BOOKS & ARTS

Hitting the right note

Our ability to predict events shapes the way we listen to and appreciate music.

Sweet Anticipation: Music and the Psychology of Expectation
by David Huron
Bradford Books: 2006. 462 pp. $40

Petr Janata

Imagine that just before sounding the final chord of a Beethoven piano sonata, a concert pianist abruptly interrupts the performance to answer the phone that has just rung in his tuxedo pocket. The audience is left pining for musical closure, livid that a sparkling performance should terminate with an insipid ringtone. It might be forgiven, however, if it was an intentional act of musical humour. In *Sweet Anticipation*, David Huron provides a richly detailed theory of how and why the audience has particular expectations and emotions about such unlikely events, as well as in more common situations.

Scientists trying to understand how we experience music have long assumed that expectations and emotions are intertwined. The basic notion, spurred by music theorist Leonard Meyer's seminal 1956 treatise *Emotion and Meaning in Music*, is that the playful tweaking of a listener's expectations engages general brain mechanisms that compare expectations with input from the environment and set our emotional tone accordingly.

At the core of Huron's account is the premise that organisms derive an evolutionary benefit from being able to predict how their environments will behave. In other words, we internalize the probabilities with which certain events follow other events in everything we do. If I tell my employer I want a raise, there are certain probabilities associated with getting what I want, being ignored or getting fired. My life experiences and understanding of the situation will guide my actions and shape my expectations. Music is no exception. Every time we listen to a blues song or a piano concerto, our brains pick up on the underlying statistics regarding which notes tend to occur together or follow one another in these different styles. We use this accumulated knowledge to appraise unfamiliar pieces of music or different performances of well-known songs. In short, our expectations are an outcome of statistical learning.

Huron does an excellent job of illustrating that there are different varieties of expectation, and that they unfold in time and across different timescales. Expectations are dynamic and shape emotions from one moment to the next. Most of the neuroscientific details of this interplay have yet to be worked out, but Huron provides a compelling framework that is likely to shape research agendas for years to come.

ARCHIVBERLIN FOTOAGENTUR/ALAMY

Composers often play with our expectations to alter our emotional response to a piece of music.

Perhaps the most far-reaching aspects of the book relate to Huron's wedding of contemporary research topics: the cognitive psychology of statistical learning and large-scale statistical analyses of music. The latter topic is important not only for music theorists and researchers, but also for the burgeoning industries of predicting hit songs and customized music-recommendation services. Music researchers face the problem of knowing whether any given piece or set of pieces used in an experiment, from the millions of possibilities, is sufficiently representative to allow broader inferences to be drawn about the psychology and neuroscience of music. Similarly, composers face the problem of deciding whether their compositions play with listeners' expectations in truly original ways.

One solution is to compare the statistics of the piece being considered — how often different notes occur and how often certain pairs of notes or chords follow each other, for example — with statistical distributions from music libraries. This computational-musicology approach allows Huron to answer question after question about the compositional practices of different composers, genres and cultures, and about the listener's perceptions. The issue of whether feelings such as tension, longing and surprise are associated with less probable musical events is addressed empirically with various examples that simultaneously inform the musical novice about the inner workings of music, and provide the music theoretician with an empirical link between the structure and function of specific compositional practices. As someone who finds Wagner's music difficult to listen to, I realize that my listening experiences would have benefited long ago from reading Huron's concise and insightful treatment of the compositional styles of Wagner, Schoenberg and Stravinsky.

Lest the reader believe that a few improbable examples have been chosen to link statistics, expectation and emotion, Huron offers several variations on the theme. Some, such as explanations of why large melodic intervals (jumps in pitch) tend to go upwards and are followed by smaller steps in the opposite direction, will appeal mainly to music theoreticians and psychologists; others, such as why we grow to like certain pieces of music, why the music of other cultures sounds strange, and the phenomenon of perfect pitch, have broader appeal. Huron's treatment of perfect pitch — the ability to

name an isolated note without any referent — is particularly refreshing and insightful. This phenomenon is one aspect of the psychology of music that has garnered considerable public and scientific attention. Huron subtly questions the utility of absolute pitch, suggesting that we may have lost this ability over our evolutionary history because the adaptive pressures of our musical environments support listening to and producing music in terms of relative, rather than absolute, pitch.

Many such intellectual provocations take the reader on a fascinating journey into the inner workings of music and how it tickles the human mind. ■

Petr Janata is at the Center for Mind and Brain, University of California, Davis, California 95616, USA.

Learning the mother tongue

The Infinite Gift: How Children Learn and Unlearn the Languages of the World
by Charles Yang
Scribner: 2006. 288 pp. $25

Annette Karmiloff-Smith

Clearly nature and nurture both play vital roles in human development, and most scholars have now rejected the old 'either/or' controversy in favour of theories that invoke complex interactions between the two. However, the debate remains as to whether nature or nurture plays the greater role in shaping the developing brain's acquisition of a native tongue. This is partly because we lack testable theories of the precise processes by which genes and environment interact, and partly because many in the field have entrenched philosophical views about what it is to have human language. For some, consistent regularities in the physical and social environments to which children are exposed play a critical role; for others, the environment simply acts as a trigger for the functioning of our genetic endowment.

In *The Infinite Gift*, Charles Yang navigates between these two positions, endorsing without question Noam Chomsky's 'nativist' theory, which holds that the abstract human capacity for language is prespecified in our genes. But Yang gives the theory a new slant: he argues that children learn their mother tongue by unlearning all the other languages of the world. According to Yang, English children have a different language from adults, not because they occasionally speak imperfect English, but because they occasionally speak perfect Chinese (or Eskimo, French, German, Swahili…). He claims that childhood errors never violate the principles and parameters of the world's languages, and can be explained by translating them into other languages.

Yang argues that, during the early years, children engage in 'variational learning', whereby several languages simultaneously form part of the child's ongoing hypotheses. Gradually, through competition between grammars, the child hones in on the mother tongue: "every instance of language learning is just a bunch of parameters fighting for supremacy". Inspired by Darwin and using some compelling examples, Yang asserts that language learning and historical change can both be explained by the mechanism of natural selection. Yang's nativist approach seems more dynamic than that of many of Chomsky's disciples, placing more emphasis on learning by the child.

Engagingly written, with fascinating examples conveying the author's enthusiasm for his topic, Yang's book vacillates between targeting parents, students and academic peers. He doesn't mention competing theories, so the naive parent or student would be forgiven for thinking that the whole scientific community concurs on how language is acquired. Yet a growing body of cross-linguistic work based on construction grammar has been emerging from evolutionary anthropology, offering the richest hypothesis-driven data sampling of early child language currently available. In my view, readers of the book would have benefited from being able to contrast chomskyan theory with at least one other. Instead, we are presented with supporting experimental work emanating solely from Chomsky's disciples. For instance, Yang mentions work on a genetic disorder called Williams syndrome, claiming that moderate to severe mental retardation coexists with unimpaired linguistic ability. But he fails to bring to the reader's attention the work of numerous labs demonstrating that the general intelligence of those with Williams syndrome is actually in the mild range, and that their linguistic ability is seriously delayed in childhood, follows an abnormal developmental trajectory, and reveals semantic, grammatical and pragmatic deficits in adolescence and adulthood.

To support his assertion that there are critical periods for language learning, Yang calls upon examples of feral children. Yet in her book *Wild Boy* (Sceptre, 2003), Jill Dawson made a convincing case regarding the 'wild boy of Aveyron' that it was not the lack of input at appropriate ages that impeded language acquisition, but the fact that the boy was severely autistic (perhaps also explaining why he was abandoned in the first place).

On the topic of genes, Yang claims that "the uniquely human ability for language must ultimately reside in some uniquely human genes". Yet elsewhere he recognizes that *FOXP2*, the so-called 'language gene', is also involved in other cognitive functions and the development of body parts. In fact, it is questionable whether *FOXP2* is directly involved in language at all. Rather, it is indirectly involved in rapid speech perception and production, and is expressed in humans, apes, mice and birds. Despite the allelic difference of *FOXP2* in humans, its function is similar across many species — the rapid coordination of intricately timed motor sequences. The gene is first expressed in many different cerebral regions, but over developmental time its expression is increasingly confined to the cerebellum.

Let me conclude by drawing attention to Yang's justification of his allegiance to a nativist theory; as he says, "we cannot poke around the child's brain". Such an assertion is rather outdated, as we can now examine online processing in infant brains by using high-density evoked related potentials, near-infrared spectroscopy, and other non-invasive methods. These have already shown that the infant cortex starts out highly interconnected, with widespread activity occurring for different inputs. Only with time does the infant brain become specialized and localized for different functions. Such studies are likely to open exciting windows on how the developing brain acquires language. ■

Annette Karmiloff-Smith is head of the Neurocognitive Development Unit, Institute of Child Health, 30 Guilford Street, London WC1N 1EH, UK.

S. WATSON/STONE/GETTY

Speaking a different language: do children start with a grasp of all the world's languages before focusing on their mother tongue?