The Body as Transitory Space of Relations and the Instrument as Multisensory Space: Expressive and Musical Gesture Analysis

DIGITAL SOCK: study and development of a digital musical instrument and its interactive character

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Introduction:

Inserted in the context of our research on the development of a digital musical instrument called Digital Sock, this chapter records the results of the analysis of expressive gesture and instrumental gesture (preliminary phase). This analysis is based on two investigative hypotheses: a) the body is configured as a transitional space of relations, that is, a changeable space where relations occur, modifying the interactional processes; b) the body of the instrument is designed as a multisensory space, changeable in its structure and in the stimulus it causes during the dialogic processes.

The analysis of the expressive gesture was geared towards the capture and interpretation of the gestures. Data collection was performed at the Movement Capture Laboratory (Capture of Movement) of the School of Arts of the Portuguese Catholic University, of thirteen volunteers between twenty and fifty years old. The participants were divided according to their professions so that we could realize how daily bodily activities could (or did not) interfere with individual bodily expression. Thus, those thirteen participants, five were dancers and / or classical ballet students; four were musicians; three were university students, and one volunteer was a therapist.

The interpretation of the data was conceived through biomechanical and psychological analysis (discourse analysis / experience report).

Crossing the data obtained during the biomechanical and psychological analysis with the attitudes - internal, psychological and dialogical - established through the analysis of the scenic movement (Laban, 1978 and Godard, 1995) showed that the expressive gesture is constituted through perception (movement that anticipates the gesture); of action (the gesture in its expression and interpretation of the environment) and interaction (how we interact with space and how the environment influences our actions). The analysis also

revealed that the gesture consists of two fundamental levels: intentional (when it performs a predetermined action. It can be: objectified, complementary, auxiliary) and meaningful (when it carries the memory and identity of the individual).

The analysis of the musical gesture was hypothesized, in its preliminary phase, the multisensory aspect of the instrument, perceived as a space where relations happen in a transient way.

This research used the gestural levels and the body stages observed in the first stage (analysis of the expressive gesture) as indicators for analysis, and refers to a Case Study. In this study, we analyzed four performances: a) T-Box by Sinclair (2010); b) Hang Instrument by Waples (2010); c) Piano by André Lamounier (2015); and d) Electronic violin by Andres (2012).

This research used the gestural levels and body steps observed in the first step (expressive gesture analysis) as indicators for analysis and refers to a Case Study. In this study, we analyzed four performances, each one with one type of instrument:

a) Sinclair T-Box (2010) - developed as part of the McGill Digital Orchestra project, the T-Box (Marshall, 2007) uses ultrasonic sensors to detect the performer's gestures in the air above the instrument.

b) Hanging Instrument by Waples (2010) - created in Bern (Switzerland) by Felix Rohner and Sabina Schärer (2001), Hang, is a musical instrument of the idiophonic class, built from two half-shells of nitrided steel, glued by edges, being its hollow interior, in UFO format.

c) Piano by André Lamounier (2015) - acoustic piano

d) Electronic violin by Andres (2012) - instrument that contains an electronic sound output.

All the instruments chosen, despite the distinct nature and diversified sound control, that were played by hand. We intend with this investigation, observe the different modes of sound control and thus, understand how were chosen the body movements for the conception of the musical gesture.

The videos used in this study were captured from the internet and inserted into the Kinovea application (software developed for biomechanical movements analysis), through which it was possible to observe the trajectory of the movement, its speed and acceleration levels. It was our goal, with this study, to understand the multisensory capacity of the musical instrument and its interference in the conception of the

instrumental gesture.

This research revealed that the instrument, perceived as multisensory space, is sustained not only by the sound it sketches, but also by the physical space it occupies, by the texture with which it is constituted, by the way it is connected and by the history of its construction. It carries in its corporeal memory a political and social position, and its sonorous projection is a representation of this creative memory. In dialogue with the one who manipulates it, it stimulates them to reflect, albeit unconsciously, on his conception and historical position. It conditions them to make decisions and encourages them to think about their instrumental manipulation.

The result of this analysis will be the basis for the next phase, in which we will investigate the musical gesture and the stimulating capacity of the Digital Sock instrumental prototype in artistic performances (interactive cycle).

The analysis of the expressive and instrumental gestures, from the perspective of the body as a transitory space of relations and instrument, as a multisensory space, showed that the conception of the instrumental gesture is determined by the same gestural levels (intentional gesture - objective, complementary and auxiliary gesture, and meaningful gesture) and bodily stages (internal, psychological and dialogic attitude) of the formation of the expressive gesture. What changes is the intention of the gesture. This gestural intentionality (the desired result, the motivation for its conception and the personal experience for its conception) is determined by the interaction between body and instrument and, therefore, suffers from interference of the elements that make up the instrument - form, structure, sound, characteristics of the handling; and interferes in its handling by the individuality that determines it.

Next, we will give a brief theoretical overview of the main studies that guided the investigation of the communicational processes involving the human body, as well as the movement analysis about expressive and musical gestures. Then, we will explain in more detail, the procedures performed during the expressive gesture analysis (performed in the laboratory of MoCap), through which we have obtained, as a result, the levels and stages of the body through which the body is organized during the gestural conception. Based on the perspective of the relations transience observed in the body space (human and instrument), and by crossing the results obtained from the expressive gesture and musical gesture research (preliminary research described above), we present, in the last topic, some conclusions about the interactional process which involves the body, the instrument

and the environment.

1. Theoretical background:

The concept that the body manifests itself as an identity space where relationships occur is supported by the thinking of Martín-Barbero (1997), Silverstone (2002) and Orozco Gomes (1993), in relation to mediation - transformation space where the interactions happen.

Martín-Barbero (1997) emphasizes the multiplicity in the composition of the messages and warns that the initial attention emitted by the sender is not always the same as the one sensed and received by the receiver. It depends on individual experiences, personal life histories, and the political, social and cultural positions with which each individual stands before the world, creating a network of meanings, the receiver being also a producer of meaning. For the author, mediation is perceived as a specific temporality and discursiveness; structures, forms and practices; as an institution or geographical location; and as a device of viability and legitimation of hegemony (Signates, 1998), that is, a process through which links are established, discourses are propagated, concepts are legitimized and space where relations are established.

For Silverstone (2002), mediation is a transformative process, a result of the production, circulation, reception, reproduction and recirculation of meanings. This circulation is subject to subjective interpretation and resignification. It is transformed through individual experience and personal practice. Increasingly dependent on the media, mediation has a strong technological character. According to this author, as it leads to decision-making and critical reflection, mediation also acquires ethical implications.

Orozco-Gomes (1993) discusses the concept of mediation by drawing attention to its multiplicity manifested through actions and discourse. According to this author, mediation, understood as a complex, multidimensional and multidirectional process, differs from mediating sources. These sources can mediate other sources and are classified into four categories: a) individual (arising from the subject - cognitive mediation); b) situational (situation of interaction); c) institutional (social institutions that mediate the agency of the subject); and d) video-technology (television as a social institution). Orozco-Gomes (1993) points out that aspects such as the individual's ability

to think and conceive ideas (cognition), the space they occupy, the institution they defend and the technological environment they use are considered mediating sources that together make mediation possible.

In the hypothesis presented here - the body as a transient environment of relationships - we question the human body as a physical space (loaded with automated knowledge in body movement; this knowledge is acquired as we grow and move around in the world), a device of political and socio-cultural legitimation, social bond, discursive space and cognitive transformation. A set of mediating sources that, in mediating other sources, makes possible the creation of a network of individual meanings that fit together and multiply.

The body ceases to be a space between relationships to become an environment where ideas are imagined, practices are experienced, and concepts are accumulated. Rather than mediating relationships, the body gains form, structure, and means to think about what happens in its scope. In this sense, we agree with the considerations of Katz & Greiner (2006) on the *Corpomedia Theory*, based on the idea that the body, being its own medium, can position itself critically in the face of everyday events. For these authors, the physical bodies of the human being, the object or the device become transformative spaces. The structure that composes it is modified during the interactions it undergoes, while it interferes in the way its interlocutor reacts to its action. Based on this assumption we come to our second hypothesis: would the instrument body be a multisensory space where relations happen?

We use the concept of multisensoriality, which refers to the stimulating activation of multiple senses, to describe the physical body of a musical instrument. It is similar to the term "interactive multimodality" (Leote, 2015: 27), used to describe the multiple modes of human-computer interaction. In this sense, we understand the structure of the instrument's physical body as a space charged with impressions and information. In interaction with another relational body, the multi-sensory (or multimodal) body of the instrument can cause sensations, stimulate the senses and create new meanings. The space that it occupies becomes, therefore, an environment where the relations happen, its form and structure being a sketch of ideas and thoughts imprinted by the interlocutors who interacted with it at the time of its trajectory.

Starting from the premise that the human body and the body of the instrument (or the device) are multisensory spaces where relationships take place, the objective of this work focused on the analysis of the movement (which forms the production of the message), and on the interactional processes (which involve the relationship between these bodies). The analysis of the movement and the study of the interactional processes were based on the study of the perception of movement (Merleau-Ponty, 1945), on the proposal of Varela, Thompson & Rosch (1991) in the context of the embodied mind, and on the understanding of information (Maturana and Varela, 1980, 1995).

The corporal scheme is conceived by Merleau-Ponty (1945) as the way the body expresses itself in the world, the consciousness of this body being inseparable from the movement. The body is, in this sense, movement (which absorbs information), sensitivity (sensorial perception) and creative expression (gesture capable of expressing perceived meanings). Through gestures, we perceive the world, shape it in our senses, and express ourselves in a creative and personal way. The action of thought is in the movement, and the relation body-mind is, therefore, a unit.

In the sphere of the embodied mind (Varela, Thompson & Rosch, 1991), cognition depends on the experience that takes place in bodily action. Inseparable from the body, knowledge is an interpretation of interactional relationships. More than a simple capacity to absorb information, cognition emerges from the mind-body relationship, the bodily movement being, expression/perception of the experience lived.

Recognizing the body as an autopoietic [1] system, Maturana and Varela (1980) define corporeality as a phenomenon composed of circularities and different interpretations. For the authors, life is an ongoing process in search of knowledge, and thus, the body's movement is an interpretative representation of information.

The idea that the body, perceived as a system in constant mutation - autopoiesis (Maturana and Varela, 1980, 1995), interprets the world through movements, guarding and re-signifying in itself the knowledge acquired in interactions with other bodies (Merleau - Ponty, 1945; Varela, Thompson & Rosch, 1991) not only supports the hypotheses presented here (the human body, as well as the body of the instrument are configured as transient spaces of communication), but it also prompts us to analyze the movement. Through this study we aim to understand how the gesture is constructed during the

[1] Autopoiesis - from the Greek [self] itself, [poiesis] creation

interactional processes. The analysis of the scenic movement (Laban, 1978 and Godard, 1995) was the starting point for the investigation of the body stages that involve the formation of expressive gesture.

The analyses of the movement by Laban (1978) and Godard, 1995) focus on the gesture in its conception to decipher the structures that make up the expressive gesture. Laban (1978) argued that it is possible to identify the purpose of a movement, or what motivates people to move, identifying the form (how we move), the structure (what moves), the spatiality (where we move) and the dialectic (with whom we move). Godard (1995), in turn, differentiates movement, understood by him as a phenomenon that describes the displacements written by the different segments of the body in space, gesture, inscribed in the distance between this movement and the individual's gravitational background.

The understanding that the formation of the expressive gesture is anchored in different stages led us to study the gestural levels that make up the body's movement (expressive and instrumental gesture). The main authors that supported the research of the gestural levels were Zagonel (1992), Delalande (1988), Marc Leman (2008), Zagonel (1992) and Delalande (1988) describe the gestural construction within the scope of its sonorous conception, its corporeal expressiveness and the imagination. Leman (2008) suggests a practice of musical meaning that is based on the codification and decoding of the patterns of the body's articulations. The body, as natural mediator, is able to transform the artist's intention into action, through felt energy, physical interpretation and his mimetic perception (repertoire of experiences accumulated in the body).

The analysis of the gestural levels (Zagonel, 1992; Delalande, 1988 and Marc Leman, 2008) and the body stages (Laban 1978; Godard, 1995) aimed to understand how the body of the instrument and the body of the interpreter shape each other in the interactional processes, and how the fruit of these interactions, interpreted through the gestures, is conceived.

2. Expressive Gesture Analysis

The aim of this phase of the investigation is the analysis of the movement during the conception of the gesture without sound intention. We seek to understand the formation of the expressive gesture during the body's stages, gestural levels and interactional cycle, as well as to study the body as a transitory space of relations.

2.1 Methodology

The analysis of the expressive gesture, guided by an exploratory research, was divided into two phases: a) data collection (capture of movements and report of experience); and b) interpretation of the data (biomechanical and psychological analysis)

The data was collected in the Movement Capture Laboratory of the Portuguese Catholic University) and CITAR in the last quarter of 2015 using a motion capture system (Vicon T40S-NR18 - 4 megapixel cameras). A group of thirteen volunteers, male and female, of different ages, and professionally divided among musicians, dancers and different activities, took part in the study. At this point we asked the participants to perform daily movements (such as walking, jumping and spinning), as well as some free movements, so that we could see how the body was oriented in the conception of expressive gesture.

After capturing the movements, we invited the participants to report their impressions of the experience before a video camera. During the reporting, they were asked to talk about moments of tension and ease in performing the tasks requested, preferences, sensations, pre-established concepts (gesture and movement) and sound absence.

The interpretation of the data was aided by the 3D animation software Autodesk Maya and the sport analysis application Kinovea 8.20 through which we were able to analyze the trajectory of the executed movements, the rotation and positioning of the lower limbs and the corporeal angulation during the gesticulation, the main objective being the biomechanical analysis of the movements.

For the psychological appreciation, we performed discourse analysis. After the transcription of the testimonies, the following aspects were analyzed: memory, life trajectory and social status of the volunteers.

2.2 Management Levels and Body Stages

The biomechanical analysis of the movements has helped us to realize that the formation of the gesture responds to a predetermined pattern which can be observed when we compare the execution of the daily movements. However, in a more careful analysis of each of these movements, it is possible to observe that even in the similar gestures, there are precise alterations that relate to the characteristics of each individual.

When we considered this evidence as the starting point for the analysis of the movement, it was possible to establish two determining guidelines for the formation of the expressive gesture. The first concerns the pattern that gives shape and structure to the gesture. It is designed with a well-defined intention, and organized in order to respond to what has been determined. The other concerns variations that modify this pattern. These changes are subject to the state of mind, the physical conditioning, the repertoire acquired and the personal idealization during the conception of the movement. These two guidelines helped us to determine and define the two fundamental levels observed during the gestural conception. They are the intentional gesture (when performing a predetermined action) and the significant gesture (when it carries within itself the memory and identity of the individual).

2.2.1 Gesture Levels: Intentional Gesture

The intentional gesture, that is, the movement responsible for performing the task internally determined, is related to the mechanics of movement and can be divided into three levels;

a) Objective (movement that determines action)
b) Complementary (movement that complements the action)
c) Auxiliary (movement is present giving body to action)

a) Intentional Objective

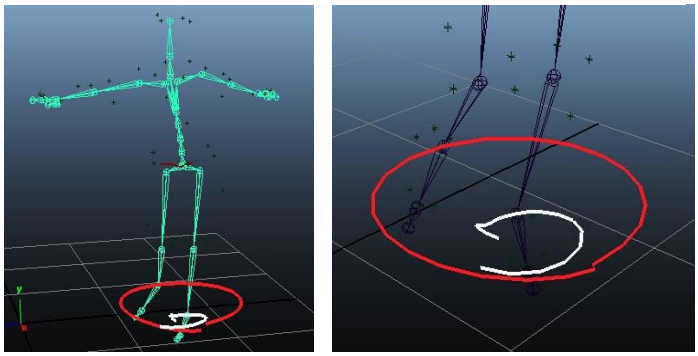
The objective gesture refers to the movements responsible for carrying out a particular gesture. When observing the movement of the ankle joint (sagittal plane) during walking, we noticed that the flexion between the foot and the surface of the body (dorsiflexion) and its antagonistic movement (plantar flexion) are essential for accomplishing the task, aiming at intended action (intentional gesture objectified). The variations observed during the different modes of walking (ankle joint angulations during plantar flexion and dorsiflexion) do not interfere with the goal of action.

To the circular movement around a part of the body we call Circumduction. The circumference consists of a combination of movements: flexion, extension, abduction and adduction. The movement of the feet is the axis that guides the movement determining the circular gestural conception. In the illustrations below, we can observe a circular variation between the feet during the turns, the circumference of the right foot being wider than that of the left foot. The variations were observed in the same volunteer and also among the participants. We called the Circular movement around the feet, which targets the action

(spin), as well as the movement of adduction/abduction of the legs and flexion/extension of the ankle, objective intentional.

Figure 2: Objective Intentional Movement - Rotate

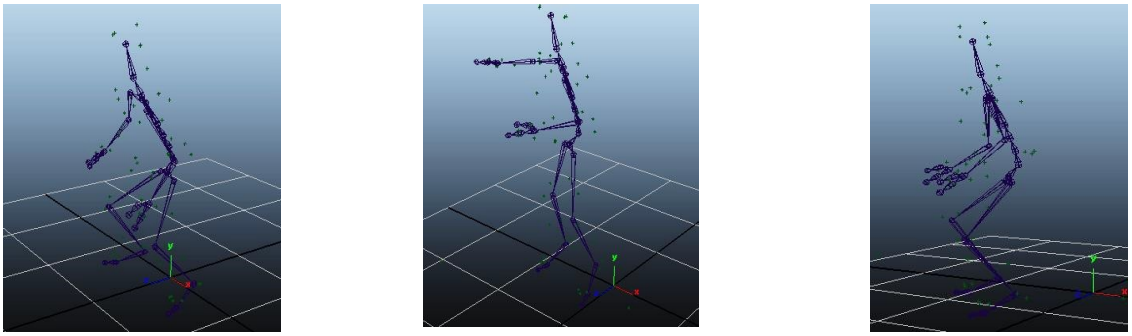
Circumduction



The jumps are composed by knee flexion and dorsal flexion of the ankle (preparatory squatting); body extension (impulsion); knee flexion and dorsal flexion of the ankle (landing squat). These movements, because they are essential to the execution of the jumps, are characterized as objective intentions.

Figure 3: Objective Intentional Movement - Jump

Flexion (preparatory squat) Extension (thrust) Flexion (landing squat)



b) Intentional Complementary Gesture

The complementary gesture, as the name suggests, concerns the movements responsible for complementing the objectified action. This movement not only accompanies the intended intentional movement, but also broadens it.

In the actions studied (walking, spinning and jumping), we observe that arm/hand movements complement the action, improving body balance and spatial organization.

Figure 4: Intentional Complementary Movement - Walking
Movement of arms/hands

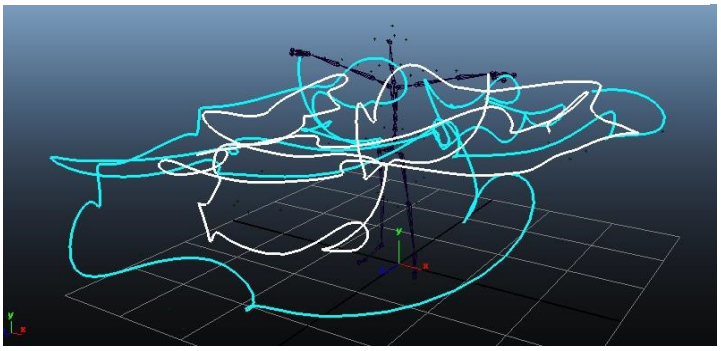


Figure 5: Intentional Complementary Movement - Rotating
Movement of arms/hands

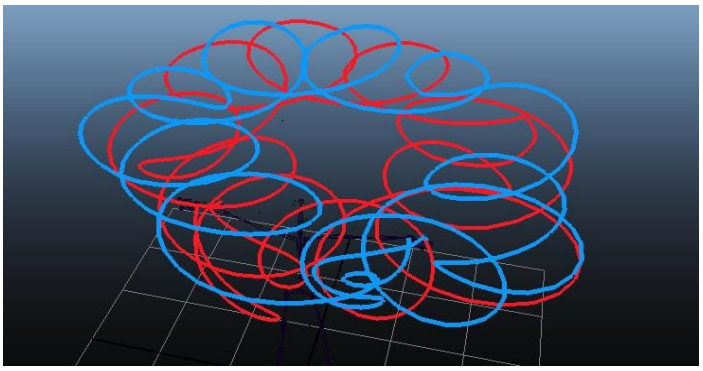
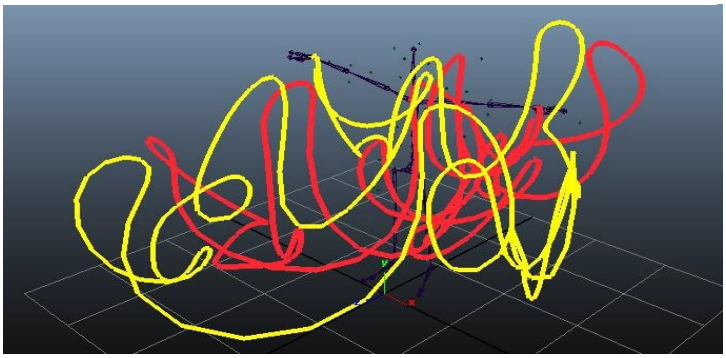


Figure 6: Intentional Complementary Movement - Jumping
Movement of arms/hands



c) Intentional Auxiliary Gesture

The auxiliary gesture refers to the movements responsible for giving body to action. They accompany the objectified movement. During the walk, these gestures can be characterized by the cadence of the hips that moves helping the formation of the steps, as well as the movement of the shoulders, elbows and knees.

If we compare the movement of the knees, hips, shoulders and elbows (Intentional Auxiliary) with the movement of the feet (Intentional Objective) we will see that there is a linearity in the action.

Figure 7: Intentional Movement Auxiliary - Walking
Movement of elbows, shoulders, hips and knees

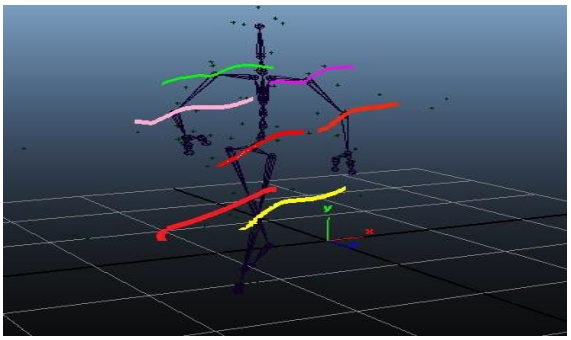
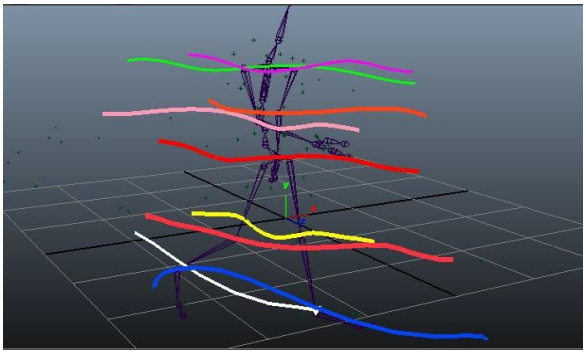


Figure 8: Intentional Movement Auxiliary - Walking
Movement of elbows, shoulders, hips and knees compared to ankles/feet movement - LINEARITY



In twists and turns, movement of the head, neck, shoulders and hips accompanies the movement of the feet/legs and helps in the body balance necessary for the activity. When comparing these movements with the path made by the feet during the action (Intentional Objectives) we will see a circular regularity.

Figure 9: Auxiliary Intentional Motion – Rotating
Movement of head, neck, shoulders and hips

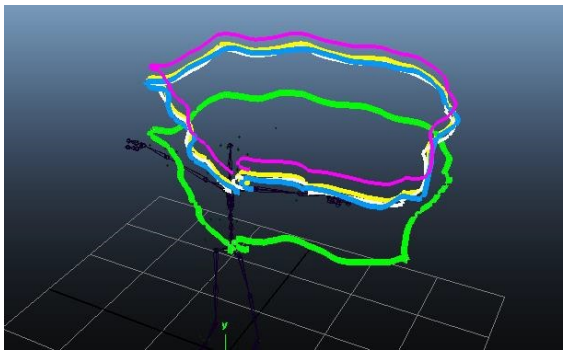
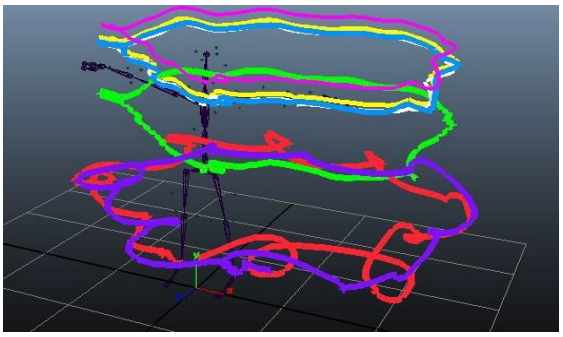


Figure 10: Auxiliary Intentional Motion - Rotating
Movement of the head, neck, shoulders and hips compared to the footpath - REGULARITY



In the case of jumps, the corporeal inclination assists the conception of the gesture giving it the impulse to accomplish the activity. At the same time, the movement carried by the shoulders, head and hips accompanies the gestural conception. When comparing these movements with the path performed by the knees during the action (Intentional Objective) we will see a regularity in the movement.

Figure 11: Intentional Auxiliary Movement Jumping Movement of head, shoulders and hips

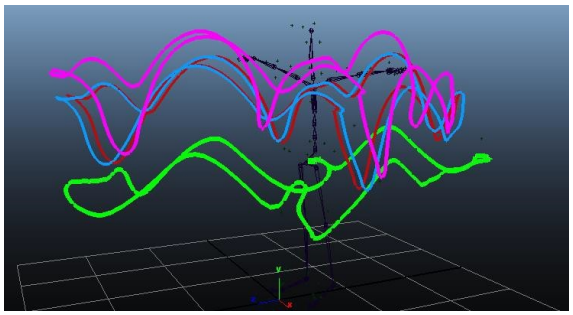
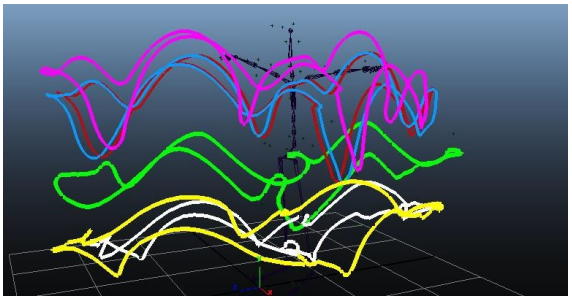


Figure 12: Auxiliary Intentional Movement - Jumping Movement of the head, shoulders and hips compared to the path taken by the knees - REGULARITY

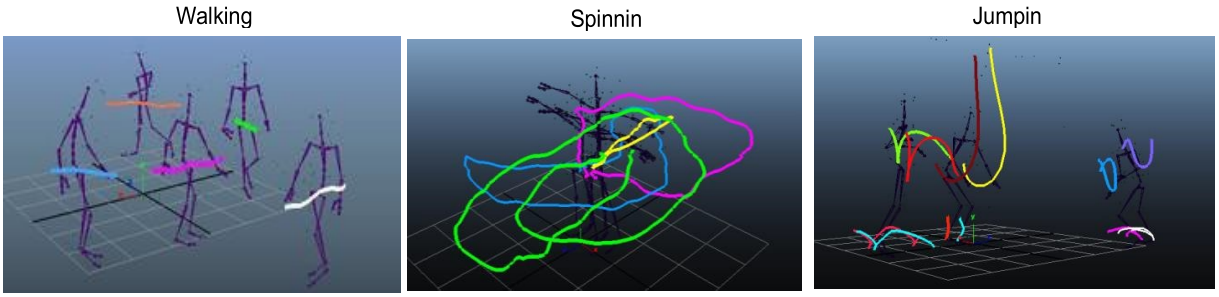


2.2.2 Gesture Levels: Significant Gesture

Significant gesture carries within itself the memory and identity of the individual. It is characterized by unintentional movement, without prior conception and/or ordered function. It is the gesture that differentiates one movement from the other, because it is subject to the moment, the environment, the critical, social and cultural positioning of the individual depends on individual actions in relation to the world, personal choices, experiences, life stories, and cultural capital. It is unique, individual and insurmountable.

In carrying the life trajectory and the personal memory, the significant gesture imprints personality on the movement distinguishing the one who designs and conceives it. When we observe, for example, the walking of the volunteers, we realize that there is a differentiation between the form and the way each one conceives the gesture. The same happens during jumps and turns. To this gestural individuality we call Significant Gesture.

Figure 13: Significant



2.2.3 Body Stages

Based on the interpretation of the data (biomechanical and psychological) and the systematic study on the main theories of the scenic gesture (Laban, 1978 and Godard, 1995), we perceive that the body is organized in stages, shaping the gesture during its conception. Individually and privately, these stages (or attitudes) can be categorized as follows:

a) Internal attitude (gestural design):

The inner attitude refers to the perception, that is, the movement that anticipates the formation of the gesture. The method we found to gain an understanding of the gestural anticipation in the analyzed exercises was to observe the initiating actions, that is, the way the gesture were thought. In the actions studied we observed that the volunteers had: a) a heterogenous initial targeting; b) sequential targeting and diversified spatial design; c) different speeds.

Biomechanical analysis provided a general orientation of the gestural design with regard to physical and motor aspects. In analyzing the locomotor actions (walking, jumping and spinning) we perceived a homogeneity, for example, in the use of space during the creation of the gesture. These data could give us the false idea that there is an equality in movement, or that we think the gesture in a similar way in relation to its anticipation and spatial perception. However, if we look more closely, we will see how all the participants used the space was different. Not all, for example, started the same movement in the same direction or in the same way. Instead, each participant had a way of initially positioning themselves (although everyone was asked to start capturing the movements with their arms crossed), a desired direction, a starting speed and a body organization in interaction with the different space.

b) Psychic Attitude (the gesture in its expression and interpretation of the environment):

The psychic attitude refers to the message imprinted on the movement, being subject to the personal information constructed along the individual trajectory of each volunteer. The way each volunteer imagines the gesture is influenced directly or indirectly by the impressions accumulated internally, by the experiences lived, stories witnessed and different outlooks on life.

We chose to analyze the Psychic Attitude through the understanding of the psychological aspects that involved the actions studied, crossing this information with the movements performed; verifying the nuances imprinted on the movement and its relationship with the personality of each participant. These studies showed that: a) when conceiving the gestures the participants sought, consciously or unconsciously, to reflect the thought and/or an idealized image (communication); b) bodily projected what they experienced at some point in life and which was significant to them (simulation); c) were influenced by humor and capacity of involvement (immersion); d) demonstrated a critical position on the society in which they live and/or the way in which they interact with the world (ethics).

c) Dialogical attitude (relationships).

The dialogic attitude concerns the relationship, that is, the way we interact with space and the way the environment influences our actions. The form used to analyze this aspect was to observe how the space in which the experimental research happened influenced or not the performance of the volunteers. The following were considered: a) the environment; b) the clothing worn at the time of movement capture; and c) the way the experiment was conducted. This analysis revealed that, regarding the dialogic attitude, the volunteers:

- Conceived the gestures considering the information provided about the final objective of the project
- Were influenced by the environment they were in
- Considered their individual experiences and ways of being

2.3 The Body as Transitional Space for Relationships

Exploring the daily movements and the formation of the expressive gesture, we studied the body as a changing, ever-evolving environment in which relationships end and/or remain forming the corporeal interactional cycle. This thought is based on the idea of the

body as a single organism, with an identity of its own. In this approach, gestures can express personal perception, objectified action, and also an individual meaning (imprinted in the body's memory) regarding the world. In contact with other subjects, other instruments and the environment that surrounds us, this network of meanings transforms itself, shaping new meanings for what we perceive and do. he body thus sustains itself as a space that allows, through relationships, the transmutation of meanings.

Thus, we conclude that:

a) the formation of the expressive gesture is conditioned to the experiences that each individual has had, as well as the physical and psychological aspects that structure it.
b) the relationships with which the body dialogues in the formation of the expressive gesture become transient insofar as they can transform, either by a new decision-making or by social, cultural and political positions.
c) The body, in interaction with the instrument, assumes an objective control. It is focused on handling and sound control, and the gestures are designed for this purpose. This control is performed in a double-way: the gesture that controls the sound is conditioned by the sound response of the instrument and vice versa. The space, occupied and perceived in this dialogue between body-instrument-body, is constrained by this interaction.
d) transformations take place at different levels of gestural formation. They are influenced by space and, at the same time, interfere in the spatial organization in which they are inserted. This process is cyclical, individual and permanent.

Understood as transitional space of relationships, the body is responsible for modeling movement, creating space for gestural expression. As an interactive space and cultural capital, the body presents itself as a complex system capable of forming concepts, creating ideas and elaborating communicational structures. Ideas and thoughts go through the body that change during the relationship. It creates a network of meanings where they are imprinted: the body's memory, the life story and the individual positions vis-a-vis our society. Studying the gestures and their interactional capacity helps us to understand the social construction of the reality in which we live; assists our understanding of the structures that interpret human beings, the machine, and its relation to the world.

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