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Comment

The meanings of semantics
Comment on "Towards a neural basis of processing musical semantics" by Stefan Koelsch

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The fascinating target article provides a well informed and empirically controlled picture of neurophysiological processes related to semiotic relations of musical events. These semiotic relations seem to be processed by the brain in a similar way as corresponding relations in the case of concepts coded by linguistic constructions. While the article definitely constitutes an important contribution to our understanding of what goes on in our brain when we sing and talk, some comments on terminological problems should be raised as these distinctions and non-distinctions, far from being trivial, are pervasive in the literature on music and language and occasionally confuse a promising field of interdisciplinary research for which the rigid control of theoretical notions is absolutely necessary.

Everybody already knows that I am talking about the use of the word *semantics*. While there is ongoing debate about the relations of and borders between semantics, pragmatics and cognitive structure, it seems that most linguists would agree that the core of semantics proper lies in the power of discrete sound chains to denote extra-linguistic referents on the one hand and the construction of propositions on the other hand. Propositions combine lexical primitives to complex meanings using operators such as quantifiers (all, every, always, no, never, some, etc.), modals (necessary, must, impossible, may/can) or connectives (and, neither. . . nor, either. . . or, etc.). These operators appear syntactically as adverbs, specifiers and complementizers. They form the hinges of linguistic semantics on sentence level and, at least to my knowledge, cannot be found in any musical tradition. This constitutes the reason why linguists always will have objections against the use of the term "semantics" to describe musical meanings or functions.

Obviously, it is possible to establish a lexicon in music by the association of meaning to sequences of sounds or tones. For instance the *leitmotif* technique creates a device for the composer to express partial iconicity, yet they are also as conventional as linguistic signs: In Wagner's Siegfried, for example, Siegfried is introduced in a heroic F-major motif that ends on a "strong" ascending fourth (how else would he be introduced?), yet the melody itself is conventional and we must learn to associate it: Without hearing it repeated each time Siegfried enters the stage, we will not form the association to "understand" it. This process is in principle comparable to the linguistic lexicon which is mostly grounded in purely conventional relations.

Importantly, however, languages lexicalize sound chains not only to denote discourse referents, which are couched in cognitive frames, but also to combine them with the semantic operators mentioned above in order to *establish* semantics. This process builds up a type of meaning on sentence level which is not to be found in music. Consequently, Wagner can introduce Siegfried by a leitmotif and can further combine it with another leitmotif, however, he will not

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be able to use it, for example, in a negative proposition because music does not possess an operator required for that. While it will be possible to express musically something like "Siegfried meets Hagen in the forest", it will never be possible to create *music* that expresses a proposition like "Siegfried does not meet Hagen in the forest" or even "If Siegfried had ever met Hagen not only once and not in the same forest, where Tristan and Isolde may have met". Of course, we could decide to construct a code to encode all of the involved logical forms and functions by sound chains produced by instruments we use in music – but with an invention like this, music would lose its musicality: we would not be able to call the output music anymore, but language played on instruments. Ultimately, language can be encoded in every possible substance, in vocal sounds, letters, braille, sign/body language, Morse code, musical tones or even colored piles of specifically ordered coke cans. However, in the same way as we would not argue that colored signs, holes in a paper, or even smoke are comparable to semantic meaning in the full linguistic sense, just because one may choose to communicate language through that medium, tones from a diatonic scale are not music when they are used to encode linguistic meaning, but a medium for language (and through the restriction of their use as linguistic medium they would lose their distinctive musical features, for instance expressing tonal centers, tonal attraction, tension, sense of finality, etc.). A *semantic system* is operating once a list of substance-meaning pairs and operators to combine them are employed – and this is what we would call a language. Refs. [1–3], among many others, provide substantial discussion of this crucial difference between the two most important communicative systems of human beings, music and language. This difference should guide our investigations. From a linguistic point of view, it is of great interest to see how the organization of communicative sound structures works without the need to encode semantics.

In my opinion, what Stefan Koelsch really (and impressively) shows are neural correlates not of lexical semantics and even less of propositional semantics, but rather of *semiotic* relations, which of course constitute a basic property of all cognitive systems of human beings and thus are relevant both for music and language – and for the whole meaningful world of human experience. In my opinion, the design of the *linguistic* experiment (page 4) does not test semantics, but cognitive associations between the proposition denoted by the sentence and the word on the screen. It examines a cognitive mismatch, not a semantic one. The problem that leads to the neurophysical events Stefan Koelsch describes should be related rather to cognitive frames and idealized cognitive models [4].

In future research, experimental stimuli should be designed to get insights exactly into the neuronal reality of the theoretical distinctions made above. In linguistic theory, semantic structure is not isomorphic to cognitive structure (that is why we need it) and different from pragmatics (even if the borders sometimes get fuzzy). For example, we could try to get a picture of possible neural events related to the difference between causal and concessive expressions, since they are identical in logical form and their difference lies in pragmatics. The same holds for the relations between the semantic operators mentioned above, like the quantifiers *all, some, no, not all*. *No* is the semantic contrary of *all*. *All* implies *some* semantically just as *no* implies *not all*, but *some* implicates *not all* pragmatically by the maxim of quantity (cf. [6] for extensive discussion). For research into the relations between music and language in the big field of meanings, it would be interesting to get further insights into the question if the form of the cognitive organization of the linguistic lexicon (cf. [5] and many others) is comparable to the organization of motives in music.

In short, I would like to welcome Stefan Koelsch's paper as an impressive collection of first insights into a new field of research which definitely will have strong impact on theoretical foundations of linguistics, music theory, psychology and neurology. But I want to emphasize that it is not only the similarities, but also the crucial differences of language and music on a cognitive level which advance our knowledge of symbolic human communication in both systems and the understanding of the cognitive operations of the brain. The task is challenging and we should try to keep different things apart if we want our science to work.

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