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Jukka Louhivuori, Tuomas Eerola, Suvi Saarikallio, Tommi Himberg, Päivi-Sisko Eerola (Editors)

Cross-Domain Mapping Processes in the Perception of Post Tonal Music

Isabel Cecilia Martínez[*1] Fernando Anta[#2]

[*]*Faculty of Fine Arts-Departament of Music-Universidad Nacional de La Plata, Argentina*

[#] *Faculty of Fine Arts-Departament of Music-Universidad Nacional de La Plata, Argentina*

[1]isabelmartinez@saccom.org.ar, [2]fernandoanta@yahoo.com.ar

ABSTRACT

Theories of embodied cognition state that knowledge is built by means of cross-domain mapping processes between different domains of experience. Recent research informs about the presence of mapping processes in the reception of both tonal and atonal music. A previous experiment suggested the occurrence of mappings between visual attributes and interpretative features in atonal music. However, these results were obtained with musicians; therefore, it is unknown to what extent they are equally valid to non-musicians. This study aims at examining the incidence of interpretative expression within the visual-musical mapping process. Three versions (two expressive and one deadpan) of an atonal musical piece were presented to musicians and non musicians. The two expressive versions, varied in the span of silence between groups. Simultaneously, different visual animated images that represented the image-schema Source-Path-Goal were exhibited. Subjects were required to estimate the correspondence between the animations and the music. It was predicted that (i) the microstructure of expressive performance would communicate a sense of goal's attainment; (ii) conversely, the lack of microstructure in the deadpan version would not; and (iii) there would not be differences between musicians and non-musicians. Significant differences were found in the responses according to the interpretative version.

INTRODUCTION

Recent theories in the field of psychology of music suggest that primitive, imaginative schematic structures, which interact with cultural variables, have an effect on the ways the mind builds knowledge and assigns meaning to musical experience.

These theories are based on ideas that were generated in the framework of embodied psychology. Embodied cognition posits that the formation of image-schematic representations occurs since early infancy as a consequence of the interaction of our body with the environment and with other bodies. Experience that is acquired in this way allows learning of a group of physical, spatial and temporal relationships that are assumed to be located in the foundation of some of the more basic conceptual categories that we use to assign meaning in the adult world.

Given that image-schemas are prelinguistic, unconscious structures, that represent spatial-temporal relations as basis as for example, the verticality schema –that conveys the up-down relation- or the front-back schema –that conveys the relation figure-background-, it begun to think that such spatial structures could be implied in those linguistic expressions of everyday language such as "the prizes went to the sky" (Lakoff, 1990; Lakoff y Johnson, 2003).

Including the body as part of the cognoscent system means for embodied cognition to widen the extent of mental domain, understanding cognition as the by-product of the individual experience with its environment and with others, that is to say, as the result of the unfolding of the psychobiological complex body-mind in action (Gibbs, 2006).

In the field of embodied cognition, these assumptions gave rise to the theory of metaphorical projections. It proposes that we assign meaning to our activity in the world, establishing correlations between different domains of experience. In the case of music cognition, it is proposed that musical meaning would be in part based on the development of processes of cross-domain mappings between the acquired experience in the physical, spatial and temporal domains and the experience coming from the sound domain. In order to correlate knowledge of a given experiential field with knowledge of another field of experience it is necessary that there exists similarities between the topographies of both domains. These similarities implicitly emerge when the group of image-schemas that are storaged in memory are activated. For example, we can understand the flow of sonic events as an oriented trajectory and then to say that "the melody of the violin goes from the tonic to the dominant"; when the goal is in fact the final destination, we can say that "the melody arrived to the tonic". These expressions contain an implicit meaning that refers to a spatial-temporal image-schematic complex that is called Source-Path-Goal (Lakoff and Johnson, 1999; see Martínez & Espanol, this symposium for further applications of SPG image-schema). In musical sources it is usual the use of metaphorical language to account for a description of tonal music (Zbikowsky, 2002).

On the other hand, it is posited in some academic musical environments that atonal music does not have expressive meaning as tonal music in fact possesses, given to a certain lack of ability to communicate goals in the sense that tonal music does. This apparent limitation has been recently discussed in relation to the first atonalism, that of the expressionist movement (Gomila, 2008). Moreover, recently, a group of musicologists that adopted the view of embodied cognition have posed hypothesis about alternative, image-schematic 'readings' of atonal pieces (Brower, 1997-1998; Saslaw 1997-1998).

Although experimental evidence has been reported, supporting the operation of mental processes of metaphorical nature in the cognition of tonal music (Martínez 2008), evidence around the metaphorical cognition of atonal music remains essentially unexplored. An equivalent situation can be observed concerning the assessment of the incidence of musical interpretation in cross-domain mappings during music listening.

The music used in this study

The selected musical fragment, showed in Figure 1, was the initial section (measures 1-11) of Shoenberg's piano piece Op. 11, no. 1; the piece is one of the first works in the atonal language and is quite available as professionally-recorded expert performance. Because of its surface interruptions, change and parallelisms, the selected musical fragment may be segmented into three musical phrases (m. 1-3, m. 4-8, and m. 9-11, respectively); besides, due to their motivic variations and parallelisms, the last phrase represent a recapitulation of the first phrase, while the middle phrase add greater variation or diversity to the structure: thus, the whole fragment conform an ABA' musical

structure. Finally, because of its internal parallelism with its pitch content repetition, the middle phrase may be segmented into three musical groups, as showed in Figure 1 (see groups B, B' and B''). In sum, it may be argued that the whole fragment may be described as conformed by five musical groups –at the observed levels of its grouping structure.

Some aspects about how the selected fragment could or could not convey a sense of movement should be discussed. First, it may be argued that this music would convey 'motion' in the very sense that it may be said that anything that 'change' would convey 'motion' (since its sounds change, music is moving). Second, it may be argued that the 'kind of motion' conveyed would be an a-directional or non-directional one, since its pitch-class structure is not hierarchically stratified(-enough); this presumption, describing atonal music as lacking well-established musical goals, is a common theoretical description about atonal music (v.g. Salzman, 1967; Kramer, 1988) and is a core concept by which atonal music is opposed to tonal music –in fact, tonal music is defined as 'directed motion' (Salzer, 1962). Atonal music, however, may show other features (besides its pitch-class organization) through which convey motion and goals. In this case, music may convey motion and goals mainly through its rhythmic structure, and through its range and motivic arrangements. For example, it may be hypothesized that melody resting on long notes, going-down and followed by silence in the Group A and A' would convey a sense of direction, closure and/or 'motion-ending'; this would be even reinforced in Group A' by its parallelism with Group A: since Group A' fairly resembles Group A, listeners may envisage that, while melody is going down, the group is going to its goal (end) and will finally stop. The same, and probably more clearly, may be observed at groups B, B' and B'', where once learned Group B it might be expected when (and how) groups B' and B'' will reach their goals and stop their movement; besides, groups B, B' and B'' may convey even more motion than groups A and A', because of their increment in rhythmic rate (the rate of events-per-time is greater in the former than in the later instances). So, it might be expected that, while 'movement' would be conveyed by each musical group, the magnitude of 'movement' and the sense of 'attained-goal' conveyed by one group or another should differ.

AIMS

The present work has the purpose of examining the presence of mapping processes between visual and musical stimulus in musicians and non-musicians, and studying the incidence of interpretative expression within the visual-musical mapping process.

METHOD

Participants

34 participants took part in this study. 17 of them (from now on referred to as 'non-musicians') were students in their first year of their careers and were recruited from a group that was taking part of the first ear training course of the music careers at the Faculty of Fine Arts, National University of La Plata City, Argentina; the others 17 participants (from now on referred to as 'musicians') were students in the last (fourth) year of their musical careers and were recruited from a group that have already approved all (four) courses of ear training of the music careers curricula of the above mentioned faculty.

Apparatus

Two kinds of stimuli were used, visual stimuli and auditory stimuli. Visual stimuli were programmed on a personal computer as a Power Point presentation, and finally, presented through an Epson projector over a classroom style projector screen. Auditory stimuli were programmed on a personal computer as MIDI audio files; then, once designed (see below), MIDI files were converted to .wav audio files, recorded on a compact disc and, finally, reproduced through a 'mini-componente' audio system (a conventional compact disc reproducer) in a classroom where participants usually take their courses. Participants recorded their responses on a paper sheet.

Materials

Visual materials consist of four animated (gradually-appearing from left to right) images; each image started as an horizontal solid line and ended on: A) a solid ball, B) a solid (vertical) line, C) a dashed (horizontal) line, and D) a right-oriented arrow. A set of images was defined as five successive images (one per musical group, see below) horizontally disposed that were displayed at each Power Point presentation slide; ten different sets were used.

Audio materials consist of three versions of a fragment (measures 1-11) of the Opus 11-1 by Arnold Schoenberg. One was a synthesized deadpan version (from now on referred to as Version-D) in which inter-onset time intervals and event-durations were those described in the musical score. Two expressive versions were also synthesized with timing or micro-structural time variations (see, for example, Repp, 1992) at group endings, as to reflect phrase-final lengthening usually observed in real/expert performances. Timing variations of expressive versions were derived form two commercially available versions of the musical piece, one by M. Pollini and the other by G. Gould (from now on referred to as Version-P and Version-G, respectively). Timing analysis of the original performances showed that versions by both Pollini and Gould introduced lengthening-relationships between final events of each musical group (performances have similar patterns of timing variations: $r = .550$, $p<.001$), but that silence durations between groups were shortest in the former than in the latter case (see Anta 2008, 2009). Expressive materials (Version-P and Version-G) were designed as MIDI sequences, and so timing variations of the lengthening type were introduced in each version at the same event where it was observed that it began in the original performances and in a proportional way (as a function of the *tempo* of the versions) in accordance with variations observed in each performances; finally, silences between groups were adjusted following the same criteria. For the three versions *tempo* was set at 60 beats-per-minute. All other musical parameters (v.g. dynamics, timbre, and so on) were hold equal and constant along the three versions.

Procedure

Participants were told that they would see visual animated images that represented different kinds of motion and that, simultaneously, they would hear several versions of a musical fragment. Visual images were defined as 'meaning motion' in specific ways: image A (line ending on a ball) was defined as meaning 'motion that reaches its goal'; image B as 'motion that is interrupted'; image C as 'motion that lost its goal'; and image D was defined as 'motion that is moving towards its goal'. It was also pointed out that each image would represent a musical group, and the each set of five images should be understood as representing the whole musical fragment. Then, participants were asked to rate on a scale form 1 (extremely bad) to 10 (extremely good) how well each set of visual animated images reflects the sense of motion conveyed by the musical fragment being heard. One pair of visual-auditory stimulation (a visual set plus a musical version) was used as training; thirty pairs, randomly arranged, were presented next to each group and considered as test stimulation. Participants were tested in groups, and different order presentations were used for each group.

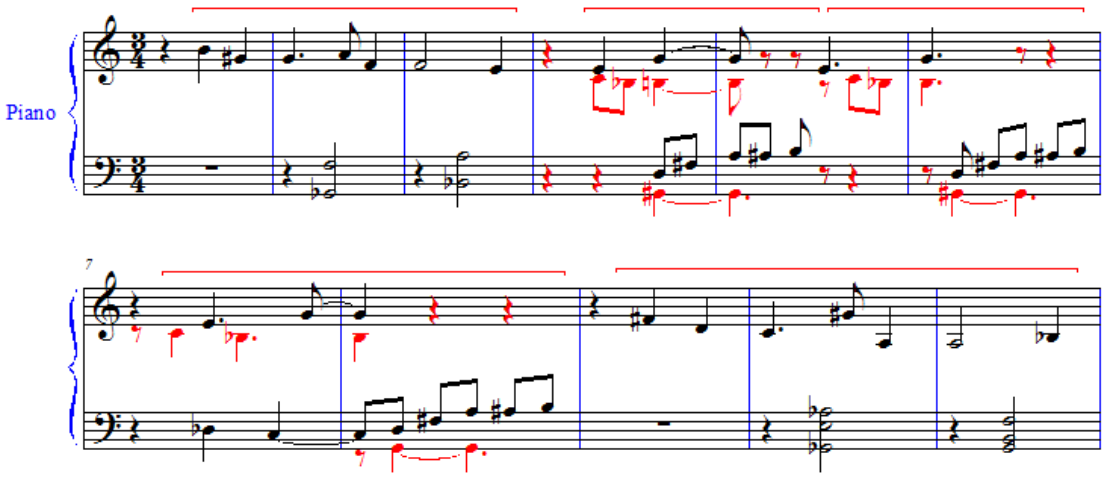

Figure 1. Excerpt (measures 1-11) of the Shoenberg's piano piece Op. 11, no. 1 used in the present study.

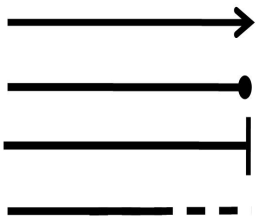

Figure 2. Visual representations of the variants of the image-schema Source-Path-Goal. From top to bottom: Directed trajectory; goal oriented trajectory; interrupted trajectory and lack of orientation- trajectory.

RESULTS

An Anova repeated measures analysis of variance of the medias obtained showed signifficant differences between the answers provided for each image-schema (F =12.677; p < .001). Interaction between the factors Schema and Version (expressive or deadpan) was also significant (F =1.958; p< .02). This indicates that participants estimated different the correspondence between the music and the same image-schema according to whether the musical fragment was a deadpan and/or expressive presentation. More precisely, it could be observed that the schema Interruption-Goal was mainly associated to the expressive version G (see above); on the other hand, the schema lack of direction was associated more to the expressive versions. On the contrary, it was not observed an incidence of the factor version beyond its interaction with the factor schema. Besides, there were no significant differences between the judgments given by the groups with different level of musical expertise.

Summarizing, in most of the cases, the presence of the Goal image-schema in the schematic chain is best associated to the deadpan versión, while the presence of the images-schemas Interruption or Lack of Orientation were best associated to the expressive versions of the performances. In those trials in which the image schematic stream contained both schemas, (trials 3, 5, 7 and 10) the differences in the degree of association between the schemas and the musical versions were higher than in those trials in which only one of them was included in the schematic chain.

DISCUSSION

The use of metaphorical processes in the cognition of atonal music is evident in the way the participants of the present experiment organized music reception in terms of trajectory, direction and expectation of arriving to goals by means of the cross-domain mappings they perform in the listening-observing situation. In some instances, the variations in the degree of rubato that resulted from the use of the timing by the performers of this atonal musical piece prompted in the participants an image-schematic association that is rather different than the association established when they listened to the deadpan version.

The apparently conflicting results of this study with those of a previous study (see above) could be attributed to the differences in the treatment of the sample stimuli. In this particular case expressive differences between the three versions were minor (only temporal) compared to those in the previous study.

It is probable that the temporal variations when they appear isolated from other expressive variations acquire a different meaning in the image-schematic listening experience of this musical material.

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