

Five Definitions
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Before I provide my definitions, I'll issue two disclaimers. First, I take it that what is being requested from us are rigorous, formal definitions of the sort which are required within scientific inquiry. As such, they will be limited and necessarily unsatisfying for some, maybe even most, of those who care about the things in question. To press into service a well worn sort of analogy, defining water as consisting of two hydrogen and one oxygen, or force as mass times acceleration, will tell you much about the natural world, but will tell you nothing very useful about Handel's Water Music, Liszt or Ravel's Jeux d'eau or Dylan Thomas's "The force that through the green fuse drives the flower." This is not to deny (as many musicians would) that science may have a great deal to teach us with respect to our experience of works of art, rather that the scientific enterprise is defined by its limited scope of inquiry. We should be comfortable with working within this scope with the awareness that numerous questions, and possibly the most important ones, are likely outside of it.

Secondly, the definitions I'm offering aren't mine. Indeed, it would be odd if they were, just as it would be if a physicist were to claim for her own the accepted definitions of angular momentum, density, or kinetic energy. What follows will be what I take to be standard definitions within the relevant fields. I'm offering them with the recognition that insofar as these are not agreed on is an indication of the degree to which the investigation into these subjects not yet achieved the status of a formal scientific inquiry.

With those qualifications in mind, I'll submit first a definition of language, offering a variant of that which is accepted within linguistics. I take this definition to be something like:

"A shared system of mental representations and computational procedures allowing for the speaker's production and hearer's comprehension of grammatical sentences."

Note that this definition is not just, as noted above, unsatisfying, it is simply wrong in that it is at variance with what everyone knows to be the fact of the matter in at least two respects. First, the view of linguistic capacities as "shared" by those speaking a given language is obviously false: individuals develop unique idioms which differentiate the structure of their utterances from that of others speaking the same language. Second, normal language, as it is routinely used, is replete with utterances which are at least in part easily perceived as and technically definable as ungrammatical.

The question is reasonably, albeit naively, asked, how can such trivially false claims function as the basis of a rigorous scientific definition? The answer is that both of these assumptions with respect to language function are exactly analogous to frictionless planes, massless springs, rigid bodies, etc. within the natural sciences. We appeal to them, despite our awareness that they are at variance with how the real world appears to

us. We do so based on the recognition that such idealizations, as Chomsky (2000) observes, are at the heart of "the procedure we follow in attempting to discover reality, the real principles of nature." Insofar as they allow us to develop come up with real answers and, perhaps more importantly, ask coherent questions with respect to the objects in question, then it is reasonable, indeed necessary, to accept them, no matter how they depart from our common sense experience.

A similarly idealized definition of music as approached within cognitive science I take to be something along the lines of the following:

"A system of mental representations and computational procedures allowing for experienced listeners' assignment of a shared, uniform structure to a particular class of acoustic surfaces."

While its lineage within generative linguistics should be apparent, it should be noted that the focus of this definition is necessarily more constrained. Most conspicuously, it is an idealized shared structure assigned by listeners which is assumed to be the core of musical cognition, omitting the productive/articulatory capacity which is taken to be a core component of linguistic competence. This would appear to be appropriate for various reasons, among them that whereas most of those who can understand a spoken language also speak it, in music, asymmetry is the norm, at least in within those cultural contexts we are most familiar. Almost everyone listens to and enjoys music, but only a few produce new musical utterances in the creative fashion which is routine in language. How or whether this seemingly inherent one dimensional aspect of cognitive approaches to musical form imposes certain constraints on what is available for a theoretical explanation is a thorny topic which is worthy of more examination than has been devoted to it thus far-though Lerdahl (1988) and recently Tymoczko (2011) provide a good starting point for discussion.

Among what is communicated though music to listeners is that which, according to Lerdahl and Jackendoff (2008), "practically everyone other than music theorists considers . . . to be the primary point of interest in the psychology of music" namely musical emotion. Given the slipperiness of the term, one could do worse than accepting this as a provisional definition, so I'll do so here.

In partial defense of what many have seen as the overly reductive priorities of the field of music theory in privileging communicative means at the expense of communicative ends, it is worth noting another comparison with linguistic theory, specifically the assumption, in the initial stages of generative grammar, of an autonomous syntax, which put to the side questions of the semantic form and pragmatic function focussing on context free phrase structure rules and transformations as the sole basis of all grammatical utterances.

It was, of course, understood at the time that the syntacto-centric assumption was highly provisional and would eventually require the incorporation of notions of logical form derived from the semantic level of linguistic description. This would occur following a better understanding of predicate argument structure as manifested in the theories of theta

roles and grammatical Case developed in the seventies and eighties. The question for music theory is whether, or how, notions of projected musical form are to be connected with intuitions with respect to musical meaning and/or emotional content. If there is an inherent, deep connection, as turned out to be the case with language, then the solution to many of the questions with respect to our capacity to infer musical structure will need to wait until we have a better handle on what is meant by musical semantics generally, and possibly musical emotion specifically.

At least superficially, it is not apparent that the levels, insofar as we understand them, interact to the same degree. A piece will impart a radically different meaning and/or emotional resonance depending the tempo of its performance, the timbre of the instruments or voices, or even by altering its tonality from major to minor. But its essential structural characteristics-its metrical form, phrase structure, functional harmonic motion, all these will remain pretty much intact. Furthermore, whereas ambiguous sentences in language tend to be resolved based on semantic or pragmatic factors, it does not appear that these factors, in any obvious way at least, require our toggling between possible interpretations of musical structures: An inherently metrically ambiguous passage such as the opening of Mozart's G minor symphony will be resolved by listeners one way or another, but it is not apparent that the choice results in a significantly altered emotional or expressive content of the passage.

Dealing with musical "action" puts us on similar albeit more speculative grounds to that of musical emotion-at least according to one definition of the term. Surely, pieces of music can convey and arguably embody types of action. Accordingly, action when it comes to music should be defined as a specific affectual component of certain pieces, and perhaps all pieces.

Of course, a very different definition of musical action applies to those physiological mechanisms which are implicated in the performance of a piece. Here there is obviously a great deal to be said, as is well known from distinguished work on expressive performance by Repp, Palmer, Sloboda and many others. How this empirical work is to be connected with theories of cognized musical structure seems to me meriting perhaps more attention than it has received.

Finally, when it comes to a definition of "brain", a cognitive theorist is required to offer a minimalistic definition along the lines of "the biological organ implicated in the theoretically posited underlying representations and computations relevant to cognitive faculties." In other words, for the cognitive theorist, the brain is, in the words of linguist Norbert Hornstein, a "black box" which functions as the repository for its theoretical posited entities. As Chomsky has noted, in this respect, an exact comparison can be made to the conception of "matter" in the 18th and 19th centuries which was taken to somehow have at its essence the capacity for attraction which the theoretically posited forces of gravity attributed to it.

Just as Newton could "frame no hypotheses" with respect to this "occult" property of matter, so too must the linguist or cognitive music theorist regard the brain as having all

sorts of occult properties which may be entirely inconsistent with our current understanding of the neurological structure. This should not be seen as bringing into question the scientific status of either of these lines of inquiry. Rather, it is an indication that a unified scientific account of linguistic and musical phenomena-one which connects the properties of brains to the properties of language and music as these are experienced is likely a long way off.

Chomsky, Noam (2000) "Language as a Natural Object" in *New Horizons in the Study of Language and Mind*. Cambridge, England: Cambridge University Press.

Lerdahl, Fred (1988) "Cognitive Constraints on Compositional Systems ", *Contemporary Music Review* 6:2 pp. 97-122.

Jackendoff, Ray and Fred Lerdahl. (2006) *The capacity for music: What is it, and what's special about it?* *Cognition*. 100:33-72.

Tymoczko, Dmitri (2011). *A Geometry of Music* New York: Oxford University press