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ABSTRACT

Laban Movement Analysis (LMA) is an expert-based method by which Certified Movement Analysts observe and analyze movement. LMA is increasingly used in a variety of research fields, particularly when studying movement expressivity and computation where it is essential to generate an understanding of the observation process. In this paper we articulate the application of LMA as a tool for movement analysis in HCI research by using qualitative methods to deconstruct the observation process of LMA experts. We conducted a focus group in which 12 expert-participants observed and annotated videos of movement according to LMA categories. We transcribed their observation process and analyzed it using grounded theory in order to extract categories, concepts and theories that best explain and describe the process of observation in LMA. By doing so, we open research perspectives in which LMA can be integrated as a method for observation in the design of movement-based computational systems.

Author Keywords

Movement, Observation, LMA, Methodology, Design

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION

Movement plays a central role in the formation of our cognitive abilities and can be considered the first language that we learn. Yet despite its ubiquitous nature, methodologies to observe and analyze movement have been neglected in art, science and technology. Within the research on whole body movement and computation, and particularly in the field of Human Computer Interaction (HCI), there is a lack of common methodologies to observe, analyze and describe movement. Although such methodologies are crucial in the design and evaluation of movement based computational systems, they remain ambiguous, lack articulation and vary from one research project to another.

In this paper, we seek to address the following questions: 1) How do experts in movement studies observe and analyze movement as a **group** process? How can knowledge and practice of movement observation inform the research on computational systems that focus on the moving body?

Movement theories and systems have emerged in domains such as non-verbal communication, sign language, motor control and dance. Among these systems, Laban Movement Analysis (LMA), developed based on the work of Rudolf Laban, has been largely applied in fields dealing with movement expressivity and computation because it conveys precise epistemological knowledge for the study of movement function and expression [18]. LMA provides methods for observing and analyzinf movement through somatic embodied practice and becoming self observer. The LMA training emphasizes self development and embodied understanding through experience as the fundamental aspects of learning to observe and analyze movement. LMA also articulates a precise use of language to describe movement in terms of *change* in Body, Effort, Space and Shape (BESS) and Phrasing components. *Body* represents *what* is moving. *Effort* represents *how* the body is moving. *Space* represents *where* the body is moving. *Shape* represents the *relationship* of the changes of body shape to the environment and the mover herself. *Phrasing* is a higher level category related to the rhythm of movement.

Although LMA language, and particularly the categories of Effort and Shape, have been used in previous works in HCI [5, 4] to describe movement in computational context, the methodologies developed in LMA for movement observation have never been directly used to capture and measure movement in the design of technology. We contribute to research on movement-based computational systems by articulating the techniques, tools, and methodologies that experts in LMA use in order to observe movement patterns, which we believe can directly apply to the design of movement technologies.

In this paper, we conducted a focus group with 12 expert Certified Laban Movement Analysts (CMAs). We asked experts to observe movement excerpts on video and annotate the change that they observe. The results of our experiment establish a fundamental knowledge about the observation process in LMA. Our results allow us to understand the value of group observation and to extract ways of applying this knowledge in the research on movement and computing.

LITERATURE REVIEW

We all observe movement and determine behavior based on what we perceive non-verbally. All humans learn and develop the capacity to observe movement because it is fundamental to existing in the world. However, there are differences between responding only to patterned behaviors and articulating observation to describe and analyze movement experience.

User studies in HCI mostly rely on Cartesian observation techniques commonly used in scientific methods that produce objective or subjective measures. This perspective posits observation as objectively gathering measurable data from the world and tries as much as possible to remove the bias of the investigators. However, as experience and embodiment are increasingly acknowledged in HCI [11], researchers are exploring alternative approaches to observational techniques that account for the felt experience and bodily sensations as suggested in seminal work by Depraz, Varela, and Vermersch in their book "*On Becoming Aware*" [10]. Experience designers, inspired by phenomenological approaches [24], involve sensorial observation as a lens to observe others' experience [27]. They are using methods of phenomenological inquiry from cognitive science where the researcher acts as a facilitator to help the subject access, articulate and describe authentically the felt experience and interpret if from a subjective but more complete stance [15, 26, 16].

When observing movement, experience and observation are linked through utilizing kinesthetic empathy. Kinesthetic empathy refers to the ability to physically sense and connect with observed movement. Brain imaging studies further support the concept of kinesthetic empathy by finding heightened brain activity in observers with physical experience and the ability to execute the movement they observe [7, 2]. Research in dance therapy has also suggested that the act of physically imitating observed movement enhances empathy [22]. In addition to physical familiarity, other studies have discussed the importance of having visual familiarity in movement observation [14], suggesting that both physical and visual familiarity with movement influence how kinesthetic empathy occurs.

In HCI kinesthetic empathy has been discussed as a design parameter to increase action understanding and prediction [8]; however, Schiphorst has discussed the concept of kinesthetic empathy in relation to observational techniques such as *observing through the self into the world*" [27]. This observational strategy is based on the "*mirror of the self*" technique developed by Christopher Alexander for observing relative wholeness within a situation, action, or object [1].

In dance and movement studies, observation is developed as an embodied process within the training and deepening of the physical and theoretical movement knowledge. Somatic practices refer to the practice of the "*living, aware body*". They are body-based practices that relate to one's own personal perspective and develop an embodied awareness of the bodily sensation and capacity as experienced and regulated from within. A major skill developed in Somatics practices is an acute movement observation, an ability to shape inner and outer attention, and a capacity to synthesize the observed movement patterns in the body. HCI researchers have developed methodologies inspired by the field of dance because it emphasizes the role of practicing and mastering observation as part of building a strong practical and theoretical knowledge for performing and crafting movement [12]. Schiphorst argues for the necessity of developing somatic connoisseurship in the design for movement experience [27]. Moen et al have found that developing movement literacy, as in somatic practices or movement studies, is central in shaping observation when designing for movement and movement experience [25]. Recently, researchers have showed the value of developing Somaesthetics knowledge in designing for the body. Somaesthetics is a technique that involves somatic introspection, meaning "*an organized inward-looking inquiry by the individual about his or her bodily perception and its related affective experiences*" [19]. Through a set of movement and design workshops, Lee et al (2014) showed how Somaesthetics practice improves the ideation process of interactive product design.

In our paper we focus on Laban Movement Analysis (LMA) because it has a rich epistemological history. LMA has a broader scope than general somatic practices. It provides a rigorous use of language to experience, observe, and articulate movement patterns based on experiential knowledge [18] which has been investigated in terms of inter-rater reliability by the psychologist Martha Davis [9]. While originating from Rudolf Laban, a movement theorist and dancer [18], its contemporary applications include interdisciplinary fields such as HCI, robotics, computer science, cognitive science, psychology, physiology, health and well-being:

> *As to my methods of mastering movement, I am ready to convey them to everybody who thinks them suitable for all the manifold purposes in which mastery of movement might play a practical role [...] My methods might be developed, or better forms might be found; the outlook on life, however, which is connected with the striving after the mastery of movement, remains fundamental as long as the human race exists.* [17].

LMA language and particularly the Effort and Shape categories have been largely used in previous works in HCI [21] in order to better describe movement in computational context. Hashim et al. presented a framework based on LMA as the primary theoretical grounding of movement that guide the design of graceful interaction [13]. Loke et al 2013 include LMA in their design methodology called "*making strange*" and offer methods and tools organized by activity, from the three perspectives of the mover, the observer, and the machine, for the design of whole body interactions [20]. Their activities can be used at each stage of the design process and span the processes of investigating, inventing and choreographing, re-enacting, describing and documenting, visual analysis and representation, exploring and mapping, and representing machine input and interpreting movement. They suggest to use LMA to visually analyze and represent the moving bodies.

Although there is a large literature in HCI and a number of design frameworks that are primarily inspired by LMA categories to describe movement in technology design, to our knowledge, none of them looks at the very fundamental process of movement observation in LMA. There has been

no attempt to use the observational process of experts in LMA to bridge their observational techniques with the design of movement-based computational systems. Our paper addresses the methodologies developed in LMA to observe movement. Drawing upon the approach proposed by Loke et al. 2013, we aim to formalize the ways in which expert Certified Laban Movement Analysts (CMAs) observe movement in order to inform the activities in designing technologies that require an investigation, inquiry, and observation of movement experience. We believe that understanding the observation process in LMA is a fundamental requirement to the use of LMA in a technological context but also as an observational tool to capture and measure movement in the design of technology.

METHODOLOGY

In this paper, we analyze the observational process of a group of expert CMAs, certified through the Laban/Bartenieff Institute of Movement Studies based in New York. The training process to become a CMA is a lengthy and rigorous process. The training seeks to heighten skills in movement observation, embodied learning, and analysis.

Participants

We conducted an experiment with total of 12 expert CMAs. The participants were asked to observe and annotate videos of movement through a focus group. All the participants were woman who were aged from 25 to 70 years old.

Data Collection

In this study, we collected data on the observation process of 12 expert CMAs during a focus group. We presented the CMAs with pairs of videos of a performer moving. In each pair, the performer executed the same gesture. One video contained the neutral gesture and the other one contained the same gesture to which an LMA variation was applied. With each pair the CMAs were asked to describe if there was a change in the movement between the videos and if so to describe this change using LMA terminology. The participants annotated the observed change using a custom-designed annotation tool that we developed for the study. The design of the annotation tool was informed by how expert CMAs observe movement. Its annotation framework was developed from coding sheets that CMAs have used. When the CMAs observed the movement and came to consensus they clicked on one answer that represented the group annotation. We collected all of these answers from the annotation tool. We also video and audio recorded the focus group and transcribed their interactions, gestures and discussions. The whole session lasted about 1.5 hours.

Movement Database

We built a database of short video clips of movements to use in our study. All clips in the database are performed by the same female dancer and consist of two sets, with each set corresponding to a different gesture performed. We chose to build a gesture-based database to build upon existing research on movement and gesture studies [23]. The gestures for the two sets are, respectively, *knocking* and *giving directions*. The *knocking* set contains 24 videos of the gesture being performed, one with *neutral knocking* and 23 knocking to which we applied one variation according to LMA categories (See Figure 1 and Figure 4). Similarly, the *giving directions* set contains 20 videos of the gesture being performed, one with *neutral gesture of giving directions* and 19 that include an LMA variation applied to the gesture (See Figure 3).

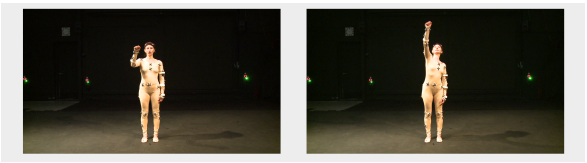

Figure 1: Right video is the neutral knocking and the left video is the knocking with a spatial variation (gesture performed in the zone Up)

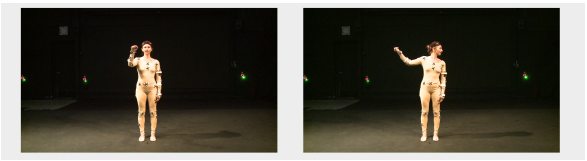

Figure 2: Right video is the neutral and left video is the knocking with a spatial variation (zone Side Open)

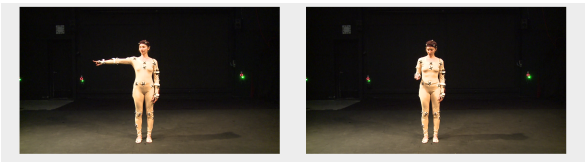

Figure 3: Right video is the neutral showing direction and the left video is the same gesture with a spatial variation (gesture performed in Near Reach)

This database was curated in collaboration with a senior CMA and co-author of this paper. The senior CMA, who also coordinates the LMA training program at the Laban/bartenieff Institute of Movement Studies, guided the dancer in the performance of each gesture and variation. To ensure that the performer, who is not certified in LMA, was able to achieve the various movements required to execute the LMA variations, we designed sets of instructions that the senior CMA used to direct the dancer during the recording session. The instructions where based on LMA categories, but where phrased to indicate movement qualities that are comprehensible to non-expert and that are observed and performed in real life. Our recording process resulted in a movement database that is labeled with the intended LMA categories that characterize the variations applied to each gesture for each video.

LMA Variations

In LMA, understanding movement is about observing, recognizing and describing the patterns of change, or what we call

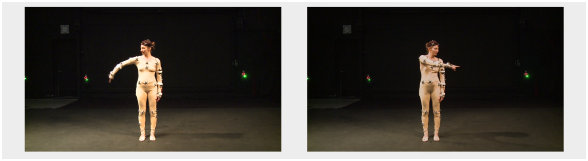

Figure 4: Right video is the neutral and the left video is the same gesture with a spatial variation (zone Side Across)

in this paper a variation. Change can occur in movement in terms of *Body*, *Effort*, *Space*, *Shape* and *Phrasing*.

In our study, we applied LMA variations to the *knocking* and *giving directions*. Because LMA has a large number of categories, we chose to narrow the variations to a smaller number within the categories of *Efforts* (variations in terms of the qualities in which the movement is performed), *Space* (variations in the zones and reaching of the movement in the Kinesphere), *Shape* (variations in the qualities of the change in shape), and *Phrasing* (variation in where the emphasize is put in the phrase).

The **Body** category in LMA describes the body parts, and body actions in the movement. Because our study relies on the observation of gesture, and because Gestures are one subcategory of Body,there was no possible variation to apply in the Body category. Therefore, we do not consider Body as one of our annotation categories.

According to Studd and Cox, in LMA, "***Effort*** *describes the dynamic or qualitative aspects of the movement. Dynamics give the feel, texture, tone, or color of the movement and illuminate the mover's attitude, inner intent, and how they exert and organize their energy. Effort is in constant flux and modulation, with Factors combining together in different combinations of two or three, and shifting in intensity throughout the progression of movement*" [28]. Effort encompasses 4 discrete Factors of Weight, Time, Space, and Flow. Weight is related to one's intention for having an impact on the world. Time is related to the mover's decision to accelerate or decelerate. Space is related to one's attention to the surrounding environment. Flow is related to one's attitude towards bodily control. Each Effort Factor is thought of as a continuum with two opposite ends called Elements in which movement can vary and thus reveal different Effort qualities. In this study we focus on variations applied to the gestures according to each single Effort Element (Space: Direct/Indirect, Time: Sudden/Sustained, Weight: Light/Strong, Flow: Bound/Free).

Space

Laban formalized the **Space** component of BESS by deconstructing what he called the Kinesphere, the space defining the reaching possibilities of the limbs relative to one's 3 dimensional Cartesian reference with an origin at the center. Among the various aspects of the Space category, we focus on the Reach Space and the Zones in the Kinesphere. In *Far Reach Space* the movers' limbs are fully extended, in *Mid Reach Space* the movers limbs are flexed closer to the body and in *Near Reach Space* the limbs are further condensed towards the body. The zones of the Kinesphere in which movement can occur are *Up*, *Down*, *Forward*, *Backward*, *Side-Open* and *Side-Across*. Other aspects of the *Space* category related to Directions, Pathways, Spatial Forms, Spatial Tensions and General Space will not be addressed in this paper.

Shape is defined as the body changing form. Among the Shape category, we focus in this paper on the Shape Qualities that are related to the experience, sensation and articulation of the Inner Space of the Body (which can often be observed through the initiation of movement through the core of the body). Shape qualities can be describe with a vertical change (*Rising* or *Sinking*), a sagittal change (*Advancing* or *Retreating*) or a horizontal change (*Spreading* or *Enclosing*).

The **Phrasing** category relates to the rhythm of action. It looks at what is rhythmically emphasized in movement and where the emphasis is occurring in the movement phrase. In this study we applied 3 variations of *Phrasing* to the gestures. *Impulsive Phrasing* corresponds to the emphasis at the beginning of the phrase. *Swing Phrasing* corresponds to the emphasis in the middle of the phrase. *Impactive Phrasing* corresponds to the emphasis in the conclusion of the phrase.

Data Analysis

We analyzed data collected from the focus group using a methodology inspired by grounded theory [6]. Grounded theory offers clear guidelines "*from which to build explanatory frameworks that specify relationships among concepts*" [3]. Our data analysis consisted on the investigators (the authors) coding the transcript of the focus group at three different stages. The first stage (or open coding) allows us to form initial categories of information by coding the data line by line. In the second stage (or axial coding), the open coding results were clustered into categories and the data moved to a more abstract and more concentrated form. The last stage (or theoretical coding), allows to link information between and across categories to form an overarching category and draw a larger picture in order to articulate a theory from the data.

FRAMING GROUP OBSERVATION

Observing movement is about articulating the patterns of change. Observation in LMA is finding the **essence** of the specified movement sequence revealed in the context of the mover's intent.

The questions that the focus group raised are: What is the essence of the movement? What tools support CMAs in capturing that essence?

Levels of Observation

The first decision that CMAs make is about the level on which they observe movement. This level of observation goes from the visible change to the mover's intention.

Visible and intended change?

Most of the time, when observing a change that occurs in Time (Phrasing) and Space, CMAs argued that what they see is what needs to be observed "*I think we should look at what is there, whether she intends to do it or she doesn't intend to do it. We should look at what is actually there.*". In situations where the change is more qualitative and related to

Effort or Shape, CMAs considered that the level of observation "*is about intention*". The CMAs asked to focus on intention while observing:"*Is she intending to go forward or backward or is she intending to advance or retreat?*". Intention in that case is beyond what CMAs simply see. In this example, in order for them to observe Shape Quality, they needed to eliminate the visible change in Space (front/back) that was occurring as a result of an intention to execute an advancing or retreating. Therefore, observing the mover's intention can lead the CMAs to disregard a visible change that is "*only*" an artifact of movement: "*I think it is just happening as an artifact not as an intention*". A change is an artifact when it is not intentional and when it occurred in order to support the mover in achieving another intended change: "*but is it just an artifact as it is something that led to another one?* ". However, grasping the movers' intention is linked to the observer's interpretation; we are not only movement observers, we are all movement interpreters.

The Context

The context became a very important second level of observation that allows CMAs to understand the motivation of the mover in making change. The context was defined through the process of articulating visible and intended change. During the focus group, CMAs have referred to the context as an important input in understanding the mover's intention: "*we are trying to contextualize what we are grappling*". A CMA who took the role of facilitating the observation process was guiding the experts in always recalling what the context is: "*keep in mind what it is: it's a knocking gesture. Go back to her [the mover's] intention, to knock. That's your context, don't lose your context*". For example, when they observed the mover performing a knocking gesture with the variation of the zone Up, a CMA was analyzing the variation by referring to the context in which a knocking gesture is performed, i.e in the forward space on a door: "*think about where the door is in relation to where the knock is occurring. I think Up is more important because that's not where the door is! So it became about Zone Up*". An other example of the importance of the context is when CMAs gather information about the mover:"*She has her own predilection, sometimes changes are not easy for her to make, she had verbal instructions from everyday*". This allow them to understand the mover's bias and personal signature in order to situate where the change is most likely to occur.

Body and Space cues

Qualitative aspects of movement such as Effort and Shape are "*hard to grasp with video*". In particular, Shape Qualities are difficult to observe because they are manifest as a core shape change and not a more obvious change in other body parts such as the limbs. Therefore, to observe Shape Qualities, CMAs use spatial cues that they call the affinities between Space and Shape. In LMA, Shape qualities are affined with the Cartesian Space and occur as a vertical change (*Rising* or *Sinking*), a sagittal change (*Advancing* or *Retreating*) or a horizontal change (*Spreading* or *Enclosing*). The CMA that took the role of the facilitator advised the CMAs to use the affinities as Spatial cues for observing Shape change: "*remember Shape Qualities are affined to Space. So look at what happening in space to give you a clue. I am suggesting to look at shape qualities relative to affinities.*" CMAs look at Body cues in order to observe qualitative change in movement. For example, to observe Direct Space Effort a CMA was using the cue of the head movement that revealed the direct attention to space: "*her attention to space is becoming direct by turning her head and looking*". Another example, to distinguish a change in Reach Space a CMA was redefining it in relationship with the body action that supports it: "*on body level, far reach is extended joints versus flexed mid limb joints*". Using Spatial and Body cues are tools that support observation and particularly when change is hard to distill from video footage.

Deconstructing the complex

Movement is complex and the categories of analyzing movement are intertwined. When observing an element that characterizes change, CMAs are "*acknowledging that there is probably other things going on*". During observation, CMAs delineate the dependencies between changes in movement: "*when something changes, something else changes to serve it functionally*". For example when deciding whether it was far reach or zone Up that they were observing a CMA commented on these dependencies in the context of knocking gesture:"*she is reaching far because she is reaching Up*".

I think that an example would help to clarify this - such as the Basic Body Action of Traveling - obviously weight is shifting and phrased actions of the limbs is happening but the overall macro take is Traveling - from one place to another in the environment

Isolating and Associating

CMAs acknowledge the difficulty of isolating one category that represents the most dominant change that is happening and making a single choice of what is observed: "*what she [the mover] is doing is much more complex than what we are been able to articulate*". To overcome this difficulty, CMAs deconstruct the movement by isolating the body parts: "*watch her shoulder and her weight shifts* ". Another strategy to overcome the difficulty is the articulate the association between the different changes and to make a choice of the most important source of change in movement. For example in observing a Swing Phrasing a CMA was able to delineate that the change in Time effort was only supporting the emphasis in the phrasing "*the Swing phrasing is created by the punctuation of the quickness*"

Making a choice

It is difficult to make a choice about the most dominant element observed: "*we all know that movement is complex and you are asked to reduce it down*". The way in which CMAs address this difficulty is by noting the first element that "*jumps to you*": "*when we talk about the most dominant [...] It is the one that you observe primarily!*". A CMA suggested to refer to the process of annotating movement using Motif symbols developed in LMA (ref). Motif writing requires one to annotate the most dominant change observed primarily and to "*to go to the essence*". The facilitator advised to "*think about that [that refers to choosing the most dominant change] from the perspective of working on Motif,*

to think about the main idea.". Unlike Labanotation, Motif symbols are not meant to annotate the exhaustive elements of change in movement, but rather to grasp the essence of movement and describe it in terms of Body Effort Space and Shape. CMAs train to write Motif by making a conscious choice about the most dominant aspect of the movement observed and associating it with a Motif symbol. This practice is a powerful tool in selecting the most dominant change and honing into the essence of movement.

Limitation of video display

Making a choice of some movement primitives is more or less difficult using video: ''*it's close to her body, I cant see how close it is to her body forward and back because the video is front only.*" Effort and Shape, are qualitative aspect of movement that are particularly difficult to observe in video footage. Whereas, Space and Phrasing (related to time and rhythm) are aspects of movement that can be analyzed in a more measurable way. The reason why Effort and Shape seem to be difficult to delineate from video recording is that they fundamentally relate to the viewer's embodied understanding of change in intention. Shape is about the experience, sensation and articulation of the Inner Space of the Body in relationship to the external Space or objects. Effort is an embodied cognitive process that can be experienced and observed as a conscious or unconscious attitude shift that reveals the movers intent. Therefore Effort and Shape are hard to observe on video: "*I am already seeing another pattern, that is difficult to come to consensus upon Effort as single element. They can say yes Effort is changing, but they cant necessarily come to consensus because, they are seeing the state, some people are seeing more of this element and some other people are seeing more of that element.* " In their and LMA training, CMAs learn how to overcome this difficulty. For example, they repeatedly watch the videos, individually or together "*look at it again and decide then*", or come closer to it: "*I need to see a couple together. When they are synchronized together*".

Using one's own body to observe

CMAs use their own body to observe movement. The aim is to enter into the movement from a first person perspective and to recapitulate the movement into their own experience. During the focus group, CMAs frequently performed and vocalized the movement as an attempt to replicate what they are seeing. They are using the mirroring process in order to articulate the movement details through understanding of the change in their own body. Their"*own connection to that [that meaning the movement observed] is vital* ". The use of the body to observe was performed in various forms.

Performing the observed movement

In many occurrences CMAs were performing the movement with one single body part. They also showed the movement to other CMAs as a way to explain and articulate the change that they observe and in an attempt to convince other CMAs about that change. CMAs are also enacting the gestures in order to 'mark' the movement. Their enactment can go from a diminished performance into only a mental practice of the movement that allows them to lay down tracks of the movement: "*is this the one [the movement variation] where she [the mover] goes like this [enact the gesture with the hand]. Even though it ends at the same place. She goes here and then she goes here, she circles there she ends at the same place [shows the space of the gesture]. This is clearly a zone difference she is gesturing in a different zone*".

Vocalizing the observed movement

CMAs vocalize the gesture particularly to observe Phrasing and rhythm. During the focus group, abstract vocalizations in the form of onomatopoeia were made"*Pa Paaaa Pa. Tatata*" is an example. In some cases, CMAs vocalized while performing the gesture in order to emphasize the rhythm and the quality of the movement: "*yawouhawee versus nian nian nianiania nian [doing the gesture and vocalizing it]*". They listened to other's vocalizations which allowed them to grasp the movement rhythm and to distinguish Impulsive from Swing from Impactive Phrasing: "*The way you are doing it, is not only with your bodies but you are singing it, in terms of supporting the phrasing and the effort*".

The Value of Group Observation

LMA encourages group observation because it is a co-educational process that helps to clarify the language. Group observation is an evolving process that allows CMAs to extend and compare their own perception of movement:"*I don't see it nearly as I do when I have my own computer right in front of me*". By observing in a group, one becomes more aware of her/his own bias in observation while also increasing awareness of how the same movement can be seen and described through different perspectives. Because movement perception is also tied to one's visual and physical familiarity with movement [7, 2], group observation has the potential to extend one's observational abilities and skills.

Coming into consensus

In LMA, coming into consensus is a central aspect of group observation. It is a way to extend the observation to the group as an entity and to find agreement on what is observed:"*consensus doesn't mean that every person is going to see the same thing*". CMAs practice group observation by training to find agreement through consensus in order to achieve a more reliable and valid observation: "*And that's the difference between when you are working by yourself and when you are working with someone else, you are actually seeing the same thing, but how are you articulating what this change is, because we know that movement is complex there is more than one thing happening. What you are going for is the consensus*".

Negotiation

In order to come into consensus of the observed change, CMAs negotiate. For example, the negotiation implies compromising to another's opinion if their rationale was convincing: '*I will be willing to capitulate to Shape and talk about that as sinking.*" CMAs attempt to convince each other by showing the movement or finding arguments to support their observation: "*Are you going to argue that there is something else strongly or is it not important to you? This is what consensus is about.*" They present their argument and use a clear rationale with an articulated use of LMA language to negotiate and convince each other or to find a counter example

in order to eliminate another CMA's hypothesis: '*The reason why I am going to counter that, is that if you play the videos side by side, the last video lasts longer when she is lingering at the end.*"

During the negotiations, some CMAs have naturally taken a leading role because of their extensive experience in observation:"*I am hearing strong opinions, maybe it is just louder voices saying that secondary change is not really important*". These CMAs have articulated clearly the arguments to support their observation and convinced other CMAs about the category that they chose to analyze the movement.

Facilitation

From the very beginning of the focus group, the negotiation process put one of the CMAs in the role of the facilitator:"*It might need some facilitation [...] You want to be careful about letting everybody say what they want to say. "* The facilitator guided the discussion and the negotiations towards finding consensus toward a general agreement. One aspect of the facilitation consisted in repeating the category that facilitator most frequently heard. For example, in negotiations about observing Shape Qualities, the facilitator has led to consensus by indicating the most repeated quality that CMAs have cited "*The Shape Quality of Rising seems to be the one that is repeat or ongoing.* However, in some cases, not enough CMAs saw the same change. Therefore, coming into consensus by choosing the most frequent observation seemed to be difficult. These divergences were due to the observers' own personal preferences or biases that came across as a disagreement with each other: "*Clearly there is not consensus you can not make a case for it*". In these cases, the facilitator chose to initiate a vote and took what the majority have indicated: '*At one point we are just going to vote. How many of you think that there is a secondary change that is significant enough that you want to acknowledge it?*".

DISCUSSION AND CONCLUSION

Our findings show that CMAs follow a specific process in order to observe movement. This is a fundamental requirement to using LMA as a way to annotate and capture movement in a technological context. Formalizing the ways in which expert CMAs observe movement informs the activities that require movement observation and inquiry and bridges with the needs of the fields designing technologies for movement.

Firstly, LMA encourages group observation because it allows CMAs to be more aware of their own bias, to open their capacities to others' perspectives and to extend their observational abilities and skills. Group observation usually requires a facilitator to help CMAs negotiate and come to consensus in order to agree on the observed change in movement. Finding agreement through consensus is crucial in order to achieve a more reliable and valid observation. If agreement is not achieved, CMAs vote and take the majority's choice. We suggest that group observation, and particularly the discussions around finding consensus towards general agreement, is a powerful tool for assessing movement in the design of technology analogous to member checking in data analysis process.

Secondly, in order to observe movement, CMAs use their own bodies and personal connection to the movement. LMA is an embodied practice that emphasizes the role of one's own bodily sensations in the analysis of another's movement patterns. It develops movement perception and observation as a a skill that needs to be honed in studying movement. This approach is correlated to recent findings in neuroscience and movement studies on kinesthetic empathy that link one's own movement, bodily sensation and movement literacy to his/her observation capacities. CMAs use the mirroring process in order to articulate and deconstruct the movement. Their tools are used to perform the movement, vocalize it, show it to each others, mark it, or use mental practice of the movement in order to lay down tracks of the movement. We suggest that training embodied observation as articulated in LMA practice is a fundamental requirement for investigating, inventing and choreographing, re-enacting, describing and documenting movement, the activities described in the Making Strange methodology of Loke et al for the design of whole body interactions [20].

Thirdly, in order to capture what is most important in human's movement functionally and expressively, CMAs make a choice about the level on which they observe movement whether it is the visible change or the mover's intention. CMAs also refer to the context in which movement is occurring. That context gives the movement its full meaning and justifies the intention of the human when moving. Context is important in defining the rationale of the movement, through the mover's intent to act and impact the world.

Because movement is complex and the categories of analysis overlap, CMAs use various tools to delineate the ones that best represent the most dominant change in movement. Among the tools, CMAs repeatedly watch the videos, individually or together, or get physically closer to it in order to adapt to the display (live or video) and grasp the movement essence from what is available to them. They deconstruct the movement according to different body parts. They articulate how one change can functionally support another change and thus pinpoint the source and the essence of the movement intention. They refer to Motif writing, which unlike the exhaustive approach of Labanotation, allows them to grasp the essence of movement by finding the gestalt of the movement and describe it using LMA language.

We believe that designing technology for the moving body would benefit from engaging the discussion about the essence of the user's movement, his/her intention or the visible change, the context in which the movement is performed and how this information is available to the designer can make a difference. The way in which CMAs grasp the gestalt of the movement is a great inspiration to posit the question at the center of understanding the user's motivations, need to move, and movement expressivity.

More generally, understanding the concepts on which relies the process of observation in LMA is a fundamental requirement to the use of LMA in the design of computational systems that support movement expressivity and embodied cognition. Moreover, observation is a skill that needs to prac-

ticed and honed, and this skill can help designing technology for rich interactions. We emphasize the need of research on movement and computation to build observation skill as it is the case in LMA, movement studies and somatic practices in order expand the perception and awarness of movement in a technological context.

In future works, we will propose concrete examples of design work that build upon a methodology of observation from LMA. Such methodology will articulate the use of the LMA observation process described in our paper within the activities defined in Loke et al.'s 2013 framework, including the investigation, invention, reenactment, description, and documentation of movement [20]. This will allow us to acquire experiential data from felt sensation of movement from a first-person perspective. Data that we will share and utilize for the purpose of designing interactions based on human processes and patterns of behavior.

REFERENCES

1. Alexander, C. *The Nature of Order: An Essay on the Art of Building and the Nature of the Universe, Book 2*. Taylor & Francis, 2002.
2. Calvo-Merino, B., Grèzes, J., Glaser, D. E., Passingham, R. E., and Haggard, P. Seeing or Doing? Influence of Visual and Motor Familiarity in Action Observation. *Current Biology 16*, 19 (Oct. 2006), 1905–1910.
3. Charmaz, K. *Grounded theory: Objectivist and constructivist methods.*, thousand oaks ed. In Handbook of qualitative research. CA: Sage Publications, 2000.
4. Chen, J., Lin, W., Tsai, K., and Dai, S. Analysis and evaluation of human movement based on laban movement analysis. *Tamkang Journal of Science and Engineering 13*, 3 (2011), 255–264.
5. Chi, D., Costa, M., Zhao, L., and Badler, N. The emote model for effort and shape. In *Proceedings of the 27th annual conference on Computer graphics and interactive techniques*, ACM Press/Addison-Wesley Publishing Co. (2000), 173–182.
6. Corbin, J., and Strauss, A. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, vol. 14. SAGE Publications, 2007.
7. Cross, E. S., Hamilton, A. F. d. C., and Grafton, S. T. Building a motor simulation de novo: Observation of dance by dancers. *NeuroImage 31*, 3 (July 2006), 1257–1267.
8. Cuykendall, S., Soutar-Rau, E., Cochrane, K., Freiberg, J., and Schiphorst, T. Simply spinning: Extending current design frameworks for kinesthetic empathy. In *In Proc TEI*, ACM (New York, NY, USA, 2015), 305–312.
9. Davis, M. Steps to achieving observer agreement: the lims reliability project. *Movement Studies (New York: Laban / Bartenieff Institute) 2* ((1987).), 7–19.
10. Depraz, N., Varela, F. J., and Vermersch, P. *On Becoming Aware: A pragmatics of experiencing*. John Benjamins Publishing, 2003.
11. Dourish, P. *Where The Action Is: The Foundations of Embodied Interaction*. MIT Press, 2001.
12. Fdili Alaoui, S., Caramiaux, B., Serrano, M., and Bevilacqua, F. Dance Movement Quality as Interaction Modality. In *Proc DIS'12*, ACM Press (2012), 761–769.
13. Hashim, W., Noor, N., and Adnan, W. The design of aesthetic interaction: towards a graceful interaction framework. In *In Proc ICIS*, ACM (2009), 69–75.
14. Jola, C., Abedian-Amiri, A., Kuppuswamy, A., Pollick, F. E., and Grosbras, M.-H. Motor Simulation without Motor Expertise: Enhanced Corticospinal Excitability in Visually Experienced Dance Spectators. *PLoS ONE 7*, 3 (2012), e33343.
15. Kirsh, D. Embodied cognition and the magical future of interaction design. *ACM ToCHI 20*, 1 (2013), 1–30.
16. Kozel, S. *Closer : performance, technologies, phenomenology*. MIT Press, 2007.
17. Laban, R. *A vision of Dynamic Space*. Taylor and Francis Inc., 1984.
18. Laban, R., and Ullmann, L. *Modern educational dance*. MacDonald and Evans, 1963.
19. Lee, W., and Shusterman, R. Practicing Somaesthetics : Exploring Its Impact on Interactive Product Design Ideation. In *Proc DIS'14*, ACM Press (2014), 1055–1064.
20. Loke, L., and Robertson, T. Moving and making strange. *ACM ToCHI 20*, 1 (Mar. 2013), 1–25.
21. Maranan, D. S., Fdili Alaoui, S., Schiphorst, T., Pasquier, P., Subyen, P., and Bartram, L. Designing For Movement : Evaluating Computational Models using LMA Effort Qualities. In *Proc CHI'14*, ACM Press (2014), 991–1000.
22. McGarry, L. M., and Russo, F. A. Mirroring in dance/movement therapy: Potential mechanisms behind empathy enhancement. *The Arts in Psychotherapy 38*, 3 (2011), 178 – 184.
23. McNeill, D. *Gesture and thought*. University of Chicago Press, 2005.
24. Merleau-Ponty, M. *Phenomenology of Perception*. Editions Gallimard, 1945.
25. Moen, J. From hand-held to body-worn: embodied experiences of the design and use of a wearable movement-based interaction concept. In *Proc TEI'07*, ACM Press (2007), 251–258.
26. Petitmengin-peugeot, C., and Varela, P. The Intuitive Experience. *In The View from Within. First-person approaches to the study of consciousness* (1999), 43–77.
27. Schiphorst, T. Self-evidence: applying somatic connoisseurship to experience design. In *Proc CHI'11*, ACM Press (2011), 145–160.
28. Studd, K. A., and Cox, L. L. *Everybody is a body*. Dog Ear Publishing, 2013.