

# EMBODIMENT IN DANCE: RELATIONSHIPS BETWEEN EXPERT INTENTIONAL MOVEMENT AND MUSIC IN BALLET

Isabel Cecilia Martínez,<sup>\*1</sup> Juliette Epele<sup>#2</sup>

<sup>\*</sup>*Faculty of Fine Arts, Department of Music, University of La Plata, Argentina*

<sup>#</sup>*Faculty of Fine Arts, Department of Music, University of La Plata, Argentina*

<sup>1</sup>isabelmartinez@sacom.org.ar, <sup>2</sup>epelejuliette@gmail.com

## ABSTRACT

Embodied music cognition posits that there is a relationship between the emergent properties of a musical piece and the way musicians, dancers and listeners experience them in their body-minds. Musicological analyses assign kinetic properties to music, under the assumption that the sonic forms have the capacity to activate movement; in other words, that music ‘moves’ us. But, in which sense the movement elicited by music is indeed based on music? These questions are not fully answered so far. This paper analyzed comparatively musical and choreographic phrases in different ballet interpretations, with the aim of identifying the extent to which these two expressive modes convey similarities, regularities and/or synchronization features. Similarities in the performances were detected with respect to: correspondences between movement, musical phrase articulation and embedded levels of metric hierarchy; quality of movement production at the locus of maximal tension; a synchronized relationship between movement and music that implies anticipated gesture preparation and delayed gesture retraction with respect to the onset sound. The coherent relationship between movement and music is similarly communicated in the expert performances analyzed. The coupling between the emergent tension of movement and the tonal tension conveyed by music is produced in a consistent way and it is not dependent on the particular type of choreographic movement but instead on its gestural quality.

## INTRODUCTION

Since ancient times, philosophers, musicians and dancers have been preoccupied with the relationship between music and movement. This relationship is approached in Psychology by a large body of studies that focus on the experience of the temporal arts.

Embodied music cognition posits that there is a relationship between the emergent properties of a musical piece and the way musicians, dancers and listeners experience them in their body-minds. Some musicological theories attribute kinetic properties to music, under the assumption that it bears the capacity to activate the embodied domain in musical experience. According to them, the sonic forms have the capacity to activate movement (Leman, 2008). In other words, they propose that music ‘moves’ us.

But, in which sense and to what extent the movement elicited by music is indeed based on music? These questions are not fully answered so far. It is assumed that the study of coherent relationships between dance gestures and the musical phrase structure will illuminate the inquiry about the way music resonates in our bodies.

Traditional cognitive Psychology of Music has focused on the relationship between music and movement under the assumption that both have similar expressive qualities. Thus, for example, patterns of timing in musical rubato were (i) compared with runners’ decreasing movement rates at the end of a race (Sundberg, Friberg y Frydén, 1991)

(ii) applied in correlations between musical tension and vocal effort (Sundberg, 1987) and (iii) used to study the similarities between sonic and visual information and their role to communicate expressivity in music performance (Davidson, 1993). Concurrently, performers’ patterns of expressive movement have been identified and their use in the performance of a musical piece was investigated (Davidson, 2007).

On the other hand, some parallels between music and dance have been considered in the arena of the cognitive structuralist tradition. It was assumed a degree of similarity between the topographies of both expressive modalities, that is evident, for example, in the extent to which both dance and music (i) bear the capacity of being segmented into phrases, which in turn are further subdivided into smaller constituent units; (ii) have preparatory elements that are located at the beginning of the phrases and that interact with more unstable components inside those formal units, and (iii) other elements that contribute to the completion of the phrasing patterns. Based on those assumptions, Carol Krumhansl developed a pioneering study, with the aim of estimating the relative contribution of both visual information (relative to the choreographic movements in ballet) and aural information, to establish correspondences between music and dance. She found, on the one hand, consistent answers between subjects’ judgments of ends of phrases and curves of emotion and tension in a segmentation task. And on the other hand, she found differences in the segmentation of units of movement and of music, being the segmentation of the former of a higher order than the latter in the formal hierarchy. Profiles of emotion and tension expressed by movement showed less variability at a local level than those expressed by music (Krumhansl, 1997).

However, Krumhansl’s hypothesis about the mappings between the organization of sound and movement arose from a theory of music, according to which cognition was built on associations between fixed, automated schemas, rather than on the dynamic forms that both music and movement adopt all along time.

Therefore, a theory of music cognition that analyses music experience based on the architectural structures of mind, on the logic of atemporal hierarchies and on the processing of the sonic input, provides necessary but not sufficient answers to the study of the experience of the temporal arts.

On the other hand, recent studies in the field of Music Psychology account for the fact that the communicational power of an expressive performance lies on the transmodal processes that take place in the context of emotional exchanges between the performer, the musical piece, and the listener. Here, the attribution of meaning is related to the ways in which the configuration of time is shared by the performer and the audience (Shifres, 2008). The genesis of those emotional exchanges appears to be found in the first intersubjective experiences between mothers and infants (Español, 2008). On the other hand, it was found evidence of the embodied nature of musical understanding. In one experiment of music listening participants performed correspondences between different domains of experience

(for example between the physical and the spatial domains) when they had to judge the tonal tension of musical pieces (Martínez, 2008).

Some of the current approaches in the field of Psychobiology provide alternative answers to the study of the relationship between music and movement. In particular, the model developed by Trevarthen (2007) bases his proposal in the experience of acting, and on the images generated by movement. He assigns a central role to the sense of time along movement, that is to say, the tensions and measurements of time that are generated in the mind and that become action. Pointing critically that the sense of time has been systematically denied both in the psychological and the linguistic literature, he proposes that the origin of human musicality may be found in the gestural mimesis and the expression of images of consciousness, that are regulated by and regulate themselves the dynamics of emotional processes. According to Trevarthen's hypothesis, opposite to the idea of traditional musicology, that treats rhythm and pitch based on a formal pattern or a structural sequence of events, with the temporal phenomenon removed, there exists a sympathetic reception of other's beat at the cerebral level, and also an "atunement or intonation" of their muscular actions relative to our own members in coordinated, purposeful actions. This mechanism, called intrinsic motive pulse makes it possible to be in tune with the motor behaviors in the world. The posture and the way of walking, also communicate temporal sentiments.

Also in the field of Biomechanics, the perceptive-motor regulation and the physiology of movements, produced significant findings, informing that the motor activity is not an effect caused by perceptual and cognitive processes but movement originated in cerebral processes that gain prospective or anticipatory control over the sensed consequences. Some theories modeled the dynamic form adopted by purposeful movement in different actions. It was found that, when perception of the intended movement is taking place, the temporal synchrony is mediated by the salience of the event; therefore, to the extent that salience is what perception grasps, if two events are meant to join at a given point in time and space, it is possible for one of them to begin before or to end afterwards, in order to preserve that given salience. Lee (2004) proposes a theoretical function Tau, to define the movement oriented to a goal or to the closure of a goal in space and time. This function defines the moment-to-moment mental information available about the temporal gap that is necessary to complete a movement. Experimental data support this hypothesis. It has been pointed that when a task is performed with a purpose, the body generates a very precise awareness of movement in space and time (the real time of a performance fits the time represented in the mind).

In social interaction, these motor images of the body-in-action are helpful to represent others' actions and their purposes. The mechanisms of prospective regulation for action would be governed by the work of a type of neurons called mirror neurons (Di Pellegrino et al., 1992; Rizzolatti y Arbib, 1998). Brain image scanning shows the location of executive centers that activate movement and indicate the way in which motor images assimilate sensorial input to the processes of imaginative perception and memory.

In line with this approach, embodied music cognition assumes the existence of a relationship between the emergent properties of a musical piece and the way musicians, dancers and listeners experience music in their minds and bodies.

Coming back to the question posited at the beginning, this work aims at observing the relationship between music and movement in dance,

in terms of the way in which classic ballet dancers organize movement over the musical form. The focus is on the study of the coherence between embodied gesture and musical phrase.

The theory of embodiment can be helpful in providing some theoretical tools to accomplish the task proposed. Movement will be analysed using the LAM categories: the system of analysis developed by Rudolf Laban (1879-1958). Four dimensions characterize the analytical system, as follows: (i) Space, defined as the area or kinesfera in which a person operates both physically and psychologically. From the physical point of view the kinesfera represents the space that a person can use remaining at a given spatial location. Psychologically speaking, it corresponds to her influential space. The use that each person does of the kinesfera is unique. Laban distinguishes four body attitudes that he describes using evoked images: Wall (characterized by the use of the vertical and horizontal axis); Ball (characterized by the use of the sagittal axis), Pin (characterized by the use of the vertical axis) and Screw (characterized by the use of the horizontal, vertical and sagittal axis); (ii) Form: defined by the body changes which qualities are associated to the basic movements of breathing, and the basic contrasts between inhale-exhale; (iii) Body: defined by the connectivity between their members and the movement of the corporal mass in the directions: ahead, back right, left, and (iv) Energy, with four factors: space, time, weight and flow, that are deployed between opposites ( for a detailed explanation of Laban system analysis see Martinez & Espanol, this symposium).

## AIMS

The present work aims at analyzing comparatively four musical and movement phrases in choreographies of different ballet performances, with the purpose of identifying similarities, regularities and degree of synchrony between both expressive modes.

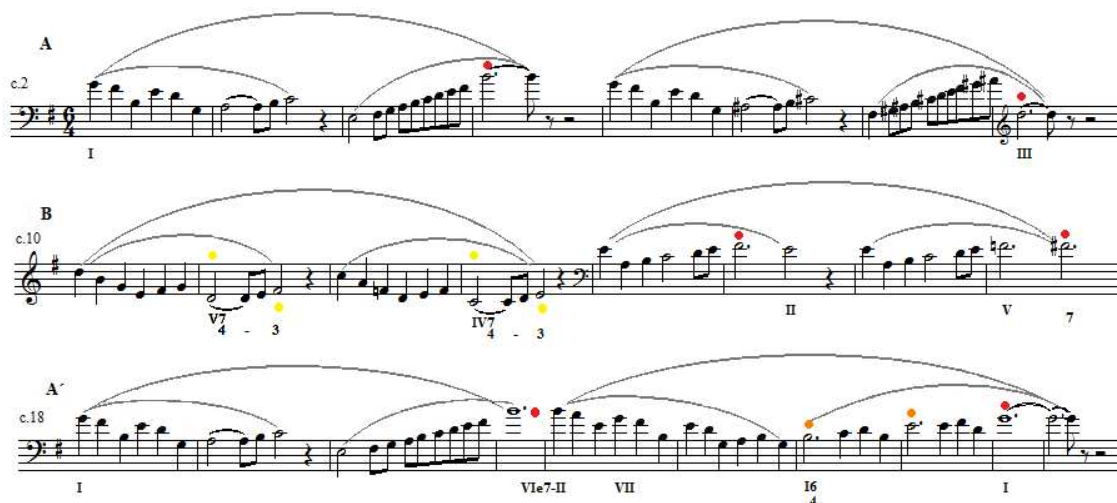
## METHOD

### *Subjects*

The choice of subjects concerns 4 expert dancers, historical examples of classic ballet that perform the choreographic piece of Mikhail Fokine "The dying swan" (1905).

### *Stimulus*

The musical piece "The swan" from the Carnival of animals by Camille Saint Saëns is written in meter 6/4 and tempo Adagio. The formal structure has three sections: A - B - A', each one divided in symmetric phrases and half-phrases. In all of them, musical tension at the climatic point is determined by a combination of factors, such as the highest melodic pitch, the harmonic resolution and the longest duration, giving as a result: locations of maximal definition or of the highest order in the climax (measures 5, 9, 15, 17, 21, 26); locations of second order in the hierarchy of musical tension (measures 24 y 25), and points of relative ambiguity (between the first and fourth beats of measures 11 and 13 (see Figure 1).



**Figure 1. Schema of the melodic constituents of “The Swan” by C. Saint Saëns. The location of the points of maximal tension is signal by (●), the location of the second order, by (●) and the location of the points of relative ambiguity by (●).**

## Aparatus

The analysis of synchrony between music and movement was performed using Sound Forge 9.0 and Diglo 15.1. These analytical tools offer the possibility of analyzing the video signal frame by frame, and comparing the sound signal in the order of milliseconds (for more details about Diglo 13.5, see Martínez & Espanol, this symposium).

## Procedure

The analysis of movement in each of the four choreographic performances was run according to the following steps: (i) description of the rhythm of articulation of ballet steps or dance movements, in relation to the musical phrases and to the different levels of the metric hierarchy of the musical piece; (ii) identification of the allocation of the maximal tension momentum within the sequence of dance steps; (iii) comparative analysis of the synchronism between music and movement in the former instances. This lead to the determination of the common aspects between music and movement and also allowed the identification of the differences between interpretations.

The qualitative study was performed focusing on the maximal tension allocations. Laban movement analysis was realized applying the following components: Space, shape, body and effort. Effort analysis was performed applying the four factors that allow the characterization of effort, bouncing between contrasts of the type:

- Direct / indirect, according to space
- Sudden / sustained , according to time
- Strong / light, according to weight
- Free / bound, according to flow

Measurement of the synchronism between music and movement was performed in the climatic point of the musical piece that corresponds to F Sharp in dotted half note at measure 17 (see Figure 1) that ends the central section of the piece, and conduits the restatement of the main theme. In order to do this, the beginning of the movement that corresponds to the dance step that each performer uses to accompany the climatic pitch was identified, and its temporal allocation was established. The trajectory of movement was followed and three

elements were identified: the preparation, the attack or beat, that is, the point in which the movement reaches its highest level or momentum, and finally the moment where the choreographic figure ends and the following new figure begins (see Mc Neill, 2002). Afterwards, the degree of correspondence between these elements was correlated with the pitch sound in each interpretative version.

## RESULTS

The different analysis allowed the observation of: (i) correspondences in the movement articulation relative to the phrase articulation and the metrical structure at different levels of the formal and metric hierarchies, respectively; (ii) correlations in the assignment of the climatic points between the different ballet interpretations; (iii) qualitative similarities between the different interpretative versions in the production of movements at the points of highest tension and (iv) a temporal deviation in the synchrony between movement and music in the order of milliseconds that implies the anticipated beginning and delayed phase of attack of the movement in relation the pitch sound attack.

(i)A comparative analysis of the rhythm of articulation of the movement in the four choreographies of ballet evidences correlations between them, both in the phrasing articulation and the metric structure at different levels, revealing, in turn, coherent relationships in reference to the musical form:

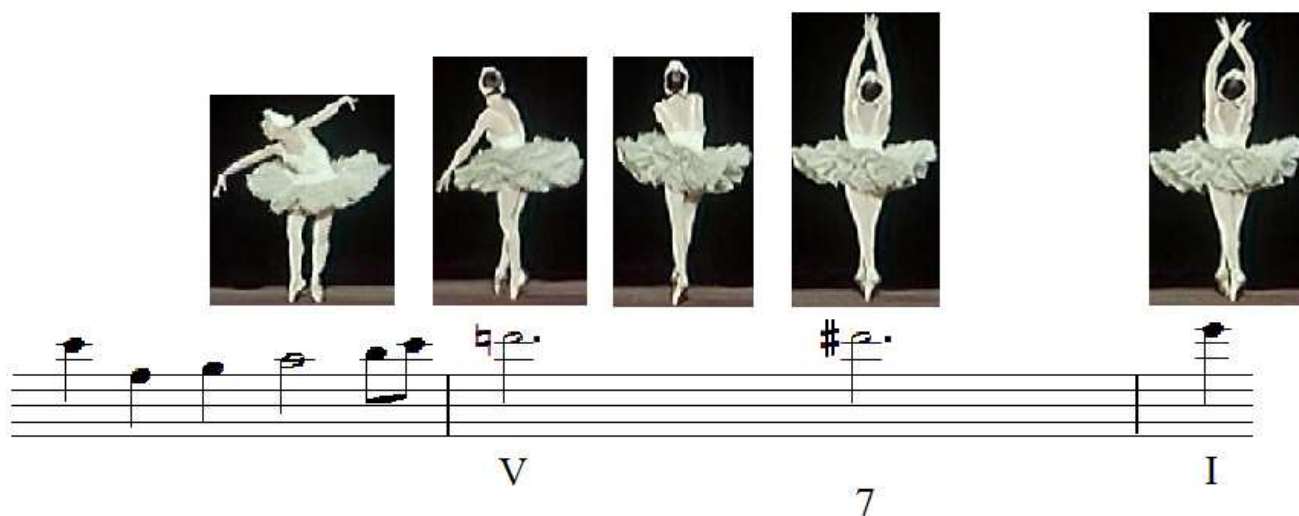
Section A: Changes of dance figure or step by phrase (Choreographies interpreted by Ananiashvili and Plisetskaya), and by half phrase and by measure (Choreographies by Makarova and Ulanova).

Section B: Changes of dance figure or step every three beats and repetition of the sequence of movements in the first and second half phrase, being these musical phrases organized around a similar sequenced melodic-rhythmic design (a-a').

Section A': Changes of dance figure or step by half phrase at the re-statement, and repetition of the sequence of movements

that accompany the repetition of the melodic-rhythmic motive

that prepares the cadence.



**Figure 2.** Example of the quality of movement in G. Ulanova’s interpretation, in the phases of preparation, attack or beat in the climax of the piece, and retraction.

(ii) Agreements in the assignment of the tension allocation between the different interpretations reveal the relative weight of the points of musical tension. Thus, correspondence is absolute at the points of maximal tension definition (mm. 5, 9, 15, 17, 21, 26), this matching occurring in all the instances analysed; correspondences are constrained in the points of second order of tonal tension (mm. 24 and 25) while 3 interpretations highlight them more or less emphatically (Ananiashvili, Ulanova and Makarova); and correspondence is weak in the points of relative ambiguity; due to this feature, 2 versions choose the first beat of mm. 11 and 13 (Ulanova and Makarova), while the other 2 (Ananiashvili and Plisetskaya), choose the fourth beat.

(iii) Similarities between choreographies concerning the quality of movement at the climax are evident mainly in relation to the following component: Shape [Stretching - Rising - Advancing]. However, the component “Effort” contributes to endorse each choreographie with coherence, making this component to result at the maximal tension points (see Figure 2):

- Focused and restrained in Ananiashvili’s performance
- Emphatic and immediately free in Makarova’s interpretation
- Controlled y luego light and abandoned in Plisetskaya’s version
- Emphatic, controlled and restrained in Ulanova’s interpretation

(iv) Deviation in the synchronization between movement and music implies, in all the instances, the anticipated beginning and the latter ending of movement in relation to the corresponding sound attack. Independently of the type, duration and velocity of both the movement and the music performance, anticipation is always shorter to retardation at the end, being the latter evolved over the sound vibrato (see Table 1).

	Dance Step		
	Lapse	Beginning of movement in relation to sound attack	End of movement in relation to the sound attack
Ananiashvili N.	4’’754	- 1’’692	+ 3’’062
Makarova N.	5’’667	- 1’’436	+ 4’’229

**Table 1.** Examples of the difference between both the beginning of the dance step and the sound attack, and the ending of the dance step and the sound attack at the climax, measured in milliseconds.

## DISCUSSION

The present study had the purpose of initiating a systematic inquiry of the relationship between music and movement, introducing the problem of its temporal organization. In order to do this, a first question was posed: to what extent the movements elicited by the music are indeed based on the music? In order to answer to this question it was decided to study a relationship between music and movement that was evident. Consequently, dance was chosen as the unit for analysis. Classic ballet choreographies of the same musical piece were analysed and compared, under the assumption that if the characteristic features of movement arise from some musical features, then it would be feasible to expect patterns of coherence in the study of categories of music and of movement. Very recent studies about early intersubjective experience, where microanalyses of the performance that adults offer to the infant were run (see Espanol & Shifres, this symposium), found that although the composition of movement maintains high levels of synchrony with that of sound, there are

moments in which the degree of attunement between both components has a certain level of asynchrony (Español et al, 2007). For this reason, in the present study the microanalysis of the synchronic relationship between the sonic and the kinesthetic components was run focusing on an outstanding point in the choreographic-musical discourse, searching for clues that accounted for information relative to the problem under investigation.

To the extent that it is valid to consider that, in the arts of movement, music provides the support to the development of dance, it is also possible to assume that music can also have an effect in the organization of movement that is in agreement with the sonic organization. Given that our research question was precisely the extent to which this bias effectively occurred, special caution was taken in the analytical procedure of both the musical and kinesthetic component. In the first place, they were analysed separately with the aim of identifying characteristic features of their organization, and only afterwards some of the ways in which the relationship between both of them is composed were considered.

It arises from the results that in the four historical interpretations of the musical piece the rhythm of articulation of the dance steps emerges from the inside of the musical phrases, and that the organization of the choreographic phrasing in the macroform keeps strict and coherent correspondence with the articulation of the metrical and formal levels of the structural music hierarchy. Depending on the choreography, the phrases of movement evolve over the macro, medium, and /or micro levels of both musical structures, being the lowest of them the articulation of the dance steps at a pace of half measure each.

Coherence was also evident when the relationship between tension of movement and tension of music was considered. The hierarchies of melodic-tonal tension that were taken into consideration showed a direct correspondence in the assignment of tension to movement: the more structurally embedded the tonal tension of the allocation, the more univocal was the assignment of tension to movement in the different interpretations.

For this reason the microanalysis of music and movement was performed at the point in which the tension of both components was clearly defined: the formal articulation between sections B and A', in order to study in detail the quality of movement and the temporal synchrony between both components. The Laban analysis concerning the quality of movement in the climax allocation showed the highest similarity in the Form, while inside each movement Form was modulated with Energy (see item (iii) in Results). It seemed that tension in movement is more the result of a composition of the different emergent energetic types of the flow of musical tension than the result of a relationship of one-to-one correspondence between movement and sound.

However, the analysis of temporal synchrony between movement and sound showed that always the movement begins *a priori* of the sound attack and terminates always *a posteriori* of it, plus the fact that the lapse of the anticipation is shorter than the lapse of termination. This data bring precise and new information to the study of the dynamic evolution of the kinesthetic-sonic flow and opens hypotheses for the analysis of the way this relationship is substantiated. The answer could be found in the Tau function (Lee 2004) that indicates that the relationship between the intended movement and sound is solved by the way in which one component begins before than the other in order to arrive together to the goal.

Is therefore the spatial-temporal dynamics that sound and movement jointly compound that illuminates the way in which two events manifest an intended movement? Does this spatial-temporal dynamic

create the illusion of being together? The pursuit of a detailed study of other relationships between music and movement will bring more insights for the further understanding of the ways in which one component contribute to the understanding of the other.

## REFERENCES

- Davidson, J. (1993). Visual perception of performance manner in the movement of solo musicians. *Psychology of Music*, 21, 103-113.
- Davidson, J. (2007). Qualitative insights into the use of expressive body movement in solo piano performance: a case study approach. *Psychology of Music*, 35 (3), 381-402.
- Di Pellegrino, G., Fadiga, L., Fogassi, L., Gallese, V., & Rizzolatti, G. (1992). Understanding motor events: a neurophysiological study. *Experimental Brain Research*, 91, 176-180.
- Español, S. (2008) La entrada al mundo a través de las artes temporales. Número monográfico dedicado a Psicología de la Música. *Estudios de Psicología*, 29 (1), 81-101
- Español, S. Shifres, F. Martínez, C. y Videla, S. (2007). Frases de sonido y movimiento en las interacciones tempranas adulto bebé. *Memorias de las XIV Jornadas de Investigación Tercer Encuentro de Investigadores en Psicología del Mercosur*, pp. 422--424
- Hutchinson Guest, A. (2005). *Labanotation. The system of analyzing and recording movement*. New York, Routledge.
- Krumhansl, C. (1997). Musical tension: cognitive, motional and emotional aspects. En A. Gabrielsson (Ed). *Proceedings of the Third Triennial ESCOM Conference*. Uppsala, Suecia, 3-12.
- Lee, D (2004) *Tau in Action in Development*. En Rieser, J.J., Lockman, J.J. and Nelson, C.A. (Eds.) *Action, Perception and Cognition in Learning and Development*. Hillsdale, N.J.: Erlbaum.
- Mc Neill, D. (1992) *Hand and Mind*. Chicago: The University of Chicago Press.
- Martínez, I. C. (2008). Cognición enactiva y mente corporeizada: el componente imaginativo y metafórico de la audición musical. Número Monográfico sobre Psicología de la música. *Estudios de Psicología*, 29 (1), 31-48.
- Rizzolatti, G. & Arbib, M. A. (1998). Language within our grasp. *Trends in Neurosciences*, 21, 188-194.
- Shifres, F. (2008) Música, transmodalidad e intersubjetividad. *Estudios de Psicología*, 29 (1), 7-30.
- Sundberg, J.; Friberg, A. y Frydén, L. (1991). Common secrets of musicians and listeners: An analysis-by-synthesis study of musical performance. En P. Howell, I. Cross and R. West (Eds.) *Representing Musical Structure*. New York, Academic Press.
- Sundberg, J. (1987). *The science of the singing voice*. Dekalb, IL: Northern Illinois University Press.
- Trevarthen, C. (1999-2000). Musicality and the intrinsic motive pulse: evidence from human psychobiology and infant communication. *Musicae Scientiae, Special Issue: Rhythm, Musical Narrative and Origins of Human Communication*. 155-211.

*References of video interpretations.*

- Ananiashvili, Nina "The Dying Swan". Live performance 1991, in:  
Nina Ananiashvili & International Stars. VAI DVD 4241.
- Makarova, Natalia "The Dying Swan". Live performance 1975, in:  
Natasha - Kultur Video DVD, 2007.
- Plisetskaya, Maya "The Dying Swan". Live performance 1975, in:  
Maya Plisetskaya Dances. VAI DVD 4264
- Ulanova, Galina "The Dying Swan". Live performance 1991, in: Paul  
Czinner's. The Bolshoi Ballet. VAI DVD 4426.