

WHOLODANCE

Whole-Body Interaction Learning for Dance Education

Call identifier: H2020-ICT-2015 - Grant agreement no: 688865

Topic: ICT-20-2015 - Technologies for better human learning and teaching

Deliverable 1.5

Data Acquisition Plan

Due date of delivery: October 31st, 2016

Actual submission date: November 3rd, 2016

Start of the project: 1st January 2016

Ending Date: 31st December 2018

Partner responsible for this deliverable: Athena

Version: 4.0



Dissemination Level: Public

Document Classification

Title	Data Acquisition Plan
Deliverable	D1.5
Reporting Period	M1-M10
Authors	Katerina El Raheb, Vivi Katifori, Aristotelis Kasomoulis
Work Package	WP1
Security	Public
Nature	Report
Keyword(s)	Data Acquisition, Plan, Methodology

Document History

Name	Remark	Version	Date
Katerina El Raheb	ToC,	0.1	18 th February 2016
Vivi Katifori	Venue and Technology section added	1.0	10 th May 2016
Vivi Katifori	Methodology section Added	1.1	30 th July 2016
Katerina El Raheb	The section "The process: Motion Capture Session" has been added to the document	1.2	15 th September
Vivi Katifori	Outcomes section added	1.3	4 th October
Katerina El Raheb	Appendix added	1.4	15 th October
Yannis Ioannidis	2 nd version of the Document updated after Athena's Internal Review	2.0	17 th October
Augusto Sarti	Document updated after PoliMi's Review	2.1	24 th October
Edwin Morley-Fletcher	Document updated after Lynkeus' Review	2.2	31 st October

Katerina El Raheb	3 rd Version of the document updated after the review process was completed	3.0	2 nd November
Antonella Trezzani	Review of the 3 rd version	4.0	3 rd November
Stefano Di Pietro	Final Review and submission	5.0	3 rd November

List of Contributors

Name	Affiliation
Katerina El Raheb	Athena
Vivi Katifori	Athena
Aristotelis Kasomoulis	Athena
Oshrey Even Zohar	Motek
Antonio Camurri	UniGe
Gualtiero Volpe	UniGe
Jean-Marc Matos	K. Danse
Muriel Romero	STOCOS
Amalia Markatzi	LCGW
Rosamaria K. Cisneros	CovUni

List of reviewers

Name	Affiliation
Yannis Ioannidis	Athena
Augusto Sarti	PoliMI
Massimiliano Zanoni	PoliMI
Bruno Di Giorgi	PoliMI
Michele Buccoli	PoliMI
Antonio Camurri	UniGe

D1.5 Data Acquisition Plan	WhoLoDancE - H2020-ICT-2015 (688865)
-----------------------------------	---

Edwin Morley-Fletcher	Lynkeus
Stefano Di Pietro	Lynkeus

Executive Summary

The following deliverable presents the methodology which was followed in order to plan the Motion Capture Sessions of WhoLoDancE, in a way that will maximize the impact of the technologies used, optimize the time management, select the movement sequences that we need to capture and store, and prepare for these sessions aiming at building a repository of movement which will cover the needs of the learning scenarios of WhoLoDancE. This deliverable according to the project time-plan has a delivery date later than the conclusion of the motion capture sessions as foreseen from the same time-plan. The deliverable reports both the data acquisition plan as it has been formulated before the realization of the sessions and also gives an overview of the results of the process. Sections 2 and 3 outline the planning process and provide details on how it has been realized whereas section 4 presents a summary of the outcomes, both in terms of content produced and infrastructure used for its storage. In particular, in section 2 (Methodology and Preparation), we describe the steps which we have followed to organize the collaboration between technical and dance partners, and deal with the variety and diversity of the four different dance genres/use cases of WhoLoDancE (Contemporary dance, Ballet, Greek Folk, Flamenco). We explain the systematic way of preparing the shot list, aiming at keeping the balance between a) user-oriented and context specific perspective, in order to select kinetic content which will be satisfying to deliver the needs of each dance genre learning scenario, and b) technical perspective, through selecting data which will be subject to further automated analysis, and synthesis of movements and will support the different objectives of the WhoLoDancE project. In section 4 (The process: Motion Capture Sessions), we describe the process of the Motion Capture sessions, including short description of the technologies used, the locations, the context of capturing and quality control. The third and last part summarizes the outcome of the Motion Capture sessions and provide numbers and statistics about the produced data. Finally, at the end (section 5) there is an appendix with the detailed schedules, and other relevant documents.

Table Contents

Executive Summary	5
1 Objectives	8
2 Methodology and Preparation	8
2.1 Dance Genres	10
2.2 Defining Movement Principles	10
2.3 Questionnaires and verbal descriptions.....	11
2.4 Shotlist and Videos Preparation	12
3 The process: Motion Capture Sessions	14
3.1 Motion Capture Technical information	14
3.2 Planning and Schedule.....	15
3.3 Capture Needs for each dance genre.....	15
3.4 Privacy and Ethics –Consent Forms	19
3.5 Venue and Technologies	19
3.5.1 Genoa Experimental Recordings	20
3.5.2 Amsterdam Recording Sessions	22
3.6 Quality Control- Context of Capturing.....	24
4 Outcomes	28
4.1 <i>Greek dance</i>	28
4.2 <i>Contemporary dance</i>	28
4.3 <i>Ballet</i>	29
4.4 <i>Flamenco</i>	29
5 Appendix	30
5.1 Movement Principles Questionnaire.....	30
5.2 WhoLoDancE Marker SetTemplate	38
5.3 Schedule of Motion Capture Sessions.....	41
5.4 Details of Genoa Motion Capture.....	43
5.5 Summary of captured Greek dance structures	49

Figure 1. Primary shotlist for Ballet.....	12
Figure 4. Capturing Movement Principles.....	15
Figure 5. Two Greek folk dancers captured at the same time	16
Figure 6. Setting the "Cube" for Contemporary dance and giving emphasis on the Directionality	17
Figure 7. Setting the markers on point shoes for Ballet	17
Figure 8. Female and male ballet dancers on the barre	18
Figure 9. Capturing Flamenco in Amsterdam.....	18
Figure 8. Capturing Ballet exercises on the barre.....	19
Figure 5-One of the 13 Qualisys cameras in Genoa	20
Figure 6. Capturing contemporary dance in Casa Paganini "ecological setting"	21
Figure 7-Schram Studio in Amsterdam	23
Figure 8. Muriel Romero guiding dancers during Ballet Motion Capture.....	24
Figure 9. Amalia Markatzi giving instructions to LCGW dancers during Greek Folk Motion Capture	25
Figure 10. Jean-Marc Matos giving instructions to dancer during Contemporary Motion Capture	25

1 Objectives

This deliverable aims at describing the plan for acquiring the “ground –truth” data for the Learning Scenarios and material and reporting the activities described in WP1 T1.5 Technical Requirements for Data Acquisition. The task is focused on organizing and harmonizing the process of Motion Capture of the different dance genres, in order to develop a systematic methodology that will balance the commonalities and peculiarities of each dance practice. This deliverable according to the project time-plan has a delivery date later than the conclusion of the motion capture sessions as foreseen from the same time-plan. The deliverable reports both the data acquisition plan as it has been formulated before the realization of the sessions and also gives an overview of the results of the process. Sections 2 and 3 outline the planning process and provide details on how it has been realized whereas section 4 presents a summary of the outcomes, both in terms of content produced and infrastructure used for its storage. It will lead to the selection of content for a movement repository which will serve the objectives of the WhoLoDancE project, but will also allow further analysis and research in the future for a variety of applications. The task is also aimed at creating a consistent plan which will guarantee time effectiveness, and quality of the content. Since the objective of the data is acquisition and storage within the WhoLoDancE repository, it was needed to focus on the Learning practices of each style, but also to reflect the bodily knowledge and tradition of each practice. To this end, we have dedicated time to discuss with each partner and understand the needs of each genre and we have also developed a methodology for selecting dance movements and sequences from each dance in a systematic way.

In brief, this deliverable presents the 1) methodologies of acquiring multimodal collections of data (Motion Capture, Accelerometers, other), 2) dance expert representatives who will participate in data collection, 3) a plan for selecting data from each Dance Institution partner using the appropriate methodologies to address the needs of Learning of the different use-cases. The last objective has two main sub-objectives: a) to capture and store movement sequences and metadata which reflect the rationale of each dance practice and teaching, and b) to capture and store the sequences in a way which will allow further automated analysis, including comparisons, interpolations, blending, 3D visualizations, volumetric projection, and other. To achieve this two-fold objective the work was carried out in close collaboration and continuous remote discussions with Coventry University and the Dance Companies (K. Danse, STOCOS, and LCGW), the technical partners who held the Motion Capture (Motek and UniGe), as well as the rest of the partners.

2 Methodology and Preparation

In this section, we describe the methodology which was followed towards building the WhoLoDancE Repository. The richness of kinetic vocabularies that lies within each one of the dance genres, and the countless movement sequences, choreographies and teaching combinations that each of the genres might produce, has created a complex planning and decision making problem in order to schedule the Motion Capture sessions in the most efficient way. Our goal was to select kinetic material which will create libraries that will serve as collections of movement which are representative for the genres, and that will facilitate both the Learning scenarios as well as data for further research on bodily knowledge within and across the different dance genres. Such libraries will also allow us to apply computational processing techniques on the available material, such as blending, search by similarity or automatic description of dance gesture. The

following methodology was also described in an Extended Abstract and presented as a poster by WhoLoDancE partners¹ at the International Conference of Movement Computing in Thessaloniki (MOCO16).

¹ Camurri, A., El Raheb, K., Even-Zohar, O., Ioannidis, Y., Markatzi, A., Matos, J. M., ... & Di Pietro, S. (2016, July). WhoLoDancE: Towards a methodology for selecting Motion Capture Data across different Dance Learning Practice. In *Proceedings of the 3rd International Symposium on Movement and Computing* (p. 43). ACM.

2.1 Dance Genres

WhoLoDancE focuses on investigating four different dance genres: Contemporary Dance, Ballet, Greek Folk and Flamenco. These four dance genres represent a variety of examples of dance practices that range from academic, traditional systems of dance art and education (ballet), to traditional art forms of intangible cultural heritage (Greek Folk, Flamenco), and contemporary practices that embrace creativity and experimentation (Contemporary dance). This variety is also reflected in the way each one of the dance genres is taught and practiced.

2.2 Defining Movement Principles

The first step for this selection led in trying to define a) learning objectives and skills that are important in dance teaching according to recent education research and practices, beyond the specific peculiarities of each dance technique and style, b) find a common ground between the different dance genres (for details see D1.1 State-of the Art), c) create specific movement sequences that will be used to teach dance in cases where there are not specific routines or structured forms coming from the dance genre or the technique. For example, contemporary dance contains a variety of techniques and influences and is not connected with specific dance structures and exercises, as it is the case with other dance genres such as classical ballet, which has a well-defined kinetic vocabulary, or Greek folk which represents specific dance structures and patterns. Having these objectives dance partners and experts agreed to focus on some general movement principles which will help us build the kinetic teaching material, rather than randomly chose steps from each dance genre.

To this end, from the very beginning of the project, we set up focus groups, at the first stage within the consortium and then including external experts, where we discussed the fact that the learning scenarios should not be focused only on teaching new steps through mimicry, but also provide exercises and examples that will enhance the Movement Principles of the dance learner. At this stage we defined a set of ten Movement Principles which summarize the most basic and essential learning objectives, beyond the limitations of each genre, and could summarize the higher level features and embodied concepts that each dance learner deals more or less, in every dance class. This first list of Movement Principles is also validated through questionnaires distributed to the wider community of dancers, dance educators, practitioners and choreographers of different styles, as well as interviews) (for more details see D1.2 Interviews Report), as well as different focus groups, and workshops (for more information see D1.3 Workshop Report and D1.4 Needs Analysis). It is important to clarify that the Movement Principles are seen as different "chapters" of teaching within the Learning Scenarios and serve to organize the process of producing and organizing the teaching content. For this reason, they do not represent directly measurable properties of movement, but higher level complex concepts (in some cases amodal) which are further analyzed into lower level features and specific definitions in D1.6 High Level Features Definition for the Learning Scenarios. The purpose of creating and continuously enhancing this list, is to assure a user-centered approach for both the learning scenarios and the concepts that will be present during the process of producing, and accessing the content.

The list of Movement Principles which was used as the basis to prepare specific Learning exercises and movement sequences to be captured, is the following:

1. **Symmetry:** The use of the two sides of the body (right vs. left side, arm, leg) etc., both in position and while moving. The ability to do the same thing simultaneously or sequentially using both sides. Each Movement Principle includes also the opposite. Playing with asymmetry and isometry is included in this principle.

2. **Directionality:** The awareness of body orientation in space. Usually this is derived from the position of hips and torso, but interesting postures might derive from the various directions of each body part in relation to a space, e.g., the audience, the camera, the studio.
3. **Balance:** The ability to stand and move in balance, but also out of balance, depending on whether the line of gravity falls within the line of your supporting limb(s) or not. The awareness of the different vector forces on your body.
4. **Alignment – Posture Stability:** The awareness of the geometry of the body (e.g., the axes (sagittal, horizontal, vertical) and planes, and how the relations of different body parts and joint create “lines” in the body shape.
5. **Weight bearing vs. Gesturing:** This principle is about the difference between movement that is concerned with bearing weight (weight transference, stepping, hand stands, etc.) and movement (gesture) that is not bearing weight but which has intention/expression.
6. **Gross vs. Fine Motorics/Isolation/Articulation:** The ability to distinguish small movements done by specific body parts e.g., hand or one hip, or one shoulder, without moving the rest of the body, vs. moving larger parts of the body as a whole.
7. **Coordination:** One of the most important skills practiced in every kind of dancing, which is about the ability to synchronize or not different parts of the body that can move in the same or separate tempos.
8. **Motion Through Space:** Progressing through space or towards particular directions, paths etc. "Moving through space vs. dancing on the spot. Also the body as moving point in space, or as continuously changing moving volume.
9. **Rhythm and phrasing.** The ability to move in particular (predefined or improvised) rhythms. This principle is also about how the dancer’s movement is related or not to the music and its rhythmical aspects (tempo, time signature, rhythmic patterns etc.).
10. **Stillness.** While movement seems to be the essence of dance, a dancer needs to improve her/his ability to remain still, whether this is a part of a choreography or interpretation of rhythmical pauses, and exercise for balance and isolation of body parts. Stillness is usually connected to the notion of being present and has been investigated in previous interdisciplinary work.

2.3 Questionnaires and verbal descriptions

Following the focus groups, we have prepared a Questionnaire (Appendix 5.1) which we distributed among the different partners, in order to get input about the understanding of these principles in each one of the dance genres, but also reflection from the technical partners. Each one of the dance partners has been asked to provide a set of exercises and movement sequences that could be used for explaining and teaching the different Movement Principles.

In particular, a short questionnaire has been distributed among both technical representatives and dance experts in order to provide feedback on the following key issues:

- a. Define a set of movements/movement sequences connected with the movement principle. (Dance Partners)
- b. How important is this principle for your dance genre-style? (Dance Partners)
- c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would choose? (Dance Partners)
- d. Do you see the connection between the movement principle, and the low level features we should capture and analyze? Is there a challenge/obstacle? (Technical Partners)
- e. Is there any related work in your institution in capturing-analyzing this particular movement principle?

For questions a and c, the dance partners, were asked to provide video shots along with their answers for each Movement Principle. The main objectives of the questionnaire were the following: 1) to validate if the Movement Principles decided during the Focus Group are appropriate for the different dance genres and learning practices; 2) to identify any relation between the Movement Principles and the Learning Principles. 3) to collect an initial number of kinetic material described verbally and captured in videos, allowing the motion capture experts to create a relevant shot list; 4) to provide an initial reflection of how basic Movement Principles, which are dance genre and learning practices independent, can be mapped into low or middle level features i.e., objective measurable features that can be derived by a minimum data processing on signals coming from sensors or other input.

This procedure helped not only to agree on a common terminology across partners, but also create a framework which we continuously evaluate and validate through the distribution of questionnaires and conduction of interviews with representatives of the wider community of dance practitioners, dancers, choreographers, teachers and educators. More detailed results are available on the D1.2 Interviews Report. In addition, we iteratively evaluate and discuss these principles through specific workshops addressed to the widest community (see. Deliverable 1.3).

2.4 Shotlist and Videos Preparation

Following the questionnaire distribution, answers and discussion, with all dance partners, each one of them (K. Danse, Stocos, Coventry, LCGW) for each of the dance genres that is representing, has uploaded on a dedicated video channel the videos which show the answers to question (c) giving movement sequences and exercises that are appropriate to enhance the student's Movement Principle (e.g., Coordination, Alignment etc).

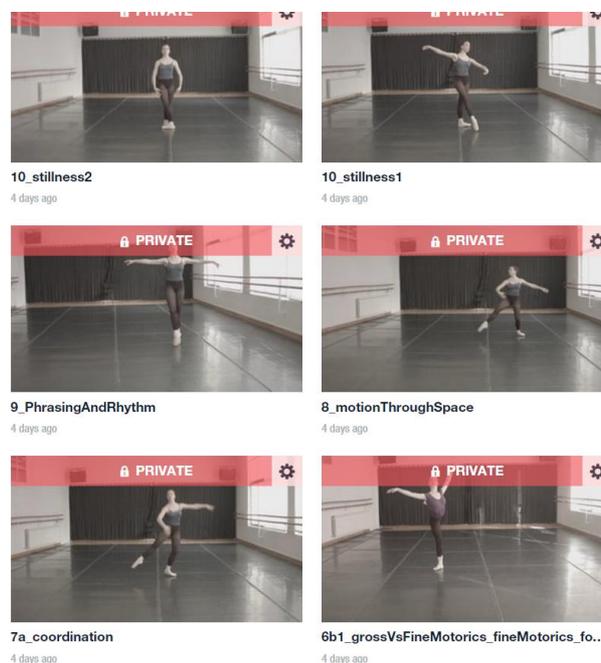


Figure 1. Primary shotlist for Ballet

Each of the dance partners covers one or more dance genres from those considered in the project. At this stage a long discussion was dedicated to decide which would be the movement segments and sequences to be captured from each dance genres, balancing different and sometime contradictive objectives: a) defining

sequences that are meaningful for the practice and teaching of the genre e.g., a ballet step or exercise, a full phrase of a Greek dance, a basic step of Flamenco, b)defining segments and sequences that could be short enough so that they could be easily handled and stored, but long enough to include the form or the nuance of each dance genre, c) define segment concepts that would be meaningful both across and within each dance genre.

For this purpose, after filling the questionnaire, each dance partner has prepared a number of videos with specific exercises and sequences for each genre and Movement Principle, based on the answers given on the questionnaire. This process helped in achieving a common understanding in the notion of movement sequence, the movement principles and set realistic goals on how many dancers, and how many days of capture we would need for each dance genre in order to have a satisfying sample and repository, that would showcase the variety of movements in each dance genre. Until now we have analytical Motion Capture Shots of all companies in the Vimeo channel² we set up for the project.

² <https://vimeo.com/user48614335>

3 The process: Motion Capture Sessions

In this section we describe the technologies used for the motion capture, the plan and schedule, the venues as well as the context of capturing and the quality control during the sessions.

3.1 Motion Capture Technical information

In this section, we focus on providing a general view of the technical decisions that took place. To begin with, all takes both from Motek and UniGe, were captured using passive marker optical capture systems.

Passive optical system uses markers coated with a retroreflective material to reflect light that is generated near the cameras lens. By using the term “retroreflective material” we are referring to a surface that reflects light back to its source with a minimum of scattering. The camera's threshold can be adjusted: only the bright reflective markers will be sampled, ignoring skin and fabric. An object with markers attached at known positions is used to calibrate the cameras and obtain their positions, and the lens distortion of each camera is measured. If two calibrated cameras see a marker, a three-dimensional fix can be obtained. It was preferred from all the other techniques, as it is the most accurate, flexible and common type of mocap.

This type of system can capture large numbers of markers at frame rates usually around 120 to 160 fps although by lowering the resolution and tracking a smaller region of interest they can track as high as 10000 fps. In our case all takes are captured at minimal speed of 100Fps (Frames per second) or more. The number of frames per second depends on the type of motion.

All takes will be down-sampled so they can be used for volumetric projection. One of the steps in motion capture production is to create a skeleton. In order to minimize fitting errors, all of our takes are solved to a skeleton that is of the same proportions of the actor.

Regarding our files, they contain a fully articulate skeleton, including the finger bones. Using a naming scheme compatible with Autodesk MotionBuilder (FBX) was selected, in order to be used as an avatar real-time throughput for the volumetric projection.

So, the master data format that was used throughout the project is the FBX. FBX is a framework that allows someone to create, edit, and manage asset templates. An asset template defines the interface of an asset. In other words, it specifies the properties that an asset must have, in order to comply with a specific asset type.

FBX is designed to describe animation scenes and is supported by many 3D animation software packages to transfer files among them. It can contain geometries, textures, cameras, lights, markers, skeleton, and animation. One large advantage that MotionBuilder has over other 3D animation packages is that it can take any of the other file formats, such as the C3D format in our case, and translate them into the .fbx format. This allows Motion Builder to work as a type of “universal translator” between not only different animation systems, but also different types of skeletal structures.

Moreover, Autodesk provides a Software Development Kit (SDK) to create, modify or open the FBX files and access to the raw data for further processing.

All datasets came with a T-pose, which contained a clean pose for correctly hooking the data to the designed avatars. Since all we need is one frame of matching data, the capture of the T-pose can include motion. As we set up the digital character, we can pick the closest frame to the model.

Generally, T-pose is the neutral pose in mocap terms. When setting up the character, it is necessary to have a neutral with which to begin (a pose that will match your modeled character's neutral position). If you have modeled the character in advance, it is necessary to capture a matching base position by measuring the angle of rotation of limbs and helping the performer adopt that stance. Finally, after having a comprehensive shot list for the selected genres, capture volume was defined.

3.2 Planning and Schedule

In the following section we briefly describe the schedule of each motion capture session, including the number of dancers needed, the detailed schedule to capture the prepared shot-list for each dance genre, and cover any additional preparations needed from the side of the studios or the dancers. For more details see Appendix 5.3.



Figure 2. Capturing Movement Principles

3.3 Capture Needs for each dance genre

Greek Folk: For Greek dance we capture 4 dancers, 2 male and 2 female dancers to cover the different variations (a) female style, b) male style, c) dancing in couples, where one dancer is captured at a time, though it is important to capture the movements related to dancers' interaction and expressivity, d) dancing in group: again even if one of the dancer is captured at a time, the way he puts weight on the other dancer, holding of hands etc. might affect the movements especially those of the "first dancer", who is doing more sophisticated movements (jumps, turns, very low bends etc). Long before the capturing day the dancers have prepared and rehearsed a variety of Greek folk dances from all over Greece (>50 dances).



Figure 3. Two Greek folk dancers captured at the same time

Contemporary Dance: For contemporary dance we captured 2 female dancers, representing two different dance companies. The dancers have worked with the choreographers of the companies and rehearsed the different exercises and movement sequences focusing on the Movement Principles and the different concepts that are part of this principle e.g., Balance emerged in the examples of working "in Balance", "off Balance", "Fall", "Fall-Recenter", "Fall-travel" etc. All the movement sequences for contemporary dance are solo sequences and do not include any floor-work or contact between different dancers.

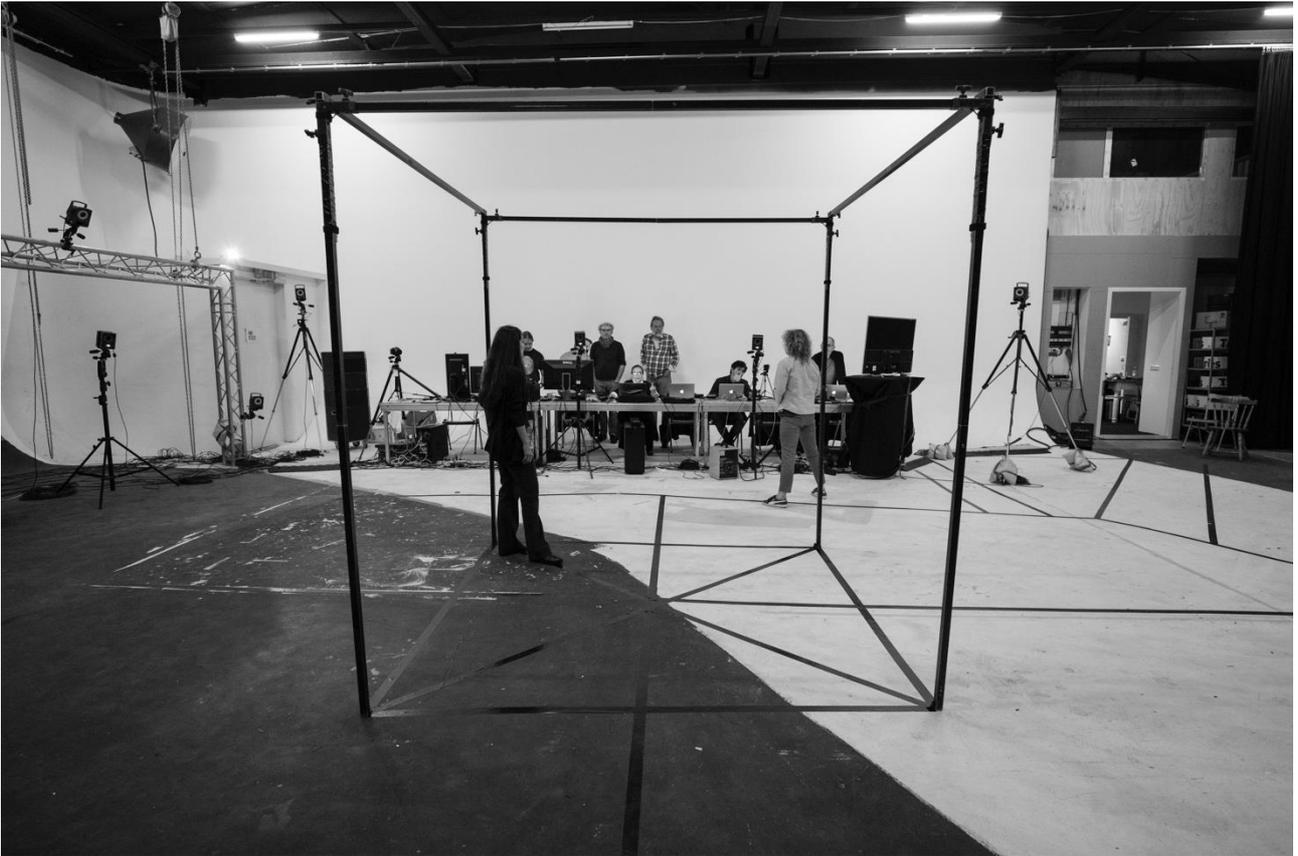


Figure 4. Setting the "Cube" for Contemporary dance and giving emphasis on the Directionality

Ballet: Two professional dancers have been captured - a male and female dancer. The capture included a whole ballet class of intermediate to advanced level, with as many different exercises as possible for both the female and the male style. Point shoes were used by the female dancer (Figure 5) and a barre has been set in the studio to simulate a real ballet class.



Figure 5. Setting the markers on point shoes for Ballet



Figure 6. Female and male ballet dancers on the barre

Flamenco: For Flamenco a professional female dancer and teacher has been captured. She prepared a variety of movement sequences including more traditional and modern styles of Flamenco, and exercises which were focused on the Movement Principles.

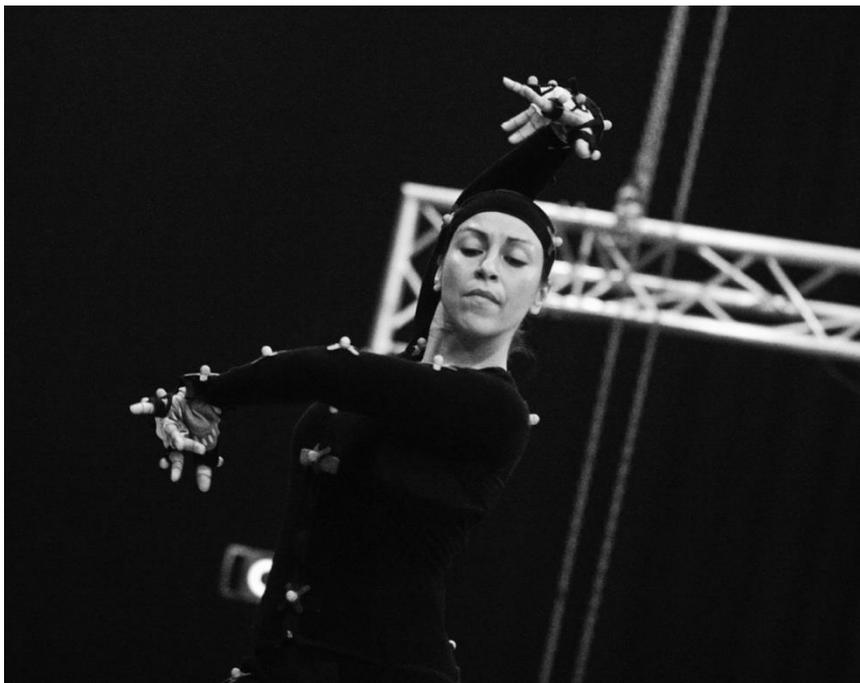


Figure 7. Capturing Flamenco in Amsterdam

The schedule refers only to the capturing, while 3-4 additional days have been dedicated by each technical partner before and after the Motion Capture sessions for the preparation and set up of the temporary storage of the Motion Capture data. The overall schedule is presented in Table 1.

Table 1 Motion Capture Schedule

Place	Dance Genre-partners	Schedule
Genoa (Casa Paganini-UniGe)	K. Danse, STOCOS	21-23th March 2016
Amsterdam (Schram Studios-Motek)	Greek Folk, Contemporary -K. Danse	2-10th May 2016
Amsterdam (Schram Studios-Motek)	Contemporary Stocos, Ballet, Flamenco	11-19st July 2016



Figure 8. Capturing Ballet exercises on the barre

3.4 Privacy and Ethics –Consent Forms

Another issue is to what extent we should reveal or not the identities – names of the dancers. This is related to the Ethic – Privacy aspect of the process. Here we have two options: a) Dancers want to be anonymized, b) dancers want to be given public credits for their contribution. It is a point we need to clarify. In any case since each capturing is going to be accompanied with a video we need to decide to what extent we can share these videos (restricted/public) and we need to prepare consent forms. (See also D2.1 Recruitment protocol and informed consent form)

3.5 Venue and Technologies

In this section we present the venues where the motion-capture was carried out, as well as the state of the art technologies that were used for that purpose.

The motion-capture procedures took place in two different locations. The first was the Casa Paganini-InfoMus research center at UNIGE, while the two following sessions took place in Amsterdam at Motek Entertainment studio and Schram Studios. Regarding the technology approaches that were available from the two partners, Motek used a Vicon system and UniGe provided a Qualisys system. Although the focus of each Motion Capture session was a little bit different, as we will explain in the following sections, both venues have been in continuous remote discussions and technical partners visited both locations prior to the recordings.



Figure 9-One of the 13 Qualisys cameras in Genoa

3.5.1 Genoa Experimental Recordings

The premise of the Casa Paganini-InfoMus³ research center at UNIGE, consisted of an ancient monumental building endowed with a 230-seat auditorium and some museum rooms. The main lab room offers a direct view of the auditorium's stage (see Figure 10). This configuration is exemplary of the interaction between artistic, scientific and technological research. Moreover, it enables the development of experiments, prototypes, and demonstrations in an almost real world setting with ecological extensions. The whole monumental building has a technological infrastructure, such as fast network, audio and video connection, including multichannel audio and video.

A Qualisys⁴ Motion Capture System is installed on the stage, which is a 9mx5m rectangle. The area that is exploitable for recordings is 5mx4m. The system is endowed with 13 video cameras. Figure 10 shows the auditorium and its stage, during a MoCap recording session with a string quartet.

The EyesWeb XMI platform, developed by the UniGe team, integrates Qualisys with other sensor systems, including accelerometers, RGB and RGBD video cameras, smartphones, microphones, and biometric sensors,

³ <http://www.casapaganini.org/>

⁴ <http://www.qualisys.com/>

for recordings of movements, gestures, audio, video, and physiology. EyesWeb enables synchronized recording, analysis, and playback of data.



Figure 10. Capturing contemporary dance in Casa Paganini "ecological setting"

The main part of the session has been dedicated to the multimodal recordings. The performers and dance partners have been prepared for the session working on specific exercises before arriving to Genoa. During these sessions, the focus was given to Movement Qualities, i.e., expressive aspects of movement such as Origin of Movement, Fluidity, Coordination, Light vs. Weighty movement etc. The recordings focused on contemporary dance, since it is more open to experimentation and exploring different qualities of movement.

During the recordings and data acquisition, and while watching of the videos of the capturing process, discussions took place, aiming among others at the common understanding of the Movement Qualities and the conceptual framework for WhoLoDancE.

The following process has been used to record a series of short fragments (1 to 2 min each) of synchronized multimodal data (MoCap, audio, IMUs (Inertial Measurement Units), 2 video cameras) focusing on specific movement qualities related to the contemporary dance scenarios:

The Recording Sessions have been done without music because the partners agreed that music can impose specific movement qualities and can affect the way the dancer performs a movement in respect to the particular aspects to be captured on this first experimental Capture Sessions. A microphone has been placed on the dancers to record the breath for the following processing.

For the recordings 13 cameras + 5 accelerometers + 2 high definition cameras have been used + 1 microphone + 1 kinect camera. Two contemporary dancers have been captured, following the list of exercises on Movement Qualities / High Level Feature. For more details, see Appendix 5.4 “Detailed description and annotated list of the Movement Qualities Captured” by STOCOS and K. Danse.

The analysis and discussion took place only on the first day to concentrate the work on the capturing sessions the following ones. The partners had the chance to have a general discussion and set the deadlines for the analysis and annotation to be completed.

3.5.2 Amsterdam Recording Sessions

Motek Entertainment is an innovative 3D animation production studio, specializing in services and production work for feature films, commercials, television series, games, digital and mobile media. Motek develops technology, assets, content, formats, custom pipelines and solutions to both technical and creative challenges.

Furthermore, Motek consists of a core team of 3D and project management specialists, with history of both developing new production technology and bringing externally developed technology from the world of research, medicine and high-end films into affordable, broadcast-ready solutions. To conclude, Motek is a company extremely interested in real time, interactive, and digital applications.

In order to go through the motion-captures processes at Motek, a multi-system setup was available, with large capture volume (up to 25 x 25 Meters). The type of mocap used, was the Passive optical motion capture, with the use of a VICON⁵ T160 camera based system and combined with BLADE2.0 data acquisition and analysis software suite.

Motion capture is a complex technology that deeply affects the aesthetics of the computer graphics art form. Although the production of graphics is not the direct goal of the WhoLoDancE project, the quality and aesthetics of the computer graphics are very important in order to transfer the required body and movement visualization and deliver its educational objectives. Because of its complexity and the speed at which profitable production proceeds, it is a challenging process to keep under control. In the current project context, passive marker optical technology (Amsterdam and Genoa) will be used in conjunction with accelerometer data, audio data and additional sensing devices (like the recording of breathing rhythm in the capture session in Genoa).

During a Motion Capture session, we distinguish two main stages: a) capture process and b) application process. The capture process obtains motion data from the performer, and the application process retargets that motion data onto an animated character. The connection between the processes is the two skeletal models in the computer. One model, the performer model, is a representation of the human performer in the capture volume. The second one, the target model, is a computer-animated figure onto which the motion is applied. Such a model or “avatar” may be a realistic figure or, as in the current project context, an abstract “motion envelope” designed for teaching.

To begin with, it is essential to obtain an insight into Motion Capture technologies. Motion capture (mocap) is the process of recording the movement of objects or people. There are several different approaches to motion capture, such as inertial, video, optical-active and optical-passive. In our case, we are going to use passive optical motion capture.

⁵ <https://www.vicon.com/>



Figure 11-Schram Studio in Amsterdam

As it has already been mentioned, the motion-capture processes took place in two different locations (Motek in Amsterdam and UniGe in Genova). To achieve the intended result in both cases without facing major interoperability issues, the use of a unified methodology of capturing was critical.

Potential compatibility problems during merging and processing of the data, needed to be solved before the pre-production starts. To address those problems, the two capture sites established a unified marker set template (Appendix 5.2) and used a unified naming convention and a common file naming and conversion scheme.

Regarding the motion capture processes, both sites used passive motion capture type systems. This technique uses retroreflective markers that are tracked by infrared cameras. It was preferred from all the other techniques, as it is the most accurate, flexible and common type of mocap.

Motek preferred to use a Vicon system. Vicon is a motion capture company that specializes in gathering precise, reliable data for any movement analysis application. On the other hand, UniGe chose a compatible Qualisys system. Qualisys is also one of the biggest providers of motion capture technology.

Regarding the data formats, raw capture from both Vicon and Qualisys systems was converted to an agreed format, the C3D⁶. Both Vicon and Qualisys can generate this type of file. After retargeting the C3D file, data had to be converted to an FBX file format, in order to be used throughout the project, for visualization and interactive projection. The C3D format is probably one of the most commonly used formats for that purpose. More specifically, C3D is a binary or ASCII file format for motion capture data used in animation, biomechanics and gait analysis to store motion capture data. The format is flexible enough to store 3D coordinates and any numeric data in a single file. However, C3D format has been developed specifically for motion capture, in addition to the FBX format, which is for 3D animation in general. C3D and FBX formats can be easily used in analysis and visualization frameworks like Unity and EyesWeb XML or converted in other

⁶ <https://www.c3d.org>

data formats more suitable to be managed in web-based applications developed in JavaScript programming language or by general purpose languages like Python.

It was essential to guarantee a unique framework during the motion-capturing process in order to offer comparable data. To achieve this, it was necessary to follow a common approach and specify some significant parameters. Firstly, we used the same templates for the marker setup, as well as for the skeletal setup. Moreover, we determined a common naming convention for all the body segments. Last but not least, clear parameter specifications had been decided as a way to achieve data accuracy.

During the recording sessions in Amsterdam, two cameras were used to capture videos of the performance and for some sessions it was used music to accompany the dance.

3.6 Quality Control- Context of Capturing

Since one of the outcomes of WhoLoDancE is the idea of stepping inside the virtual body of the professional dancer-teacher master, one of the objectives of the Motion Capture sessions was to record performances that represent ideal professional realizations and embodied examples of each dance genre. Apart from the detailed procedure which we described in previous sections, about the selection of the content and preparation of the shot list i.e., the selection of the movement sequences to be captured for each dance genre, a careful and informed selection of the dancers has been made from each one of the dance partners.



Figure 12. Muriel Romero guiding dancers during Ballet Motion Capture

These movement sequences have been rehearsed by the selected dancers, long enough before the motion capture sessions. In addition, all the respective choreographers and dance directors of each dance partner were present during the Motion Capture Sessions, both in Genoa and Amsterdam and were continuously guiding the dancers and providing feedback. More than one take has been done when needed, and each take was evaluated by both the technical and dance partners, in order to be repeated if the result was not satisfying.



Figure 13. Amalia Markatzi giving instructions to LCGW dancers during Greek Folk Motion Capture

In parallel, based on the detailed schedule for each dance genre and partner, to cover the defined movement sequences according to the content selection, additional performances and takes have been conducted in order to have variances in speed, styles, and other dance characteristics parameters.



Figure 14. Jean-Marc Matos giving instructions to dancer during Contemporary Motion Capture

Dance Genre	Partner	Segmentation/ Shotlist	Music	Motion Capture Session	Emphasis on
Contemporary	STOCOS (Muriel)	Exercises and tasks related to each one of the qualities e.g. Fluidity with resistance vs. without resistance	metronome (no music).	Genoa-March 2016	Movement Qualities
Contemporary	K. Danse (Marianne)	Exercises and tasks related to each one of the qualities e.g. Fluidity with resistance vs. without resistance	metronome (no music).	Genoa March 2016	Movement Qualities
Greek Folk Dance	LCGW (Athina, Aliko, Pavlos, Konstantinos)	Greek Dances have been captured. For each dance we have captured <ol style="list-style-type: none"> 1. the whole motif (which is repeated to create the dance), 2. parts of this motif ("steps"), 3. Variations of the parts of the motif 	Greek Dance captured with its specific music. Since each Greek dance is danced on a specific music, for each dance-motif we had the corresponding music/song playing and recorded while motion capturing.	Amsterdam July 2016	Greek dance structures and motives
Contemporary	K. Danse (Marianne, Katerina)	Movement Principles was the driving force to create /prepare the segments Exercises and tasks related to each one of the principles e.g. Directionality with different parts of the body	metronome (no music). Some longer sequences of Marianne have been captured with music (improvisation on a music chosen ad-hoc).	Amsterdam –May 2016	Movement Principles were the driving force to create /prepare the segments Exercises and tasks related to each one of the principles
Contemporary	STOCOS (Muriel)	Movement Principles were the driving force to create /prepare the segments. Exercises and tasks related to each one of the principle e.g. coordination with different parts of the body	metronome (no music). Some longer sequences of Muriel Romero have been captured with specific music from the composer Pablo Palacio and other contemporary composers.	Amsterdam –July	Movement Principles were the driving force to create /prepare the segments Exercises and tasks related to each one of the principle e.g.

					coordination with different parts of the body
Ballet	STOCOS (Alicia, John)	Ballet Class Exercises that combine all the steps belonging to the Classical Dance within a methodological structure.	Classical Dance is captured with specific music. Since each ballet step is danced on a specific music, for each dance-exercise we had the corresponding music playing and recorded while motion capturing.	Amsterdam –July	Methodology Classical dance
Flamenco	Coventry (Rosa)	Both technique exercises and actual full-length dances were captured. A series of styles were explored ranging from very traditional to more popular dance styles. There was a mix of choreographed and improvised dances, in addition to the very technical bits. Movement principles and Movement qualities were at the core of all the work. For the technical exercises we might clearly say that Movement principles were fundamental, where for the other dances it was a combination.	Recorded music was used in all cases. For the technical exercises music and a metronome was used in combination.	Amsterdam –July	Movement principles and Movement qualities.

4 Outcomes

This section presents an overview of the results of the motion capture sessions described in Section 3 and their storage and distribution.

Table 2 Motion captured sequences per dance genre

Dance genre	Movement Sequences Captured
Greek folk	342 (93 full phrases, and 249 segments)
Contemporary	961
Ballet	248
Flamenco	30
Total	1581

4.1 Greek dance

In the case of Greek folk dance, 52 Greek dance structures have been recorded, along with 10 basic step sequences common in many of the Greek dance structures. This recorded sample is representative of the Greek folk dance as it is manifested in different parts of Greece. The dance sequences were recorded in 93 full structure files and 249 segments. A summary of these results per dance structure is presented in Appendix 5.5. For each dance structure at least one full phrase has been recorded and in most cases, when needed more than one segments presenting segment variations. In the case where there is differentiation between the male and female form, both variations have been recorded. Each dance sequence has been recorded with its own music.

4.2 Contemporary dance

For the contemporary dance the capture process followed the movement principles (Section 2.2) to record a total of 961 sequences. From these, 817 are captured exercises for specific movement principles (Table 3) and 144 are a series of experimental and improvisation sequences.

Table 3 Captured sequences for contemporary dance

Movement principle	Number of sequences
Symmetry	96
Directionality	286
Balance	78
Alignment / Posture Stability	63
Weight bearing vs Gesturing	73
Gross vs. Fine Motoric/Isolation/Articulation	84
Coordination	71
Motion Through space	37

Rhythm and phrasing	14
Stillness	15
Movement Principles (total)	817
Free movement and improvisation with emphasis on Movement Qualities, and expressive aspects	144
Total	961

A more detailed analysis of the recorded content for all the dances can be found in Deliverable D2.3 Outcome of the capture process.

4.3 Ballet

In the case of Ballet, the recordings focused on a full capture of a ballet intermediate to advanced class, with emphasis on the Movement Principles. 248 sequences have been recorded, covering a variety of different exercises at the barre, in the center and across space for both the female and the male style, including also point work for the female style.

4.4 Flamenco

30 sequences of the flamenco dance genre have been recorded, including full dance motifs as well as exercises. The segments have been recorded with their own music.

The files were kept at the servers of MOTeK and then transferred to the FTP server set up for the needs of the WhoLoDancE project by ATHENA, to be made available for distribution and sharing to the project partners. More details on the file storage and distribution process can be found in deliverable D5.1 Data Modeling, data integration and data management plan report.

5 Appendix

5.1 Movement Principles Questionnaire

WhoLoDancE-WP1 Learning Models and Technical Requirements

Movement Principles

1. Symmetry/asymmetry, isometry
2. Directionality
3. Balance
4. Alignment/Posture/Stability
5. Weight bearing/Gesture
6. Gross vs. fine motorics, isolation/articulation
7. Coordination
8. Motion through space
9. Rhythm-phrasing
10. Stillness

Learning Principles

1. **Mimesis** – the teacher is teaching the student a specific movement or sequence of movements;
2. **Generative** – the teacher gives the student an exercise/phrase/sequence as a starting point to achieve technical and creative goals;
3. **Reflexive** – the student is given a movement/task/image to work with, improvising without trying to achieve a specific phrase/sequence and the teacher provides feedback.
4. **Traditional method** (command style teaching), where the teacher makes all the decisions and the learner follows these decisions. The method requires precision and accuracy of performance.

?

?

Questionnaire

?

?	Movement Principles Questionnaire
1	<p>Symmetry/asymmetry, isometry):</p> <p>The relation of the two sides of the body, left-right side, left-right arm, left-right leg etc.</p>
?	<p>a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)</p> <p>?</p> <p>?</p> <p>?</p> <p>?</p> <p>b. How important is this principle for your dance genre-style? (Dance Partners)</p> <p>?</p> <p>?</p>

	<p>e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)</p> <p>d. Comments (All)</p>
3	Balance
	<p>a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)</p> <p>b. How important is this principle for your dance genre-style? (Dance Partners)</p> <p>c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would chose? (Dance Partners)</p> <p>d. Do you see the connection between the movement principle, and the low level features we should capture analyze? Is there a challenge/obstacle? (Technical Partners)</p> <p>e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)</p> <p>d. Comments (All)</p>

4	<p>Alignment/Posture Stability Relation of the different body parts, joints</p> <p>a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)</p> <p>b. How important is this principle for your dance genre-style? (Dance Partners)</p> <p>c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would chose? (Dance Partners)</p> <p>d. Do you see the connection between the movement principle, and the low level features we should capture analyze? Is there a challenge/obstacle? (Technical Partners)</p> <p>e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)</p> <p>d. Comments (All)</p>
5	<p>Weight bearing/Gesture</p> <p>a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)</p> <p>b. How important is this principle for your dance genre-style? (Dance Partners)</p>

	<p>c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would chose? (Dance Partners)</p> <p>d. Do you see the connection between the movement principle, and the low level features we should capture analyze? Is there a challenge/obstacle? (Technical Partners)</p> <p>e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)</p> <p>d. Comments (All)</p>
6	<p>Gross vs. fine motorics, Isolation/articulation Small movements of particular body parts, isolated from the rest body versus larger more wholistic movements</p>
	<p>a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)</p> <p>b. How important is this principle for your dance genre-style? (Dance Partners)</p> <p>c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would chose? (Dance Partners)</p> <p>d. Do you see the connection between the movement principle, and the low level features we should capture analyze? Is there a challenge/obstacle? (Technical Partners)</p>

	<p>e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)</p> <p>d. Comments (All)</p>
7	<p>Coordination Synchronization of the different body parts</p>
	<p>a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)</p> <p>b. How important is this principle for your dance genre-style? (Dance Partners)</p> <p>c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would chose? (Dance Partners)</p> <p>d. Do you see the connection between the movement principle, and the low level features we should capture analyze? Is there a challenge/obstacle? (Technical Partners)</p> <p>e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)</p> <p>d. Comments (All)</p>

8	Motion through space Progressing through space or towards particular directions, paths etc.
	<p>a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)</p> <p>b. How important is this principle for your dance genre-style? (Dance Partners)</p> <p>c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would chose? (Dance Partners)</p> <p>d. Do you see the connection between the movement principle, and the low level features we should capture analyze? Is there a challenge/obstacle? (Technical Partners)</p> <p>e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)</p> <p>d. Comments (All)</p>
9	Rhythm –phrasing
	a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)

	<p>b. How important is this principle for your dance genre-style? (Dance Partners)</p> <p>c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would chose? (Dance Partners)</p> <p>d. Do you see the connection between the movement principle, and the low level features we should capture analyze? Is there a challenge/obstacle? (Technical Partners)</p> <p>e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)</p> <p>d. Comments (All)</p>
10	<p>Stillness</p> <p>a. Define a set of movements/movement sequences that are connected with the movement principle. (Dance Partners)</p> <p>b. How important is this principle for your dance genre-style? (Dance Partners)</p> <p>c. Give two examples-learning scenarios of teaching the particular principle. Which of the Learning Principles you would chose? (Dance Partners)</p>

d. Do you see the connection between the movement principle, and the low level features we should capture analyze? Is there a challenge/obstacle? (Technical Partners)

e. Is there any related work in your institution in capturing-analysing this particular movement principle please provide a link along with a very short description (2-3 lines). (All)

d. Comments (All)

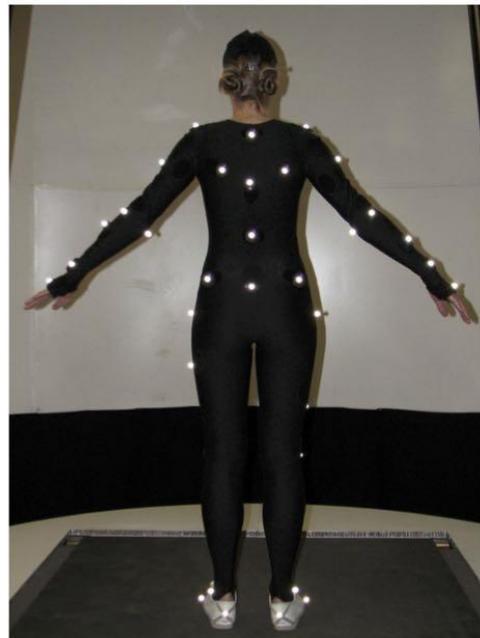
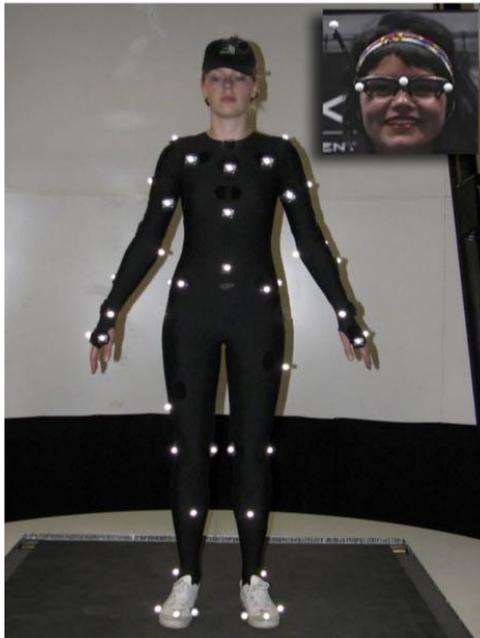
5.2 WhoLoDance Marker SetTemplate

WholoDance (WD) Marker set template

No.	Marker		Remarks
1	ARIEL	Top Head	On top of the head, offset from middle-above earline
2	LFHD	Left front head:	Just left above the ear, in front of earline.
3	RFHD	Right front head:	Just right above the ear, in front of earline.
4	MIDHD	Front Head:	Above noseBridge - forehead.
5	C7	C7:	On the 7 th cervical vertebrae.
6	T5	T5:	On the 5 th thoracic vertebrae.
7	T10	T10:	On the 10 th thoracic vertebrae.
8	BWT	Sacrum bone:	On the sacral bone.
9	FWT	Below Navel:	Front belly, same line of sacrum
10	CLAV	Xiphoid process:	Xiphoid proces of the sternum. Base of the calvici bones
11	STRN	Sternum:	On the jugular notch of the sternum.
12	LBSH	Left Scapula	On the inferior angle of the left scapula
13	LSHO	Left shoulder:	+/- 1cm posterior and lateral to the acromion process of the scapula
14	LFSH	Left deltoid muscle:	apex of deltoid muscle
15	LFUPA	Left front upper arm	1/3 range between shoulder and elbow front side
16	LBUPA	Left back upper arm	Mid range between shoulder and elbow back side
17	LIEL	Left lateral elbow:	First place LELB, place RELB near radial styloid process, in line with LIEL. Upper one in T-pose.
18	LELB	Left medial elbow:	elbow: on ulnair styloid process, medial as in anatomical pose. lower one in T-pose
19	LFRM	Left forearm:	On 1/3 on the line between the LLEE and LMW. See picture (not exact for creating assymetry)
20	LOWR	Left outside wrist:	on styloid process ulna, pinky side
21	LIWR	Left inside wrist:	on styloid process radius, thumb side
22	LIHAND	Left inside palm:	Palm on index finger side

23	LOHAND	Left outside palm:	Palm on pinky side
24	RSHO	Right shoulder:	+/- 1cm posterior and lateral to the acromion process of the scapula
25	RFSH	Right deltoid muscle	apex of deltoid muscle
26	RFUPA	Right front upper arm	1/3 range between shoulder and elbow front side
27	RBUPA	Right back upper arm	Mid range between shoulder and elbow back side
28	RDELTA	Right deltoid muscle:	apex of deltoid muscle
29	RIEL	Right lateral elbow:	Symmetrical to Left arm setup. Upper one in T-pose.
30	RELB	Right medial elbow:	On ulnar styloid process, medial as in anatomical pose. Lower one in T-pose
31	RFRM	Right forearm	On 2/3 on the line between the RLEE and RMW. See pictures (not exact)
32	ROWR	Right outside wrist	on styloid process radius, pinky side
33	RIWR	Right inside wrist	on styloid process ulna, thumb side
34	RIHAND	Right inside palm:	Palm on index finger side
35	ROHAND	Right outside palm:	Palm on pinky side
36	LFWT	Pelvic bone left front	Left anterior superior iliac spine
37	RFWT	Pelvic bone right front	Right anterior superior iliac spine
38	LBWT	Pelvic bone left back	Left posterior superior iliac spine
39	RBWT	Pelvic bone right back	Right posterior superior iliac spine
40	LFTHI	Left thigh front	On 1/3 on the line between the LFWT and LKNE, front side. See pictures (not exact).
41	LBTHI	Left thigh back	On 1/3 on the line between the LFWT and LKNE, back side. See pictures (not exact).
42	LKNE	Left lateral epicondyl of the knee	on joint axis, outer side
43	LKNI	Left lateral epicondyl of the knee - inside	On joint axis, inner side
44	LSHN	Left anterior of the tibia	Left Sheen. see pictures (not exact)
45	LANK	Left lateral malleolus of the ankle	Right in the center
46	LHEL	Left heel	center of the heel at the same height as toe
47	LTOE	Left toe	tip of big toe

48	LMT1	Left 1 st meta tarsal	Caput of the 1 st meta tarsal bone, on joint line midfoot-toes
49	LMT5	Left 5 th meta tarsal	Caput of the 5 th meta tarsal bone, on joint line midfoot-toes
50	RFTHI	Right thigh front	On 2/3 on the line between the RFWT and RKNE. See pictures (not exact).
51	RBTHI	Right thigh back	On 2/3 on the line between the RGTR0 and RLEK. See pictures (not exact).
52	RKNE	Right lateral epicondyl of the knee	on joint axis outer side
53	RKNI	Right lateral epicondyl of the knee - inside	on joint axis inner side
54	RSHN	Right anterior of tibia	Right Sheen. see pictures (not exact)
55	RANK	Right lateral malleolus of the ankle	Right in the center
56	RHEL	Right heel	Center of the heel at the same height as toe
57	RTOE	Right toe	tip of big toe
58	RMT5	Right 1 st meta tarsal	Caput of the 1 st meta tarsal bone, on joint line midfoot-toes
59	RMT5	Right 5 th meta tarsal	Caput of the 5 th meta tarsal bone, on joint line midfoot-toes



5.3 Schedule of Motion Capture Sessions

Table 4-Genoa Motion Capture Agenda

Experimental Recording Sessions - Minutes Wholodance											
Meeting	Experimental Recording Sessions Casa Paganini-InfoMus research centre, Genoa (IT)										
Day/Date	21 st , 22 nd , 23 rd March 2016										
Participants 21 st	Stefano Di Pietro (Lynkeus)*, Antonio Camurri (UniGe), Gualtiero Volpe (UniGe), Katerina El Raheb (Athena), Amalia Markatzi (LCGW), Michele Buccoli (PoliMi), Massimiliano Zanoni (PoliMi), Jean-Marc Matos (K.Danse)*, Marianne Mason (K.Danse)*, Pablo Palacio (Stocos), Muriel Romero (Stocos)										
Participants 22 nd	Stefano Di Pietro (Lynkeus), Antonio Camurri (UniGe), Gualtiero Volpe (UniGe), Katerina El Raheb (Athena), Michele Buccoli (PoliMi), Massimiliano Zanoni (PoliMi), Amalia Markatzi (LCGW), Jean-Marc Matos (K.Danse), Marianne Mason (K.Danse), Pablo Palacio (Stocos), Muriel Romero (Stocos)										
Participants 23 rd	Stefano Di Pietro (Lynkeus)** (Morning), Antonio Camurri (UniGe), Gualtiero Volpe (UniGe), Katerina El Raheb (Athena), Massimiliano Zanoni (PoliMi), Amalia Markatzi (LCGW), Jean-Marc Matos (K.Danse), Marianne Mason (K.Danse), Pablo Palacio (Stocos), Muriel Romero (Stocos)										
Notes, description of work, annotations	Jean-Marc Matos (K.Danse), Pablo Palacio (Stocos), Muriel Romero (Stocos), Katerina El Raheb (Athena), Antonio Camurri (UniGe)										
Contributor, final revision, integration and approval	Stefano Di Pietro (Lynkeus)										
<p>*Only Afternoon</p> <p>**Only Morning</p> <p>Agenda</p> <table border="1"> <thead> <tr> <th>Point</th> <th>Agenda topic</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Test and consolidate the multimodal recordings setup</td> </tr> <tr> <td>2</td> <td>Record series of short fragments (1 to 2 min each) of synchronized multimodal data (MoCap, audio, IMUs, 2 videocameras) focusing on specific movement qualities related to the Contemporary Dance scenarios</td> </tr> <tr> <td>3</td> <td>Analyse and discuss the results of the capturing</td> </tr> <tr> <td>4</td> <td>Others issues raised</td> </tr> </tbody> </table>		Point	Agenda topic	1	Test and consolidate the multimodal recordings setup	2	Record series of short fragments (1 to 2 min each) of synchronized multimodal data (MoCap, audio, IMUs, 2 videocameras) focusing on specific movement qualities related to the Contemporary Dance scenarios	3	Analyse and discuss the results of the capturing	4	Others issues raised
Point	Agenda topic										
1	Test and consolidate the multimodal recordings setup										
2	Record series of short fragments (1 to 2 min each) of synchronized multimodal data (MoCap, audio, IMUs, 2 videocameras) focusing on specific movement qualities related to the Contemporary Dance scenarios										
3	Analyse and discuss the results of the capturing										
4	Others issues raised										

Table 5-Detailed Schedule of Motion Capture in Amsterdam

MOTEK Entertainment Shoot planning Location: SCHRAM STUDIOS Amsterdam Studio phone: +31 (0)20-6345123 Thijs Mobile phone: +31 654 977 438

	Saturday 30 April 2016	Sunday 1 May 2016	Monday 2 May 2016	Tuesday 3 May 2016	Wednesday 4 May 2016	Thursday 5 May 2016	Friday 6 May 2016	Saturday 7 May 2016	Sunday 8 May 2016	Monday 9 May 2016	Tuesday 10 May 2016	Wednesday 11 May 2016	Thursday 12 May 2016
Time	Studio	Studio2	Studio3	Studio4	Studio5	Studio	Studio						
9:00-9:30	Technical setup	Pre-vis setup	System Calibration	Setup Performer (Greek)	Setup Performer (Greek)	Setup Performer (Kdance)	INTERNAL						
9:30-10:30	Technical setup	Pre-vis setup	Preview testing	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	INTERNAL						
10:30-10:45	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break
10:45-11:15	Technical setup	Pre-vis setup	Performer Setup	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	INTERNAL						
11:15-11:45	Technical setup	Pre-vis setup	Mocap (Greek)	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	INTERNAL						
11:45-1:15	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch
1:15-1:45	Technical setup	Pre-vis setup	Mocap (Greek)	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	INTERNAL						
1:45-2:15	Technical setup	Pre-vis setup	Mocap (Greek)	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	INTERNAL						
2:15-2:30	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break
2:30-3:00	Performance test	Pre-vis performance setup	Mocap (Greek)	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	Free	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	INTERNAL
3:00-3:30	Performance test	Pre-vis performance setup	Mocap (Greek)	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	Free	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	INTERNAL
3:30-3:45	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break
3:45-4:15	Performance test	Pre-vis performance setup	Mocap (Greek)	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	Free	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	INTERNAL
4:15-4:45	Performance test	Pre-vis performance setup	Mocap (Greek)	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	Free	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	INTERNAL
4:45-5:00	Performance test	Pre-vis performance setup	Mocap (Greek)	Mocap (Greek)	Mocap (Greek)	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	Free	Mocap (Kdance)	Mocap (Kdance)	Mocap (Kdance)	INTERNAL

Crew	Osh, Thijs, Jochem, Ali	Osh, Thijs, Jochem, Marcella, Stefano	Jasper Osh, Thijs, Jochem, Marcella, Stefano	JASPER OSH, THIJS, JOCHEM, MARCELLA, STEFANO+VID	Jasper Osh, Thijs, Jochem, Marcella, Stefano	Processing								
Performers	Dummy	Marcella	Greek dancers	Greek dancers	Greek dancers	Jean-Marc / Marianne								
Transport		Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	

Table 6 Detailed Schedule of Motion Capture in Amsterdam

MOTEK Entertainment Shoot planning Location: SCHRAM STUDIOS Amsterdam Studio phone: +31 (0)20-6345123 Thijs Mobile phone: +31 654 977 438

	Saturday 9 July 2016	Sunday 10 July 2016	Monday 11 July 2016	Tuesday 12 July 2016	Wednesday 13 July 2016	Thursday 14 July 2016	Friday 15 July 2016	Saturday 16 July 2016	Sunday 17 July 2016	Monday 18 July 2016	Tuesday 19 July 2016	Wednesday 20 July 2016	Thursday 21 July 2016
Time	Studio	Studio2	Studio3	Studio4	Studio5	Studio	Studio	Studio	Studio	Studio	Studio	Studio	Studio
9:00-9:30	Technical setup	Pre-vis setup	System Calibration	Setup Performer (Classic)	Setup Performer (Classic)	Setup Performer (Stoccos)	Setup Performer (Stoccos)	Setup Performer (Stoccos)	Setup Performer (Flemenco)	Setup Performer (Flemenco)	Setup Performer (Flemenco)	Setup Performer (Flemenco)	INTERNAL
9:30-10:30	Technical setup	Pre-vis setup	Preview testing	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
10:30-10:45	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break
10:45-11:15	Technical setup	Pre-vis setup	Performer Setup	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
11:15-11:45	Technical setup	Pre-vis setup	Mocap (Classic)	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
11:45-1:15	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch
1:15-1:45	Technical setup	Pre-vis setup	Mocap (Classic)	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
1:45-2:15	Technical setup	Pre-vis setup	Mocap (Classic)	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
2:15-2:30	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break
2:30-3:00	Performance test	Pre-vis performance setup	Mocap (Classic)	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Free	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
3:00-3:30	Performance test	Pre-vis performance setup	Mocap (Classic)	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Free	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
3:30-3:45	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break	Break
3:45-4:15	Performance test	Pre-vis performance setup	Mocap (Classic)	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Free	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
4:15-4:45	Performance test	Pre-vis performance setup	Mocap (Classic)	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Free	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL
4:45-5:00	Performance test	Pre-vis performance setup	Mocap (Classic)	Mocap (Classic)	Mocap (Classic)	Mocap (Stoccos)	Mocap (Stoccos)	Mocap (Stoccos)	Free	Mocap (Flemenco)	Mocap (Flemenco)	Mocap (Flemenco)	INTERNAL

Crew	Osh, Thijs, Jochem, Ali, Jasper, Ruth, Bruno	Osh, Thijs, Jochem, Marcella, Stefano, Bruno	JASPER OSH, THIJS, JOCHEM, MARCELLA, STEFANO, RUTH, BRUNO	Jasper Osh, Thijs, Jochem, Marcella, Stefano, Ruth, Bruno	JASPER OSH, THIJS, JOCHEM, MARCELLA, STEFANO, RUTH, BRUNO	Jasper Osh, Thijs, Jochem, Marcella, Stefano, Ruth, Bruno	JASPER OSH, THIJS, JOCHEM, MARCELLA, STEFANO, RUTH, BRUNO	Jasper Osh, Thijs, Jochem, Marcella, Stefano, Ruth, Bruno	JASPER OSH, THIJS, JOCHEM, MARCELLA, STEFANO, RUTH, BRUNO	Jasper Osh, Thijs, Jochem, Marcella, Stefano, Ruth, Bruno	JASPER OSH, THIJS, JOCHEM, MARCELLA, STEFANO, RUTH, BRUNO	Jasper Osh, Thijs, Jochem, Marcella, Stefano, Ruth, Bruno	JASPER OSH, THIJS, JOCHEM, MARCELLA, STEFANO, RUTH, BRUNO	Processing
Performers	TBF	Marcella	Classic dancers	Classic dancers	Classic dancers	Muriel ++	Muriel ++	Muriel ++	Rosamarie	Rosamarie	Rosamarie	Rosamarie	Rosamarie	
Transport		Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	Pick up and drop off	

Note: Friday July 8th Dance floor layout at studio

5.4 Details of Genoa Motion Capture

Detailed description and annotated list of the Movement Qualities Captured

21st March

Stocos - [Muriel Romero, Pablo Palacio](#)

Trial 1 – calibration

1. ORIGIN/DESTINATION OF MOVEMENT

Quality connected with the concept of *point of inscription*. It also leads to enhance the awareness of each body part.

Task 1: Trial 2 move each limb individuality

Hands, elbows, feet, shoulders, hips, knees, arms, head, torso, head

Different parts of the cube with larger movements.

Exercise with single parts of the body and at the same time with the relation of the Laban cube (pedagogical objective to be in relation with the external space).

As a preparation to this quality, we start to feel each part of the body separately, moving them independently with different qualities (direct/flexible) and directions.

Trial 3: leading joints, full body movements

Right hand;

Trial 4: leading joint: left shoulder

Trial 5: origin leading joint to a destination (Skip)

Trial 6: origin-destination (sequenza, troppo separate)

Trial 7: skip

Trial 8: right elbow – right foot (4 times)

Trial 9: head should knees head feet.

Trial 10: start from different posture

2. FLUIDITY

Trial 11 fluidity in all directions of the cube (direct)

Trial 12: fluid different limbs (flexible)

Trial 13 and 14: staccato in the cube

Trial 15 skip

Trial 16: Coordination cross-hemispheres fluid

Trial 17: internal propagation fluidity

Trial 18: external propagation fluidity

19 skip

Trial 20: external propagation fluidity (basic) main arms

Trial 21: external propagation fluidity (basic) other parts of the body

Trial 22 alternance fluid/staccato (Perdita sensore tallone)

Trial 25: external propagation fluidity (basic) REPEATED

Trial 26: internal and external propagation (fluidity) REPEATED

Trial 27: alternance fluid/staccato REPEATED

Trial 28: collapse of joints (Weight - Task 1)

Trial 29: collapse of joints (Weight - Task 1) more samples

Trial 30: catch a falling hand

Trial 31: skip

Trial 32: multidimensional gravity

Trial 33: multidimensional gravity repeat

Trial 34: natural gravity: heavy and light alternating

3. BALANCE

Trial 35: in/out of balance (small postural changes, fw/bw, left/right...)

Trial 37: in/out of balance (in directions of the cube)

22nd March

K.Danse - Jean-Marc Matos, Marianne Masson

Propagation

Trial 2: 3 repetitions of fluid propagation, adjacent propagation origin-arrival

6

Origin to destination: h, rs, ls, h, rk, rangle, f

Trial 3: 3 repetitions of fluid propagation, adjacent propagation origin-arrival
Lh, lw le ls back/spine hip rk lf

Trial 4: 3 repetitions of fluid propagation, adjacent propagation origin-arrival

Trial 5: 3 repetitions, non adjacent (external) propagation (within fluidity)

Trial 6: 3 repetitions, non adjacent (external) propagation (within fluidity)

Trial 7: 3 repetitions, non adjacent (external) propagation (any possible mix of quality)

Trial 8: 3 repetitions, non adjacent (external) propagation (any possible mix of quality)

Trial 9: 3 repetitions, non adjacent (external) propagation (fluidity) if too slow down for a longer time, we tend to lose the perception of source-origin ->

Trial 10: 3 repetitions, (faster) non adjacent (external) propagation (regardless fluidity or any other quality): response in same or different direction: in fluidity same direction and same quality.

Fluidity:

Basic drawing in space with different parts of the body (first approach)

Pedagogical: start on directionality

Trial 11: same drawing in space done by left shoulder, hips, head, right hand.

Trial 12: same drawing drawn by different parts combined (transfer the drawing from one part to another).
Same drawing but larger in volume. (3 times)

head, le, lh, chest, ls, rf

when passing drawing from one limb to another, there is internal or external propagation in the crossing.

Trial 13: fluidity obtained internal wave propagation with low level of muscular contraction

Trial 14: fluidity obtained internal wave propagation with medium level of muscular contraction

Trial 15: fluidity obtained internal wave propagation with high level of muscular contraction -> slower

Fragmentation; with/without modulation (connecting fluid parts)

Three ways to produce fragmentations: points/segments/translations

Trial 16: fragmentation (without rigidity and without modulation)

Trial 17: strict fragmentation (rigid, sharp)

Trial 18: rigid movements connected by fluid parts (modulation)

Trial 19: strict rigid with modulation (fluid parts connecting rigid parts).

Trial 20: Mix of 16-19 but without moving the feet

Highest level of Fragmentation: trembling. One part of the body Vs whole body.

Trial 21: trembling. Single parts

Trial 22: trembling, whole body

Trial 23: fragmentation also on time (avoid rhythmic patterns as much as possible).

Equilibrium:

Trial 24: reach points of lack of equilibrium (important first pedagogical thing to learn)

Trial 25: travel from one point of equilibrium to another

Trial 26: travel from one point of equilibrium to another, without recovering to the central position (without recuperating), constantly at risk

== afternoon

COORDINATION

Trial 28: simple coordination and symmetry hands and fingers, then arms (interrupted)

Trial 29: simple coordination and symmetry hands and fingers, then arms, Shoulders, Knees and feet, jumps

Task3 of coordination (Jean-Marc):

Trial 30: coord of two different parts of the body, but at same side

Trial 31: cords two different parts of the body, but at same side: other movements (right shoulder and feet)

Trial 32: coord two parts at diagonal (rh +ll;)

Task4:

Trial 33: coord, drawing external, symmetrical

Trial 34: coordination of rhythm, speed; same rhythm of ra and ll

Trial 35: arm-arm, differentiate rhythmic approach

Trial 36: leg-leg, differentiate rhythmic approach (also includes balance)

Trial 37: arm leg head same side

Trial 38: coordination 3 parts head and arms: different rhythms and actions

Trial 39:

Trial 40: go to sequence (not simultaneous); complesso

Different qualities, rhythms, sometime at the same time (go back to simultaneous)

Trial 41: repeat (alla fine perde un sensore)

==

SUDDEN interpreted as expectancy/surprise/cause of tension

Sudden changes between two qualities

Trial 42: extremely slow and sudden changes then again slow (acceleration peak, high speed for a short time, changing directions and parts of the body)

Trial 43: task 2, any kind of event (incl stop) in unexpected way; constraint: not let any kind of leit motiv too regular: break regularity.

Trial 44: (repeat) irregular durations of stops and events.

==

WEIGHT

Trial 45: collapse of joints (different joints)

Trial 46: play with an imaginary ball bouncing on the body (also significant for origin-destination)

Trial 47: weight: gravity: different paths to the ground; avoided balance/unbalance as far as possible (but present: unavoidable to have balance with weight);

Trial 48: repeat;

23rd March

(Morning)

Stocos - Muriel Romero, Pablo Palacio

COORDINATION:

Trial 3: hands coordination, symmetry, fluidity

Trial 4: elbow coordination, symmetry, fluidity

Trial 5: shoulders coordination, symmetry, fluidity

Trial 7: arms coordination, symmetry, fluidity

Trial 8: knees coordination, symmetry, fluidity

Trial 9: feet coordination, no symmetry, fluidity

Trial 10: full-body coordination, symmetry, fluidity (longer)

= second step:

Trial 11: coordination, one side (right) of the body, different qualities

= third step:

Trial 12: coordination, Two body parts, at different sides, different qualities, incl. Symmetry

Total jerk – trembling

Jumping
Robot

This exercise is also a choreographic tool.

(Marianne)

4 levels of Conversations concurrently active in the dancer:

Feel body and muscles;

feel external space, volume managed by the body;

Relations with other people;

Imaginary: Imagine a floor with a texture, or wet, or it's raining, it's hot, ...

Multiple possibilities to make complexity, multiple emotions at the same time, and change main communicated emotion in one second: e.g. from picant, to honest, to bored...

Change

5.5 Summary of captured Greek dance structures

This appendix presents the number of sequences recorded per Greek dance structure

Table 7 Summary of captured Greek dance sequences

Dance structure	Full sequences	Segments
Baintouska	1	4
Ballos	4	23
Chaniotikos	1	6
Chassapiko	4	
Enteka	1	3
Forlana	1	
Gaida	4	
Ikaritico	1	5
Issos	3	3
Kalamatianos	2	
Kaneloriza	1	3
Karatzova	4	6
Karsilamas	3	5
Kastrinos	2	19
Katsivelikos	1	7
Kotsari	1	
Koutsos	1	8
Leventikos	3	13
Letsina	1	4
Nisamikos	1	4
Papadia	2	15
Patima	1	6
Patinada	1	3
Patrouninos	1	3
Pentozali	2	
Pidiktos	4	6
Pousnitsa	1	
Proskynitos	1	7
Pyrgousikos	1	
Raiko	3	
Raiko	1	7
Sera	2	8
Seranitsa	1	3
Sfarlys	2	
Sousta	1	4
Sta Dio	3	
Sta tria	4	

Streis	1	6
Syghistos	2	9
Syrtos	2	
TikTrom	1	
TikPal	1	2
Trigona	1	2
Tritepati	1	3
Tsamiko	2	13
Vagelitsa	2	
Vlaha Naxos	1	2
Zagorisio	2	12
Zervodexos	1	6
Zervos	1	3
Zonaragitos	1	6
Zorba	3	
Basic steps		10
Total	93	249