form 15 July 2012; accepted 19 July 2012

Abstract

Two themes in music cognition research are highlighted—inspired by the contributions in this volume: (a) statistical learning and (b) evolutionary theorizing. Our ability to test alternatives to statistical learning is threatened by the rapidly diminishing opportunities for cross-cultural studies unconfounded by bimusicalism. Our ability to infer possible evolutionary origins for music is confounded by the ''hedonic plenitude'' of modern music-making—where multiple pleasure channels are activated simultaneously. Cognitively inspired music research will benefit by studying a wider range of musical cultures. Evolutionary theorizing will benefit by further work involving comparative animal behavior.

Keywords: Music; Statistical learning; Evolution; Cross-cultural research

The articles in this issue of *topics* in Cognitive Science offer something of a cross-section of the state of cognitively inspired music research. Although the reports in this volume are not a representative sample of the topic of music cognition, they nevertheless echo two themes that have been dominant in music cognition circles for the past decade or two: statistical learning and evolutionary theory. In this commentary, my aim is to draw attention to some methodological problems associated with these two enthusiasms.

1. Statistical learning

Beginning with a classic paper by Krumhansl and Kessler (1982), several lines of music research have converged over the decades, pointing to the importance of simple learning from exposure in the perception of music. This continuing line of research is amply illustrated in the articles in this issue of *topiCS* Psyche Loui's work uses artificial grammars to demonstrate how statistical learning can be observed in melodic and harmonic perception.

Correspondence should be sent to David Huron, Center for Cognitive Science, Ohio State University, Columbus, OH 43210. E-mail: huron.1@osu.edu

Marcus Pearce and Geraint Wiggins explicitly model musical expectation as a Markovian process. Martin Rohrmeier and Patrick Rebuschat's work focuses explicitly on implicit learning—a topic that many regard as statistical learning by another name. Perhaps the only topic missing here is a discussion of Bayesian methods in music perception, such as might be advocated by David Temperley (2007).

Although the nativist-empiricist debate continues to generate creative friction in linguistics and cognitive science circles, in music, there are simply too few nativists to even say that nativism is in retreat. Perhaps the absence of any clear concept of musical semantics makes music more amenable to the empiricist program.

One of the unexpected benefits of statistical learning has been our ability to account for many subjective ''qualia'' associated with different musical patterns. It appears, for example, that the ''itchy'' qualia of what musicians call the ''leading tone'' and the mixture of stability and instability that characterizes the ''dominant'' pitch can be traced to the first-order probabilities of how these tones are used in Western musical culture (Huron, 2006). When expectations are high, listeners experience a feeling of yearning and forward motion. When expectations cease, listeners experience a sense of repose and closure. In short, many of the seemingly transcendent and mysterious phenomenological experiences evoked by music can be plausibly traced to the objective statistical patterns evident in the music itself.

Whether justified or not, researchers who are enthusiastic about statistical learning have taken heart in two developments outside of psychology. The first is the remarkable success of machine learning. Applications such as computer speech recognition provide existence proofs that bottom-up statistics can achieve surprisingly robust and impressive results. The second arises from the completion of the Human Genome Project. The small number of protein-encoding genes in the human genome has cast suspicion on nativist views. Of course, individual genes serve multiple purposes (pleiotropy) and interact with regulatory genes in convoluted ways. Whether the argument holds merit or not, the popular impression has been that most of the innumerable mental functions painstakingly chronicled by psychologists and linguists are unlikely to be biologically ordained in any meaningful interpretation of the word ''innate.''

In conjunction with the human disposition for gaze-following, shared attention, and imitation, statistical learning seems to offer a powerful empirical ''explain-all.'' Statistical learning seems to provide a sort of explanatory solvent that can dissolve the most intractable of cognitive problems.

If the history of psychology is any guide, as this research matures, we are apt to discover various oddities—aspects of behavior that are approximations of Markovian processes rather than direct parallels (e.g., Huron, 2006). These anomalies are likely to provide decisive clues regarding the underlying developmental and neural mechanisms involved in learning.

Although many of us are devotees of the empiricist program, there are reasons to be wary of its prominence—at least in the case of music. In both language and music, we see a huge variety of cultural variants around the world. Languages differ, and musics do, too. Statistical learning seems to offer an omnibus solution, suggesting that the variations evident across musical cultures are mere variations on a theme. Cultural differences, we might presume, are simply artifacts of divergent practices. Different scales, tunings, timbres, rhythms, and forms are simply the effects of accumulated cultural drift. There exist no fundamentally different mental mechanisms (goes the argument) from one musical culture to another.

If the mechanisms of statistical learning are universal, then we ought to be able to understand these mechanisms by studying any group of people. There is no need to look beyond the unique culture of undergraduate Westerners.

The problem with this theory is not that it is wrong, but that if it fails to be right, there are onerous Type II repercussions. In his article in this volume, Ian Cross (2012) aptly refers to ''the embarrassingly small cognitive literature that has explored music across cultures.'' The contrast between music and linguistics is both instructive and sobering.

Comparative linguistics has provided pivotal and essential insights within the field of linguistics generally (e.g., Trask, 2001). The lifeblood of scientific discovery is data variance. Aware of this, linguists have long bemoaned the inexorable decline in the world's linguistic diversity. (The United Nations estimates the number of languages in existence to be around 5,000.) Of course, comparative linguistics would still be a viable enterprise even if the number of distinct languages could be counted in the hundreds—or even perhaps in the dozens.

Music, unfortunately, is not doing so well. There exist robust non-Western musical traditions, notably the traditional musics of India, Indonesia, China, Africa, and the Middle East. However, the major concern is not the number or variety of existing musical cultures. The principal problem from a research perspective is to be found in the pervasiveness of bimusicalism. Through Hollywood films, television, and the ubiquitous reach of Western media, nearly everyone on the planet is now familiar with Western music.

To the casual ear, the rich cacophony of ''world music'' available on the Internet suggests a bewitching diversity of musics. However, this apparent richness does not necessarily reflect a corresponding richness of musical minds. A South African group might sing in Xhosa, but their harmonies still follow the Western principles described by Jean-Philippe Rameau (1722). Native American Lakota singers make valiant efforts to preserve their traditions, but their singing bears the unmistakable imprint of Western scales. The casual listener hears a wealth of variety; the trained musicologist detects a rapidly spreading monoculture—albeit expressed in many forms (Huron, 2008). Ethnomusicologists have long been aware of the homogenizing effects of musical globalization (e.g., Nettl, 1983).

Despite the utopian dreams of some, it will be many centuries before everyone on the planet speaks a common language. Ironically, the dream of a universal second language (such as Esperanto) is being achieved in the case of music. Predictably, it is not simply the case that Western music is becoming ''everyone's second musical culture.'' For most people—-from Koreans and Navaho to Bugandans and Javanese—Western musical language is now their native musical culture, with their indigenous musics amounting to an acquired local taste.

Bimusicalism develops through passive exposure and appears to be acquired far more rapidly than bilingualism. This renders comparative musicology a suspect enterprise. No matter how well versed, or how steeped in a non-Western musical tradition, we just cannot be sure that any purported universal is not the product of Western musical contamination. Although ethnomusicologists have documented innumerable cases of syncretic musics, there is regrettably almost no parallel psychological work regarding the acquisition of second-culture musical competence.

The challenges are aggravated by the inexperience of experimentalists in working with non-Western populations, and a regrettable clash of research cultures when attempting to collaborate with anthropologists and ethnomusicologists (Huron, 2009).

At this point, one sincerely hopes that statistical learning (or its future research progeny) proves to be the One True Model for music, because we may have a hard time deciphering any other possibility.

2. Evolution and music

The second theme evident in the accompanying articles is the debate concerning possible evolutionary origins for music. The contributions by Gary Marcus, Ian Cross, Henkjan Honing, and Annemie Ploeger all address questions of evolutionary psychology.

Over the past decade, there has been an explosion of evolutionary speculation regarding music (e.g., Brown, 2000; Cross, 2003; Dissanayake, 2009–10; Fitch, 2005; Freeman, 2000; Huron, 2001; Justus & Hutsler, 2005; Livingstone & Thompson, 2009–10; Masataka, 2009; McDermott, 2008; Merker, 2000; Miller, 2001; Mithen, 2005; Nettl, 2005; Parncutt, 2009–10; Patel, 2006). Were Stephen J. Gould alive, he might very well be apoplectic over the proliferation of speculative storytelling (Gould & Lewontin, 1979). Although there is precious little empirical evidence, etiological speculation is not without value.

Music really is something of an enigma. If some extra-terrestrial being were to visit earth, it would recognize the value of most human activities. It would observe Homo sapiens engaged in food production, transportation, education, governance, communication, health, and a myriad of activities that would make sense to any sentient alien. Music, however, seems utterly baffling. The sheer amount of time and resources devoted to this peculiar human enthusiasm certainly gives pause for thought. Unlike various addictions, musical activities do not appear to represent any straightforward hijacking of some neurological pleasure channel. We rarely find music lovers living bedraggled lives, sleeping on the streets, and begging for money for their next concert ticket. In short, the love of music does not seem maladaptive in the way that love of drugs, alcohol, gambling, or gluttony can be. Music does not obviously appear to be a form of non-adaptive pleasure seeking. Indeed, failing to profess a love for music is usually regarded as a sign of significant deviance. To say you do not like music is to invite deep suspicion and (especially among teenagers) social ostracism. Something is going on with music, and it may take a while to determine what that something is. Music may yet reveal something quite interesting about human minds.

Unfortunately, identifying some evolutionary origin (if it exists) is apt to prove challenging. The foremost challenge, I propose, is that modern musical behaviors are unlikely to provide a good starting point for theorizing about possible evolutionary origins.

Consider, by way of example, the dinner party. Apart from the preparation of the food, we typically attempt to enhance the experience through other (non-gustatory) pleasure channels. We commonly serve the food in a visually appealing way—creating pleasant table settings, using fine china and silverware with floral arrangements. We may add background music, or we may arrange to eat in a beautiful setting—perhaps while watching a sunset. Apart from these sensory appeals, we may also endeavor to cater to non-sensory hedonic channels. Rather than eating alone, people normally add a social pleasure by dining with close friends or inviting socially entertaining guests. Perhaps, we will eat on a day that has a special meaning, such as an anniversary. Through a process of hedonic plenitude, the simple consumption of food is transformed into the elaborate dinner party. This hedonic agglomeration, I would suggest, is the model for musical pleasures.

The proclivity toward ''hedonic plenitude'' is evident in virtually every human activity. Suppose we crafted an activity that appeals to some human pleasure channel. The activity might be anything—from lawn bowling to fox hunting. The natural tendency for these activities is to accrue additional ways of experiencing pleasure. (Why activate pleasure channel A, when you can arrange the experience to simultaneously activate pleasure channel B as well?) Over time, human ingenuity tends to transform all pleasure-inducing activities into multi-pleasure-inducing activities.

Now, suppose you were an alien attempting to decipher the original adaptive value (if any) of the (modern) dinner party. One could easily be sidetracked by the floral arrangement, by the etiquette of fork use, by the laughter-inducing conversation, or by the blowing out of candles on a cake. It is not obvious that the original adaptive purpose underlying the behavior is to be found in the nutritional content of the proteins, fats, and carbohydrates being consumed.

Similarly, it is hard to know what to focus on in music. Is ''melody'' or ''rhythm'' or ''consonance'' or ''lyrics'' imperative to understanding music's origins? Or do these phenomena represent later embellishments? Is the social context for music-making central or supplemental? Is dancing essential or dispensable in deciphering music's primordial appeal? Modern music-making is apt to provide little insight into any possible evolutionary origin because music has probably accrued many ancillary forms of pleasure in addition to whatever adaptive pressure instigated the behavior in the first place (Huron, 2005).

Once again, a comparative method is apt to offer the most promising approach. In the case of possible evolutionary origins, it is helpful to compare human behaviors with those of non-human animals. Ancient behaviors leave little or no historical evidence. However, as ethologists have long recognized, comparing cross-species behavior provides an independent tool for tracing possible phylogenetic connections. Comparative studies, such as those deciphering consonance/dissonance across species (McDermott & Hauser, 2004) or identifying beat-synchronization abilities across species (Patel, Iversen, Bregman, & Schulz, 2009) may yet provide critical clues as to why music-making has come to loom so large in the human behavioral repertoire.

In the context of music research, the challenges facing both statistical learning and evolutionary theorizing point toward the need to emphasize comparative methods. Cognitively inspired music research will benefit by addressing a wider range of (dwindling) musical cultures, and issues in evolutionary psychology will benefit through comparative animal behavior. These changes warrant more interdisciplinary collaboration, and more catholic attitudes in research funding.

References

Brown, S. (2000). Evolutionary models of music: From sexual selection to group selection. In F. Tonneau & N. S. Thompson (Eds.), *Perspectives in ethology 13: Behavior, evolution and culture* (pp. 231–281). New York: Plenum Publishers.

Cross, I. (2003). Music and evolution: Consequences and causes. *Contemporary Music Review*, *22*(3), 79–89.

Cross, I. (2012). Cognitive science and the cultural nature of music. *Topics in Cognitive Science*, *4*, 668–677.

Dissanayake, E. (2009–10). If music is the food of love, what about survival and reproductive success? *Musicae Scientiae*, Special issue 2009–2010, *13(2 supplement)*: 169–195.

Fitch, W. T. (2005). The evolution of music in comparative perspective. *Annals of the New York Academy of Sciences*, *1060*(1), 29–49.

Freeman, W. J. (2000). A neurobiological role of music in social bonding. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The origins of music* (pp. 411–424). Cambridge, MA: MIT Press.

Gould, S., & Lewontin, R. (1979). The spandrels of San Marco and the Panglossian paradigm: A critique of the adaptationist programme. *Proceedings of the Royal Society of London, Series B*, *205*, 581–598.

Honing, H., & Ploeger, A. (2012). Cognition and the evolution of music: Pitfalls and prospects. *Topics in Cognitive Science*, *4*, 513–524.

Huron, D. (2001). Is music an evolutionary adaptation? *Annals of the New York Academy of Sciences*, *930*, 43–61.

Huron, D. (2005). The plural pleasures of music. In W. Brunson & J. Sundberg (Eds.), *Proceedings of the 2004 music and science conference* (pp. 65–78). Stockholm: Kungliga Musikhögskolan Förlaget.

Huron, D. (2006). *Sweet anticipation: Music and the psychology of expectation*. Cambridge, MA: MIT Press.

Huron, D. (2008). Lost in music: Music provides unique opportunities for understanding both brain and culture. *Nature*, *453*, 456–457.

Huron, D. (2009). Why some ethnomusicologists don't like music cognition: Finding common ground in the study of musical minds. Keynote address, European Society for the Cognitive Sciences of Music (ESCOM) Conference. Jyväskylä, Finland (August 12, 2009).

Justus, T., & Hutsler, J. J. (2005). Fundamental issues in the evolutionary psychology of music: Assessing innateness and domain specificity. *Music Perception*, *23*(1), 1–27.

Krumhansl, C., & Kessler, E. (1982). Tracing the dynamic changes in perceived tonal organisation in a spatial representation of musical keys. *Psychological Review*, *89*, 334–368.

Livingstone, S. R., & Thompson, W. F. (2009–10). The emergence of music from the theory of mind. *Musicae Scientiae, Special issue 2009–2010*, *13(2 supplement)*: 83–115.

Loui, P. (2012). Learning and liking of melody and harmony: Further studies in artificial grammar learning. *Topics in Cognitive Science*, *4*, 554–567.

Marcus, G. (2012). Music, musicality, evolution, cognitive development, innateness, instinct, skill-learning. *Topics in Cognitive Science*, *4*, 498–512.

Masataka, N. (2009). The origins of language and the evolution of music: A comparative perspective. *Physics of Life Reviews*, *6*, 11–22.

McDermott, J. (2008). The evolution of music. *Nature*, *453*(15), 287–288.

McDermott, J., & Hauser, M. (2004). Are consonant intervals music to their ears? Spontaneous acoustic preferences in a nonhuman primate *Cognition*, *94*, B11–B21.

Merker, B. (2000). Synchronous chorusing and human origins. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The origins of music* (pp. 315–328). Cambridge, MA: MIT Press.

Miller, G. (2001). Evolution of human music through sexual selection. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The origins of music* (pp. 315–328). Cambridge, MA: MIT Press.

Mithen, S. (2005). *The singing Neanderthals: The origins of music, language, mind, and body*. London: Weidenfeld Nicolson.

Nettl, B. (1983). *The study of ethnomusicology: Twenty nine issues and concepts*. Urbana, IL: University of Illinois Press.

Nettl, B. (2005). In the beginning: On the origins of music. In *The study of ethnomusicology: Thirty-one issues and concepts* (pp. 259–271). Urbana, IL: University of Illinois Press.

Parncutt, R. (2009–10). Prenatal and infant conditioning, the mother schema, and the origins of music and religion. *Musicae Scientiae*, Special issue 2009–2010, *13(2 supplement)*: 119–150.

Patel, A. D. (2006). Musical rhythm, linguistic rhythm, and human evolution. *Music Perception: An Interdisciplinary Journal*, *24*(1), 99–104.

Patel, A., Iversen, J., Bregman, M., & Schulz, I. (2009). Experimental evidence for synchronization to a musical beat in a nonhuman animal. *Current Biology*, *19*(10), 827–830.

Pearce, M. T., & Wiggins, G. A. (2012). Auditory expectation: The information dynamics of music perception and cognition. *Topics in Cognitive Science*, *4*, 625–652.

Rameau, J.-P. (1722). *Traité de l'harmonie reduiteà ses principes naturels*. Paris.

Rohrmeier, M., & Rebuschat, P. (2012). Implicit learning of music: What do we know today? *Topics in Cognitive Science*, *4*, 525–553.

Temperley, D. (2007). *Music and probability*. Cambridge, MA: MIT Press.

Trask, R. L. (Ed.) (2001). *Dictionary of historical and comparative linguistics*. Dearborn: Fitzroy/Routledge.