

Analysis of corporal gestures in dance students' improvisations as a response to controlled musical parameters

Daniel Valiente-Ochoa, *^{#1} Blas Payri, *²

**Universidad Politécnica de Valencia, Spain*

[#]*Conservatorio Profesional de Danza de Valencia, Spain*

¹dvalientel@yahoo.com, ²bpayri@har.upv.es

ABSTRACT

This study addresses the lack of a theoretical basis in dance piano accompaniment music geared towards dance. We study which musical features are perceptually most relevant and prompt specific dance movements and gestures, particularly in academic dance. 11 musical pieces using an academic style (duration approximately 30s) were composed for the experiment and recorded on a piano. The pieces varied along 6 musical features: mode, tempo, time signature, intensity, anacrusis and syncopation. For each video-recorded improvisation, we analyzed the performance of movement and gesture types. One-way ANOVAs were performed taking each musical feature as a factor and each movement as a dependent variable. Tempo and mode have the largest general influence on movement. Mode influences displacement amplitude and gesture assertiveness. Tempo influences the use of the floor and displacement amplitude. Time signature influences structure and displacement related movements and equilibrium. The results are significant for dance students with no musical training and no explicit knowledge of the musical features under study.

I. INTRODUCTION

This experience aims at analyzing a central issue in academic dance training: the pertinent way to compose an accompaniment music for the purpose of academic dance exercises. This field has not been thoroughly explored using and experimental design, and even there is a lack of theoretical work by music or dance performers or instructors. The process of music for dance creation can follow three main types:

1. The music is composed before hand, with the musical ideas of the composer, and the choreographer can adapt the dance independently of the composer, which is the case in many instances of well known pieces for ballet made by Stravinsky or Tchaikovsky.
2. The musician and the choreographer work simultaneously to build together the complete work adding "dialectically" new ideas and modifying dance and music to fit both needs
3. The choreographer or dance instructor creates the movements and the musician fits the music to the dance requirements.

This article will study the third option as it is the most common procedure, but instead of proposing an academic dance movement and then creating the music ad hoc, the procedure will be reversed: the musician will present a musical proposition and the dancer will have to fit the musical gestures that it is meant for. Usually, the accompaniment during dance practicing at the conservatory is done by a pianist, following the instructions of the dance instructor.

These instructions are mostly the general atmosphere or character that the music needs to convey in order to make certain types of technical movements and displacements that will require certain speed, beat, rhythm, softness, and so forth. The dance instructors do not share with the accompanying musician a technical musical language that will describe how the music should be composed, and the task of the musician is to find, with trials and errors, the right music to perform the dance exercise. The accompanying musician will progressively acquire an empirical knowledge of the musical tricks that will get the students dancing and doing properly the required exercises, but there lacks a systematic study of this empirical knowledge and every musician has to go through the adaptative learning.

The literature describes results of the affective response to musical parameters, and in some cases the movement response to musical stimuli. Other research focuses on the modification of the perception of music due to gesture or other visual stimuli. For instance, on the experiments by Frego (1999) cited by Southall (2003), the authors examined the effects of aural, visual, and combined aural/visual conditions on the emotional response to music and dance of musicians and non-musicians. Measurement was recorded on the perceived amount of artistic tension occurring in three stimuli. Subjects rated the tension in three experimental groups: aural-only, visual-only, and combined aural/visual. Results indicated no significant differences in perceived artistic tension between musicians and non-musicians. Additionally, no differences were found in perceived artistic tension among the responses to the three experimental conditions. In a very detailed study, Dahl (2005) studied the gestures and body movements of musicians expressing the musical intention. Subjects rated silent video clips of musicians performing four different emotional intentions, Happy, Sad, Angry, and Fearful. The results showed that Happiness, Sadness and Anger were well communicated, while Fear was not. Considering a consistent response to audio and visual input, we may foresee a consistent response of gestures to audio input.

The main goal of this experiment is to explore whether there is any coherent response to music parameters in dance improvisation, for children studying dance but lacking musical training. The musical parameters that we will privilege in the musical stimuli are the most common features of academic dance piano music. We will refer to the actual piano accompaniment practice in a dance classroom rather than the parameters described in the music perception literature.

II. EXPERIMENTAL DESIGN

A. Music Stimuli

11 musical pieces were composed by the first author and a colleague. The structure of each piece followed a certain number of conditions: the music is built on music phrases that use simple and recognizable melodic-rhythmic patterns. Each music phrase encompasses 8 beats, as academic dance is always structured on 8 beat sequences. The global structure is always symmetrical, grouping by pairs the music phrases. In general, the style was very close to the music that is used in actual dance classes at the conservatory, where the first author is a pianist for dance accompaniment. In order to have a condition familiar to the students, all the pieces were performed on a piano. Using the above-mentioned constraints, the pieces were composed using different music parameters that we want to test. Not all the combinations of the musical parameters were used, as the quantity of music material would have gone beyond the scope of this preliminary study in which we want to understand and select the most salient features that will be systematically explored in future experiments.

1) *Mode: Major/Minor*. Two pieces were composed using exactly the same material and changing the mode from E Major to E minor as displayed in figure 1.



Figure 1. Initial excerpt of the Major (above) and Minor (below) pieces

2) *Tempo: Fast/Slow* The same piece was performed at two different tempi: ♩=180 versus ♩=90. These were recorded once using a MIDI keyboard, and then the MIDI file was modified to obtain the faster and slower versions.

3) *Time Signature: Duple/Triple*. In this case, the two pieces cannot be identical as there is an intrinsic temporal difference. The two pieces had the same melodic shape and number of long and short notes, adding some grace notes to have coherent melody as seen in figure 2.



Figure 2. Initial excerpt of the duple (above) and triple (below) time signatures.

4) *Anacrusis* Two pieces were composed with the same melody, in the second piece 6 grace notes were added before the strong beat to create the anacrusis shown in figure 3.



Figure 3. Initial excerpt of the piece containing an anacrusis (6 grace notes, above) and without anacrusis (below).

5) *Syncopation*. Two pieces were composed with exactly the same melody, adding a rhythm change to generate the syncopation as can be seen in figure 4.



Figure 4. Original melody (above) and syncopated version (below)

6) *Forte/piano*. One single piece was composed within which in each pair of phrases, the first was forte, and the second piano.



Figure 5. Initial phrases opposing the forte and piano indications within a piece.

A. Task and subjects

The subjects were 18 4th-year dance students. All the subjects were male, due mainly to the scarcity of male students in academic ballet. Each subject performed the task individually and alone in the usual Conservatory dance room, with the dance teacher and the piano accompanist and researcher. Subjects listened to the musical piece once, and then performed a free improvisation on the second listening. 89 improvisations were video-recorded.

III. ANALYSIS AND RESULTS

A. Gathering the responses as gestures

Following a procedure similar to (Krantz, Madison & Merker, 2006), after video-taping the different dance improvisations, the authors made a preview of the sequences to determine the gestures that actually appeared from all possible movements that were listed beforehand. A list of 72 movement types was established, in such a way that every movement could be rated with a yes/no answer by a viewer. Taking in account the great variability in the performance possibilities, there were very diverse movements and for reliability sake in the rating, only the presence or absence of a gesture was accounted.

Then, for each dance performance, the absence or presence of each movement was rated marking 1 or 0 after several

viewings of the sequence. Both audio and video were used as some features measured the relation gesture-music, like “beats time” or “jumps at the forte phrase”. The global list of parameters can be found in (Valiente-Ochoa, 2008).

B. Analysis of main results

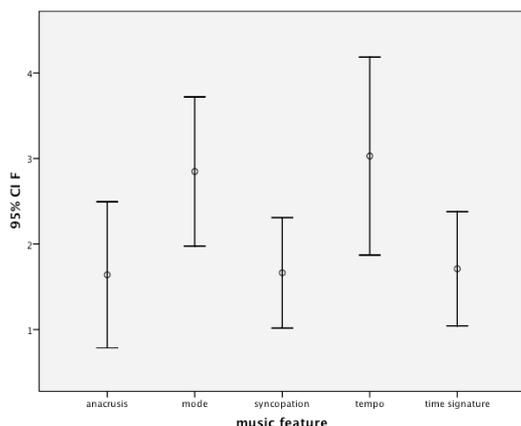


Figure 6. Means with confidence interval of the F value for each music feature.

For each musical feature we computed a one-way ANOVA for the difference of the means of each gesture, resulting in an F value measuring the influence of each music feature for each gesture. We compared the mean of the F values for each music feature, as can be seen in figure 6. A one-way ANOVA comparing the F values indicated that there was a significant difference ($p < 0.05$) in the means: Mode and Tempo had a stronger influence on the gestures than the other three features: Anacrusis, Syncopation and Time Signature.

C. Influence of each musical parameter on gestures

For each musical parameter, we performed a one-way ANOVA on the presence of each gesture, and recorded the gestures that varied most significantly for each musical parameter as can be seen in table 2 for Tempo, and in table 1 for the other musical parameters.

We can see that each musical parameter has a specific effect on the dance students to perform specific gestures. In table 1 and 2 we can see not only the significance of the difference of the mean for each parameter, but also the percentages. For instance in table 1, there is a significant difference in the performance of spinning due to time signature, as triple signatures prompt more spinning than double signatures: typically, the waltz is the triple-signature dance that is meant for spinning, and military marches, having double time signature, do not prompt spinning but rather march to the tempo (“beat time”) and have stability (“start with flat foot”).

Nevertheless the gesture responses are not binary: there is a lot of spinning with double time signatures, so it is possible to make spinning exercises with double signatures.

There are some gestures that can be explained as the reflection of an expressive intent and others are more related to physical constraints of movement performing. For instance if we focus on the gestures associated to tempo in table 2, we can see different kinds of responses:

1. Gestures that respond to an expressive intention to convey a mood through body movement

2. Gestures that require certain physical conditions to be performed and will only occur with certain musical parameters, because they are more comfortable
3. A combination of the above: often the body expression and its psychological interpretation are due to body possibilities

Table 1. Gestures with a high significance ($p < 0.01$) when computing a one-way ANOVA for the influence the musical parameters of Time Signature and Mode. For each gesture there is the results of the anova (F and significance level) and percentage of times when the gesture was performed by the dancers in response to the musical parameter.

Gesture	ANOVA		% of cases	
	F	Sig.	Triple	Double
Time Signature				
Spinning	6,944	,010	90	68
Start with flat foot	10,403	,002	22	55
Beat time	13,345	,000	9	39
Mode				
	F	Sig.	Minor	Major
Start crouching	6,953	0,01	34	12
Start standing	9,578	0,003	59	87
Plié	7,096	0,009	59	30
Jump	12,087	0,001	14	50
Anacrusis				
	F	Sig.	Without	With
Arms extended upwards at 135°	7,792	,006	35	80
Beat time	23,437	,000	13	70
Syncopation				
	F	Sig.	Without	With
Spinning	6,678	,011	85	40
Beat time	14,500	,000	15	80
Arms extended frontwards	6,546	,012	7	40
Arms extended upwards	6,495	,013	27	80
Loudness				
	F	Sig.	Piano	Forte
Always standing	7,283	,008	69	35
Plié	7,071	,009	46	12
Jump	10,196	,002	31	71
Grand battement	6,769	,011	22	53
Flat foot	15,988	,000	76	29
Run	6,574	,012	32	65

Gestures like “start looking down” or “end lying down” clearly have solely an expressive role and express some how the rather depressive role of slow tempo as compared to the tense or cheerful influence of fast tempo. There is no need of a certain tempo to look down. Many studies suggest that tempo is a primary factors in generating perceived musical tension (Frego, 1999; Geringer & Madsen, 2003; Ilie & Thompson, 2006) and that can explain the expressive influence of slower tempi.

On the other hand, gestures like “développé” require inherently a certain time to be fully “developed” and hence only slow tempi will allow to perform it. Here we have no particular expressive intention, just a technical constraint.

Finally gestures like “run”, “walk” or “large displacement” may be both associated to the level of excitement created by tempo and to the physical

constraints. For instance “walking” can be easier performed with an “andante” tempo, which literally means walking, than with *lento* or *presto* tempi, that are different from the human normal walking tempo. Also “walking” is fit to express a normal excitement corresponding to a normal tempo.

Table 2 Gestures with a high significance (p<0.01) when computing a one-way ANOVA for the influence the musical parameters of Time Signature and Mode. For each gesture there is the results of the anova (F and significance level) and percentage of times when the gesture was performed by the dancers in response to the musical parameter.

Gesture	ANOVA		Tempo		
	F	Sig.	Slow	Medium	Fast
Plié	26,405	,000	0	72	14
Jump	15,833	,000	20	12	64
Start looking down	9,422	,000	60	25	2
End lying down	10,146	,000	20	0	0
Large displacement	7,206	,001	20	20	57
Diagonal displacement	4,999	,009	0	8	32
Run	9,849	,000	60	15	57
Walk	8,214	,001	20	53	14
Développé	6,745	,002	40	12	0
Beat time	12,910	,000	0	40	2

D. Gesture and movement type grouping

In order to have an easier interpretation of results, we proceeded to group the gestures into meaningful sets, as summarized in table 3. Namely:

1) *Elevation*: this feature groups everything related to up-down. Downward related movements decreased elevation (“looking down”, “lying down”) whereas that were upward related movements increased elevation (“jumping”, “thrusting arms upwards”)

2) *Equilibrium*: this feature groups everything related to the equilibrium of body position. Stable positions increased equilibrium (“standing on both feet”, “flat foot predominant”) and unstable positions and movements decreased equilibrium (“développé”, “standing on one foot”)

3) *Assertiveness*: this feature grouped mostly gestures that denoted increased assertiveness or even defiance (“looking at the camera”, “thrusting arms forward”), as opposed to gestures linked to self-protection or shyness (“looking down”, “covering the face with hands”, “self-embracing”) that decreased assertiveness.

4) *Structure*: only two features were recorded: “beat time” and “marks musical phrasing”.

5) *Displacement*: this took in account the movement of the subject within the room (“runs”, “diagonal movements in the room”). All features that implied a movement in the room increased displacement.

6) *Body movement*: this was related to the movement of limbs and the body that did not imply a displacement in the room. Features that implied limb movement increased this feature (“grand battement”, “arm circular movement”)

Table 3. Pearson correlations and their significance for each musical parameter and each set of movements. The syncopation parameter did not have any significant correlation and does not appear in the table.

		mode	tempo	time sign.	anacrusis
elevation	Corr.	.462**	.422**	.218*	
	Sig.	.000	.000	.040	
equilibrium	Corr.		.245		
	Sig.		.21		
assertiveness	Corr.	.436**	.313**		
	Sig.	.000	.003		
structure	Corr.	.292**	.359**	.417**	
	Sig.	.005	.001	.000	
displacement	Corr.		.282**		
	Sig.		.007		
body movement	Corr.				.217*
	Sig.				.041

IV. CONCLUSION

In this preliminary experiment, results show that 12 year-old children, with no knowledge of the mode or time signature of a piece, actually respond coherently in their improvised dance movements, connecting the perception of music features to body movement and emotional response.

The association of gestures with musical parameters can have three tentative explanations: first, there are learned patterns that associate arbitrarily certain gestures to certain music features and that can be present in academic dance; second, there is an expressive intention in the gestures that try to convey the mood of the music, and here we can use dance as a means to understand musical perception; third, and may be most important, there are technical constraints that make it easier to perform certain movements with certain musical parameters. The latter can be the most interesting to explore for academic dance sake, as the role of the accompanying music at the conservatory is to prompt the academic dance exercises. This is the case for instance with spinning and all circular movements that prefer ternary time signatures: the braking of the stability and symmetry with the three-beat signature helps the spinning and the unstable movements. Large gestures require slower tempi, the more exaggerated movements that require jumping or using a lot of energy will need a clear indication of the gestures and the strong beats for instance with the adjunction of anacrusis and the use of certain tempi.

As this experiment has proved that there can be significant correlations between movement and music in the frame of academic dance, we need to delve into the study of each parameter. To understand further the implications in pedagogy and music composition for dance, future research will add rhythm and intervals to the music features. Future research will implement a systematic study of different basic rhythmic patterns, both for double and triple signatures. This will create a larger set of combinations. This experimental design can be applied to other dance genres within the conservatory, namely Spanish classic dance or contemporary dance, with the advantage of having a better distribution across genders, unlike classic academic dance, that is mostly feminine.

Opening to other dance genres would also allow the use of other music styles and idioms, including contemporary music, electroacoustic music, and different traditional or pop music genres. This is useful to extend and generalize the musical concepts that prompt dance movements.

ACKNOWLEDGMENT

We would like to thank Miguel Gironés for participating in the composition of the music pieces and Laura Villanueva, classic dance instructor, for her enthusiastic collaboration in the analysis of movements in the recorded videos

REFERENCES

- Dahl, S. (2005). On the beat: Human movement and timing in the production and perception of music. *PhD Dissertation* Sweden: KTH Royal Institute of Technology
- Frego, R. J. D. (1999). Effects of aural and visual conditions on response to perceived artistic tension in music and dance. *Journal of Research in Music Education*, 47, 31-43
- Geringer, J. M., & Madsen, C. K. (2003). Gradual Tempo Change and Aesthetic Responses of Music Majors. *International Journal of Music Education*, 40, 3-15.
- Granot, R. Y., & Eitan, Z (2008). Dynamic Auditory Parameters and Perceived Musical Tension. *10th International Conference on Music Perception and Cognition*. Japan: Hokkaido University
- Ilie, G. & Thompson, W.F. (2006). A comparison of the acoustic cues in music and speech for three dimensions of affect. *Music Perception*, 23, 319-329.
- Krantz, G., Merker, B., & Madison, G. (2006). Melodic intervals as reflected in body movement. 9th International Conference on Music Perception and Cognition. (pp 265-268). Bologna, Italy
- Valiente-Ochoa, D. (2008). Estudio de las improvisaciones de estudiantes de danza en función de parámetros musicales contrastantes. Master Thesis. Universidad Politécnica de Valencia, Spain.
- Maher, T. (1982). Verbal and exploratory responses to melodic musical intervals. *Psychology of Music*, 21, 48-72.
- Shove, P. & Repp, B. H. (1995). Musical motion and performance: theoretical and empirical perspectives. In J.Rink (Ed.), *The practice of performance. Studies in musical interpretation*. Cambridge, UK: Cambridge University Press.
- Southall, J.K. (2003). The Effect Of Purposeful Distractors Placed In An Excerpt Of Puccini's LA BOHÈME To Ascertain Their Influence On The Listening Experience. *PhD Dissertation* USA: Florida State University, School of Music
- Truslit, A. (1938/1993). Shaping and motion in music. *Psychology of Music*, 21, 48-72.