

Chaffin, R. (2002). Review of B. Snyder, *Music and memory: An introduction*. *Music Perception*, 20, 18-24.

Bob Snyder, *Music and Memory: An introduction*, Cambridge MA: MIT Press, 2000, 291 pp., ISBN 0-262-19441-4 (hardcover) ISBN 0-262-69237-6 (paperback).

The psychology of music was an active field of inquiry in the first half century of psychology's existence as a science (e.g., Seashore, 1938; Stumpf, 1911). Given this early start, it might be expected that music would now have a place in any list of basic human faculties whose study is central to the discipline. A glance at the table of contents of any introductory or cognitive psychology textbook will show, however, that this is not the case. Chapters on "perception", "memory", and "reasoning" are standard, but you will be lucky to find "music" in the index. This is a heritage both of the behaviorist focus on the economics of behavior, and of the cognitive focus on language -- the only medium of communication to earn a place in the canon of basic human faculties. The debate over the nature of language gave birth to cognitive psychology in the 1950's and 1960's, and its theoretical constructs have been developed to account for language comprehension. Applying those constructs to music comprehension can provide valuable new insights. This is what Bob Snyder has done in his creative and entertaining book, *Music and memory: An introduction*.

Snyder is a composer and video artist. His book was written as a text for his course in composition at the School of the Art Institute of Chicago. He believes that composers can benefit from an understanding of how cognitive architecture constrains musical structure. His students are not, for the most part, trained musicians, and he therefore assumes no specific knowledge of music -- notation, theory, or the classical canon. But this is not an easy book. The first half takes as its framework the information processing pathway from sensation to perception, to memory. The second half applies the ideas developed in the first part to the basic building blocks of music: pitch, melody, rhythm, and form. The result is a refreshingly idiosyncratic view of many core constructs of cognitive psychology and an excellent introduction to the psychology of music.

The basic insight organizing the book is that musical structure is a product of the ability of the nervous system to process information. More specifically, different levels of musical structure are related to the temporal characteristics of the different encoding processes and memory stores along the information processing pathway. For example, pulses of air pressure that occur at a rate of 20 per second and higher fuse together and are experienced as a single pitch, while pulses that are slower than this threshold are experienced as separate auditory events. This reflects a fundamental limitation on the speed of neural processing.

Other characteristics of musical perception depend on the parameters of echoic and working memory, for example on the fact that information lasts approximately 250 msec in the former and 8 seconds in the latter. One consequence of these temporal parameters is that finer pitch discriminations are possible when two tones occur in close succession, so both are in echoic memory, than when they are more separated in time, so that one must be stored in short term memory. The high resolution of echoic memory permits discrimination of upward of 1400 distinct pitches. This number shrinks dramatically when the two pitches are more separated in time, requiring the use

of short term memory. In short term memory, pitch is represented by the categories of whatever tuning system the person has acquired from their musical community. People who have been exposed to the Western European tuning system can distinguish about 90 different pitches.

The parameters of each memory store also determine the ways that musical events are grouped together, creating the different levels of musical organization. At the first level, musical events are organized according to primitive grouping principles that operate within the 250 msec window of echoic memory. At the next level, events are organized into melodic and rhythmic phrases whose length and composition is constrained by the parameters of short term memory. Phrases typically have an upper limit of around 8 seconds on their duration and of  $7 \pm 2$  on the number of melodic or rhythmic groupings they contain. The third level of musical organization involves comparison of events that are separated by more than 8 seconds. This requires that at least one of the events be retrieved from long-term memory. This kind of use of long-term memory is the hallmark of the higher levels of musical structure. It permits identification of units of musical organization of the size of sections and above, with time spans ranging from 8 seconds up to an hour or more.

The mapping of music structure onto the stages of information processing does not, of course, provide a perfect fit. For example, the size of melodic and rhythmic groupings is only loosely related to the temporal parameters of the echoic and working memory levels. Nevertheless, Snyder's scheme has a lot of explanatory power. For example, questions about the universality of musical principles are dealt with in terms of bottom-up and top-down processes, with earlier, bottom-up processes having stronger claims to universality and later, top-down processes being more open to the influence of previous experience. Snyder is primarily interested in the former.

The sequence of chapters on the information processing pathway, "Echoic memory and early processes", "Short term and working memory", and "Long-term memory" is punctuated with chapters on how acoustic information is organized at each level. The discussion of echoic memory is followed by a chapter on how the Gestalt principles of proximity, similarity, and continuity establish sequential groupings of musical events. Melodic groupings are established through changes in relative pitch and direction of motion, and rhythmic groupings through changes in the time interval between events. After the chapter on short-term memory, this analysis is extended to phrases and higher levels of musical structure, through a description of how the same principles are used to create musical boundaries signifying varying degrees of closure.

The chapter on long-term memory is followed by chapters on categorization and schema. Schank and Abelson's (1977) restaurant script is used as an example of a temporal schema, and the idea of slots, default values, and memory for gist are mapped onto the experience of listening to and remembering music. Activating a musical schema generates expectations for what comes next, and the disappointment or satisfaction of these expectations is a source of musical tension and release. Unexpected events stand out both in experience and in memory. Just like memory for prose, memory for music is a complex mixture of default values generated from the generic schema and specific memories of ways in which the particular piece departed from what was expected. Because schemas are

acquired from experience, listeners will have different experiences of the same piece of music to the extent that they have different schemas for it. By the same token, shared schemas are a basis for a common experience and musical culture.

Interesting use is made of the idea that musical events are treated categorically. The fact that we recognize a limited number of distinct pitches and intervals, rather than an infinite continuum, allows us to classify different musical events as examples of the same pitch or interval. Listeners hear two intervals as the same despite the fact that they are not exactly identical. Categorical effects of this sort occur for most important aspects of music including pitch, rhythm, and form. The ability to categorize makes possible the higher levels of musical structure because it allows us to recognize the relationship of acoustic events currently in short term memory to events that occurred earlier in the same piece, or to events experienced on previous occasions.

Categorization, however, comes at a cost. We remember the category, but we forget the variations within it. The same mechanism that makes it possible to recognize two different examples of an interval as the same interval makes it hard to remember the differences. Variations within a category are called “nuances”. For every aspect of music that can be categorized, there are corresponding nuances. Melodic nuances are produced by variations in pitch, interval, vibrato, and intonation. Rhythmic nuances involve pushing or dragging the beat. Formal nuances involve variations in larger patterns, as when the same theme is repeated with subtly different dynamics and timing. Nuances are perceived but not easily available for explicit recall. For this reason, our ideas of musical form are restricted to those aspects of music that can be categorized, like the repetition of themes and intervals. These are what we can recall at will, given the requisite experience and knowledge. The nuances of a performance, on the other hand, are not readily recalled. In so far as we do remember them, the memories are implicit, not available to deliberate recollection. Much of the interpretation of a piece lies in this implicit realm of nuance. Snyder attributes the fact that we can listen repeatedly to the same recording of a piece without getting bored to our inability to recall the nuances of the performance.

The first half of the book closes with a fascinating chapter on the role of metaphor in music. The starting point is Lakoff and Johnson’s (1980) proposal that metaphors rooted in core sensory experiences of everyday life form the basis for our understanding of more abstract domains. The information that “taxes have gone up” makes use of our gravity-based experience of space. Likewise, when we talk about “the falling line” of a melody we tap into the same metaphor, based on the same sensory experiences. Other metaphors that play important roles in our experience of music are centrality, linkage, causation, tension, pathways to a goal, and containment. For example, the idea of a “rest” is part of the metaphorical system of talking about music as a form of motion. Literally, of course, there is no motion in music -- just sounds. But without the idea that a melody “moves” from higher to lower, faster or slower, we would be at a loss to conceptualize our experience. This is not because music is uniquely ineffable. Barsalou (1993) has argued that even simple, everyday concepts are based on abstract “image schemas” that include sensory components of our experiences. Snyder’s analysis does, however, suggest that exploring the role of these

sensory metaphors in music might help to better understand their role in language, just because music does not have the denotative function of language.

This is just one of several places in which Snyder's treatment points to how the psychology of music may help to better understand cognitive processes in general. Here is another example. "The limits imposed by habituation and by short-term memory are the two major constraints on the structure of comprehensible messages, and are related to the concepts of information and redundancy, respectively" (p. 209). Habituation? The notion that short-term memory forms a major constraint on communication is familiar enough. The realization that center-embedding of sentences is restricted by short-term memory constraints was one of the early insights of psycholinguistics. The idea that habituation provides a similar and complementary constraint seems more novel. Habituation is not a phenomenon that springs readily to mind in thinking about language -- except perhaps the artificial, laboratory phenomenon of "verbal satiation". The kinds of spoken and written messages that we normally encounter simply do not contain the level of redundancy and repetition required to produce habituation. Music, on the other hand, does. When listening to music, our attention is continually drawn to novel elements, while repetitive elements fade into the background. As Snyder points out, this is why accompaniments are more repetitive than melodies. No sooner is this noted, than parallels with language spring to mind -- all those jokes about old married couples who do not listen to each other; the retention of gist at the expense of the more predictable verbatim details of an utterance. Of course there is habituation in everyday linguistic communication. We just do not notice it. Music holds up a mirror to our science, showing us things that were previously invisible.

The second half of the book applies Snyder's ideas about memory and organization to several important aspects of music: pitch, melody, rhythm, and form. No doubt this works pedagogically, but there is a good deal of redundancy with the first half, and the material sometimes seemed repetitive. There is no treatment of harmony or timbre. Snyder explains in the preface that many of his students use monophonic instruments and that harmony is primarily a European phenomenon (p. xiv). Timbre is omitted because it is only partly understood and its treatment requires considerable background in acoustics.

More important omissions from this generally excellent treatment of the basic psychological mechanisms underlying music are the topics of emotion and performance. The preface tells us that emotion is "simply too big a subject to include in an introductory book" (p. xiv). More likely, the problem is that cognitive psychology has yet to integrate emotion into the information processing path that provides the conceptual foundation of the book, in spite of substantial efforts to do so (Damasio, 1999; Griffiths, 1997; Juslin & Sloboda, 2001). The centrality of emotion to musical experience draws attention to this gap in our knowledge and suggests that music could be the phenomenon that provides the key to this important puzzle. Snyder's neglect of music performance reflects another gap in the field. Cognitive psychology has been strangely silent about how thoughts are translated into actions, and music psychology has followed this lead, neglecting performance for perception. Again, there is much to recommend music as a domain in which to study this problem (Clarke, 1988; 1995; Chaffin, Crawford & Imreh,

2002; Chaffin & Imreh, 2001; Palmer, 1989; 1997). Notational systems and technologies are available for recording musical performance, making it a domain that lends itself to the study of complex action.

In spite of these omissions, Snyder has done the field an important service in this scholarly and innovative integration of psychology and music. It is instructive to watch someone from outside of the field making sense of what cognitive psychology has to offer. His choices are not always the standard ones. For example, psychologists have learned to live without an answer to the central question of how conscious experience arises out of all this processing of information. Snyder, however, wants to know, citing Barrs (1988) and Dennett (1991) on the “global workspace” by way of an answer. Perhaps it is just because Snyder is not a psychologist that his book would make an excellent textbook for an introductory course in the psychology of music.

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