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Abductive Reasoning, Brain Mechanisms and Creative Cognition: Three Perspectives Leading to the Assumption that Perception of Music Starts from the Insight of Listeners

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ABSTRACT

Background

Over half a century ago, Leonard B. Meyer coined his theory according to which emotional responses to music arise through expectations set up by musical patterns. Since then, researchers working in different areas of music (e.g. Narmour 1990; Krumhansl, 1997; Zbikowski, 2002; Huron, 2006) have shown that expectations of musical continuations are based on different musical structures experienced in the past and stored in memory, even if listeners are not explicitly aware of this acquired knowledge. In addition, prediction processes are important issues in other disciplines.

From the philosophical perspective, Charles Sanders Peirce has been the main promoter of the epistemological concept of abduction in the scientific debate. He describes the so-called logic of discovery as follows: abduction is the process of forming an explanatory hypothesis. It is the only logical operation to introduce a new idea (Peirce, 1958).

Moreover, within neuroscientific work on musical processing, results showed that prediction processes are a physiologically measurable reality. For instance, experimental psychology (e.g., Patel et al. 1998; Koelsch et al. 2000; Sonnadara et al. 2006) is beginning to reveal brain mechanisms by which expectations are set up, and by which musical events are evaluated.

The Creative Cognition Approach (e.g. Mednick, 1962; Smith & Ward & Finke, 1992; Hawkins, 2005; Deliège, 2006) focused more on certain processes, such as association, analogical transfer and combination, in its attempts to improve the understanding of individual constitutions involved in creative thinking. In terms of music, one goal is to describe processes at work in creative actions, such as the composition of music and listening to music.

Aims

With the tools of cognitive science, philosophy, experimental psychology and creative cognition approach, we present some indications that listening to music starts from the inside: through both, a pre-wired and an experienced extrapolation into the future (we call this a-priori listening).

Main Contribution

Shown schematically in Figure 1. We outline an ensemble of interacting processes, which elicit the a-priori listening. First, a musical context can be established by presented stimuli, eliciting the analogical activation of pre-wired and experienced knowledge.

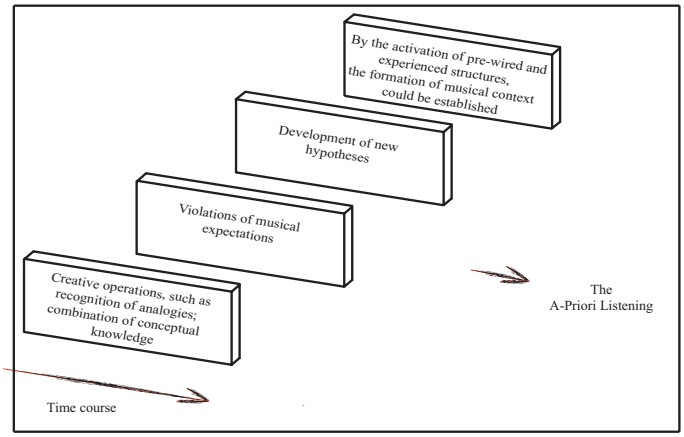

Figure 1. Schema of interacting processes for a-priori listening

This is the foundation for prediction processes. That is to say, perceptual categories are elaborated, in the manner of analogical activation to pre-wired and previously stored categories. Such brain mechanisms are also important factors within more complex structures, such as conceptual knowledge, because, for an experienced listener, pre-wired and experienced perceptual categories are mostly parts of conceptual knowledge. Moreover, through the detection of multiple analogies between different conceptual structures, the probability increases, that they could be combined into a new one.

Within the perspectives of experimental psychology and philosophy, findings also encourage us to propose that the perception of music starts from the inside of listeners, through a pre-wired and an experienced extrapolation into the future (we call this a-priori listening). First: in case of 'violations of musical expectations', MMN and ERAN responses demonstrate that the brain is continually using the recent past to predict the future, and the magnitude of these responses reflects the degree to which these expectations are not fulfilled (Trainor & Zatorre, 2009, p. 176). Second: the epistemological concept of abductive reasoning makes it possible to describe the process of forming an explanatory hypothesis, which stems from a discrepancy between expectations and observed facts.

Finally, it is suggested that analogical activation of more complex structures is already a factor for processing a-priori listening. If one considers that, while listening to music, various brain mechanisms mainly organize events in a successive manner, then it stands to reason that the estimation of the overall "current listening situation" is considerably improved by the fact that auditory events activate conceptual knowledge, such as scripts (Schank & Abelson, 1977) of

musical processes. As shown in Figure 2, some parts of this knowledge form the musical context at current time, and other parts elicit the a-priori listening in the form of, first, a restricted space of possible anticipations, and second, one or more hypotheses about what will happen next.

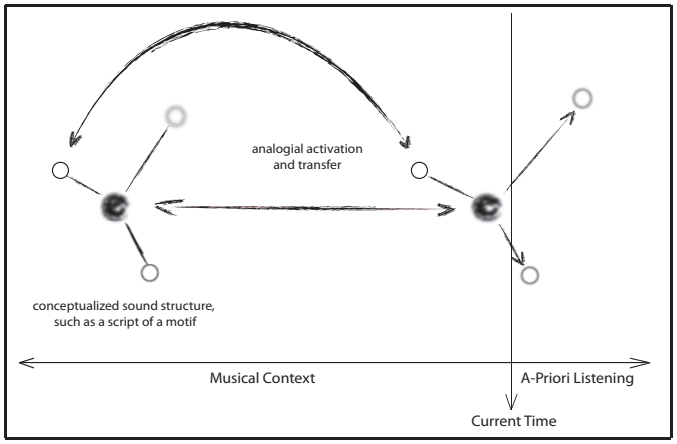

Figure 2. Schema of a-priori listening while conceptualizing variation of a motif

Depending on the magnitude of violations of these predictions (measured by neural responses, such as MMN or ERAN), we propose that certain processes could follow. First: the number of hypotheses are reduced; second: hypotheses or parts of them are changed; third: violations lead to the formation of a new space of possible anticipations. On this basis, one or more new hypotheses are generated.

Implications

Encouraged by findings within the perspectives of cognitive science, philosophy and experimental psychology, we propose that the process explained above is an extended contribution to the discussion of the creative cognition approach. Because, first: the activation of pre-wired and experienced knowledge by presented stimuli, is already a component of a-priori listening to music. Second: new incoming patterns are compared with activated structures to obtain assurance that the elicited a-priori listening matches the actual incoming pattern.

This perspective could open an enhanced discussion about the complexity of listening to music. In contrast to the mere physical concatenation of sounds, highly creative and parallel processes characterize the psychological reality while listening to music. The mental re-activation of faded sound structures elicit the a-priori listening of various possible events. The physical concatenations of sounds only constitute reference points for musical concepts, and are certainly not music itself.

With regard to the controversial discussion concerning the characterization of creativity, we conclude that indications advocate for the existence of particularly creative processes while listening to music, which could be defined as the formation of parallel hypotheses about what will happen next. To handle more than one perspective in order to structure one's own environment indicates a high degree of flexibility, which is an important foundation for creative processes.

ACKNOWLEDGEMENT

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Keywords

Abductive reasoning, brain mechanisms, creative cognition approach, prediction processes, music perception, conceptual knowledge, a-priori listening.

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