

Visual and Sound Gesture in Dance Communication

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Introduction

In technique class (e.g. classic ballet, modern dance) and in dance rehearsal, different persons meet who fulfill different roles: teacher, student, dancer, dance musician, choreographer, rehearser, conductor. They have heterogeneous professional backgrounds and express themselves through multiple and dissimilar means. They use language in different ways, and focus on different aspects of dance seen as a whole (Humphrey 1959; Laban 1960; Lopukhov 2002, Laguna 2008; Mason 2012; Popa Blanariu 2015; Gentot 2016). This variety makes this encounter a kind of Babel that often causes disorders and communication failures between them. We have been working on the problem of communication in dance class [Laguna 2009, 2013; Shifres y Laguna 2013, 2015] in different contexts between teachers and dance students (academic level), dancers (professional level) and dance musicians (in both academic and professional context), finding some important clues to identify such failures and proposing some lines of work to fix them. They circumscribed this communicational problem to an intersubjective exchange of subjects that fulfill different roles (dancers and musicians) and have different body experiences, immersed in a context of abundant multimodal information (propositional and non-propositional content conveyed by voice and movement).

In this work we focus on a key moment in dance class that takes place when the teacher proposes an exercise to be performed by the dancers. We propose to emphasize the importance of the teacher's voice (semantic-prosodic and musical components) in the demonstration of dance exercises and describe some communication problems that emerge from the aforementioned complexity. In that circumstance, the dance teacher *marks* a series of movement exercises for the dancers, using a combination of physical demonstration and verbal description. Although this combination is idiosyncratic, since

its details depend on each teacher, in general they keep certain principles that can be understood as general because they have been presented in a similar way over time throughout the world (Royal Academy of Dance 2019). Although the teacher can give clear indications to either the dancer or dance musician (Teck 1989; Cavalli 2001; Ochoa and Payri 2009; Toenjes 2009; Wong 2011; Laguna 2013) separately, in general all indications are taken into account by both. In addition, Ballet exercises (modern dance, among other techniques) are designed so that their movements can be adjusted to the metric and formal framework of tonal music, that is, rhythms based on an underlying pulse and groupings of 8. It is in this way that a unified language is articulated.

When marking the exercise, the dance teacher is simultaneously demonstrating and distributing his movements to a *count* constituted by the verbalization of numerals expressed in a more or less isochronous way on which he adds verbal indications (Laguna 2012; Diehl and Lampert 2014). Meanwhile, the dancer imitates the teacher's movements with the aim of internalizing their rhythmic, dynamic and spatial structure. Usually the dancer makes his own mark using movements of less amplitude and/or that represent the real movements, performed with the hands or by reducing the size of the steps, the height of the jumps and the extension of the limbs. It is clearly a spatial, dynamic and rhythmic representation of the observed (or remembered) movement and an important cognitive resource for learning and a vehicle for physical thought (Côté-Laurence 2000; Wulf and Prinz 2001; Kirsh 2010; Warburton, Wilson, Lynch and Cuykendall 2013; Warburton 2014; Bläsing and Sauzet 2018; Bläsing, Coogan, Biondi and Schack 2018).

It is thus noted that it is a double marking. The teacher, bodily and verbally, marks the exercise for the others (dancers and musicians) and the dancer interprets this information by marking for himself.

Due to all this, one can observe that the teaching of dance movement is based on a complex crossing of sensory modalities: visual spatial and kinesthetic (Carroll and Moore 2008; Sheets-Jonhstone 2010; Olsson 2018) for physical demonstration, and auditory and linguistic-conceptual for verbal instructions. This informational confluence appears, in principle, as an advantageous reinforcement. However, this cannot always be the case. Vines, Krumhansl, Wanderley and Levitin (2006) affirm that the information coming from the various perceptual channels interact both reinforcing and contradicting each other. Furthermore, several studies suggest that there is a supremacy of auditory rhythmic information over visual rhythmic information, so that the auditory stimulus tends to be more relevant for the metric organization of the information compared to the visual stimulus (Glenberg and Jona 1991; Repp and Penel 2002; Vines et al. 2006; Laguna and shifres 2012).

With the teacher's marking acting as a model for the exercise, and in the embodied representation (whether internal or slightly externalized) of the model by the dancer, a sort of virtual score or embodied text is established that remains available during the exercise and upon which communication between the two is established for the entire learning process. In this process, the teacher makes visible the rhythm and dynamics of the movements that compose his exercise (he establishes the tempo, the rhythmic relationships between the different movements, their different qualities and the spatial location of the in-out accents).

The count —the verbal component that accompanies the visual marking of the exercise— consists of both lexical elements (typically numerals, but also names for

movements and spatial and technical indications such as right-left, up, rise, flexion, suspend, spiral, heel forward, plié, etc.) and non-lexical (onomatopoeic expressions such as tim-tum-plash, pa, etc.). The function of the count is to reinforce both conceptually and prosodically the order, rhythmic regularity, and metric position of the movements that are being marked by the teacher.

The count is segmenting the flow of the movement into equal time units that reflect at least two levels of regularity. A superordinate level represented by numbers (one, two, three, four) and a subordinate level represented by the conjunction *and* that indicates weak metric positions. The movement patterns thus verbalized (one-and-two-and) are updated in the *metrical structure* of the music taken as reference. According to Lerdahl and Jackendoff (1983) the 'metrical structure expresses the intuition that the events of the piece are related to a regular alternation of strong and weak beats at a number of hierarchical levels' (p.8). The same authors explain that it is about a mentally constructed entity where 'the listener instinctively infers a regular pattern of strong and weak beats to which it relates the actual musical sounds (...) our term for these patterns of beats is meter' (p.12).

Thus, the count generates in whoever observes the mark (typically the dancer, but also the dance musician) expectations of future-oriented regularity in order to anticipate when the different actions that compose the exercise will be completed. This helps the observing dancer develop the movements according to the rhythmic pattern adjusted to the count.

In addition, as one of the main objectives of the body marking of an exercise is to help the dancer notice the intentions of the movements' trajectories that compose the exercise (the idea that this movement is directed away with one intention, or back with a different intention). The sounds of the count have the objective of reinforcing the

rhythmic-metric instantiation (strong-weak relations) and the expressive and articulatory qualities (e.g. legato-staccato) of that directional intention (e.g. in-out accents).

In the development of this process, certain key moments in the movement of some parts of the body play a fundamental role. These are considered as *Visual Spatial Indicators* of the metric emphasis (beat) of the movement (Laguna and Shifres 2011; Laguna 2014, 2016).

With the help of the count, the observer (dancer and dance musician), intuitively identifies these points which allow him to mentally configure the basic metrical structure upon which to accommodate his own movements - more specifically those key points of his own movement that are analogous to those of the master's.

The use of voice combined with movement is anything but a trivial event that exceeds the mere utterance 'one-and-two-and'. We are talking about a highly complex interpersonal communication in which a bodily and visuospatial (kinethic-kinesthetic) experience must be integrated into the metrical music experience of teacher, dancer and musician. A true temporary - multimodal exchange where non-verbal, non-propositional contents and linguistic statements are articulated.

Dance research has devoted little space to issues related to the multisensory approach to dance / cross modal features as belonging together (Olsson 2018), such as thinking about the integration of the 'movement of music' in the movement of a body that dances (Carroll and Moore 2008) and other communication-relevant topics on kinesthesia and proprioception (Shets-Johnstone 2009) in first-person body affective dynamic experience.

The present work continues on identifying communication problems in the context of the dance class-rehearsal between teachers, dance students, dancers and

dance musicians, and on explaining their causes. Here we focus on the analysis of an experience of the first author, who is also a researcher, dancer and dance musician. This modality of approach has already been put into practice in previous works [authors 2020] that are framed in the principles of the *Collaborative Autoethnography* (Chang, Ngunjiri and Hernández 2013), although the field of inquiry is not so much sociocultural as psychological. From a series of autoethnographic reports by the first author, which were adjusted through questions and reasoning by the second, a series of data was identified that was analyzed in a laboratory context, with the assistance of methods developed in previous works ([Laguna 2015, 2017]; Hopper, Weidemann and Karin 2018) for the analysis of the dancer's movements and their potential as visospatial indicators of rhythmic-metric regularity. In this way, an attempt is made to bring the *etic and emic* approaches into a collaborative dialogue both in the collection and analysis of data and in the preparation of conclusions. Thereby, in the following section we present a report by way of posing the problem in which, in the first person singular, the emic approach that initially guided the inquiry is taken as a reference. However, this report must be understood clearly as the result of the type of collaboration proposed between both authors.

Part one: Description of the exercise, statement of the problem and delimitation of the unit of analysis

I am a musician and a dancer. Initially I studied music and then started to learn dance as well as playing for it. Many years later, already as a professional and taking one of my usual dance classes, my teacher (T) suggested a very simple exercise composed of two identical sequences of 8 movements that was divided into two parts of 4 movements each. The first part consisted of 4 *batement tendu* (BT), a codified ballet movement composed of two equidistant trajectories performed in the same direction and then in the

opposite direction. As shown in figure 1 (top panel) T extends his right leg forward (distal direction) until reaching *pointe tendu* position (instant of maximum elongation of the toes without losing contact with the floor) and from this position he reverses its movement (proximal direction) until reaching *closed position* in parallel.

The second part consisted of 4 different movements (figure 1; bottom panel). The first movement, a *battement jeté* (BJ) consists of extending the leg forward until the foot loses contact with the floor and rises to about 30 degrees. In the second movement, a *tombé en avant* (TA), the weight of the body is transferred to the front leg that flexes (*plie*) on the support of the foot. The third movement is a *dégagé derrière* (DD): the supporting leg lengthens and the contralateral leg loses contact with the floor. From this position, the fourth movement begins, the *fermé de dégagé* (FD), where the leg of the *dégagé* joins the supporting leg. The sequence is repeated with the left leg.



Figure 1. Right-sided exercise sequence in parallel first position. Top panel: first part, battement tendu forward x 4 (pointe tendu - closed position). At the rate of one BT for

each count; Bottom panel: second part, battement jeté (BJ), tombé en avant (TA), dégagé derrière (DD), fermé del dégagé (FD). At the rate of one movement for each count.

T began to mark the movements of the exercise described above, using, of course, both his body and his voice. While watching and listening to him I couldn't follow (understand) his movements. I immediately noticed that, even without meaning to, my attention was randomly oscillating between what T was *saying* and what T was *doing*, and this generated in me intense confusion. If I followed the voice with what its rhythm and prosody proposed to me as strong-weak relationships, the movement should be done according to a type of gesture in which the intention was directed towards a future moment (*anacrusic gesture*¹). This is so because his count began with an *e um* (and one in english). In this way, *and* was the upbeat of *one*. On the contrary, when observing the movement, the same voice seemed to have an intention generated from the energy of the present moment (*thetic gesture*²), as if the *and* were the stressed syllable. It was evident that something about the way T marked the exercise made me feel (perceive) that the body mark and the verbal count, although they were synchronized beat to beat, were not metrically unified. Yet, in addition, since at times (mainly in the second part of the exercise) the marking of the exercise did not adhere to a pulse (isochronous), it was very difficult for me to establish a structure of temporal regularity. This episode was the starting point of a series of lobbying on the *metrical structure* of the marking, the temporal organization of visual-spatial indicators of energy discharge, its relationship with the verbal count, the articulation of its conceptual

¹ When the metric position occupied by the first sound does not coincide with the first beat of the meter (...) the energy is directed towards a more stable point (Shifres and Burcet 2013,154).

² When the starting point of the melody coincides with a stable position in the metrical structure (...) with the first beat of the meter (Shifres and Burcet 2013,154).

and prosodic contents and the way in which I myself could organize my action according to the structure and expressive intentionality of T's instructions.

Despite being familiar with the movements of the proposed sequence, when T began to verbalize the count, my doubts about the metric interpretation of the exercise also began. I am referring to the consideration of what were the exercise's strong and weak points (in terms of intentionality of the movements). Following the BT marking gave me an out of phase sensation between the intention in the movement of his leg and the intention of his voice. This out of phase sensation was present during the first part of the exercise (BT) but not in the second part of the sequence in which the final positions of BJ, TA, DD and FD tended to coincide with the stressed vowels of their respective counts (Out-shift-balance-close). Thus, the first four BTs were marked in a regular *tempo* but they appeared metrically ambiguous, while the next 4 movements, although marked somewhat slower, were metrically clear.

When T had finished marking the exercise, I still was not clear about the metric organization of the beginning because I had not been able to interpret the gestural intentionality of the first part since I did not understand the relationship between what he was saying and doing. I explained my doubts exemplifying them with my own movement and voice. The main doubt lay in the location (outside or inside) of the foot's intention in BT.

T again marked (demonstrating and counting) the exercise. However, his marking again raised the same doubts in me. To put it clearly, I couldn't tell if T wanted the *one* of his count to coincide with the *pointe tendu* (distal location) —which in music would imply a thetic gesture or from the downbeat—, or if, on the contrary the *one* should relate with closed position (proximal location) —which would indicate an anacrusic gesture, or towards the downbeat—. The exchange we had from that point on,

made me see that I could not communicate the nature of the doubt that had arisen in me from linking the problem not only with my dance concepts, but also with my experiences as a musical instrumentalist. Finally I directly expressed to him that I needed to know if he was accentuating the *pointe tendu* or 'the accent on the closed (...) position' (See Hammond 1982, 42). To my surprise, T answered without hesitation: "The movements in this exercise have no accents."

From that very specific answer, I proceeded to carry out the exercise avoiding loading the trajectories of each BT with a determined metric interpretation (beat by beat). T then gave me interesting feedback on the alignment of my hip during my performance and finalized the exercise.

It was then that I asked him if he would allow me to film him, performing once again the marking of the exercise so that I could observe and study his proposal in greater detail and better understand the origin of my confusion. With his usual generosity, T agreed to my request.

What had just happened referred me to innumerable occasions when, acting as a dance musician, I could not coordinate my *musical ideas* relative to what I inferred from the markings of some dance teachers. This led me to feel that analyzing in depth the situation of confusion caused by the T's marking would allow me to go beyond the problem of this exercise itself and perhaps could advance in the knowledge of certain communication problems in the framework of the learning of dance.

From that moment I had the opportunity to ask dancers with different levels of expertise to mark this same exercise. The marking of one of them, D, was remarkably clear to me. I asked her to allow me to film her, to analyze her movements and her voice. We designed a new exercise similar to the one proposed by T, but focused on the

BTs in the first part. The sequence was made up of 8 BTs, of which 4 were carried forward in profile plane and 4 towards the side in frontal plane.

We asked D to mark the exercise for us. She articulated the count in Portuguese (D's mother tongue) through a sequence of 8 numerals preceded by a cue or *verbal cue* (seven-eight) that metrically prepared the precise moment of the beginning of the first BT. D also verbalized some *and* that divided in equal parts some of the numerals. In this way, the semantic component of the verbal stimulus was configured as follows [sete oito] *um-e dois-e três-e quatro cinco seis-e sete oito* ([seven eight] one-and two-and three-and four five six -and seven eight).

The exercise was videotaped frontally by a camera mounted on a tripod and operated by a professional. Thus we put together both videos (T and D) in order to analyze the differences.

Part two: Analysis of Differences in Markings

Movement analysis

Regarding viso-spatial information, authors (Laguna y Shifres 2011) have highlighted the importance of communication between the participants in the dance class / rehearsal (teachers, students, dancers, choreographers, rehearsers, dance musicians, etc.), of the description of the so-called *visual spatial indicator* (VSI) (Laguna 2016). The VSI represents an abstract concept of motion consisting of a point (infinitesimal) that has no surface, which the observer takes into account to follow and assess the kinetic traits. This movement indicator acquires an objective dimension when it becomes configured by a certain part of the body, such as a joint (knee, elbow, shoulder, among others) or a distal segment of a bone (such as the phalanx of the finger or toe). In practice we say that the VSI is located in the knee, elbow, heel, the distal end of the hallux finger, etc.

Through the VSI it is possible to identify the distance traveled, its location in three-dimensional space, the velocity at each point of its trajectory, its acceleration, among other objective measurements. In this sense, the point at which VSI reaches or drops *velocity 0* (stillness point), serves as a signal that allows segmenting the movement into units for analysis. These points (key moments) are an emphasis on the temporal continuum (visual-spatial beats) which, as such, are information that contributes to establishing the psychological scheme that we call *Metrical Structure* (Lerdahl and Jackendoff 1983; London 2004; Shifres y Laguna 2013). The movement can then be seen as a concatenation of *discrete units* limited by the instant in which the velocity (V) of the VSI reaches 0 (instant which coincides with the final zero velocity denominated as *goal*) or ceases to be 0 (instant which coincides with the initial zero velocity denominated as *origin*). Zero velocity (V0) is reached and dropped in a multiplicity of circumstances: for example, due to the impact of the VSI, when the VSI changes direction, as well as when the VSI stops without an impact and in the instant immediately before starting to move. In another example, V0 will be reached at the instant the *calcaneal bone* (heel) VSI touches the ground while walking and will be lost the instant it loses contact with the ground. Likewise, in a plié movement V0 of the VSI *knee* will be reached the instant it stops flexing. For its part, while the V of the VSI remains at 0, we are in the presence of a *Stillness Period* (SP).

Through this procedure called *Microanalysis* (See Microgenesis in Bermejo 2005; Diriwächter and Valsiner 2006) a dance exercise can be analyzed (frame by frame) as if it were formed by a sequence of $V_{VSI=0}$ distributed on the timeline. By placing a position sensor on the part of the body that configures the VSI we obtain the distance traveled, thus being able to calculate the duration of each trajectory of

movement, of each stillness Period (the duration of the IVE stays at V0), velocity and acceleration.

The choice of VSIs depends on the type of movement being studied. According to previous studies (Laguna et al. 2018) the *first distal phalanx* is the VSI that best describes the rhythmic alternation of BT movement.

According to Sheets-Jonhstone (2011) 'the projectional quality of movement determines its temporal dynamics' so that, 'those dynamics being marked by tensional quality in terms of accents and shadings that mark the dynamics rhythmically' (49). For this reason, in dance, this dynamic is understood not as occurring in space but creating its own space. This clearly links the conformation of space with the possibility of understanding rhythm as a metric in a temporal configuration given by the particular form the dancer creates when moving. However, the systematic study of time and space in relation to this phenomenological notion of built space has been scarcely addressed (Mora and Pellicer 2013). In this direction, we previously explored the variables that describe the accent of movement in a BT sequence (Laguna et al. 2018). By taking a set of measurements (time, distance, speed, acceleration), we were able to observe that the appreciation of the accent of movement was better described by the SP. This is consistent with the opinion of expert dancers (Laguna 2009; Laguna et al. 2018).

Considering this set of information, we measured the time elapsed in each BT trajectory according to the movement of the VSI I distal phalanx in both T and D's audiovisual tracks. We selected the I distal phalanx to perform the measurement because it was considered to be the point that provided information most clearly, precise and homogeneous throughout for the audiovisual tracks of both exercises. The analysis included calculation of the duration of both the periods during which the I distal phalanx was in motion as well as its permanence at V0 (SP). For both audiovisual

tracks, the result showed higher SP values in the *pointe tendu* (distal goal) (see Figure 2 top and bottom panel).

The average duration values of the SP show that T remained longer in the *pointe tendu* position than in the closed position (110ms vs 20ms). Thus it is clear that T indicates the *accent* of his movement in *pointe tendu*, despite his insistence on the absence of accentuation in the exercise.

This difference is more clearly expressed in D's track where the average duration of the distal SP was = 264ms (*pointe tendu*), notably greater than the average value of the proximal SP = 80ms (closed position), although D never stated that the exercise would not present beats ranked by some accentuation factor. Thus, we can conclude that during both tracks of BT, in T and D there are agogic accentuation factors on the *pointe tendu*, that is, outer accentuations.

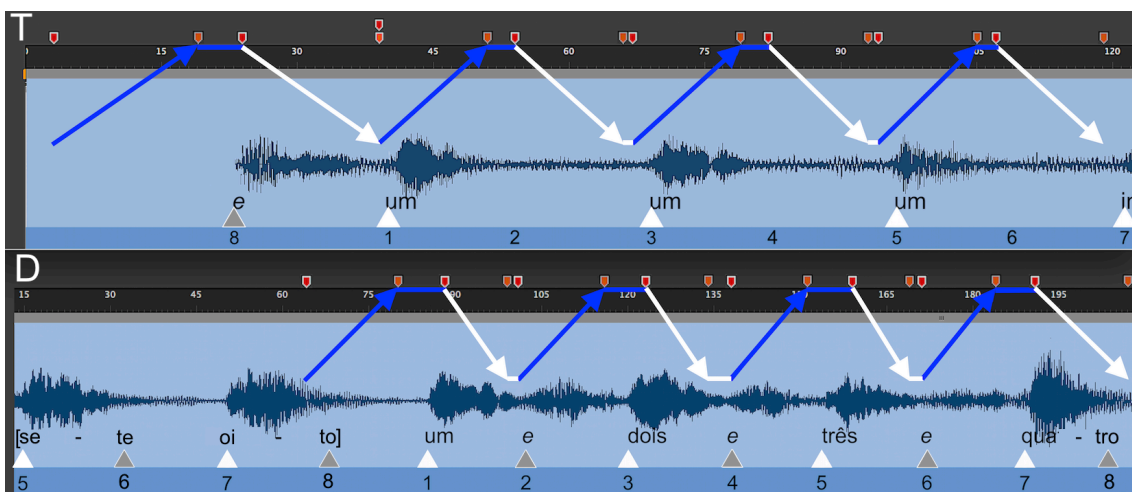


Figure 2. Multimodal microanalysis of the marking of the first four BTs of T and D. The graph represents the direction of movement of the VSI I distal phalanx (y-axis) with respect to time (x-axis). In both analyzes, the red wedge is the origin of the trajectory (the moment when the VSI speed stops being 0) and the orange wedge is the trajectory's goal (the moment when the VSI speed is 0). The blue lines represent the movement of the VSI distally (outward trajectory) and the arrow's tip the instant in which the indicator reaches V0 (*pointe tendu*). The white lines express the movement of the VSI in the proximal direction (inward trajectory) and the arrow the instant in which the I distal phalanx reaches V0 (closed position). The blue and white horizontal lines represent the distal and proximal SP. The white triangles indicate the onset of the

superordinate level of regularity. The gray triangles the subordinate level of regularity. According to the dynamics of the BT performance, ordinal numbers represent the base beat.

Sound analysis

We analyze the sound-verbal information according to two components. On the one hand, the *semantic component* refers to the words used and their meaning (typically numbers, which establish a sequential order and group movements in cycles). On the other hand, the *prosodic component* refers to the sonic characteristics - time, height, intensity, timbre - of the words. The sound analyzer allows us to identify with millisecond precision when the stressed vowels of each word are pronounced. The frequency and intensity information makes it possible to infer other accentuation factors (tonic and dynamic), according to the classification of accentuation factors proposed by music theory (see Cooper and Meyer 1960; Berry 1967; Lerdahl and Jackendoff 1983). Figure 3 shows both measures for the performances of T and D. In general terms, the results demonstrate that both frequency and intensity reinforce the accent on the numerals of the count.

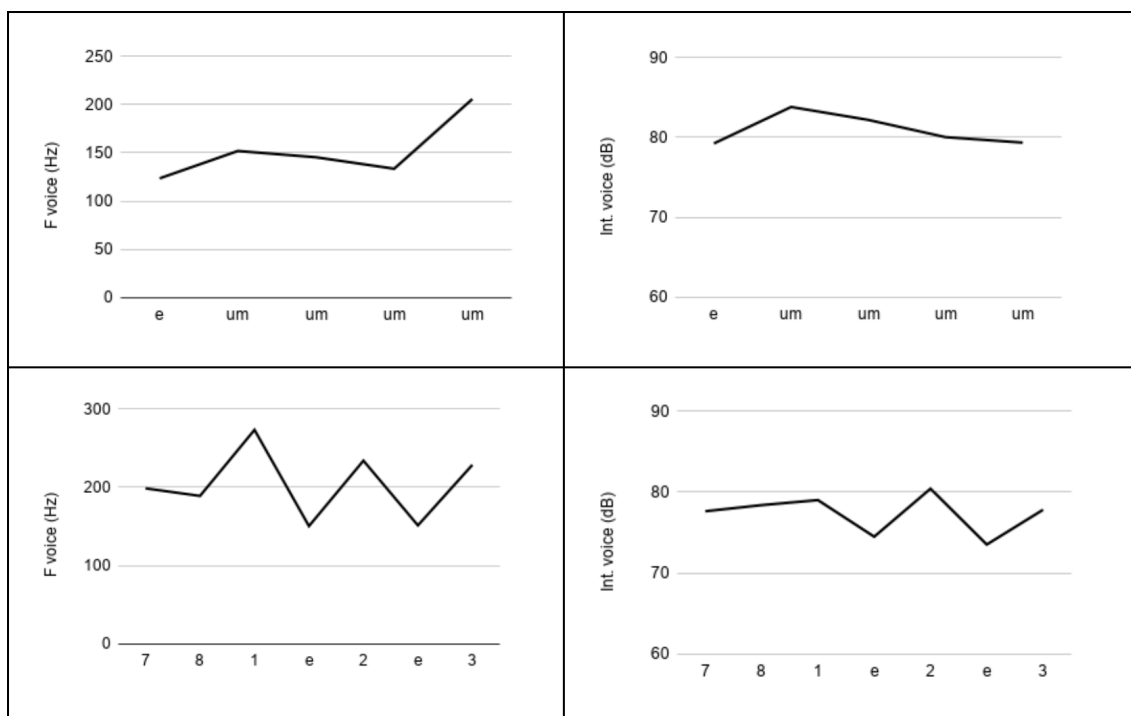


Figure 3. Analysis of F_0 and Vowel Intensity in the counts of the two compared videos, T (top) and D (bottom). In the verbalization of T, *one* is used in an onomatopoeic way (it has metric gravitation but does not establish an order of movements), on the contrary, the numbered verbalization of D is establishing an order.

However, the most eloquent information that the auditory modality provides is semantics. The count that begins with *sete oito* (seven eight) in the case of D and with *e* (and) in the case of T, orients the stress towards *um* (one), indicating that the beginning of the sound sequence is anacrusic in both cases. In addition, the alternation of short (*e* /and) and long (*um* /one) intervals reinforces the accents on the numerals in the performance of T. This analysis allows to clearly identify a *prosodic accent for each numeral*, allowing the metrical structure to be clearly configured. In addition, this has a customary basis, since as we anticipated previously in the context of dance, the use of *and* coincides, and therefore indicates, weak metric positions (e.g., one-and two-and three-and four-and). Concomitantly, the numbers or words correspond to the reference metric level. It is therefore also in accordance with this habit that beginning the count with the sound *e* (*and*) is felt as an anacrusic beginning.

Discussion of the combination of both analyses

From observation of the sound and movement analysis (see Figure 2 top panel) some interesting considerations can be deduced. T begins to count —the *and* which introduces the initial *one*— articulating the voice almost synchronously when the I distal phalanx drops V_0 and begins its movement towards the closed position of the BT. Then it can be seen that the articulation of the counts *um... um... um...* tend to coincide with the closed position of the BT (very close to the proximal goal V_0 and slightly from the initial point of the distal trajectory),

(1) one can observe that M's leg reaches the *pointe tendu* position before starting the count at *e* (*and*). This particular organization of the marking (finishing the movement before counting) weakens the count's function, which consists in creating the

expectation both for the moment when one is going to start moving and for the moment when one is going to arrive at the final position. Figure 2 (top panel) shows that the first sound of the count (the *and*) synchronizes with the start of the foot's return. This implies that the *pointe tendu* was left out of the exercise (since it was prior to the *anacrusis*). This singularity with respect to marking habits, was possibly one of the causes for the ambiguity that was being felt. Contrarily, D (see Figure 2 lower panel), begins her count before starting to move, and although she does not pronounce the *e* (*and*) before *um* (*one*) the movement of her outer leg begins in the middle of the count *oi-to* (the second syllable divides the distance between *oi-to - um* (eight - one) into two equal parts). Thus the count precedes the movement and disambiguates the strong-weak relationships.

(2) the return of the BT to closed position is aimed towards the accent of the voice (*anacrusic gesture*). This suggests that the proximal trajectory takes place during the weak part of the beat. Reciprocally, the distal trajectory (towards the *pointe tendu*) would take place during the strong part of the beat (that is, from one onwards). In the case of D (lower panel), the count begins while the movement is held, and the *one* coincides with the *pointe tendu* (distal position), with which the outward trajectory is felt during the weak time (contrary to what occurs with M).

(3) the Figure 2 shows that the longest stillness periods tend to be in the *pointe tendu* (distal goal). Although the performance of D is much more differentiated in that regard (clearly all the SPs in the *pointe tendu* are considerably longer than in closed position). Thus, the performance of D is in phase, that is, the accents of sound and movement coincide. On the contrary, in the performance of T, while the sound accentuation falls on closed position (proximal goal), the movement's accent tends to be on *pointe tendu* (distal goal). We call this type of configuration *out of phase*.

The hypothesis that here emerges is immediate: the in-phase configuration is clearer to follow than the out-of-phase configuration. It also adds to this hypothesis if that clarity depends on the type of experience of the perceiving subject.

For this we designed an experiment that sought to explore the incidence of the various possibilities of synchronization of the count and body demonstration based on the concept of visual spatial indicator and the variables that qualify it. We aimed to determine what type of temporal correspondence favors the clarity of a teaching instruction in the context of a dance class and how it is compatible with the experience of dancers and musicians. Accordingly, the marking of a BT exercise can be followed with greater clarity and precision when the location of voice accent (prosodic-metric emphasis) coincides with the location of the movement's accent.

Part three: Experiment

Method

Participants

75 participants divided into 3 groups, (M) Musician without experience in dance n = 25 (10 women) of average age 42, all with professional training (D) Dancers without experience in music n = 25, (24 women) of average age 25, all undergraduate dance students; (X) no dancers - no musicians n = 25, (21 women) average age 35, university level training.

Stimuli

The audiovisual track from D's performance analyzed above was taken as the original stimulus. The BT sequence was composed of eight BTs, four of which were performed forward in the profile plane and 4 performed sideways in the frontal plane. The verbal stimulus (in Portuguese) consisted of the eight numerals that coincided with the *pointe tendu* (distal goal). In addition, the dancer verbalized some positions on the metric

division level with the voice *e* (and) coinciding with some closed positions (proximal goal) of the BT. This particular dynamic of articulation between movement and voice corresponds to what in dance is called BT with the *accent out*. The marking of the exercise was preceded by a two-beat verbal anacrusis. This stimulus was called the in-phase (IP) stimulus. The sound of the in-phase stimulus was manipulated by advancing the audio in order to match the count with the proximal position of the foot. This stimulus was called out of phase (OP).

Procedure

Two testing strategies were combined in a single trial. Both strategies followed the same general directive: "Watch the video as if you had to carry out the proposed exercise." The first test followed the *qualification* strategy. Stimulus videos (IP and OP) were presented 3 times each. The participants had to estimate on a scale of 1 to 10 (very difficult, very easy respectively) how difficult it was for them to follow each of the videos presented. The second test followed the *comparison* strategy. The videos were presented in pairs in their two ordering possibilities (IP-OP and OP-IP). Participants had to say which member of the pair was easier for them to follow. In this way, each test contained a total of 8 items that were presented in random order for each of the participants. The objective of carrying out the two test modalities was to verify if one strategy followed by another caused any difference in relation to the attention given to the stimulus as a whole (auditory and visual). Participants had up to 10 seconds to evaluate each item.

Once the test was finished, a brief interview was conducted in which they were asked to narrate the experience, the difficulties they had encountered in the task, the causes to which they attributed these difficulties, etc. The participants took the test sitting in front of a 13 'computer screen.

Results

Comparison

For the analysis of the comparison task, the choice of the IP stimulus was considered as 1 and the OP stimulus as 0. Thus, the closer the average of all comparisons was to 1, the higher the estimate of ease for the IP stimulus compared to OP stimulus. The general average was 0.76 ($t_{s}=5,237$; $p<.000$; for 0.5 as a random value [A28]), IP being clearly easier than OP.

The Group factor was significant (see figure 4). Thus, the average for the dancers was 0.92, for the musicians 0.80 and for the participants who were neither dancers nor musicians 0.56 ($F_{2}=5.04$; $p = .009$). This means that the phase adjustment was more relevant for the dancers than for the participants who were neither musicians nor dancers (difference of 0.36; $p = .009$ - DHS of Tukey).

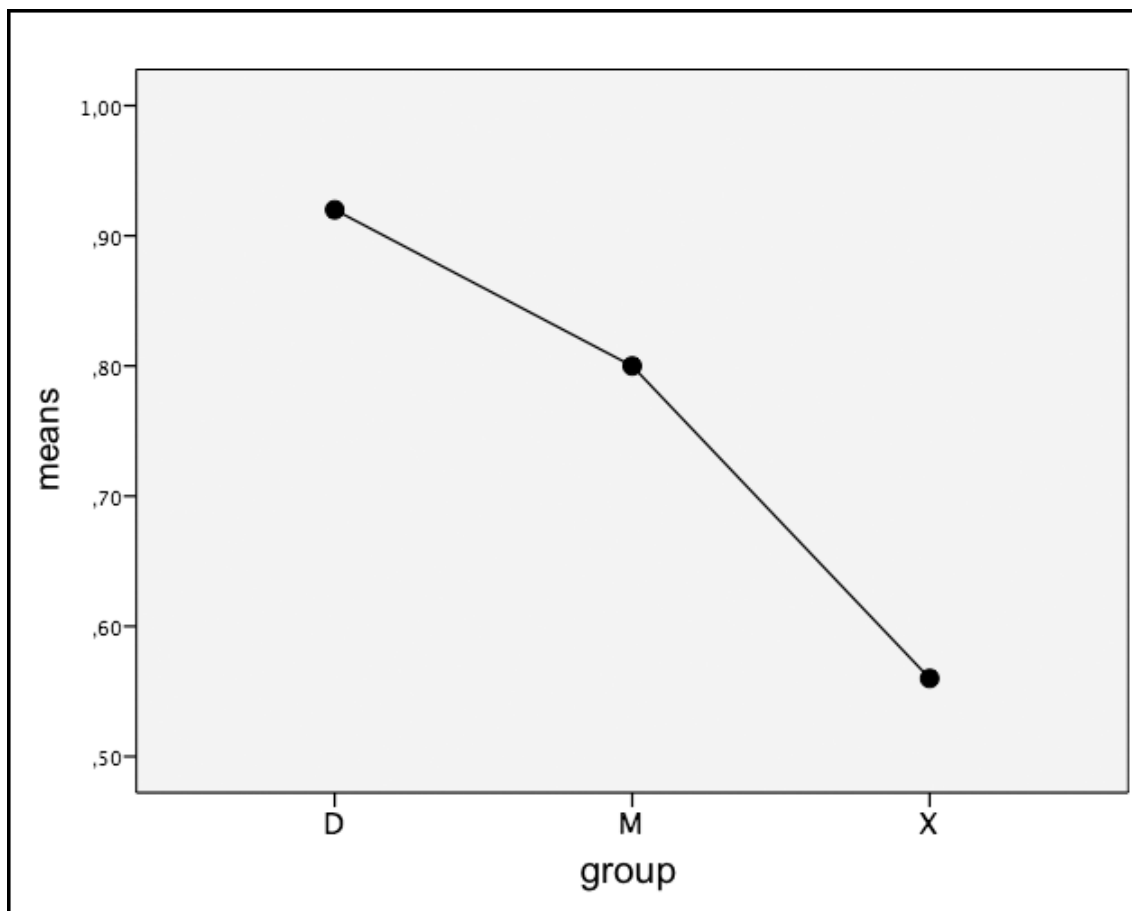


Figure 4. Averages of comparisons on ease to follow the exercise between the IP - OP stimuli.

We could assume, then, that dancers are more affected by the divergence of accent information (visual-auditory) than musicians and non-dancers non-musicians. In other words, possibly, the musicians and non-dancers non-musicians (while watching D's demonstration) are guided mainly by the sound, while the dance students take into account the visual component. It is even possible that their own experience as dancers and their habit of articulating a second mark while watching the choreographer mark, favors some kind of kinetic-kinesthetic experience (see Sheets-Johnstone 2010) by simulation (see Gallese 2005, 2016; Butterfill and Sinigaglia 2014).

Qualification

The difficulty rating was evaluated three times in each stimulus. As the differences between these three times were not significant, the data was subsequently collapsed. An ANOVA yielded significant differences for the stimuli. The average for EF was 8.916, and for FF was 6.356 ($F[1-74]=65,647;p<.000$). The differences between groups and the interactions between factors were not statistically significant.

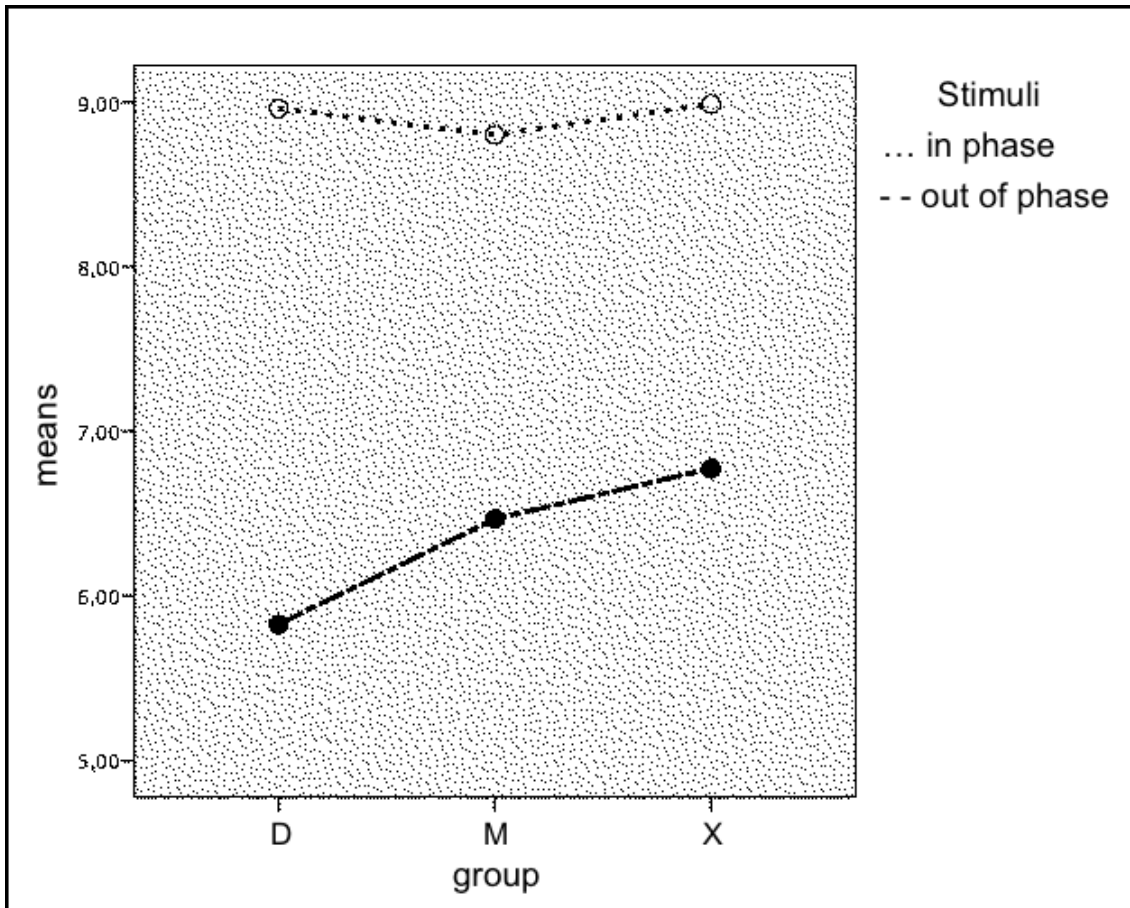


Figure 5. Average of ratings on ease to follow the exercise between stimuli IP - OP

Synthesis of the interviews

In general, the analysis of the interviews carried out showed a great coincidence in the assessments of the three groups. The differences between the groups were more of specific vocabulary than perceptual or attentional. In this way, the participants were able to express that: (i) the exercise was easier to follow when the number coincided with the “tip of the foot” (IP); (ii) that there was a contrary version in which the voice was heard when "the feet were together" (OP) and that this form was more difficult to follow because the voice and the tip of the foot felt out of phase (non musicians, non dancers) and/or in anacrusis (musicians), or out of phase with the tip of the foot forward (dancers); (iii) they were able to differentiate the sound and visual components of the stimulus, and attribute the difficulty to the problem of synchronization between the two,

particularly in that the problem of phase shift or difficulty to follow was attributed to the counts (the positioning of the count) and not to the movement.

Group 1 (dancers - non musicians) considered the experience evaluating the location of the foot with respect to the numerical count (one, two, etc.), understanding the experience in terms of the accent of the inward (feet together-inside) or outward (toe-out) movement with metric prosodic reinforcement of sound. The opposite version “number-feet together” was considered defective. They tended to view position in the context of dance from the use of *e* (and) as the main point of conflict in the location of the count. Notably, the dancers used in very few cases specific terminology (such as *pointe tendu*, closed position, sixth position, *battement tendu*). On the contrary they tended to give gestural responses explaining their ideas through their own movements (gestures).

Group 2 (musicians non-dancer) evaluated the task considering the metric location (strong - weak) in which the “extended toe” was found. They tended to quickly link musical concepts, such as upbeat, metrical structure, strong and weak beats. Probably this type of link allowed them to adapt quickly to the situation of phase shift. Thus, for example, one of the participants declared that "the first movement of the foot was strange in some and very accurate in others ... then everything settled down."

Group 3 (non-musicians non-dancers) related the coincidence, fluency and alignment of the voice's number with “the point furthest from the foot”.

The clear forecast of following is the number that the voice marks with its foot outside. However, in this group, two participants declared that they found no differences, and one expressed that at the beginning he did not understand any of the proposals, and as the examples went by he understood some.

Regarding the version that is easier to follow, all participants conceptualized it as “the one with the movement that was on time”. However, in the opposite version only the musicians could overcome the initial phase shift and follow the BT as if it were in anacrusis (even when their favorite version is on time). On the other hand, dancers and non-dancers non-musicians understood the opposite version as faulty due to a poorly formulated count. Only the dancers were able to explain that in the OP stimulus the movement occurs after its number and that, at the end of the exercise, the count ends but the movement continues.

General Discussion

This work set out to explore a typical pedagogical problem: Students seem do not seem to understand what the teacher proposes. This research emphasizes the role that the voice plays in the communication of the temporal and gestural structure of movements. The particularity of the dance class places this problem in a framework of great complexity in communication. This complexity emerges from the involvement not only of conceptual aspects (the student does not seem to understand the concepts that the teacher is transmitting), but also perceptual issues (the student understands one thing, but sees and/or hears another). Logically this is due to the fact that the directive given for an exercise is not only conceptual, and fundamentally rests on an intersection of stimuli of different perceptual modalities. Movement instructions in dance class are naturally multimodal.

In the reviewed literature, the teacher's voice fulfills the function of counting movements, producing rhythms and describing body action. However, the effects that its linguistic and prosodic components may have on the communication of the exercise are not analyzed. Such important issues that may be linked to the production of musical information as well as the way in which sounds and movements are assembled and

articulated in that account have been scarcely studied. Studies need to be expanded on the mechanisms by which the teacher's voice and movement (and the dancers' response to them) are actualized in the metrical context of the musical performance in Classical Ballet or Modern classes.

We believe the results this research produces on the understanding of the temporal-gestural structure of dance communication can benefit the work in the class between teacher, student/dancers and musicians.

The qualitative and quantitative analysis of this work demonstrated that an exercise can be followed with greater clarity and precision when the location of the voice accentuation (prosodic-metric emphasis) coincides with the location of the movement's accent. The voice must be able to accurately and sonorously illustrate the rhythmic-metric and expressive structure (articulation, dynamic accents and phrase) of the movement that we want to convey. Clarity of instruction understood in this way should leave us in a favorable position so that multimodal instruction can be actualized 'in and with' the music.

According to Lerdahl and Jackendoff 'the norm in tonal music, provides what might be called a *metrical grid* in which the periodicity of beats is reinforced from level to level' (1983, p.20). Based on this, so that the demonstration of the rhythmic structure of the exercise is metrically stable, the periodicity of the different levels of regularity verbalized by the teacher (the levels of the 'numerals', the 'and', as well as other linguistic and non-linguistic verbalizations) and the levels of the movements articulated in them (according to final V0) must be reinforced.

During the demonstrations of the movements it is overriding to take into account the (i) importance that the multimodal ensemble (voice-movement) has in the success of the transmission and interpretation of the instructions, and (ii) the importance of the

voice as a vehicle of musically metric information by being able to 'point out' precise locations of the movement key points. Furthermore, to improve this ensemble it is necessary to consider that (i) each movement to fit metrically with the syllabic rhythm and prosodic emphasis of the voice; (ii) the movements have a preparation, a beginning and an end.

This work encourages the teacher to act as a true conductor who 'leads' himself and others with his own voice and movements, managing the delay of his cues, anticipating the dancers in the precise moments of the beginning of phrases.

The music-dance dichotomy continues to be rooted in the training of dancers. There is a tendency to believe that 'sound' belongs to the field of music and the 'movement' belongs to the field of dance. It is necessary to be able to begin to think of the danced movement as an event in time that expresses itself spatially. We propose that dance instructions be thought of and analyzed from a multimodal perspective (kinesthetic, tactile, auditory, visual) and interdisciplinarity (music psychology, dance phenomenology, biomechanics) can help to soften the music-dance dichotomy.

The methodological development of microanalytical analysis according to zero velocity is a tool that allows to the movements of the dancer and study the movement exercises as being composed as a series of discrete units that can also be analyzed with respect to the metric positions of sounds. of the music (onset) that are being taken as reference. This has strong implications for dance research and applications in education.

Despite there being a scarce number of publications about the relevance of visual and sound gesture/cues in dance teaching and performance, it would be useful for dance training to emphasize areas such as Psychology of Music, rhythm cognition, production and perception. Specifically the notions of rhythmic and metrical structure of music, and that they be covered from the experience of the body themes related to

periodicity (regular recurrence of events that leads to cycles with a particular repetition rate-frequency and a specific onset time within a cycle-phase), motor periodicity, beat extraction, audiomotor extraction and metrical phonology (see Kotz, Ravignani, Fitch 2018).

We suggest the integration of the previous areas with microanalytical movement analysis, zero velocity detection (discrete units) and addressing knowledge by leaving the a priori definitions towards listening to what the body tells us. In this sense, the phenomenological reduction (Sheets-Johnstone 2017) can be of great importance.

Numerous studies in the field of Developmental Psychology. (Bahrick 2001; Bebee et al 2003; Malloch and Trevarthen 2010; Hannon, Schachner, Nave-Blodgett 2017) show that multimodal redundancy reinforces the content of the message. This redundancy is based on the synchrony of the highlighted events in the course of the different simultaneous stimuli lines (auditory, visual, kinetic, tactile, etc.). For the metric frame configuration, this timing is fundamental. In addition however, the complexity increases when understanding that the receiver (student, dancer, musician, etc.) is a subject who orients his attention selectively. Other studies indicate that auditory information is more relevant than visual information for the synchronization task (Repp and Penel 2003). If this is so, it is possible that the participants in our experiment were guided more by auditory information. The data collected would indicate that dance students are selectively more oriented to spatial kinetic information (three-dimensional, sense, direction) than musicians. For this reason the dancers had more difficulty in following the contradictory information (OP).

This difference has important implications for class and rehearsal room work: not all the subjects involved in them direct their attention in the same way towards the different streams of information available. This attention seems to be linked to

accumulated personal experiences and also, possibly, to the objectives that each one pursues in the context of the class. Thus, the dancers have a look at the instruction while the musicians have other interests placed in it. As the instruction tends to be unique, it is important to know if it has the same communicational power. The results show that experience is important, but it seems that the experience of musicians and dancers is being modeled with relatively similar guidelines (remember that the musicians had no experience of dance, nor of being dance musicians).

Like any message in a communication context, the dance class guidelines rest on trust in eloquence. This refers to the way we take it for granted that the elements we articulate in the exercise instruction speak and convey the content of the message. We could see the first conflict in relation to this question in T's answer to the researcher's inquiry about where the movement accent was located. T said "the exercise has no accent." But, in fact, the student would see the accent, and the microanalysis revealed the existence of that emphasis. This means that, although T performed everything with the same *intensity* (force) and hence assumed that there is no emphasis, the distal stillness periods are configuring visual emphases that are not manifested in his own experience. T relies on his bodily eloquence, however it fails. In the same way that happens with prosody. In other words, the multimodal complexity of the instruction and the differentiated attention of both senders and receivers often threatens the clarity of the message.

The first part of this work showed that the word accent is polysemic and that this affected the communication between the researcher and T. While the first sought to understand accent in terms of how the strong-weak relationship of the movements was distributed in the exercise understood as a whole (if the intention gravitated on the *pointe tendu* or closed position), the latter understood the notion of accent in terms of a

*phenomenal emphasis*³, as a phenomenon produced locally by increased energy. Because of this, and because he considered that he had not emphasized any of the BT's goals, he denied the existence of an accent. This complexity highlights the need to strengthen research on the different accentuation factors in the integration of music in dance (Laguna et al. 2018). One of the objectives of the strategy of combining the emic and ethical perspectives is to have a direct impact on the basic pedagogical problem, which is that of the obviousness of the instruction. To what extent my own movements (and therefore my embodied understanding of them) are self-evident to those who observe me. In previous studies we saw that this was a crucial point in the problem of communication in dance. It also leads us from there to the difficulty of thinking about the elements of the exercise marking and its articulation. Teachers may be more concerned with movement, believing that it is what brings all the information to students and dancers, while they may tend to ignore the importance of other things they do, such as 'saying things and how they say them' while marking the exercise. For example, the rhythm of D's count (See Fig. 2) shows two levels of regularity: A superordinate level, composed by the odd syllables *Se-te Oi-to* (anacrusis) plus the numerical counts *Um, dois, três* (monosyllabic) and the first syllable of *Qua-tro*; and a subordinate level which, dividing the previous level into two equal parts, is formed by the even syllables of the anacrusis plus the *e* that articulate the counts *Um dois três* as well as the second syllable of the count *Qua-tro*. In addition, it can be observed that the values of the intensity and the tone of the voice (Fig 3) are reinforcing the strong-weak relationship in the rhythm of the voice. This means that D produces a metrically clear communication through 'how she says what she says'. This type of message helps the

³ For kinds of accents in music, see Lerdahl and Jackendoff 1983, 17.

observer — by making use of his metric intuition— to more accurately simulate the movements that are shown to him.

What strategies can be incorporated into daily teaching experiences based on this research? We suggest starting by considering that the demonstration of an exercise is not a closed and infallible form. We believe that an informed reflection from the areas that we have suggested above and the findings of this research could help to elaborate more effectively the way in which we conceive ‘what and how’ we are communicating what we want to communicate.

From the didactics of dance, the dancer should be encouraged to listen to the music, associating it to the different levels of regularity of the metric grid and then taking this new perception to the key points (V0 final) that are reached by the dancer in their movements. Think about the rhythm of the music that we imagine for a certain movement and imagine how the key points are distributed in the different levels of regularity.

Verbalize and distribute the key points of the movements of the exercise with the same temporal precision that sounds occupy in music, with the same metric perception that we have of the music that we listen to or think about it. Accurately articulate the voice stresses (syllables must be considered) with the accents and other key points of the movement.

The metric perception of the movement 'with the voice' should be present in all phases of each exercise (voice and visual instruction of the exercise / verbal levare / verbal indications that are superimposed on the music) in a dynamic co-construction between the teacher, the dancers and the musician. Here it would be important to consider the functions that musical performance has in this co-construction. In addition to being an expressive stimulus for the dancer, the music fulfills the function of

maintaining a metric pulse in the present (relating to an account) while creating metric expectations that help the dancer to think and prepare each one of his movements and to adjust them (temporary narratives that generate expectations towards the future, showing the dancer 'where and when each phrase breathes').

One of the critical points of communication in dance is the clarity with which the beginning of the exercise is elaborated. This work showed that perception is elaborated around a multimodal and metric ensemble around the emphasis of the voice and the final V0 of the movement. Therefore, it is important to pay attention to the first thing the voice says (what, how and when) and how it relates to the first movement the body makes when demonstrating an exercise. This initial instance called *levare* fulfills the function of defining the metric gesture of the exercise, that is, with what energy, with what impulse and from what metric position (strong or weak) does the first movement of the exercise start. In addition, the *levare* informs the base tempo of the execution, the metrical structure and the expressive articulatory characteristics (*legato-staccato*) of the movements.

It is extremely important for teacher-dancer-musician communication to clearly establish whether the first movement of the exercise is starting from a stable metrical position, addressing the voice accent of the *One* (strong) count, or whether the first movement part of a less stable metrical position addressing the voice emphasis of the *and* (weak) count.

We will finally give an example on how the metric gesture of voice and movement is organized in two types of beginning: *Thetic* and *Anacrusis*. Let us take as an example the relationship *Attitude-Developpé* articulated in two equal parts (*fifth position-attitude* and *attitude-developpé*). If the energy of the first movement starts from a stable point of the metrical structure, that is to say from the *One*, we are in the

presence of a thetic beginning (attitude in 'One'). If instead the energy of the first movement starts from a less stable point of the metrical structure, that is to say from the weak beat (attitude in 'and') and is directed towards a stable point of the metric (developpé in 'One') we will be in the presence of an anacrusis beginning. (There is a third type of metric gesture, the *acephalous*, which is not exemplified here as it exceeds the scope of this work).

The dance teacher, the dancers and the musician should work more closely. There are a series of a prioris in the beliefs of dancers and musicians that do not allow them to put their non-propositional experiences and embodied knowledge into dialogue.

As important and useful as the definitions of music and dance theory are, they do not explain the interpersonal experiences that come into play between the teacher-dancer and the musician. That is, they are not sufficiently equipped to account for the non-propositional nature of the experiences that are present in those exchanges.

We propose meetings (outside the classroom) in a laboratory context (Laguna 2016) that allows leaving aside theoretical a prioris, promoting phenomenological reduction, seeking to assemble their knowledge, their notions, in terms of bodily dynamic kinesthetic experiences. The findings of this research could be consolidated through reflection, analysis and the multidisciplinary meeting of teachers, choreographers, dancers, and musicians in a laboratory environment.

We propose a turn in the way of understanding the integration of music -in- movement. Pay more attention to the metrical distribution of voice and movement, and to the conflicts that occur at the crossing of propositional knowledge (mediated by linguistics, of a rational nature) and non-propositional knowledge based on bodily experience (mediated by knowledge kinesthetic, auditory, visual and tactile stimuli).

The present study called for taking care of some aspects of communication in dance technique classes / rehearsals with both dance students and dancers, as well as with musicians. We have shown that communication in dance encompasses metrical and multimodal routes and that a problem can arise when the teacher (or the dancer who marks an exercise) is not aware of this multimodality and *neglects* some of these routes due to other teaching issues, and that neglect can lead to the distortion of the message. We need to develop more theoretical reflection on music 'from' the dance perspective in dance research.

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References

- Bahrick Lorraine. 2001. "Increasing Specificity in Perceptual Development: Infants' Detection of Nested Levels of Multimodal Stimulation." *Journal of Experimental Child Psychology* 79 (3): 253-270. doi:10.1006/jecp.2000.2588.
- Beebe, Beatrice, Doriene Sorter, Judith Rustin, and Steven Knoblauch. 2003. "A comparison of Meltzoff, Trevarthen, and Stern." *Psychoanalytic Dialogues* 13 (6): 777-804. doi:10.1080/10481881309348768.
- Bermejo, Vicente. 2005. "Microgénesis y cambio cognitivo: adquisición del cardinal numerico." *Psicothema* 17 (4): 559-562. doi:10.5281/zenodo.3242058.
- Berry, Wallace. 1967. *Structural functions in music*. New York: Dover.
- Bläsing, Bettina, Jenny Coogan, José Biondi, and Thomas Schack. 2018. "Watching or Listening: How Visual and Verbal Information Contribute to Learning a

- Complex Dance Phrase.” *Frontiers in Psychology* 9 (2371): 1-15.
doi: <https://doi.org/10.3389/fpsyg.2018.02371>.
- Bläsing, Bettina, and Odile Sauzet. 2018b. “My Action, My Self: Recognition of Self-Created but Visually Unfamiliar Dance-Like Actions From Point-Light Displays”. *Frontiers in Psychology* 9 (1909): 1-9. doi: <https://doi.org/10.3389/fpsyg.2018.01909>.
- Butterfill, Stephen and Corrado Sinigaglia. 2014. “Intention and Motor Representation in Purposive Action.” *Philosophy and Phenomenological Research* 88 (1). doi:10.1111/j.1933-1592.2012.00604.x.
- Carroll, Noël, and Margaret, Moore. 2008. “Feeling Movement: Music and Dance,” *Revue internationale de philosophie* 246 (4): 413-435.
- Cavalli, Harriet. 2001. *A Guide to Dance. Accompaniment for Musicians and Dance Teachers*. University Press of Florida.
- Chang, Heewon, Faith Ngunjiri, and Kathy-Ann Hernandez, K-A. 2013. *Collaborative Autoethnography*. Walnut Creek: Left Coast Press.
- Côté-Laurence, Paulette. 2000. “The Role of Rhythm in Ballet Training”. *Research in Dance Education* 1(2): 173-191. doi:10.1080/713694263.
- Cooper, Grosvenor, and Leonard Meyer. 1960. *The rhythmic structure of music*. Chicago: Chicago Press.
- Diehl, Ingo, and Friederike Lampert, eds. 2014. *Dance Techniques 2010: Tanzplan Germany*. Leipzig: Henschel Verlag.
- Diriwächter, Rainer, and Jaan Valsiner. (2006). Qualitative Developmental Research Methods in Their Historical and Epistemological Contexts.” *Forum: Qualitative Social Research* 7 (1) Art., 8. doi:<https://doi.org/10.17169/fqs-7.1.72>.
- Gallese, Vittorio. 2016. “Finding the Body in the Brain. From Simulation Theory to Embodied Simulation.” *Goldman and His Critics*, First Edition. Edited by Brian McLaughlin and Hilary K. Kornblith 297–317. Chichester/Malden/Oxford, John Wiley & Sons. doi:10.1002/9781118609378.ch14.
- Gallese, Vittorio. 2005. “Embodied simulation: From neurons to phenomenal experience.” *Phenomenology and the Cognitive Sciences* 4: 23–48
- Gentot Laurent, dir. *The soul of the dance. Ulyana Lopatkina*. 2016. Crescendo FX. <https://www.youtube.com/watch?v=nxWp5MC52V4>.
- Glenberg, Arthur, and Menachen Jona. 1991. “Temporal coding in rhythm tasks revealed by modality effects.” *Memory & Cognition* 19: 514-522.

- Hammond, Sandra. 1982. *Ballet: Beyond the basics*. Mountain view, CA: Mayfield Press
- Hannon, Erin, Adena Schachner, and Jessica Nave-Blodgett. 2017. “Babies know bad dancing when they see it: Older but not younger infants discriminate between synchronous and asynchronous audiovisual musical displays.” *Journal of Experimental Child Psychology* 159:159-174. doi:10.1016/j.jecp.2017.01.006.
- Hopper, Luke, Andries Weidemann and Janet Karin. 2018. “The inherent movement variability underlying classical ballet technique and the expertise of a dancer.” *Research in Dance Education* 19 (3): 229-239. doi:10.1080/14647893.2017.1420156.
- Humphrey, Doris. 1959. *The art of Making Dances*. New York: Grove Press.
- Kirsh, David. 2010. Thinking with the body. In *Proceedings of the 32nd Annual Conference of the Cognitive Science Society*, 2864– 2869. Austin: Cognitive Science Society.
- Laban, Rudolf von, and Lisa Ullmann. 1960. *The mastery of movement*. London: MacDonald & Evans.
- Laguna, Alejandro. 2008. “O Acompanhador Musical de Dança. Como identificar o tempo subjacente à frase de movimento?” [The Dance Accompanist. How to identify the underlying beat of a movement phrase?] In *Proceedings of the XII Meeting of S Argentine Society for Cognitive Sciences of Music*, 379-389. Rosario: SACCoM.
- Laguna, Alejandro. 2009. “Timing del Movimiento vs Timing Musical.” [Movement vs Musical Timing]. In *proceedings of the VIII Meeting of the Argentine Society for Cognitive Sciences of Music*, n/p. Villa María: Editorial Universitaria de Villa María.
- Laguna, Alejandro. 2012. “Transmodalidad y Divergencia Informacional en la Enseñanza de Danza.” *Cuadernos de Música, Artes Visuales y Artes Escénicas*, 7 (2): 43–63. doi: <https://doi.org/10.11144/Javeriana.mavae7-2.tdie>.
- Laguna, Alejandro. 2013. “Revisión de Problemas Comunicacionales en la Clase de Técnica de Danza Observados por un Músico de Danza.” [Revision of communication problems in the context of technical dance classes from the perspective of the dance musician]. PhD thesis, University of Évora. [http://dspace.uevora.pt/rdpc/handle/10174/16039?mode=full&submit_simple=Sh](http://dspace.uevora.pt/rdpc/handle/10174/16039?mode=full&submit_simple=Show+full+item+record)ow+full+item+record

- Laguna, Alejandro. 2014. "Movimiento del Cuerpo y Musicalidad." [Body movement and musicality]. *Bulletin of the Argentine Society for Cognitive Sciences of Music* 6(2): 30-36.
- Laguna, Alejandro. 2015. "Estudio de la performance del ritmo musical en movimientos de danza." [Study of the performance of musical rhythm in dance movements]. In *proceedings of the XII Meeting of Cognitive Sciences of Music 2* :61-72. Buenos Aires: SACCoM.
- Laguna, Alejandro. 2017. "Incorporação da experiência da regularidade na produção artística." *IMPAR - Online Journal on Artistic Research* 1 (2): 31-44. doi:10.34624/impar.v1i2.781.
- Laguna, Alejandro. "Visual Spatial Zero Velocity Indicators". August 23, 2016. Last modified January 11, 2022. <https://visual-spatial-indicators.tumblr.com>
- Laguna, Alejandro, and Favio Shifres. 2011. "Indicadores viso-espaciales para la localización del punto de impacto en el acompañamiento musical de la danza". [Visuospatial indicators for locating the point of impact in the musical accompaniment of the dance]. In *proceedings of the X Meeting of the Argentine Society for Cognitive Sciences of Music*, 451- 458. Buenos Aires: SACCoM.
- Laguna, Alejandro, and Favio Shifres. 2012. "Indicios visuales y auditivos en el ajuste sincrónico del pulso subyacente entre bailarines y acompañantes musicales" [Visual and auditory cues in the synchronicity of pulse between dancers and musician]. In *Proceedings of the XI Conference of SIBE*, n/p. Lisboa: Reitoria da Universidade Nova de Lisboa n/p.
- Laguna, Alejandro, Favio Shifres, Rui Pires, and Diana Pinto. 2018. "Prosodia y métrica: paradojas de la comunicación en danza." [Prosody and metric: paradoxes of communication in dance]. In *proceedings of the XIII Meeting of the Argentine Society for Cognitive Sciences of Music*, 224-233. Buenos Aires: SACCoM.
- Laguna, Alejandro, and Favio Shifres. 2020. "Understanding movement from dance and music". *European Review of Artistic Studies* 11 (2): 81-101. doi:10.37334/eras.v11i2.233.
- Gentot, Laurent. 2016. *The Soul of Dance*. Production Crescendo FX.
- Lerdahl, Fred, and Ray Jackendoff. 1983. *A Generative Theory of Tonal Music*. Cambridge: MIT Press.

- London, Justin. 2004. *Hearing in Time: Psychological Aspects of Musical Meter* (first ed.). Oxford: Oxford University Press.
- Lopukhov, Fedor. 2002. *Writings on ballet and music*. Madison: University of Wisconsin Press.
- Malloch, Stephen, and Colwin Trevarthen. 2009. *Communicative Musicality. Exploring the Basis of Human Companionship*. Oxford: University Press.
- Mason, Paul. 2012. "Music, dance and the total art work: choreomusicology in theory and practice", *Research in Dance Education*, 13(1): 5-24. doi:10.1080/14647893.2011.651116.
- Mora, Xavier, and Marta Pellicer. 2013. "Understanding and measuring rhythm quality in dance: What is a movement accent?" In *Proceedings of Bridges 2013: Mathematics, Music, Art, Architecture, Culture*, 111–118. Phoenix, Arizona: Tesselations Publications.
- Olsson, Tyler. 2018. *The Perceived Fit between Music and Movement: A Multisensory Approach to Understanding Innocent Dance Appreciation*. Retrived from https://www.academia.edu/38988074/The_Perceived_Fit_between_Music_and_Movement_A_Multisensory_Approach_to_Understanding_Innocent_Dance_Appreciation_2018
- Repp, Bruno, and Amandine Penel. 2002. "Auditory dominance in temporal processing: new evidence from synchronization with simultaneous visual and auditory sequences." *Journal of Experimental Psychology Human Perception & Performance* 28(5): 1085-1099. doi:10.1037//0096-1523.28.5.1085.
- Repp, Bruno, and Amandine Penel. 2003. "Rhythmic movement is attracted more strongly to auditory than to visual rhythms." *Psychological Reserch* 68: 252-270. doi:10.1007/s00426-003-0143-8.
- Royal Academy of Dance. "Playing for Ballet Class: An introduction for beginners." Accessed 27 June, 2019. <https://www.royalacademyofdance.org/about-us/music-at-the-rad/playing-for-ballet-class-an-introduction-for-beginners/>
- Sheets-Johnstone, Maxine. 2010. "Kinesthetic experience: Understanding movement inside and out". *Body Movement and Dance in Psychotherapy* 5 (2):111-127. doi:10.1080/17432979.2010.496221.
- Sheets-Jonhstone, Maxine. (2011). "From movement to dance." *Phenomenology and the Cognitive Sciences* 11: 39–57. doi:10.1007/s11097-011-9200-8

- Shifres, Favio and Alejandro Laguna. 2013. "La co-construcción del marco métrico en la clase de técnica de danza". *European Review of Artistic Studies* 4 (1): 76-94. doi:10.37334/eras.v4i1.69.
- Shifres, Favio y Alejandro Laguna. "Una exploración de la experiencia subjetiva del bailarín al sincronizar con la música." Lecture in the *XII Meeting of Cognitive Sciences of Music*. Facultad de Filosofía, Humanidades y Artes Universidad Nacional de San Juan, August 15, 2015.
- Shifres, Favio and María Burcet. 2013. *Escuchar y Pensar la Música. Bases Teóricas y Metodológicas*. La Plata: EDULP.
- Teck, Katherine. 1989. *Music for the Dance: Reflections on a Collaborative Art*. New York: Greenwood Press.
- Toenjes, John. 2009. "Musical Improvisation in the Modern Dance Class: Techniques and Approaches in Fulfilling a Multi-Layered Role." *In Musical Improvisation: Art, Education, and Society*, edited by Gabriel Solis and Bruno Nettle, 221-238. Urbana: University of Illinois Press.
- Popa Blanariu, Nicoleta. 2015. "Paradigms of Communication in Performance and Dance Studies." *CLCWeb: Comparative Literature and Culture* 17 (2). doi:10.7771/1481-4374.2331.
- Vines, Bradley, Carol Krumhansl, Marcelo Wanderley, and Daniel Levitin. 2006. "Cross-modal interactions in the perception of musical performances." *Cognition* 101 (1): 80-113. doi:https://doi.org/10.1016/j.cognition.2005.09.003.
- Warburton, Edward. 2014. *Body double: The enactive approach to research on marking in dance*. In L.Y. Overby and B Lepczyk (eds) *Dance: Current selected research*, Vol. 8 (pp. 1-17). New York: AMS Press.
- Warburton, Edward, Margaret Wilson, Molly Lynch, and Shannon Cuykendall. (2013). "The Cognitive Benefits of Movement Reduction: Evidence From Dance Marking." *Psychological Science*, 24(9): 1732-1739. doi:10.1177/0956797613478824.
- Wong, Yee. 2011. "The art of accompanying classical ballet technique classes". PhD thesis, University of Iowa. doi:https://doi.org/10.17077/etd.wygbzz36.
- Wulf, Gabriele and Wolfgang Prinz. 2001. "Directing attention to movement effects enhances learning: A review". *Psychonomic Bulletin & Review* 8 (4): 648-660. doi:10.3758/BF03196201