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“Sources of difficulty in dance movements acquisition”

Verfasst von

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1. Introduction

This study aims to pilot a methodology for research on the perceived difficulty of learning movements from a dance style. The main assumption behind this study is that this particular type of motor learning may be perceived as difficult for many different reasons that are, by far, not limited to physical load or to high memory demand. The study hypothesizes about the relevance of complexity, familiarity and awkwardness (category summarizing different types of hesitation occurring during acquisition) for the perception of difficulty. The empirical example involves ballet dancers and non-dancers attempting to copy hip-hop movements, grading their difficulty in a questionnaire and then elaborating on the learning experience in an interview. All learning outcomes have been recorded with two motion capture systems – AnimaZoo and Kinect and have later been graded by a panel of dance expert judges (using a tailor made assessment sheet).

The two groups of participants were selected in order to cover a different scope of kinesthetic and motor learning abilities and experience. While the ballet dancers are expected to be more successful in the performance of the moves, in general, they are thought to experience a specific type of difficulty based on occurring "negative knowledge transfer" (Detterman 1993). In other words, their proficiency in ballet is expected to make the learning process more difficult as the movements they should learn are incompatible with their training. This remains to be tested by this work.

The master thesis is structured in the following way. First, a general introduction is combined with motivation and interdisciplinarity section (Chapter 1). Second, theoretical background, definitions (Chapter 2) and the methods of the study (Chapter 3) are outlined. Third, the validation of the study (Chapter 4), the quantitative and qualitative study results (Chapter 5) are presented. This is followed by a discussion of the results (Chapter 6) and a conclusion (Chapter 7). The most relevant materials of the study, e.g., the questionnaires and the interview guidelines, as well as a small sample of the interview transcripts can be found in the Appendix (Chapter 9).

1. Motivation

This feasibility study is a part of my two and a half year long work on task difficulty. My previous experience includes theoretical and empirical research on topics such as: Dynamic Difficulty Adjustment (DDA) in first person shooter games; the effects of irreversibility on perceived difficulty; estimating difficulty of chess tactical problem (Hristova 2014a, 2014b). The last project has inspired a part of the methodology of my Master thesis project, as shown in Table 1. The difficulty estimates, as well the qualitative

interviews used have proven extremely useful for the purposes of my previous research. Hence, they built the core of my methodology of the current project and have been complemented by data from the two motion capture sensors AnimaZoo and Kinect.

My research focus has shifted from chess problems to acquisition of dance style due to my experience with classical ballet and dance. This Master thesis project has also inspired further projects of mine, such as the art-science project Dynamic Difficulty Adjustment (2015) where the same motion capture equipment has been used, however the methodology differs significantly. DDA provided a more open framework for explorative research on the sources of perceived difficulty in creative work and as a creative concept.

Research projects	Estimating the difficulty of chess tactical problems	Sources of difficulty in dance style acquisition
Methods	Eye tracking, difficulty rankings, qualitative interviews	Motion capture x2, difficulty questionnaires, qualitative interviews

Table 1. Methodology comparison – previous and current study

2. Interdisciplinarity

This is an interdisciplinary study on the perceived difficulty of dance movement acquisition. The main disciplines (and their topics) involved are:

- Psychology and Cognitive science – task difficulty has been studied within various research on games and classical cognitive tasks (Van Merrienboer 2005), as well as on the neural underpinning of perceived difficulty (Brawner 2014).
- Psychophysiology in human-robot interaction and games/virtual reality – attempts have been made to measure physiological parameters such as heart rate, skin temperature, galvanic skin response and pupil dilation, to detect increased physical or cognitive load. These measures have been used as an input for dynamic difficulty adjustment (DDA) in computer games or serious games (in rehabilitation, military simulations etc.) using psychophysiology sensors (Yun 2009).
- Anthropology – the hypotheses connected to negative knowledge transfer (Detterman 1993) are based on concept of internalization of movement culture. Two concepts are crucial to this research – "habitus" (Bourdieu 1990), "techniques of the body" (Mauss 1936).
- Kinesiology and Movement research – a research on task difficulty (Sanli 2014) in motor learning is crucial to the current study. The distinction between nominal

and functional task difficulty provides an understanding of difficulty (Guadagnoli 2004) that enables a better design of training and rehabilitation routines.

- Artificial intelligence - the movement data captured with AnimaZoo and Kinect will be analyzed for training related motion patterns in a follow up study.

Some main contributions are outlined in the following chapter "Theoretical background".

2. Theoretical background

1. "Difficulty" in Cognitive Science

The focus of this investigation lies on the perceived difficulty of learning a movement from a dance style, on the example of ballet dancers and non-dancers copying hip-hop moves. It is embedded in the context of the diverse research on difficulty. In this section, I am going to first briefly outline the research on task difficulty in cognitive science in the areas of: neuroscience; psychology; psychophysiology; and game design. Then the concept of difficulty, as well as several classification attempts from kinesiology and human performance research, will be discussed in more detail.

Task difficulty has been around as a topic of cognitive science for some time and has been explored in studies based on: quantitative questionnaires (Bergstrom 2014; Passyn 2012), fMRI (Barch 1997; Gould 2003; Drummont 2004. Anticevic 2011), EEG (Gevins 1997; Rietschel 2012; Brouwer 2014). Most commonly, neuroscience studies have focused on the neural correlates of task difficulty and in most cases use difficulty as means to alter the experimental conditions and to observe change in physiological reactions, without problematizing "difficulty" as a concept. A body of literature is also available on difficulty in classical problems such as the Sokoban puzzle (Jarusek 2010), Tower of Hanoi (Kotovsky 1985) Chinese rings (Kotovsky 1990), nine-dot problem (Ollinger 2014), Traveling Salesperson problem (Dryn 2006) and Sudoku (Pelanek 2011) among others. These works are primarily concerned with the complexity of the problems they examine. An example of a work focused on the difficulty perceived by the person solving them is the research of Hristova, Guid and Bratko (Hristova 2014a, 2014b)[1] on estimating the difficulty of chess problems.

Finally, "difficulty" has gained significance in the field of psychophysiology and particularly in relation to game design due to its importance for the involvement of the player in the game. More recently, Dynamic Difficulty Adjustment (DDA) (Hunicke 2004; Liu 2009) has been brought into being – the effort to dynamically alter the difficulty level as a direct response to the player's experience of difficulty. The aim is to read the player's

[1] As previously mentioned I myself have been involved in research on estimating task difficulty in chess.

state – by psychophysiology or performance measures – and to alter parameters so that they don't experience boredom (not enough challenge) or frustration (too high challenge). DDA strives to use psychophysiology signals indicating anxiety or stress reactions, such as increased heart rate, changes in the galvanic skin response, signs of fear that can be read from facial expression or temperature fluctuation (Yun 2009). However, one of the most commonly used indicators of high difficulty remains poor performance by the player. For example, Hunicke and Chapman point out "flailing" detection as one of the primary parameters for altering difficulty of task in a DDA algorithm (Hunicke 2004).

In motor learning research, task difficulty has mostly been "taken for granted", meaning considered without a definition and simply as a parameter to be altered within the learning conditions (Pavlides 1993; Keetch 2007; Andrieux 2014). The main application of the concept is in applied terms for designing exercises and tools for the assessment of motor pathologies. An exception in this regard is the "challenge point framework" by Guadagnoli and Lee (Guadagnoli 2004) - a paper combining the applied view on the topic with a useful classification of difficulty types: nominal and functional. This distinction will be addressed shortly.

As Sanli and Lee point out (Sanli 2015), task difficulty should be classified for each different type of tasks since one universal definition of the sources of difficulty cannot be found (Guadagnoli 2004). Hence, the purpose of this study is to contribute to the deeper understanding of the sources of subjectively perceived difficulty during learning dance.

2. Types of difficulty

a. "Task difficulty" refers to the characteristics intrinsic to the task itself, such as complexity etc. Within the "challenge point framework", this type of difficulty is referred to as "nominal task difficulty" (Guadagnoli 2004). Traditionally this type of difficulty has been approached as a problem of combinatorics and attempts are made to describe it for various tasks using complexity indexes. The most influential example of a study describing nominal task difficulty is Fitts' "index of difficulty" using the size of a target and the distance to it to describe the difficulty of a reaching task aiming at it (Fitts 1954). In other words, the larger and the closer the target is, the easier reaching for it is considered. Fitts' Law outlines the relationship between task difficulty and movement time. Another more recent example of a "task difficulty" measures is provided by Chan et al. who define complexity in their experiments in terms of the "frequency (the times of movement per second), sequential length, number of movements, movement phase, or the task nature" (Chan 2009).

In the current research, "task difficulty" could refer to parameters, such as the number of body parts actively involved in the movement or the complexity of their coordination and to the length of the move. This type of difficulty has been taken in consideration for the selection of the experiment moves. One of the categories is termed "complex movements" and has been included in order to study the influence of move complexity on the perceived difficulty. A more detailed description of the classification of experiment movements is presented in the chapter "Methods". Furthermore, "task difficulty" and more specifically, the "task nature" (Chan 2009), has implications for the design of the learning outcome assessment sheets where both the transitions of the different body parts and the characteristics of the move performed are graded.

b. Sanli and Lee (Sanli 2015) define **"functional difficulty"** (Guadagnoli 2004) as "the challenge presented by a task relative to the conditions in which the task is performed and the skill level of the learner". In this experiment, the skill in movement of the participants varies within two main groups: the professional ballet dancers and the non-dancers[2]. However, the two groups are more heterogeneous when it comes to knowledge of hip-hop and the ability to copy movement accurately. The analysis of the skill of the participants is outlined in more detail in the "Methods" section of this work. What concerns the learning conditions, the order in which the movements are presented or motion capture suit that they are wearing has an impact on the functional difficulty of the movement. In this experiment, the set of moves is presented in a random order to avoid a sequence effect. The effects of the measurement environment (social setting, sensors) are addressed in the "Validation" chapter.

c. **"Perceived difficulty"** is the primary concern of this study. It describes the purely subjective perceived difficulty of a task for each particular person. One can say that it is the reported derivative of the functional difficulty that takes into account not only the skill and the circumstances for performing but also the knowledge set and the attitudes of the learner. In this study, both are addressed through quantitative and qualitative methodology. The most influential assessment tools connected to self-reported perceived effort are the Borg rating of perceived exertion scale (Borg1982) and the NASA Task Load Index (Hart 1988).

[2] More precisely – non-professional dancers.

6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

Fig.1 Borg rating of perceived exertion scale

Borg's scale has been used mostly in sports – for the design or training routines – and in medicine – for clinical diagnosis of different conditions such as chronic obstructive pulmonary disease and musculoskeletal pain. In the original scale, effort has been assessed between 6 and 20, where 6 stands for "no exertion at all" and 20 – for "maximal exertion". Within the context of this Master thesis the Borg exertion scale has inspired the "physical demand" scale in the difficulty assessment sheets. However, the scale has been presented as a 7-point Likert scale from "physically very light" to "physically very demanding".

Furthermore, measures have been taken that the movements included in the experiment do not significantly differ from each other in terms of physical demand (low). The main aim was to provide tasks where the difficulty is, in Passyn's and Mita's classification, skill-based, and not effort-based (Passyn 2012). Nevertheless, a measure of perceived exertion is considered to be a crucial component of the difficulty assessment. Under other circumstances, with a different selection of movements (e.g. capoeira or break dance acrobatics), physical exertion or effort-based difficulty may be among the most influential aspects of difficulty.

The NASA TLX index is probably the most influential method for assessment of perceived difficulty. Studies like Cao's (Cao 2009) review the strong impact of the NASA TLX on the human performance research. It assesses multiple categories of difficulty parameters, such as: mental demand, physical demand, temporal demand, performance, effort and frustration. The scales for each parameter are 20- point scales from (typically) "very low" to "very high". This assessment tool has been the primary inspiration for this study. The items in the quantitative questionnaires in this study include modified NASA TLX items, plus additional ones tailored to the study of dance moves acquisition. The "performance" scale has been omitted as the participants' learning outcomes in this study are analyzed and graded by a panel of three dancer judges. However, the variety of sources of difficulty addressed is supposed to be preserved. The relevance of the rest of the scales for the quantitative questionnaire used in this Master thesis project will be discussed in the following sections.

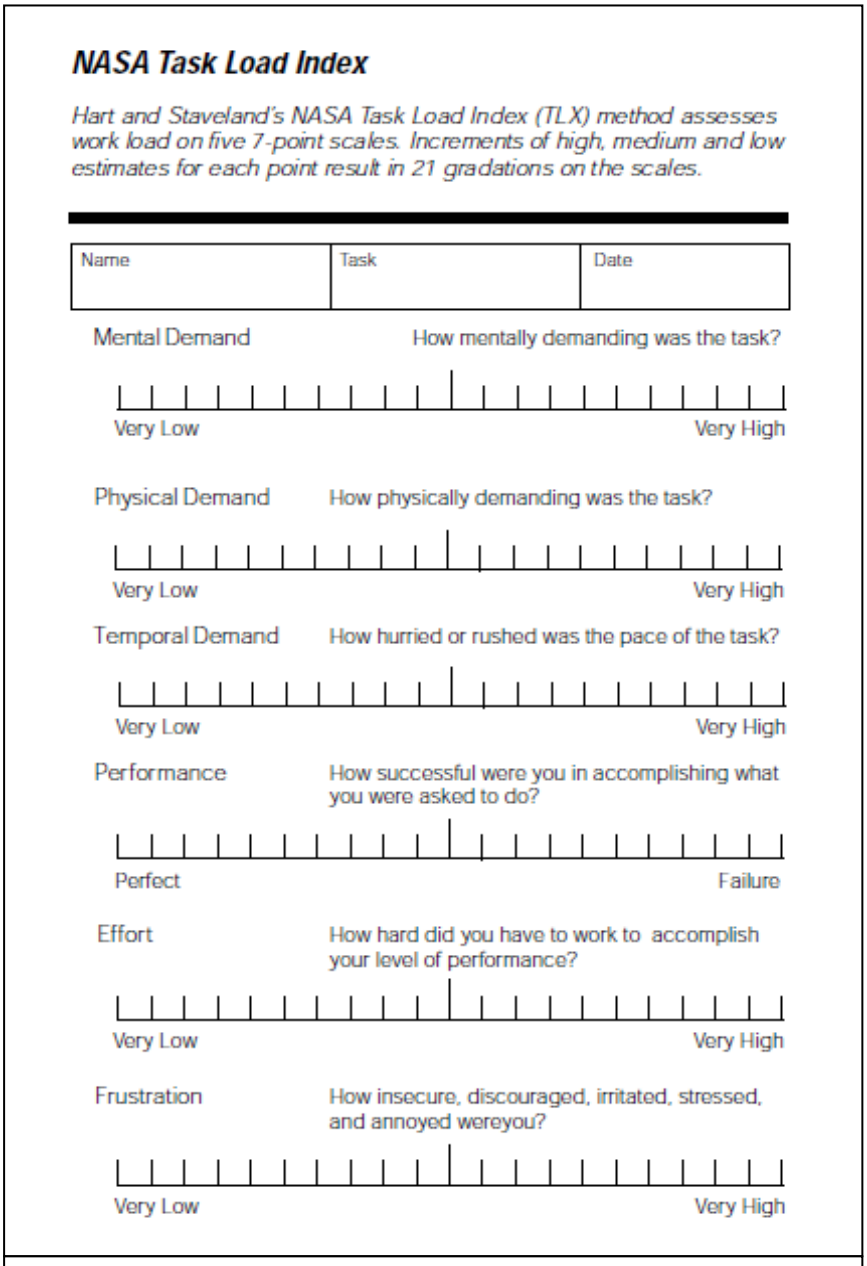

Fig.2 NASA Task Load Index (TLX)

3. Motor learning and dance

This chapter briefly outlines the process of motor learning in human development. Since dance is acquired relatively late in a child's life, or certainly – after the acquisition of the basic capacities to move and to move in a way that is considered acceptable by the society (Lomax 1968), it has a different impact on the movement patterns. In other words, dance moves step on the ground of the individual's biological inheritance, cultural adaptation, and life experience" (ibid.).

a. Basic kinemes

First, motor patterns and basic solutions to the most basic tasks in a person's life should be acquired: the know-how to reach, crawl, stand up, walk etc. (Jeannerod 2006). There

are multiple levels of the organization of the motor system based on "a set of motor rules which become progressively installed as maturation of the nervous system progresses" (ibid.). This set, bound to the biomechanical limitations of the organism, lays the foundation for the ongoing motor learning.

b. Being appropriate

Second, the child is learning to perform all movements in an appropriate way – in a manner adequate to the given society. A crucial part of this ability is the inhibition of urges and the management of behavior in the way dictated by the norm etc. The requirements towards one's social graces change throughout their socialization towards adulthood, with social control being strict for the adults, a.k.a. the full members of society. Lomax, Bartenjeff and Pauley speak of "body attitude as the limiting postural state from which the individual in a culture develop their activities and from which their movements unfold" (Lomax 1968). In cultural and social anthropology this is commonly referred to as enculturation or "habitus". Habitus stands for the "cultural habitat which becomes internalised in the form of dispositions to act, think, and feel in certain ways" (Bourdieu 1990) and is conceived of as "culturally determined bodily dispositions which have no representative content and at no stage pass through consciousness" (ibid.). The concept of habitus originates from the earlier work of Marcel Mauss on the techniques of the body (fr. "Les techniques du corps") (Mauss 1936) – the culturally specific ways to manage the body (positions and movement). Learning movements from dance necessarily steps on the base of the individual and culturally specific motor patterns.

c. Learning dance[3]

Dance acquisition comes in interaction with preexisting personal motor patterns shaped around: social requirements towards behavior and motion, body's shape and size (bones length, joints shape, flexibility of tendons), history of injuries, asymmetries etc. It consists in incorporating a set of new rules into one's organization of movement. Modifying preexisting motor schemes through new rules is the essence of learning a dance style for each person. Depending on the dance style (the cultural and philosophic framework within which it emerged) the training is carried out differently. Some dance styles, such as contemporary dance and improvisation dance (as a direction of Western dance culture)

[3] A somewhat similar process is observed in the acquisition of other types of procedural knowledge, such as training martial arts or learning to play a musical instrument. Becoming proficient in a particular dance style is somewhat similar to practicing martial arts as it requires whole body mobilization and incorporation of the technique. However, among the crucial difference between them is the functionality of movement. In martial arts movement has already been defined as a tool to hurt, or to pacify a potential attacker. Dance moves functionality is not that straight forward, although the origins of different cultures' dance styles are argued to be representations of everyday activities of the society or of routines or abilities that are crucial to it (Lomax 1968).

focus rather on the expression then on the uniformity of the shape of expression. Hence, the main effort during training is channeled into the state of mind and the in-the-moment expression of inner state in communication with the dancer's body. This type of dance is not the subject of the current study.

In other dance styles, like ballet, the focus lies on the well defined proper shape of the movement. In other words, the main emphasis is put on the acquisition of set of movements and their desirable characteristics, as well as the acceptable transitions (as defined by the physics, aesthetics and functionality of the dance style). With respect to the previous section, acquiring such a dance style is similar to a further socialization of the body. This involves training of the motor system, pruning it in such a way that the individual is able to perform the dance style specific movements in an acceptable manner. Training means participating in a practice of internalizing a cultural system and can be, hence, bound to identity reconstruction through disciplined guided incorporation of the dance style identity (Foucault 1977).

d. Acquiring a different dance style

With reference to the previous section, acquiring a dance style that radically differs from the one a person is proficient in involves a specific type of difficulty: the negative knowledge transfer (Detterman 1993). It requires modification of the previously incorporated basic motor skills, culturally appropriate ways to perform tasks and the enculturation in a dance style (a cultural systems almost entirely focused on acquisition of motion). The difficulty of acquiring a new dance style differs depending on the dance proficiency of the person and on the influence that the training has on their movements.

The participants in this study have been selected on the base of their proficiency (or lack of it) in ballet because of ballet's canonical rules concerning what is a beautiful move profoundly influences the dancer's movement schema (Laviers 2011). The high formality of the style has more recently made it attractive for researchers on movement notation and robotics (ibid.). Since it is very difficult to map the influences of different parameters on the movement patterns of an individual, ballet has been a selection criterion for participation as its canonical kinemes are easily recognized across contexts (LaViers 2011). Hence, it is easier to hypothesize about the functional difficulty of tasks across individuals. Ballet training is regarded as shared history and culture of movement internalized by the individual dancers. No social construct is internalized to 100% (Wacquant 2004) despite of the wide spread Foucauldian approach to discipline and the creation of "docile bodies" (Foucault 1977) trough training. Hip-hop was selected as its movement culture is largely incongruent with ballet training, in terms of acceptable positions, transitions and movement characteristics.

The aim was to have two groups of participants whose abilities vary (professional ballet dancers vs. non-dancers) however who are not professional in the style they are to learn. This is a prerequisite for observing different sources of difficulty in dance moves acquisition – one related to knowledge transfer (Detterman 1993), proficiency in movement or in copying moves. Furthermore, some of the experiment items have been selected because they are typical for hip-hop, however they are considered inappropriate within the cultural frame of ballet and the society in general. The selection of movements and the hypotheses they are testing is discussed later in this chapter. It is expected that movements that contradict the logics and aesthetics of ballet will be perceived as more difficult by the dancers. Whereas, the non-dancers will report additional problems with the mobilization of their body to perform the particular movement. Finally, qualitative interviews will indicate whether learning dance style movements has implications for the subjective sense of agency of the participants.

4. Research focus and hypotheses

The main assumption behind this work is that there are different parameters inducing perceived difficulty in learning a dance move. In this study, physical demand (physical exertion) and speed of display (perceptual difficulty) are kept low (in all moves) while the contribution of complexity, unfamiliarity and awkwardness to the overall perceived difficulty is explored. This feasibility study focuses on the analysis of the correlation between the different components and overall difficulty, the strategies of assessing difficulty as well as on the performance measures in the form of graded learning outcomes. This research aims to find the best predictor of perceived difficulty among the parameters: unfamiliarity with the task, complexity and perceived awkwardness based on the quantitative assessment sheets. The set of hypotheses is briefly outlined here:

a. **H1 & H2: Ballet dancers issue lower difficulty ratings (H1) and need a higher number of attempts (H2) than non-dancers.** Rationale: the proficiency in another dance style and the routine in motor learning facilitate lower difficulty grades.
b. **H3: Ballet dancers receive higher performance grades than the non-dancers. Rationale:** Ballet dancers are more used to learning and performing dance moves despite of the difference between dance styles.
c. **H4: The moves compatible with the ballet training are easier (according to graded learning outcomes) the incompatible moves by the ballet dancers but not necessarily easier for non-dancers.** Rationale: effects of negative knowledge transfer (Detterman 1993) (between ballet and hip-hop) can be spotted in the difficulty assessments.

d. **H5: There is a negative correlation between performance grades and difficulty ratings.** Rationale: this is to test the general assumption that higher difficulty is indicated by poor performance.

The focus in the qualitative assessment lays on: the previous experience with hip-hop dance and culture in general; the concepts of difficulty (and all the difficulty components); assessment of difficulty; the influence of the research setting on the perceived difficulty. The data types used are: difficulty questionnaires; qualitative interviews; performance measure of the learning outcomes (assessed by three judges). The data gathering and the different types of data will be explained in the chapter "Methods". The next section describes the selection of the experiment movements.

5. Selection of movements

All of the selected movements were 2 – 3s long and were recorded with a proficient hip-hop dancer. Here are the criteria each group of moves had to meet.

a. Training moves

The first two movements in each session were training moves. They were selected on the base of not being specific neither to hip-hop nor to ballet. They were meant for participants to get acquainted with the research setting and the order of the measurement protocol.

b. Experiment moves

Fig.3 Movement compatible with ballet - snapshot

The rest eight movements were typical for hip-hop but had different hypothesized connection to ballet training.

i. compatible with ballet training

Ballet dancers can use their training to learn the movements more quickly. For example, a spin involving two (initially) crossed legs is typical for both Michael Jackson style and for ballet (channee). The second movement of this kind has been selected for the experiment was the arm plastics from shoulder to fingers that is widely used in hip-hop dance and resembles soft ballet arms, e.g., used in Swan lake.

ii. incompatible with ballet training

Ballet dancers have to oppose their training in order to learn. For example, movements such as sudden squatting or dropping lose shoulders do not exist in classical ballet so it is more difficult for ballet dancers to learn them.

iii. psychological/ social/ aesthetic incompatibility with ballet

Ballet dancers have to fight the dance aesthetics they usually use when performing, e.g., if they have to perform a simple move including genitalia grabbing or hip movements. Sexuality or the hip-hop battle-like provocative behavior does not find an expression in ballet. This holds also for the everyday life in Slovenia (where the experiment was conducted) hence this was expected to increase the difficulty of some movements also for the non- dancers.

iv. neutral, but complex movement

Ideally, ballet dancers do not have an advantage or disadvantage learning them, but the move itself requires complex coordination of body parts.Table 2 presents the initial selection criteria for the movements of this experiment.

Parameter	Categories of movements				
	Training movement	Compatible with ballet training	Incompatible with ballet training		
			with ballet motorics	Psychological/ aesthetic	Complex coordination,
Short (2 - 3 sec)	V	V	V	V	V
Physically demanding	X	X	X	X	X
Compatible with ballet	-	V	X	X	-
Incompatible with ballet motorics	-	X	V	-	-
Psychological/ social/ aesthetic incompatibility	-	X	X	V	-
Complex coordination	X	X	X	X	V

Table 2. Movements selection: "V" = yes "X" = no "-" = neutral

The results of the verification of the movement selection can be found in the "Validation" section of this work.

3. Methods

In its essence, this study uses quantitative assessments of difficulty obtained from questionnaires and qualitative data gathered in interviews to scrutinize the research question. In addition to this, participants' learning outcomes were captured by two motion capture systems - AnimaZoo and Kinect. This chapter presents all stages of the measurement protocol in detail, including brief descriptions of the sensors and the materials (questionnaires, interviews, performance measure), used in the study.

1. Participants

The participants were 6 ballet dancers and 6 non-dancers (age avg = 21.8 years, stdev = 3.4). Both genders were equally represented (male = 6, female = 6), also among the skill groups (e.g., 3 male dancers, 3 female dancers). The "dancer" participants were all members of the Ballet Slovenian National Theater in Ljubljana, Slovenia. The "non-dancers" were undergraduate or postgraduate students at the University of Ljubljana who do not dance professionally. The participation eligibility criteria for the study also included that candidates do not have injuries or disease (e.g. neurological) and are currently not taking medications that can influence their performance.

2. Measurement protocol

Each session[4] started with an AnimaZoo profile creation. Then, during the experiment the participants had to copy 10 short hip-hop moves (2-3 sec) displayed on a screen. All learning attempts were recorded with AnimaZoo and Kinect. Upon completing each of the 10 moves, the participants graded its difficulty on a modified NASA Task Load Index (Hart 1988), assessing: speed of the display, physical demand, complexity, familiarity, awkwardness and overall difficulty.

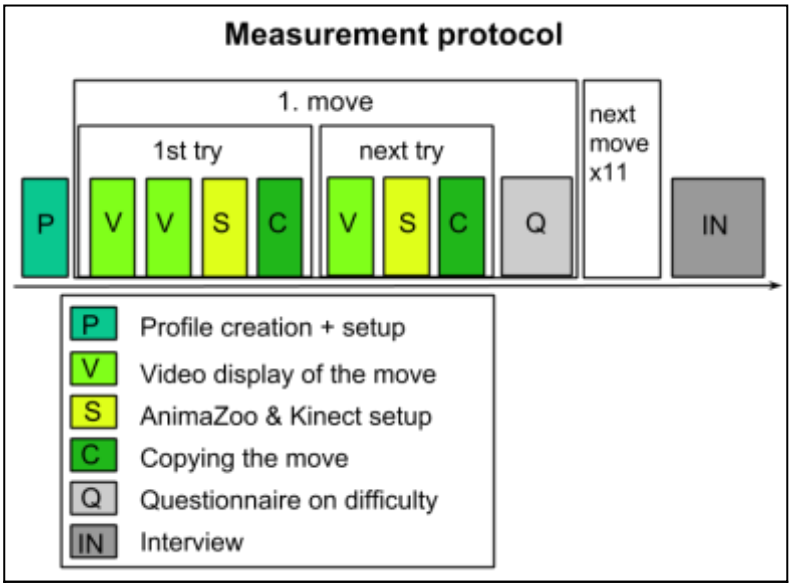

Fig.4 The experiment's measurement protocol

[4] All measurements were carried out in the Faculty of Computer Science, University of Ljubljana.

At the end of the experiment, participants were asked to elaborate on their difficulty grading in a semi-structured ethnographic interview. The measurement protocol is visualized by Fig.6[5]. The recording process is outlined step-by-step in the following points, starting with a description of the two motion capture systems used.

a. Motion capture

Here are the AnimaZoo's and Kinect's main characteristics and impact on the experimental design in a nutshell.

i. AnimaZoo

AnimaZoo IGS-190 is a gyroscope based 3D motion capture suit. 18 gyroscopes are placed on all major bones of the body and their rotation and 3D coordinates are calculated in relation to the root node (Rxyz = [0,0,0]) placed on the sacrum. The data animates a stick figure representation of the participant's body in real time. This system has primarily been used by film industry to record motion for animating movie characters. However, in the recent years the IGS-190 has been increasingly used by research in fields such as ergonomics (Shi 2012), development of dance tutoring systems (Trnjanin 2012), and rehabilitation (Lai 2013). In this experiment, the sampling rate of the sensor was 120fps (frames per second).

Fig.5 AnimaZoo suit

A profile setup is required hence the biometric data of each actor is obtained before the experiment[6]. During the experiment the participant is dressed in the suit and needs to undergo initial system setup and short calibrations before each recording. Hence the overall impact of this system on the experiment procedure is rather strong – both in terms of time requirements, as well as in terms of measurement conditions. Within the frame of this master thesis, the AnimaZoo data has been used for a qualitative analysis and grading of the participants' learning outcomes by a panel of judges.

ii. Kinect

Microsoft Kinect is a webcam- style 3D full body motion sensing device developed for interacting with Xbox 360 remotely. In this experiment, only the motion capture functionality[7] of the sensor has been used. It is using infrared projector, a RGB camera

[5] The original experiment protocol can be found in the Appendix.
[6] See Section 2b for a more detailed description of the procedure.
[7] The rest of the functions include facial recognition and voice recognition.

and a depth sensor to capture the movements in three dimensions. Kinect can acquire the points on the human body in the line of sight (i.e. no hidden joints, points can be detected). It includes a powerful mathematical algorithm for creating the stick model. However, this algorithm has its problems, e.g. one legged person will never be detected correctly, Kinect only knows how to capture the motion of humanoids who poses a full set of body extremities: one head, two arms and two legs. All of them should be visible.

While Kinect is developed by the game industry, it has been increasingly used also in research, for example, in the fields of rehabilitation (Fern 2012) and coaching elderly population (Obdrzalek 2012). This sensor is very easy to use (needs no profile set up or calibration) and does not add up substantially to the complexity of the experiment. The only disturbance it introduced to the measurements was the necessary synchronization between it and the other motion capture sensor.

The data obtained by the two motion capture systems will later be used for comparing the qualities of AnimaZoo IGS-190 and Kinect, contributing to recent research (Han 2014).

b. Profile creation

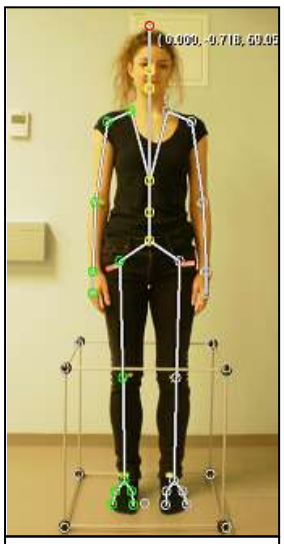

Fig.6 Profile - front

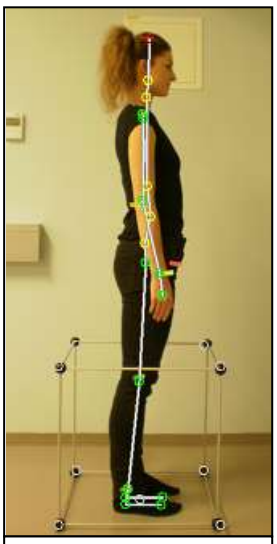

Fig.7 Profile - side

Each experiment session was preceded by an AnimaZoo profile creation[8]. The biometric data of the participant was obtained through two pictures with the reference cube (en face and profile). Colorful markers were placed on major joints of the body in order to enable a more effortless and accurate profile creation. Upon taking the pictures, the experimenter worked with Autocal to produce the custom profile while the participant was filling out the demographic questionnaire.

c. Demographic questionnaire

This initial questionnaire included standard questions such as the age, gender and level of education of the participant[9]. However, it was also used to control for diseases or the use of medications that can alter the performance in the experiment. The last part of the questionnaire focused on the participant's previous experience with dance, sport,

[8] The profile creation took place in the Artificial Intelligence lab at the Faculty for Computer science of University of Ljubljana.

[9] The full demographic questionnaire can be found in the Appendix of this work.

watching hip-hop videos and learning movement from videos in general. These factors were expected to influence the performance due to potential familiarity with the presented contents or previously developed motor or copying skills.

d. Recording site and setup

Upon completing the questionnaires and the profile creation, all equipment was moved to the recording site – the largest lecture hall of the Faculty of Computer science, University of Ljubljana.

Fig.8 Experimental setup. Yellow circles – the PCs operating AnimaZoo and Kinect; green circle – video presentation display; red circle – Kinect device and a camera

Due to the electromagnetic nature of AnimaZoo suit, i.e. the incorporation of gyroscopes and magnetometers in the device, a thorough investigation of electromagnetic surroundings had to be made prior the measurements. The recording location was selected after a thorough measurement of the properties of the electromagnetic field monitoring at several potential locations. The measurements were performed by means of two devices: Holaday 3604 field meter and Barington MAG01H fluxgate magnetometer[10]. The Holaday 3604 field meter measured AC magnetic flux density and AC electric fields (both of 50 Hz power-line frequency). The Bartington MAG01H fluxgate magnetometer measured DC magnetic flux densities. This way, both AC and DC extranous electromagnetic fields were monitored. Lecture hall 1 was selected as the site that clearly introduces least electromagnetic disturbances to the measurements. The qualities of the recording site have been confirmed one more time in a recording session with the AnimaZoo[11]. In order to test the amount of noise introduced to the measurements, the

[10] Both devices are property of the Laboratory of Metrology and Quality, University of Ljubljana.
[11] The measurement was carried out in cooperation with Dr. Aleksander Sadikov (AI lab, University of Ljubljana).

IGS-190 suit was stabilized to an inanimate frame and recorded for one minute. No noise introduced by the electromagnetic environment was detected.

The recordings took place far away from the walls of the hall and from any ferromagnetic objects. Since none of the movements required a significant displacement from the initial position of the participant, the quality of the recordings could be secured.

The measurements were made in the constellation presented in Fig. 33. The participant wearing the suit was facing the experimenter, the Kinect device, as well as the video camera recording the session. The monitor displaying the videos of the movements (outlined in a green circle) was placed at ~40cm height. Kinect and the camera were positioned just behind it (red circle). The computers operating both motion capture devices, as well as the one projecting the videos, are circled in yellow on the picture.

e. Experiment

i. Instructions

The research participants were informed about the broader topic of the research. Information concerning the theoretical background of the study or the hypothesis had been omitted in order to avoid influence on the participant's performance. They also received general instructions about the structure of the whole experiment: including the quantitative questionnaires and the qualitative interview. Overall warming up before the experiment will be required in order to reduce the variability in body abilities between the first and the last trials.

Visual presentation of the movement (video recording) was presented to them. No additional explanations or feedback were provided. This decision is based on a study (Blasing 2014), demonstrating that dancers learn more efficiently when they're shown movements, rather than when they first receive verbal instruction. Also, the topic of dance notation is a topic of discussion for long years (Benesh 1977; Guest 1986; Camurri 1998; Wilke 2005; Guest 2005; Moghaddam 2014) in the movement and dance research community. Hence, a simple video presentation was used, combined with the instruction: "copy the movement that you see". The participants were given the freedom to either copy or to mirror the movement of the dancer in order to avoid the effects of handedness on their performance.

The experimenter also explained the routine associated with the two motion capture sensors. The video display was followed a calibration of the AnimaZoo suit (1s required) and a synchronization of the recordings with Kinect and AnimaZoo. The overall lapse between display of the video and a repetition attempt was between 5s and 10s. The cases

when this time limit was violated due to technical difficulties were annulated and the participant was invited to re-watch the video before their next attempt.

ii. Learning from videos

Upon the initial instructions, the participants set out to copy the movements from the videos presented to them. The videos were showing the dancer en face. Since movements are simple and most details that have to be learned are happening in the front of the person, the front view was chosen as means of presentation. Furthermore, most online tutorials are filmed from this perspective (an indication of a common practice).

Since the movements are short, they are displayed two times in order to get the participants (even the non-dancers) familiar with the movement. Then for each next attempt, the participants were allowed to see the video one additional time. This provides them with enough time to process the movement and to go on with its implementation while at the same time providing them the security of a standardized experiment procedure.

Fig.9 Video display example

In the case of my experiment, the movements are only 2 or 3 seconds long, hence their first presentation may catch the participant unable to fully perceive it. A second display, followed by a first attempt is a combination that allows them to understand and to test their understanding of the movement by trying it out.

On average, three attempts were needed before proceeding to the next movement however the number of attempts went up to eight in individual cases. Each participant had to copy all of the 10 movements in order to complete the experiment.

iii. Difficulty questionnaires

After completing each movement, the participants received a form, containing 6 scales (5–point and 7-point) related to difficulty assessment and one open question about their experience with learning the step. The questions included: speed of the display, familiarity with the move and movement characteristics such as complexity, physical demand, awkwardness and overall difficulty.

As previously discussed, the design of the scales was inspired by two measures of difficulty: the Borg scale of perceived exertion (Borg 1982) and the NASA Task Load Index (NASA TLX) (Hart 1988). However, the scales were adjusted in order to provide a more

suitable measure of the sources of difficulty in dance style acquisition. Ultimately, five 7-point Likert scales and two 5-point Likert scales were used. The question of each scale was formulated in such a way that they grant the *symmetry* of the categories e.g. "How simple or complicated was the move". They included a midpoint with clearly defined linguistic qualifiers: e.g. "somewhat familiar" (on the scale from "not at all familiar" to "very familiar"). Here is a detailed description of the utilized scales[12].

1. How slow or fast was the movement for you?

A 7-point scale from "very slow" to "very fast". This question was used to control for the subjectively perceived speed of the display. At the same time this can also be an indicator of the inability to process the information from video display as a source of difficulty (perceptual) in copying the movement. It is related to the "Temporal demand" scale of the NASA TLX however the question here focuses on the temporal demand in perception.

2. How physically light or demanding was the move for you?

A 7-point scale from "very light" to "very demanding". This question is based on Borg's work on perceived exertion and on the "Physical demand" part of the NASA TLX. Within this experiment, this parameter was supposed to range from low to medium. In other words, the movements were selected in such a way that there are no significant differences between their physical demand ratings.

3. How simple or complicated was the move for you?

A 7-point scale from "very simple" to "very complicated". This question was included as it is supposed to hint at the characteristics of the task (number of active components, coordination etc.) in relation to the cognitive performance and to the coordination effort required to perform the move. To some extent it is connected to the "Mental demand" part of the NASA TLX. This parameter was expected to be a major contributor to the overall difficulty assessments.

4. How familiar was the move for you?

A 5-point scale from "not at all familiar" to "very familiar". Controlling for familiarity with the move to be copied is crucial to this experiment as it considered to have an impact on the subjectively perceived difficulty of the task. This assessment is even more necessary due to the fact that hip-hop culture is widely spread across the globe.

5. How awkward was the move for you?

A 5-point scale from "not at all awkward" to "very awkward". This measure refers to the amount of hesitation that each participant had to deal with during the learning process.

[12] Find the whole Difficulty assessment questionnaire in the Appendix.

The aim of this scale is to highlight some personal or cultural aspects of learning that may have an impact on the perceived difficulty. Within the frame of the qualitative interview at the end of the experiment, this question was used to provide an in depth understanding of the personal reasons that may make a task easier or harder.

6. All in all, how easy or difficult was the move for you?

The overall difficulty measure is considered to provide an overview. Later, it has been used to understand the contribution of the different aforementioned parameters to the assessment of difficulty. When analyzed, the relation between the other parameters and this one may be used for weighting the components of a model of difficulty.

iv. Interviews structure

Upon completing the experiment, the participants were invited to talk about their experience with the difficulty of the tasks in a semi structured interview. The videos of the movements were displayed again in order to facilitate a better recollection of participants' experience. The quantitative questionnaires were used as a guideline for the interview. In addition, as part of the validation of the questionnaires, the participants have been asked to describe how they understood the questions. The participants were also invited to explicate aspects of their experience that they find relevant.

The role of the interviewer was to both follow the structure and to open the space for deeper understanding of contents. The main types of interview questions, including examples, are outlined here[13].

i. **Procedural:** What were you thinking at first when you saw the move?
ii. **Causal:** What was the reason you give this grade? What caused this feeling?
iii. **Explicating**: (#Read the participant's comment from the questionnaire and ask them) Can you, please, tell me more about how you felt while learning the move?
iv. **Background:** What is your experience with this dance style?

The qualitative interviews are the source of the categories crucial for modeling the actual sources of difficulty for the participants.

The next section will present the way the learning outcomes (AnimaZoo recorded movements) of the participants were graded.

3. Grading of learning outcomes

Performance measure of participants' learning outcomes has been obtained from their AnimaZoo recordings. A jury of three dancers (2 female, 1 male) graded the final trial of

[13] A more detailed list of questions can be found in the Appendix.

each movement. The judges have different dance background: one- in break dance and hip-hop; the second has done hip-hop before she started learning ballet; the third has trained rhythmic gymnastics and ballet before she made her first experience with hip-hop. Two members of the jury were not notified whether they are grading a dancer or a non- dancer, a male or a female participant. The assessment has been made on the following scale:

Assessment criterion	Options	Explanation	Grade
Completeness of the move	Full 2 Partial 1 No movement 0	Has the move been completed?	
Coordination of:			
Legs	Correct/ small error 2 Medium error 1 Large error 0	Do the legs/ arms/ head and torso move correctly?	
Arms	Correct/ small error 2 Medium error 1 Large error 0		
Head and torso	Correct/ small error 2 Medium error 1 Large error 0		
Characteristics:			
Time	Correct/ small error 2 Medium error 1 Large error 0	Too fast/ slow or too long/ short move	
Quality of movement	Correct/ small error 2 Medium error 1 Large error 0	e.g. weight, acceleration, smoothness	
Amplitude of movement	Correct/ small error 2 Medium error 1 Large error 0	e.g. how deep to bow, how far to stretch	
Skilled performance of the move	Skilled performance 2 Average performance 1 Poor performance 0	Moving with style/ skill/ elegance	
			Max = 16

Table 3. Learning outcome grading sheet

The scale contains modified element of: the Action Research Arm Test (ARAT) (Yozbatiran 2008), such as the assessment of the movement's completeness. The first part of the scale assesses to what extent the participant was able to copy all components of the movement. The second part assesses the qualities of the performed movement. All grades, apart from the "skilled performance" are with reference to the original move

presented in the video. In other words, the video is the golden standard (max 16 points). Hence, small deviations from the video (in terms of the movement of single body part or quality of the movement) would receive high grades and significant deviations will receive low grades. The first item, the "completeness of the move" has more impact on analyzing the grading since it would not be accurate for a partial movement to receive a higher grade than a whole one that does not meet the characteristics of the move. Hence, the "completeness grade" has an impact on the maximum grade through the following conditions:

If compl_move = 0:	If compl_move = 1:	If compl_grade = 2:
Max_grade = 0	Max_grade = 10	Max_grade = 16

Two of the judges were not notified about the effect of the completeness grade. But their grades were modified with regard to the aforementioned conditions. In other words, if a judge has graded a move as "incomplete" (compl_move = 1) and their overall grade exceeds 10, then the grade is reduced to 10 points.

"Skilled performance" is an extra measure introduced after a piloting the prototype of the scale that made clear that participants fail to perform the moves accurately for different reasons. Some of them would not be able to perform due to lack of proficiency in their movement, while others - because of their proficient performance enriched by an individual style.

Ultimately, the correlation between the grades of the different judges have been calculated ($cor_{1-2} = 0.62$; $cor_{1-3} = 0.64$; $cor_{2-3}=0.71$). The average of the three judges' grades was then considered the move's final grade.

4. Validation

This chapter is going to present the results of this feasibility study. The main focus lies on: the validation of the research setting and the materials used. All materials, including the demographic and difficulty questionnaire, the selected movements, the interviews, the learning outcome assessment sheets are going to be reviewed.

1. Demographic questionnaire

According to the data provided by the demographic questionnaire all participants were eligible for participation. The questionnaire controlled for injuries or medication by which the participant's performance may have been affected. The participants' experience with movement (dance or sports) showed a large variability. Suggested changes include::

1. Merging the two questions "What sports have you trained so far?" and "For how long?" can be of use. Then the participants will input the name of the sport and then in brackets the amount of time (in years). Same note is valid for the dance experience question from the demographic questionnaire.
2. Including a question concerning how comfortable are participants with dancing/ performing in front of others on a five point Likert scale from "not at all comfortable" to "very comfortable" would provide further information that is relevant to the awkwardness evaluations.
3. Including more detailed questions concerning participants' experience with hip-hop will contribute to the better understanding of their degree of assimilation of the hip-hop culture. Potential relevant questions concern:

i. Music

"How often do you listen to hip-hop?" (5-point Likert scale from "never" to "very often"); "Do you enjoy listening to hip-hop music?" (5-point Likert scale from "do not enjoy at all" to "enjoy very much"); "How many of your closest surroundings (friends or family) listen to hip-hop?" (5-point Likert scale from "none" to "everyone");

ii. Clothes

"How often do you wear hip-hop style of clothing?" (5-point Likert scale from "never" to "very often"); "How many of your closest surroundings (friends or family) wear hip-hop clothes occasionally?" (5-point Likert scale from "none" to "everyone");

iii. Dance

"How often do you dance hip-hop?" (5-point Likert scale from "never" to "very often"); "Do you enjoy dancing hip-hop music?" (5-point Likert scale from "do not enjoy at all" to "enjoy very much"); "How many of your closest surroundings (friends or family) dance hip-hop?" (5-point Likert scale from "none" to "everyone");

I am convinced that the suggested modifications will improve the questionnaire.

2. Validation of the selected movements

The selection of movements was initial thought to obey the following categories: training moves; compatible with ballet training; incompatible with ballet motor patterns; incompatible with ballet aesthetics; complex movements. However, the pilot testing indicated difficulties with the clear separation between the aforementioned five classes. A thorough analysis of the qualities of each movement provided the ground for a valid grouping. Three groups of moves were defined according to their compatibility with basic ballet kinemes and movement characteristics: training moves (#1, #2); compatible with ballet (#3, #4); incompatible with ballet (#5-#9); mixed (#10). This resembles the original categorization of the movements[14] however the group of the complex movements turns out not to be neutral to ballet training. The movement #9 is perceived as incompatible with ballet, and some parts of move #10 have being perceived as not compatible with ballet (closed legs, arms management), and others - as compatible (open legs in plier).

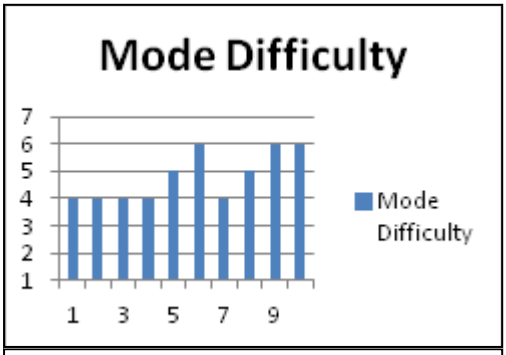

Fig.10 Difficulty grades - modes

Upon careful examination of the averaged items such as difficulty, complexity and physical demand, the movements can be divided in two main groups based on the overall difficulty grades. The mean difficulty rating of the easy movements group (the moves #1-#5 & #7) varies between 3.1 and 3.5. The high difficulty group's (#6 & #8-#10) means vary between 4.5 and 5.3.

The movements were possible for all participants' physical capabilities. The ballet dancers, due to their high proficiency in dance perceived all as less difficult than non-dancers. All movements were short 2-3 sec. However, the different complexity (number of body parts that have to be coordinated within one move) they occurred different to participants. Some movements were evaluated as longer than others due to their complexity, e.g., how much is happening at the same time. The movement has been assembled from the video not only in term of trajectory but also of time as observed by Orgs et al. in their research on observation of quasi movement (Orgs 2011). In other words, the longer the way the limb has to move (for the same time), the faster the movement was perceived to be.

Here are several common remarks (from the interviews) on part of the movement:

a. **#4** – arm wave – there are subtle differences between a wave in hip-hop and soft arms movement from ballet. The move has often associated with bird's wings.

[14] See the section "Selection of movements" in the "Theoretical background" chapter.

b. **#7** - has been systematically interpreted as an emotional expression apart from being a highly representative hip-hop move. It also scored high on the familiarity scale as compared to other movements.

c. **#5** – is perceived as very specific/ more difficult because of the stop in the middle. Participants reported that they are not able to estimate how low they should go with their torso in order to perfect the movement. The segmentation of the movement (the short break in the middle of the movement) also altered their perception of the speed of the motion.

d. **#8** - was hypothesized to be not complicated, but potentially awkward for the ballet dancers. First, it turned out to be too complex for many of the participants. A few of them showed an emotional reaction to the movement but then reported that its difficulty has been only based on the coordination of body parts.

3. Validation of the questionnaire

The questionnaire was filled out by all 12 participants with the objective to gather data about the difficulty and the sources of difficulty or ease of each movement in the experiment.

The internal consistency of the questionnaire, as tested using the Cronbach's alpha test in SPSS, was excellent ($\alpha = 0.96$). The following graph shows the correlations between the individual items in the questionnaire (averaged over all participants). For all items the results vary between high (0.70) and very high (0.99) positive correlation. A more thorough analysis of the different items in the questionnaire and their connection will be presented in the next section of this chapter.

Inter-Item Correlation Matrix

	Display	PhysDemand	Complexity	Unfamiliarity	Awkwardness	Difficulty
Display	1	0,91	0,89	0,74	0,69	0,92
PhysDemand	0,91	1	0,97	0,86	0,77	0,98
Complexity	0,89	0,97	1	0,85	0,77	0,99
Unfamiliarity	0,74	0,86	0,85	1	0,86	0,89
Awkwardness	0,69	0,77	0,77	0,86	1	0,78
Difficulty	0,92	0,98	0,99	0,89	0,78	1

Table 4. Inter-item correlations - questionnaire

The feedback I got from participants hints at the following improvements of the scales and questions:

a. "1. How slow or fast was the display of the move for you?" – Most participants had no problems answering this question but one of them remarked that the velocity

of change in the position of different body parts may be hard to evaluate. For example, the participant stated that the arms were changing fast in one of the movements, while the rest of the rest of the body was slow/ at a normal velocity and hence his estimation of the display was more ambiguous.

b. "2. How physically light or demanding was the move for you?" Most participants had a correct idea as to what they are supposed to answer here. Perhaps, an example (sweating vs. being bored) could have made it clearer. One participant reported answering this question in relation to the complexity of the movement. A remark from the same participant: "It is not that trivial to answer how physically demanding it was. Perhaps I am doing it too fast or too slow." She was seeking to evaluate how demanding was the move, but she was hesitant because she was not sure whether she performed it right. In any case, the speed of performing the move matters to the degree of physical demand, as correctly identified by the participant.

c. The question "How familiar was the move for you?" should be split into: a) "How familiar was the move for you in terms of seeing?"; b) "How familiar was the move for you in terms of doing?"; c) how familiar did the move feel to you (~r body)?

d. An additional question "Why?" or "What was the reason for this?" (for free answer) should be added after "5. How awkward was the move for you?". In this way, the ad hoc reasoning of the participant will be captured. There was no clarity about the particular reasons. Some of the participants seemed like they were confabulating. This question ought to be masked somehow because the answers may be selected to fit expectations or what the participant would envision as desirable answer.

e. Two additional questions may provide useful data: "How much did you like the movement?" and "How much do you enjoy performing the movement?" on a 5 point scale from "don't like it at all" to "like it very much". The goal would be to assess the effect of preferences (aesthetic, general, cultural) on the performance of the movements. Another additional question would be concerned with the self-estimated performance of the movement: "How satisfied are you with your performance of the movement?". To be answered on 5 point scale from "not satisfied at all" to "very satisfied".

f. One participant suggested a modification of the questionnaire: adding the question "How satisfied were you with your expression of the movement and its underlying attitude?" component on a 5 scale from "not satisfied at all" to "very satisfied".

Since applying all of those suggestions would result in extending the questionnaire, it remains to be seen to what extent they should be adopted. If the questionnaire is too long, it may interfere with the flow of the experiment and additionally irritate the participant.

4. Qualitative interviews validation

The average length of the qualitative interviews was one hour. Neither the participants, nor the researcher were native speakers in English. However, elementary fluency was required in the process of participant recruitment. Since the interviews were not aiming at a profound phenomenological account of experience, all interviewed persons were able to communicate about their experience with learning the movements. However, the speed of talking + the different level of proficiency made it different.

The quantitative questionnaires were used as a guideline for the interview. The method used was based on elaborating on the information contained in the artifact. As part of the validation of the questionnaires, the participants have been asked to describe how exactly did they understand the question and hence why they gave such answers. Interesting differences between the participants were spotted. The results of the interview will be presented later in this chapter.

It is important to note that since there is a gap between filling out the questionnaire and actually commenting on it, the retrospections and the written difficulty estimations are not to be mistaken for the same information. Even the participants themselves sometimes failed to interpret what they were thinking/ feeling when they were filling out the questionnaire straight after the movement.

5. Validation of the measurement setup

Here is a list of the main aspects of the experiment experience that the participants identified in their interviews:

- The lack of music – they argued that it would be the easiest way to feel and assimilate the hip-hop style and attitude.
- Real person showing the move (+ feedback) – some participants emphasized that they would learn more successfully if there was a tutor showing the movement.
- The lack of a mirror to provide visual feedback about their learning outcomes. In the experiment the participants relied only on their proprioception and the scarce visual feedback from their own movement to imply about their learning outcomes.

- Hip-hop clothes and no sensor suit were also mentioned as conditions under which the participants thought they would perform better at the experiment. The rationale behind this was that they would feel more relaxed and more attuned to the hip-hop culture.
- Not being directly observed would take off some of the awkwardness, was the opinion of some participants indicated. Minimum two or more researchers operated two motion capture sensors. Hence, the measurement anxiety increases.
- Starting from the AnimaZoo calibration position (standing with straight legs) was perceived as unnatural. The participants would like to be free to start from other positions that feel more comfortable.

Most of those sources of disturbance were taken under consideration during the experiment design phase however they were rejected for the purpose of standardization of the measurements or for other logistic reasons. This actually is a list of background difficulty factors that frame the evaluation of difficulty of the expetasks.

6. Validation of the judges' rating

Judges correlation varied between 0.62 (questionable) and 0.71 (good) but a one-way-ANOVA ran on the grades did not indicate significant differences (p=0.32) between the performance measures of the three judges. Ultimately, the grades of all three judges were used to create the average grade for the learning outcomes.

Inter-Item Correlation Matrix

	Judge1	Judge2	Judge3
Judge1	1	0,62	0,64
Judge2	0,62	1	0,71
Judge3	0,64	0,71	1

Table 5. Correlation between the ratings of the three judges

The judges perceived the grading sheets as comprehensive and focused on relative assessment criteria. The jury was also pleased with the presentation of the movements – AnimaZoo recordings- as they were able to analyze the recorded moves from different perspectives which would not have otherwise been possible. They also reported that this type of visualization allowed them to focus on grading the moves as they were not distracted by the gender, the appearance or the artistic expression of the participant.

5. Results

1. Quantitative questionnaires

This section presents the results from the difficulty assessment questionnaires with a focus on answering the hypotheses H1-H5 formulated in the "Theoretical background" chapter of this work. Regarding the ongoing debate in statistics whether to treat data from Likert scales as ordinal or as interval data (Allen 2007; Norman 2010; Coolican 2014), I subscribe to Norman's argumentation (Norman 2010) and analyze the data as interval data using parametric statistics. The data has been analyzed in Matlab, Excel and SPSS.

a. Inter-item correlation

The following graph shows the difficulty grades for each movement (averaged over all participants). It makes visible an almost full overlap between the ratings of complexity and the overall difficulty, as well as a high correlation between those items and the physical demand, unfamiliarity and the display speed. Only the awkwardness scale seems to be associated more loosely with the remaining items.

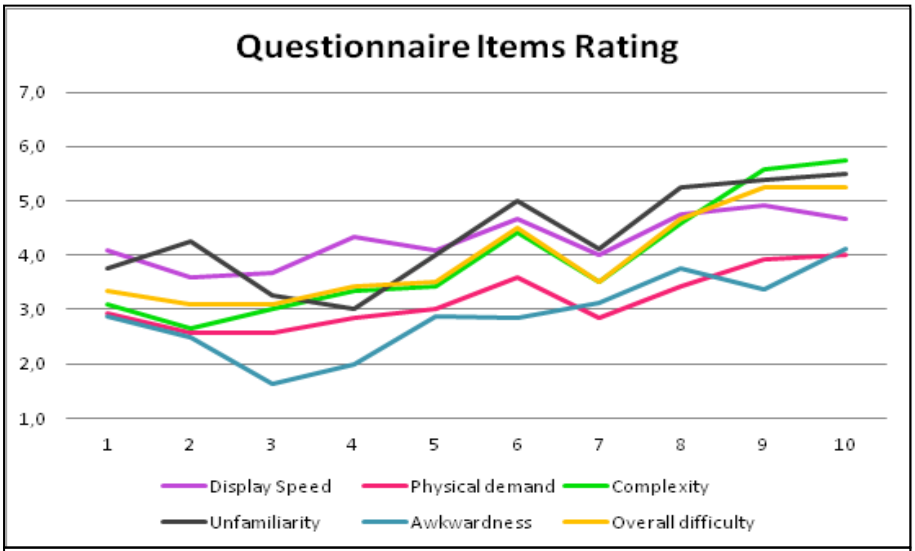

Fig. 11 Average grades of all categories for the 10 experiment

The inter-item correlation matrix shows that all items in the scales are highly correlated (min. corr. = 0.69). Overall difficulty correlates highest with physical demand (0.98) and complexity (0.99), followed by speed of display (0.92), familiarity (0.89) and awkwardness (0.78). This comes as a surprise considering the idea that the moves of similar physical demand were selected for the study and physical demand was not expected to influence the difficulty ratings.

However, it is not possible to conclude whether the difficulty was caused by the physical demand or physical demand was influenced by the person trying harder to accomplish the difficult movement. Considering the high correlation of the overall difficulty grades with all other questionnaire items[15], only it is used to answer the five hypotheses of this study. The next section presents the results of the hypotheses testing.

[15] Presented earlier in Table 4.

2. Hypotheses testing

a. H1: Ballet dancers issue lower difficulty ratings (H1) than the non-dancers.

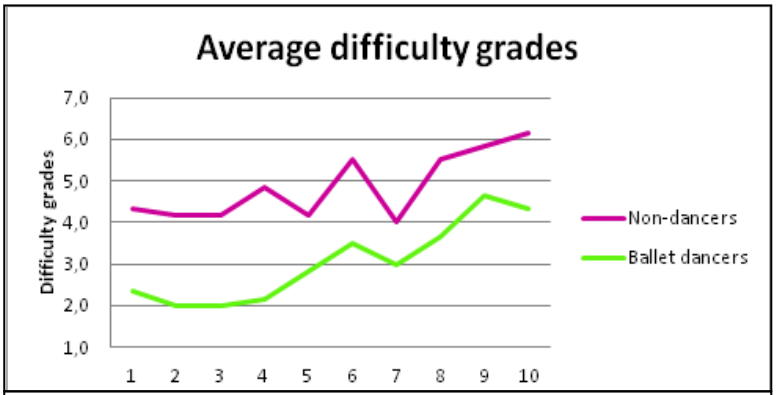

Fig. 12 Average difficulty grades by non-dancers and ballet

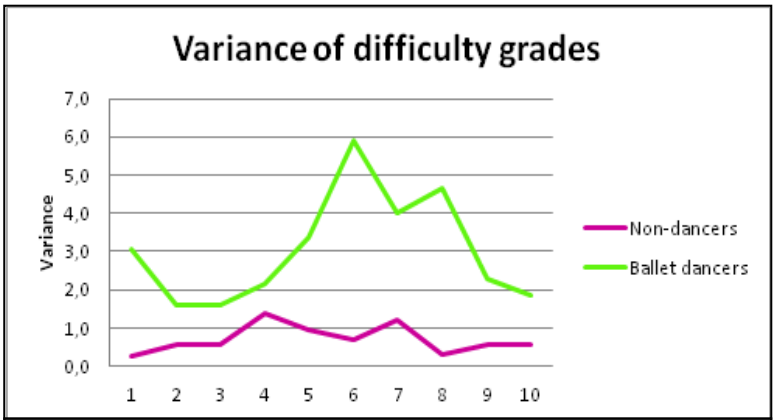

Fig. 13 Variance of the difficulty grades of non-dancers and

For both, dancer and non-dancer samples, the null hypothesis of Kolmogoroff-Smirnov test could not be rejected due to high p-values: p1= 0.20 and p2=0.09. Hence, a t-test was performed on the two data sets. This hypothesis has been confirmed ($p<0.05$) by the by the Welch's t-test performed in Matlab with a t value t= 4.56. Fig. 12 shows the overall difficulty ratings of the two groups of participants for all ten experiment moves.

Fig. 13 shows that non-dancer participants also had lower difficulty ratings variance.

H2: Ballet dancers will need a lower number of attempts than non-dancers.

Despite of high kurtosis and skewness values of both samples (dancers and non-dancers), the Kolmogoroff-Smirnov test returned high p-values: p1= 0.07 and p2=0.20 respectively. Hence, a t-test was performed on the two data sets. This hypothesis has been rejected by the by the Welch's t-test performed in Matlab. No significant differences ($p>0.05$) between the number of attempts of the two different groups of participants have been found.

b. H3: Ballet dancers receive higher performance grades than the non-dancers.

Once again, the Kolmogoroff-Smirnov[16] test returned high p-values for both participants' groups, p1 = p2 = 0.18. Hence, a t-test was performed on the two data sets. Hence, a t-test could be performed using the two data sets. This hypothesis has been confirmed ($p<0.05$) with a value of the test statistics t= 9.20.

[16] The null hypothesis is that the "sample distribution is normal".

c. **H4: The moves compatible with the ballet training are easier (according to graded learning outcomes) the incompatible moves by the ballet dancers but not necessarily easier for non-dancers.**

This hypothesis has been rejected ($p = 0.15$) by the repeated-measure ANOVA performed in SPSS[17]. The test showed significant difference ($p<0.05$) in the difficulty ratings of the movements compatible and incompatible with ballet training for both dancers and non-dancers. However, the test reveals no significant interaction between the participants groups and the type of movements (compatible/ incompatible with ballet).

d. **H5: There is a negative correlation between performance and difficulty ratings.**

Both data sets were normalized on a scale from 1 to 10 before the analysis was performed, using the formula:

$$nv = (ov - nmin)*(nmax - nmin)/ (omax - omin)$$

nv = "new value" nmax = maximum of the new scale nmin = minimum of the new scale

ov = "old value" omax = maximum of the old scale omin = minimum of the old scale

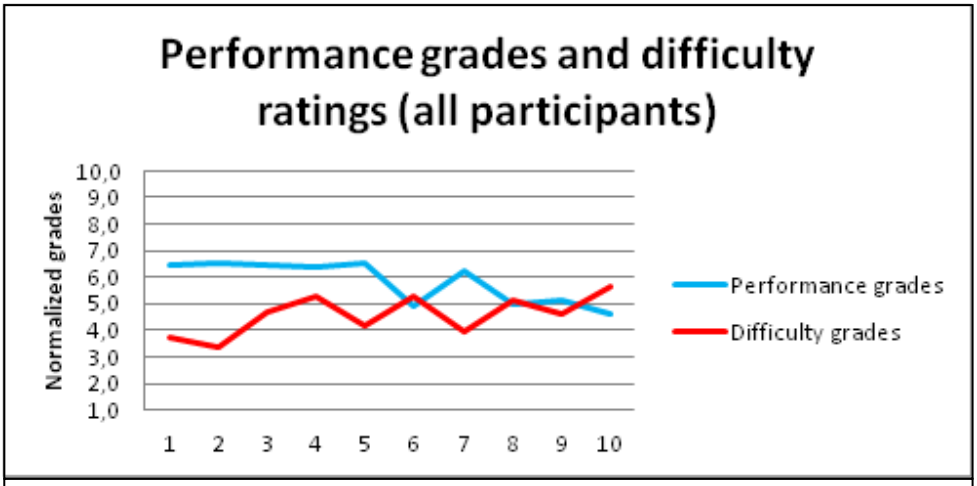

Fig. 14 Performance grades vs. difficulty ratings by all participant.

There is a strong negative correlation between the performance grades and the difficulty ratings (-0.7). These results confirm the intuition that the higher the difficulty, the lower the performance. Fig. 14 visualizes the normalized average grades for the 10 moves. This concludes the presentation of the hypothesis testing. These results will be further addressed in the "Discussion" chapter.

[17] The normality of the two data samples has been tested in H3.

3. AnimaZoo and Kinect

Each attempt of the participants to copy an experimental movement has been recorded with both the AnimaZoo and the Kinect motion capture systems. Only one movement could of one participant was discarded due to electromagnetic disturbances affecting the IGS-190. The rest of the recordings will be used for quantitative analysis in a follow up work on the raw data (3D coordinates) obtained with the two systems.

The AnimaZoo recordings have already been used for a qualitative motion analysis that the learning outcomes grades are based on. The three judges viewed the recording of each movement and each participant in AnimaViewer software showing the movement on a stick representation. Hence, they benefited from the ability to watch the recording from different perspectives while at the same time not receiving information about the person's appearance, height, gender or expressivity. As mentioned in "Validation of the judges' rating", these display characteristics were beneficial to the assessment process.

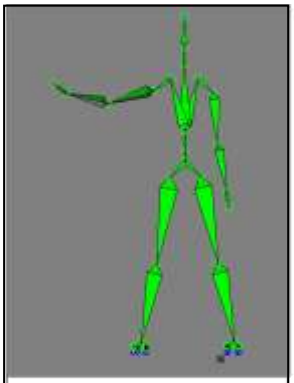

Fig. 15a AnimaZoo #3

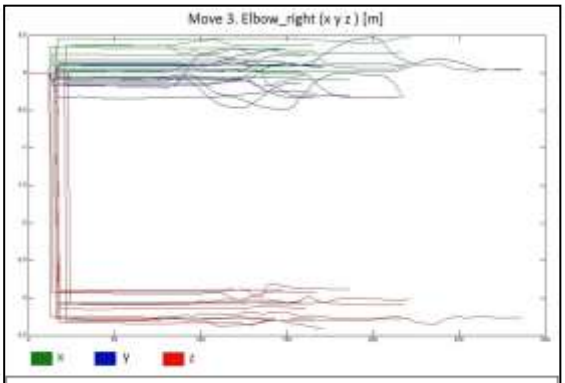

Fig. 15b Kinect – Elbow motion – all participants

Fig. 16a AnimaZoo #10

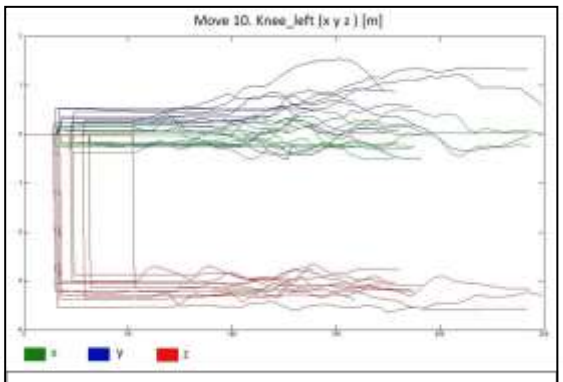

Fig. 16b Kinect - Knee motion – all participants

Fig. 15a and 16a present the stick representation used for data visualization in AnimaViewer, and Fig. 15b and 16b show a single joint Kinect plot of the three coordinate axes of one joint's movement.[18] The trajectory curves of all participants can be analyzed using the Kinect and AnimaZoo data for timing, amplitude of performance, tendencies and deviations in joins trajectories and for indicators of increased perceived difficulty.

[18] The center of the coordinate system [0, 0, 0] is Kinect's position.

4. Qualitative interviews

This section presents the results from the qualitative interviews with focus on the different strategies that the participants used to assess difficulty and on the concepts of difficulty (and all the difficulty components). All interviews have been transcribed and coded for the topics that they address. The quantitative questionnaires and the videos of the movements have been used as artifacts supporting participants to remember their experience with learning better. Since the structure of each interview was provided by the questionnaire, its main items will necessarily occur in each comment. However, in the code the topic was reported only if it was mentioned more than once, meaning either in several consequent sentences or in several places during a single comment. The results are reported in the following categorizations and for each theoretical item an example – a quote from an interview- has been presented. The results from the interviews present topics relevant to further research on the topic of perceived difficulty in acquiring dance style movements.

a. Strategies of rating difficulty

The data from the qualitative interviews indicated a variety of very different strategies to assessing difficulty despite of the uniformity of the questionnaires and the whole measurement protocol. A distinction was made between three main categories: 1) absolute; 2) relative; 3) meta. This section starts with few short notes on difficulty assessments before proceeding with the description and the examples of each category.

First, baseline awkwardness/ difficulty associated with the research setting could be included or excluded from their difficulty assessments. This results in some participants increasing their awkwardness rating by 1 grade for each movement, whereas others have already isolated the setting influence as a stable factor and do not include it in their grades. Furthermore, the first one or two movements would produce higher awkwardness grades because participants have to get accustomed to the experiment setting. Second, the participants' expectations shape their grades. For example, some subjects expected that the moves will get more difficult so there were reports such as "I put 3 here because I thought that for sure worse is coming".

Last but not least, the assessed difficulty is relative to the precision and self-assessment (of kinemes and movement characteristics. In a future research these factors should be taken into account and the new methodology has to include them as assessment items. The following sections describe the categories of difficulty assessment, exemplified through participants' statements from the interviews.

i. Absolute

In this type of assessment strategies people grade each move/ set of movements separately according to a particular criterion. For example, the participants in this experiment have reported grading:

1. Each movement separately:
   - According to feeling – "this didn't feel natural as I am not familiar with it"
   - According to another criterion/ criteria. E.g.:
     - identity "it's difficult for me because it doesn't feel like a male movement"
     - aesthetic/ moral judgment: "I can't do it properly, it looks slutty"
2. Each movement as compared to experience with other dance styles: "I didn't get that tired because we [ballet dancers] are used to doing something worse"

ii. Relative

This strategy is observed when participants grade the difficulty of each move in comparison to another move or sample of moves.

3. Each movement is compared to the last one or two movements. This is to be explained with the effect of recency and the necessity to reduce memory demand in a sample of larger size: "Maybe I compared mostly to the last two movements as by the 9th and 10th, it was already hard to remember".
4. On a difficulty curve – fluctuation among the different trials of one and the same move. In case there is a lack of progress among the individual attempts, the perception of difficulty can be additionally boosted: "That's why I took 2 tries anyway. Because I didn't feel comfortable with performing it. But after the 2nd try I just left it as it is". This statement remains to be tested in further experiments.
5. Each movement as compared to the sample of all previous movements. The sample constantly changes: "towards the middle I was comparing to all the previous moves".
6. Baseline or difficulty measure is developed only in the end. Only then the participant is confident to give an assessment of the difficulty of all elements. Constant insecurity due to the wish to assess the difficulty of all movements in the end as compared to all movements/ the whole sample. "I would put 4, I think, because the last one was very awkward". The participant wants to have a ranking already implied in the difficulty grading. This happens even in the interview: "[Was this the easiest move?] How many do we still have? Two, right?" (BP).

iii. Meta evaluations

In this type of strategies, difficulty is assessed in dissociation to the person's own experience with the task. A typical example is the statement: "It was not difficult but I should have done it better". In other cases, the participants predict the difficulty for a person of different expertise, e.g., "it is not difficult, I mean it would not be difficult for a hip-hop dancer but it is for me".

iv. Compound

This category signifies cases when participants combine two or more of the aforementioned types of strategies. For example, one participant reported grading the difficulty of the first experiment movements according to their feeling, the moves in the middle – by comparing them the all previous moves, and the last ones – rating in comparison to the immediate predecessors of the current move.

<table>
<tr><th colspan="3">Difficulty assessment strategies</th></tr>
<tr><td>Absolute</td><td>Relative</td><td>Meta</td></tr>
<tr><td>Grading according:
- to feeling
- judgments</td><td>Comparing to:
- all previous moves
- last one/ two moves</td><td rowspan="2">Grading the difficulty of the move and one's own learning experience separately</td></tr>
<tr><td>Range:
- focus on a part of the scale (e.g., 5 -7)</td><td>Grading the whole set of moves (only at the end)</td></tr>
<tr><td>Comparing to previous dance experience</td><td>Grading according to the expectations of the difficulty</td><td>Predicting difficulty for a person of different expertise</td></tr>
<tr><td colspan="3">Compound</td></tr>
<tr><td colspan="3">e.g. first moves – grading according to a feeling; middle – comparing to all previous moves; end – comparing to one/two previous moves</td></tr>
</table>

Fig. 17 Difficulty assessment strategies (based on the qualitative interviews data)

When difficulty is assessed there are also other types of strategies that can arise, such as grading the movements within a particular range. For example, one participant reported: "I was giving just 5, 6 and 7. Because I didn't think that I performed any of these ok. None of the movements was "just right" so I focused on the evaluations from the 5 -7 range of the scale".

b. Onset of difficulty

Another interesting aspect of understanding perceived difficulty is its onset. In this study it is divided in three types: immediate, in-attempt or post-attempt. According to the data from the interviews, the immediate onset of perceived difficulty occurs after the movement video is view by the participant. The following classification is briefly outlined and exemplified through quotes from the interviews.

i. Immediate onset

The immediate onset of increased perceived difficulty can be linked to:

- Limitations of the perception of movement/ processing of all the information about the movement – "I couldn't see all components"
- Processing information about the movement, such as the decomposition of its different parts - "I saw it but I can't understand it". Two cases are:
    - Segmentation of coordination "I had to get how the arms are moving. Like the first was going from back to front and the other one - from front to back".
    - Proper way to perform the movement - "[What was more difficult to remember?] The correct coordination of the hands, I think. Also, how low should I go with my torso?".
- Evaluation of the difficulty of the movement upon viewing it – "I knew that it's going to be hard when I saw it"

ii. In-attempt difficulty

The interview data indicates that in-attempt difficulty can occur in the form of:

- Hesitation before executing the move due to inability to reproduce it. This type of difficulty is closely linked to the perception and processing triggered increased perceived difficulty. Some participants reported this hesitation occurring as they were not sure how to scale the movement to their own body's proportions. For example, they had difficulties estimating how large a particular step should be.
- Difficulties during the performance of the movement. The participants reported realizing that they have not fully understood the movement and hence feel like they cannot perform it properly. Coordination was often the cause. In other cases, lack of flow in the performance was the main problem. According to subjects experiencing this, they could perform the moves on a mechanistic level but were not able to go in the state of flow. The most commonly listed reasons were: no music; performing from a static position; stiffness of the body; the social situation

of the experiment (the presence of researchers and sensors). Peculiar expressions of this type of difficulty are the reports of disassociation between the self and the body. For example, one participant stated: "my mind was clear about it but then you feel that your leg is doing something wrong there".

iii. Post-attempt difficulty

The post-attempt difficulty is commonly connected to the self-evaluation of the performance of the movement. For example, the participant did not have difficulties performing the move but was frustrated/ not satisfied with the results: "I expected it to be easier. I thought I could do it but then I couldn't".

The categorization of the different types of difficulty according to their onset is not meant as an absolute division. Any combination of aforementioned difficulty stages can be encountered. However, it is crucial to acknowledge that the perception of difficulty is evolving within the process of the movement acquisition and the constant change of person's knowledge base. In other words, any information, e.g., visual input about the task, proprioceptive feedback about performance, is involved in reevaluating the difficulty of the task. For example, in the interview, participants often could not relate to the difficulty grades they gave in the assessment sheet immediately after completing the movement. Upon completing the whole set of movements their evaluation of difficulty had changed (adapted to the new knowledge set).

c. Sources of difficulty

Qualitative Thematic analysis (Braun 2006) was performed on the data from the interviews (Fig. 18). Research findings reveal that while difficulty is largely associated with the complexity of the movement, factors such as expertise, familiarity with or attitudes towards the movement and impact the difficulty rating. Figure 1 visualizes the clusters of difficulty inducing aspects of the experiment task that the participants reported in their interviews.

i. Complexity

The most commonly discussed cluster of sources of difficulty in the interviews were connected to the complexity of the movement, addressed in issues such as coordination, decomposition and cognitive processing of move related information, dynamics and balance (e.g., weight management). The definition of complexity by one participant was connected to style: "I've never really done this movement so I perceive it as complex since I don't know what to do with my body". The different elements of this cluster are linked to the process of copying a movement. First, one needs to see the move

(perception). Second, one has to understand it in all of its elements (decomposition and cognitive processing). Third, they have to manage the dynamic coordination and weight management (performance). Finally, the performance is evaluated with regard to one's own expectations. This process can was previously outlined in "Onset of difficulty" where the categories immediate, in-attempt, post-attempts difficulty were defined.

ii. Performance

As mentioned earlier, the outcomes of the dynamic coordination and balance build a significant part of performance that participants have to evaluate themselves since they are not offered any external feedback. Self-evaluations vary with regard to intellectual styles of self- observation and degree of precision or report. In other words, if a participant is self-critical and very observant they tend to see their mistakes more clearly.

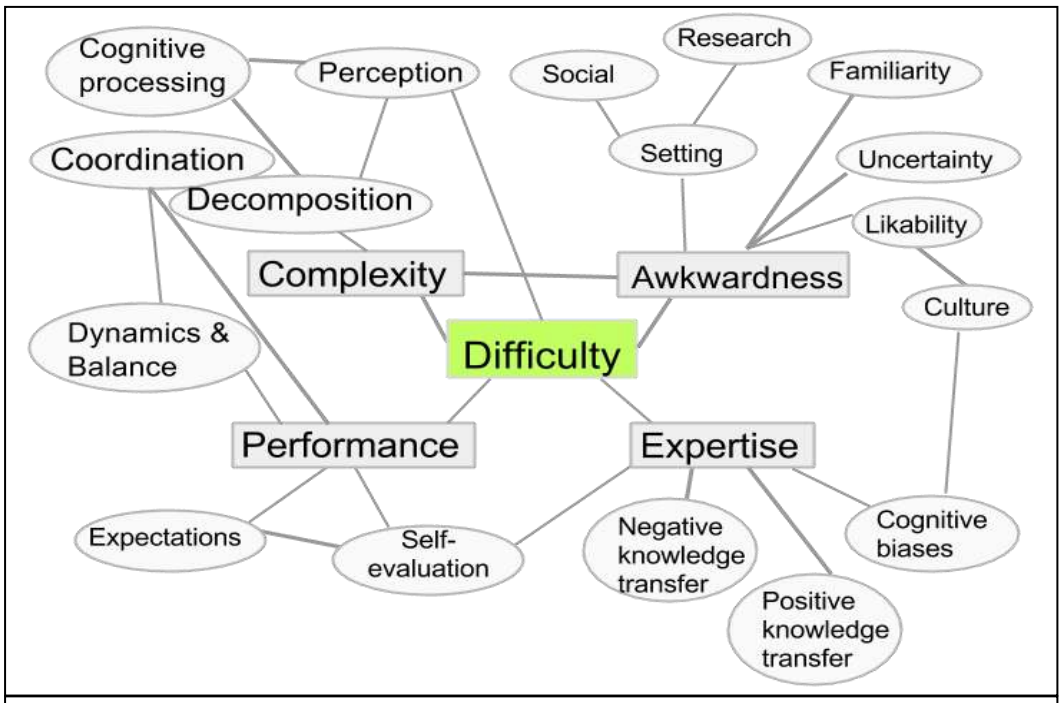

Fig. 18 Sources of difficulty (categories from the qualitative interviews data)

The expectations to one's own performance provide the framework for the difficulty assessment. From the interviews becomes clear that if high expectation of one's own performance or of the difficulty curve of the experiment are not met this has an effect on the evaluation of difficulty. Actually, difficulty, as a cognitive evaluation, can be viewed as a function of the expectations of the participant. Difficulty is the difference between the expected difficulty and the actually perceived functional difficulty.

Perceived difficulty = expected difficulty – actual functional difficulty

This relation can be described as a top-down modulation of perceived difficulty. For example, one participant reported: "I am still waiting for the hardest one. This expectation was the reason to rate it like this".

iii. Expertise

The effects of expertise on the perceived difficulty and performance are described earlier in the quantitative results part of this paper. Although, they hypothesis explicitly testing difficulty rating for negative knowledge transfer could not offer any significant results, the qualitative interviews provide evidence for the effects of expertise on the perception of difficulty. Ballet dancers were comparing the movements compatible with ballet training in terms of ballet, e.g., "Maybe just in this piruette it's easier because we do this in ballet", or "It's more similar to ballet than others. We do this in ballet, this wave with the arm. In Swan lake". In the discussions, ballet dancers also reported on negative learning transfer from ballet. In other words, what movements were more difficult for them because of their proficiency in ballet. The experiment offered several movements incompatible with ballet training and they received comments such as "It's not hard but because I train ballet it's hard. Because all the time we need to have a stretched back. We don't do this bowing the back". Some of the ballet dancers reported on difficulties that people of their professional background would have with the incompatible moves. However, they themselves did not experience such difficulties as they had danced some hip-hop before and are more accustomed to its specific body culture: "Well, this movement is more natural for a human beeing. For a ballet dancer, it's maybe strange but for a human beeing it's more normal". The most often mentioned problems with learning hip-hop were the inability to: loosen the torso and the shoulders (due to its stiffness); do closed legs while in plier; doing arms that violate the proper positions defined in ballet exercise. In some cases the negative knowledge transfer was facilitated by a cognitive bias of the ballet dancer, such as that they cannot properly perform hip-hop movements because of their training: "I don't feel good in this movement, in hip-hop, because it's hard. It's just not for me".

The non-dancers also reported on different experiences that either enhanced or diminished their performance. An example is one participant remembering that she used one of the experimental moves when she was dancing at home in her childhood. However the ballet dancers have primarily been selected due to the strict education they have in a highly formal dance style.

iv. Awkwardness

Under the "Awkwardness" cluster of sources of difficulty accounts both for the influence of the environment - experiment (measurement and social) setting- and for the participants' background and attitudes - cultural influences, the degree of familiarity with and likability of the task. All of those parameters are relevant to functional task difficulty and to perceived difficulty. In the feedback part of the interviews, the participants

described the research setting, both as inhibiting: “Awkwardness was mostly influenced by the setting: all this equipment, no music, two researchers are watching you” and in facilitating: “If it wasn’t an experiment, I wouldn’t do this move anywhere else”. The cultural background was closely connected to whether the participants like/ are familiar with a movement: “I felt like a wrong person, in a wrong place, doing something that has nothing to do with me. It was awkward because of the culture”. The data from the qualitative interviews will be used for modifications of the research questionnaires and the experimental conditions, as well as for ideas for future research.

6. Discussion

The results of the quantitative questionnaires indicate that the overall difficulty grade correlates highly with all the other difficulty-related grades, such as physical demand, complexity and unfamiliarity among others. While the average grades of overall difficulty and complexity overlap to a large degree, physical demand is seen to correlate with difficulty almost perfectly (c=0.99). This comes as a surprise as the movements for this study were selected because they were hypothesized to be of equivalent physical demand. Two interpretations of the high correlation between all questionnaire items come to mind, the first being that all of the listed items contributed to the overall difficulty grade. The second is that the participants were capable of defining the level of difficulty that they perceived but they were not able to report on the particular aspect(s) of the movement that shaped the overall difficulty. In any case, since the overall difficulty captures the different aspects of difficulty in learning dance steps efficiently, it has been used to test the hypotheses of the study.

To sum up, the quantitative results show that ballet dancers received significantly higher grades for their performance and graded the movements as less difficult than non-dancers. The number of learning attempts for the two groups did not differ significantly. Those three hypotheses were included in order to test for the difference in performance and perception of difficulty as a function of the skill level of the participants. The number of attempts to copy the movement was included in the analysis in order to test whether this purely objective measure can provide information about the difficulty perceived by the dancers or about their proficiency. However, it failed to provide conclusive evidence for either directions of research. Another wide spread assumption – that poor performance is associated with high perceived difficulty – was confirmed by the study where high negative correlation was found between the difficulty ratings and the grades of the learning outcomes.

The last hypothesis was connected to the knowledge transfer between the background knowledge of the participants and the experimental hip-hop task. It was expected that professional ballet dancers will perform movements incompatible with their training more poorly due to negative knowledge transfer (Detterman 1993). On the other hand it was expected that the incompatible moves will not necessarily be performed worse by the non-dancers. While it has been confirmed that the ballet dancers performed better movements compatible with ballet, this has also true for the non-dancers. This observation has been confirmed by all other statistic tests however this difference can be attributed to the complexity of the movements. A further evidence in support of this explanation is that, due to the ballet dancers' feedback, one of the hypothesized

"complex but neutral" moves had to be moved to the group of the movements that are incompatible with ballet. While the quantitative data does not reveal the discussed effect but there is evidence coming from the qualitative interviews that the negative knowledge transfer is influencing more than the half of the dancers for the incompatible movements. For example, compatible movements have often been described in ballet terms by the dancers. Furthermore, comments on incompatible movements included descriptions of ballet kinemes that interfere with learning the new movement: stiff upper body and shoulders, open legs (feet rotated outwards) or the classical ballet positions of the arms. This sort of interference with ballet training is the reason for ballet dancers to be selected as participants. The canonical enculturation of the body (Bourdieu 1990; Mauss 1936; Foucault 1977) makes it easier to predict and test which of the motor patterns they have internalized will facilitate or interfere with the new moves they are learning. It is also easier to distinguish the effects of dance style training and the person specific motor patterns.

The qualitative results of this study provided the data for categorizing four types of difficulty assessment strategies: absolute, relative, meta and compound. Whereas in the absolute type of strategies the participants grade the difficulty of each movement separately, in the relative they grade them in comparison to other moves. Meta evaluations refer to grading based on cognitive evaluations of difficulty, rather than on one's own learning experience. The compound strategies combine any of the aforementioned types of assessment. These categories ought to be studied in follow up experiments as they are crucial to the validity of each research project using perceived difficulty questionnaires. A model of the impact of the different assessments on the data can contribute to a better understanding of the results of all studies on the topic conducted in the past, present and future. The same holds for the procedural classification of the perception of difficulty that contains the following categories: immediate onset (perception and cognitive processing), in-attempt (enacting the move) and post-attempts (performance evaluation) onset.

Analyzing experienced difficulty in detail contributes to understanding the mechanisms involved in learning movements from a new dance style. This study showed that difficulty highlights various requirements needed for the performance of a movement. When a movement is very easy for the person it can be accomplished automatically and does not trigger a profound involvement in the decomposition of the move. This is exemplified by the comments of some of the most proficient (in terms of hip-hop) participant who just said that "nothing [came] to [their] mind". This was the case for two of the dancers who did not elaborate on most of the moves because they were "nothing special".

1. Further research

The main idea of this study was to test a methodology for studying perceived difficulty in dance moves acquisitions and to gather qualitative data that lays the basis for a series of experiments testing observation made in this work. Here are the main areas targeted for further research.

a. AnimaZoo and Kinect data quantitative analysis

As previously mentioned, the data from the two motion capture systems will be analyzed for ballet related kinemes and for performance success traits. Furthermore, the goal will be to model movement characteristics that are crucial to the successful performance of the selected tasks. The data can also be used in a technical paper comparing both systems and evaluating their strengths and weaknesses.

b. The effects of dance expertise on copying movement tasks

A follow up study can focus on poor performance in copying movement that is due to the learner's proficiency. In other words, if the dancer is professional and expresses the movements through the prism of their style, they can also be worse at copying movements accurately. This is an effect that was observed in several ballet dancer participants in this study. The evidence is in favor of copying being a specific ability (that requires talent but also training) that is not reflected in their dancing proficiency or is reflected in a negative manner. A similar rationale has been behind Bläsing et al.'s hypothesis that dancers would achieve higher grading at learning from verbal descriptions of the movements and at copying the movement sequence from a video (Blasing 2014). Their data rejected this hypothesis but a more different approach to studying copying dance movements as a specific ability will reveal more about the problematic of this phenomenon. The result will be crucial for modeling the process of learning dance.

c. Test the scales with radically different movements

The scales ought to be tested with a different set of movements that are selected to be difficult for completely different reasons. For example, some of the moves should require flexibility, others- endurance or coordination. The further tests should also be conducted upon including feedback on the research setting that the participants gave.

7. Conclusion

This feasibility study's main goal was to develop and optimize a methodology for studying perceived difficulty in dance style acquisition. The experiment consisted in presenting a group of professional ballet dancers and non-dancers with hip-hop movements with the task to copy them. In addition to validating the methodology, the research tested five hypotheses connected to the performance and the difficulty perception of ballet dancers and non-dancers. The results indicate high correlations between all questionnaire items – overall difficulty, physical demand, complexity, speed of display and awkwardness. Hence, no single clear source of difficulty was identified. The study shows that ballet dancers receive better performance grades and perceived the tasks as less difficult than non-dancers. However, dancers did not need a significantly lower number of learning attempts. No clear negative knowledge transfer effect could be detected in the quantitative results but the qualitative data confirmed its impact on perception of difficulty. Further qualitative results include the categorization of sources of perceived difficulty (and their onset) and strategies for difficulty assessment.

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9. Appendix

1. English abstract

Sources of difficulty in dance movements acquisition

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Abstract— The paper at hand pilots a methodology for qualitative and quantitative research on perceived difficulty of learning dance style moves, on the empirical example of hip-hop. In addition, it studies the impact of different parameters such as complexity and physical demand on the overall difficulty assessment. This study is based on a behavioral motion capture experiment, including modified NASA Task Load Index questionnaires and semi-structured qualitative interviews focused on the sources of difficulty for the participants. The participants, professional ballet dancers and non-dancers, were instructed to copy short hip-hop videos. The quantitative results indicate high correlations between overall difficulty, physical demand, complexity, speed of display and awkwardness. Expertise was observed to increase performance grades and diminish perceived difficulty grades. The quantitative questionnaires data did not provide clear evidence for negative knowledge transfer between ballet training and hip-hop. However, the qualitative data indicated its influence on perception of difficulty. The interview results provided the basis for building categorization of sources of perceived difficulty (and their onset) and strategies for difficulty assessment.

Keywords— Perceived Difficulty, Dance Style, Motor Learning, NASA Task Load Index, Motion Capture

2. German abstract

Quelen von Schwierigkeit beim Erlernen von Tanzbewegungen

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Abstract: Diese Masterarbeit testet eine Methodologie für qualitative und quantitative Erforschung der Wahrnehmung von Schwierigkeit beim Erlernen von Bewegungen eines Tanzstils, am empirischen Beispiel von Hip-Hop. Darüber hinaus beschäftigt sich diese Studie mit der Auswirkung unterschiedlicher Parameter, wie zum Beispiel Komplexität und physishe Belastung, auf die Einschätzung von Schwierigkeit. Diese Forschung beruht auf einem Verhaltensexperiment, das Bewegungserfassung, modifizierte NASA Task Load Index Fragebögen und halb-strukturierte qualitative Interviews inkludiert. Die TeilnehmerInnen, professionelle Ballet TänzerInnen und Nicht-Tänzer, hatten die Aufgabe, zehn kurze Hip-Hop Bewegungen zu kopieren. Die Ergebnisse von den quantitativen Fragebögen zeigen hohe Korrelationen zwischen aller seiner Komponenten: gesamte Schwierigkeit, physiche Belastung, Komplexiät, Geschwindigkeit der Videodarstellung und Peinlichkeit. In dieser Studie haben BallettänzerInnen bessere Leistungen im Lernprozess erzielt und durchschnittlicht niedgrigere Schwierigkeit empfunden als die NichttänzerInnen. Die Daten der quantitativen Fragebögen haben keinen klaren Beweis dafür, dass ein negatives Wissenstransfer zwischen Ballet und Hip-Hop vorkommt, angeboten. Allerdings wird der Einfluß von diesem Transfer auf der Wahrnehmung von Schwierigkeit durch die qualitativen Daten klar ersichtlich. Die Interviews haben eine Basis für die Kategorisierung der Uhrsachen für die Wahrnehmung von Schwierigkeit und der Strategien für die Bewertung von Schwierigkeit.

Schlagwörter— Wahrnehmung von Schwierigkeit, Tanzstil, Motorisches Lernen, NASA Task Load Index, Bewegungserwassung

3. Demographic questionnaire

MIDDLE EUROPEAN MASTER PROGRAMME IN COGNITIVE SCIENCE

UNIVERSITY OF LJUBLJANA

RESEARCH REGISTRATION FORM

All information is *confidential* and will be used for research purposes only.

Age: …….

Gender: Male ☐ Female ☐

Handedness: Left ☐ Right ☐

Currently completed educational/ academic degree: Primary school ☐ High school ☐

University undergraduate degree (e.g., BA, BS) ☐

University postgraduate degree (e.g., MA, MSc) ☐

Do you, currently, take any medications? Yes ☐ No ☐

If yes, what kind of medications? …….

Do you have any injuries that may affect your performance? If yes, what kind of injuries?.....

……

Do you train any kind of dance at the moment? Yes ☐ No ☐

Which one (s)? …….

Which dance style(s) have you trained so far?: ……

……..

How long have you trained this (these) dance style(s)?: ……

……..

Do you train any kind of sport at the moment? Yes ☐ No ☐

Which one (s)? ……..

Which kind(s) of sport have you trained so far?: ……

……

How long have you trained this (these) kind(s) of sport?: ……

……

Do you watch hip-hop video dance footages? Yes ☐ No ☐

If you have answered “Yes”, how often?

Very seldom ☐ Seldom ☐ Sometimes ☐ Often ☐ Very often ☐

Do you learn movements from video clips? Yes ☐ No ☐

If you have answered “Yes”, how often?

Very seldom ☐ Seldom ☐ Sometimes ☐ Often ☐ Very often ☐

4. Difficulty questionnaire

1. How slow or fast was the display of the move for you?

1	2	3	4	5	6	7
very slow			just right			very fast

2. How physically light or demanding was the move for you?

1	2	3	4	5	6	7
very light			just right			very demanding

3. How simple or complicated was the move for you?

1	2	3	4	5	6	7
very simple			just right			very complicated

4. How familiar was the move for you?

1	2	3	4	5
not at all familiar	not very familiar	somewhat familiar	familiar	very familiar

5. How awkward was the move for you?

1	2	3	4	5
not at all awkward	not very awkward	somewhat awkward	awkward	very awkward

6. All in all, how easy or difficult was the move for you?

1	2	3	4	5	6	7
very easy			just right			very difficult

7. Describe in one or two sentences your experience with learning the move?

.....

5. Qualitative interviews

Short introduction to the interview.

E.g., instructions: "We are now going to go through your evaluation sheets from the experiment and I will ask you few additional questions."

Go through each movement assessment sheet. Show videos. Ask clarifying questions about the answers of the participants. For example:

a. Did you feel like there were many ways you could go wrong with this movement or was is rather straight forward – to remember, to implement? Was there a particular body part whose movement you had problems learning? [complexity]
b. How successful do you feel you were in copying the move? What do you think you could have done better? [performance]
c. Read their comment + "Can you, please, tell me more about how you felt while learning the move? Focus on the experience. How did your body feel? What were you thinking about?" [experience]
d. Address peculiarities: "Here you said the move was very familiar. How come?", "Very awkward? How come?", "Very demanding? Why?" What did you mean by that?
e. [familiarity] Do you mean you've seen it or you've done it or "it feels familiar"? Do you remember in what setting you have done it? In what setting would you imagine yourself doing this movement?
f. So, is it about thinking is it about feeling? Is it about something else?
g. What were you thinking when you saw the move? When did that image emerge? When did that happen? When did you start to feel that? How did it change throughout the session/ after you actually did the movement? [process questions]
h. At the last performance you had, you were feeling that you... [fill in the gaps]

Additional questions: e.g.:

2. Which movement was most difficult? What made it so difficult?
3. Which movement was most easy? Why?
4. Which moves did you enjoy most?
5. Which ones – least?
    a. Would you say that you considered some moves to be more beautiful/ nice than others? Which move and why?

Encourage feedback at all times:

6. Under what conditions do you think that you would you have done better?
7. Would you like to add any further remarks or impressions?

Thank you!

6. Transtription sample

Since the full length of all 12 transcripts surpasses 40 pages, only a sample of four is included here.

Abbreviation	Dancer/ Non-danc.	Gender	Page
JT	ND	M	59
BP	D	F	62
EC	ND	F	67
FJ	D	M	71

JT

1st - didn't know what to expect as it was the first one, Training moves were more difficult than the first real ones. Didn't feel very natural, I am not familiar with it. I haven't really done something like that before. My body was not used to doing that – not familiar (that's how I interpret it). It's kind of awkward but still ok. Awkward is usually not familiar. You don't feel good with the movement if you don't know it. Awkward and not familiar go hand in hand. If you are familiar with a movement you feel comfortable with it. It wasn't very difficult, but not easy either. It didn't seem much like hip-hop, but I am really not familiar. [D: Spotted.] Apart from the **5th** movement, the 1st was the most difficult that he encountered. The body felt weird doing the move. Also the speed(?). Just seemed harder.

2nd - Not too fast. I never found any move physically demanding. All of them are quite right. It's not very accurate because we do the movements separately and usually when you dance, you put all of them together. Always seems very light when you're doing one movement. Not very complicated. Didn't look complicated but actually doing it is much harder. There is a big gap between understanding it and actually doing it. This is one of the moves that looked much easier than it was to perform. Most of the moves are not familiar. I just don't know why. I have never danced apart from in the club. So the movements just don't occur familiar. Not very awkward (dif to 1st?) – I felt more comfortable but it can be that I was getting used to the experimental setting. It was getting gradually less awkward. But there were many more awkward moves up ahead, in the end. The more difficult ones are more awkward because you can't copy them. Your body freezes (**5th** one). It looked easier to copy when looking at it. Overall not that difficult. I didn't do too badly. I am careful when evaluating my performance to diminish the gap between what I think and what actually happens.

3rd - Only once. Sounded fairly easy – just the arms like this and like this. Wasn't really hard to understand. This one I copied best, I think. Felt quite normal. Seemed easier than the previous moves. Felt more natural, but it's still not very familiar. None of the moves were

very natural. They felt like something I've never done. Define natural. I feel comfortable with doing. Nothing more to it. Done it, used to it. More familiar than the other ones. All of them were. I have never passed #3 on the familiarity scale, I think.

4th - Looks easy but it is hard to make the feet and arms match. Not as easy as it looks. Didn't feel as not familiar as the first two. Not too bad. In this grading system, when really comparing to the previous ones, I would have put "5", but if I knew what moves were about to come, I would have selected a lower grade. We grade on the basis of the past. Maybe from one to 7… but it still doesn't feel "just right". [D: Then it's a 5.] Exactly! Under what circumstances would you have performed better? (like situation or social situation). At first, maybe was bothered, but here I was starting to get used to it. It's really ok. Besides, it's not like any of us hasn't danced in front of other people before. All of us have! In a club. Not on a stage, but it's important to be comfortable with dancing in front of other people.

5th - couldn't do the foot work. Can I see it again? She moves the front foot, but I couldn't do it. I understand but couldn't copy it. From the 2nd video display. She crosses her front foot. Her hands were just here, it wasn't complicated. But I lost myself during the spin as I was occupied with the foot work. Got it from the 2nd time – I was paying attention to something else. You can't look at everything. You need to focus. Otherwise you're lost. Ex. First on the arms – see that they are not doing anything. The rotation caused the trouble. She does the leg crossing and after the spin she has barely moved from her place. I couldn't slide my feet so. I was constantly moving away a lot. [Fast display] The rotation… I lost track of which foot is doing what.

6th - This is the most awkward one because of the hip movement. Not used to it. I think. I didn't feel comfortable. It wasn't familiar, was strange. I have seen it, of course. But my body is not used to it because it always feels different when you see it or whether you do it yourself. Not familiar – actually never done it. My body doesn't remember that. All of those moves – I have seen on video clips. Maybe in a concert, possibly. [Awkwardness] – If it wasn't an experiment, I wouldn't be doing it anywhere else. No idea. I don't like it. Didn't like doing it. [D: You reacted quickly – associated it with awkwardness]. I thought I would like to do it while people are watching. I just realized I didn't like it, when I actually did it. It may have influenced my 2nd or 3rd performance. At first, I was thinking of how easy or difficult it is. But then I realized that I don't like it. Just right display, physically very light (I never put to the total, deviated from the rest – every time "1"). Not familiar at all to my body. Not very complex. It can be familiar to my body. Awkwardness scale's up. 5 on the difficulty scale. Source of difficulty – assembling the body and the arm. Overall not very complicated. I think I didn't do too badly. But I didn't like it. Wouldn't like people seen me. It seems intimate – source of awkwardness. Under what circumstances – in a dance. Any kind of move is ok in a dance class. When learning how to dance. I wouldn't do that with strangers. Maybe with people I know well. I wouldn't do that in a club. Maybe if I am really drunk – then you don't behave like you normally do.

7th – These start getting harder. This one was not too hard, but… This move isn't easy, but it felt more familiar than the other movements. Felt like my body was more attuned to it, more than the other ones. Maybe somewhat familiar. It looked easy but each limb does something different. I may have felt that I do well but have actually performed poorly. Hard to understand the move. It was somewhat ok but I don't know. I understand but it's hard to get the big picture but when you're doing it, it's ok. When moving, it felt ok. It felt like just one movement, if you treat the arms as just one thing. [D: different to the other moves – hard for the big picture, but ok when doing]. Maybe when I dance and when I drink. Perhaps some moves I've seen in the club. Could be experience from random dancing. The movement is natural somehow. At the same time, it kind of feels similar to the martial arts I did. We had to use ziber (sword) so this somehow reminds me of it – the bodywork. The movement of the body (+ arms) felt like I was using the sword. Although that's nothing that you would do in a sword fight but it's somehow familiar. I only realized it now while doing the interview.

8th wasn't too bad. Familiar. Because of clubbing. Not sure about the feet, but I could get the arm movement. I just didn't do both things well at the same time. Coordination was the problem. That's the difference between dancers and non-dancers. The arm is more familiar to my body. Not the same, but it seems and feels like a smooth move. Felt like something I would do if I would go out drinking and dancing. Not too far from what I would do. [Dancing in a club] – Hip-hop similar music. Club music. Don't pay that much attention to it but sometimes it can even be hip-hop. [D: That's connected to the familiarity]. Felt like the easiest, only 2 limbs involved. The rest of the limbs are like dead. I only needed to see this once to understand it. This was easier than the others. The overall difficulty I may have misjudged.

9th this was the hardest one for me. Doesn't look that complicated: down – up –down and open-close-open. I could understand it but I just couldn't do it. Separately I can do both the legs and then the arms. Up-down-up . And the feet are open-close-open but I can't do them together. Problem of coordination up to the extent that is made me standing without moving for 5 seconds before moving. What was the source of this freezing? My brain was telling me to do both at the same time but I just couldn't so I didn't move. I just ended up doing none of them. Performance? Quite badly. I didn't get it right at all. Would there have been something to help you handle this better? Practice. You need to feel the movement. To actually do it more often. It would have helped to do both body parts' moves separately and then put them together (like with piano). Somewhat awkward – the freezing. Not familiar at all – I couldn't even do the movement. Didn't feel familiar. The hardest one but it doesn't look complicated, but it was!

10th I remember this one. This one was harder to understand than most of the movements. Don't know why. Probably it has two phases. It's kind of hard. No idea. Ha, I put 2 for the physical effort?! No idea why I put this. Probably it's because of the leg. It's not demanding but you get tired if you do it many times. The lifted leg is the reason.

[Not very familiar, not very awkward, but 6 on difficulty] – This move is not easy to do. I don't have that much to say about this one. Harder to understand the movement. Many independent moves with the limbs. Didn't get it at first that it has 2 phases. Once you see this, it's really not hard. It's hard to identify it if you're looking on separate limbs, but easy to spot if you're looking at the whole body. In the case of this movement, it's really beneficial to look at the whole body. But it's not in every case. Sometimes it's easier to look at separate limbs. The 2 phases made it easier. It seemed less complicated in my brain. 2 phases. You look at each separately; figure out what she's doing. But if you look at the limbs separately you find yourself tracking 6 things. [Decomposition could help you previously. What about this one?] – For this one I needed more displays. First 2 trials, I was tracking 6 body parts. Afterwards – only the two. If somebody decomposes it for you? I don't know which one is better. In martial arts they were always teaching us separately. But in dancing sometimes you need to look at the whole movement. It's easier to understand, but is it easier to do - Phases will be easier because this was clearly has 2 phases. This depends on the person.

Settings – was ok. Dancing was awkward somewhat. At first the suit was uncomfortable. It felt a bit short, but I got used to it quickly. Most difficult movements – 2.7, 2.3, 2.8. Easiest – 2.1, wave, 2.6. Not demanding in terms of body - the wave – easy but I didn't do it right. Familiarity with the move. Always found waves easy to do. Sources of difficulty – coordination – putting everything together. Awkwardness is not related to the difficulty of dancing but it is psychological – judgment may have influenced the performance of the movement (the sexy move). Not comfortable -> not doing it. It depends on who you are with. Dance is very intimate if you're doing some moves. It's an expression of the body. If you're not ok with it, you will not be doing it well. You have to be comfortable with the people around you. Or else, there is no point in doing it. Learning environment and social surroundings. Clubs - hip-hop – familiarity with the culture – familiarity of the body with the move. I wouldn't say I like to listen to hip-hop but it plays somewhere and I don't listen to it myself.

BP

1st - display of first movement - just right; physically - light; not that complicated. I've already seen this movement. It was not at all awkward. Difficulty - wise, it was just right. I kinda expected it would be harder. With this one I was still satisfied. Kind of satisfied with my performance. Although I would never say that I am satisfied with myself. Especially with hip-hop moves. #00:01:22-8#

2nd - it was kind of ok. Time-wise. Physically - more demanding than the previous one and it was more complicated. It was familiar. I've seen it. In movies or in some videos of street dancing. It was kind of awkward for me because it is about moving the upper part of the body and I am not that good at it. [why?] I have this problem in ballet already. My body is getting stiffer and stiffer, maybe I think too much. [what did you think about?] I thought

"Oh, this one will be hard for me" and after I did it I thought "this one was no good". [stiffness? what would be a comfortable move for you?] Something that doesn't move the upper part that much. maybe something more down. Moving legs or something. [the upper part should be straight and stiff or?] Well, maybe like one pose and that's it. Nothing much. It's just me. #00:04:07-9# [any position would do, just not moving a lot? difficulty - 5?] Yes, as already said, this was hard for my stiff body. [so this was the reason? you prefer not to have movements?] Yeah, sure. In the upper body, just... #00:04:45-9# [did you feel during performing?] Yes, I did feel it. I was stiff still. Even though I tried to. I also felt unfomfortable because I tried... I usually check myself in the mirror but now I don't have anything. I have a bad feeling about it if I don't see myself doing. Having a mirror means feeling more sure about yourself. [mirror? otherwise insecurity? how did that affect you? did it also contribute to this feeling that you described?] Yeah, sure. Yeah. [did this bother you with all movements?] Yeah, of course. But with some of them I felt better. Feels better in the movement itself. But, all in all, I prefer checking out myself before I do it. [was this one of the moves that was better or worst?] Worst. #00:06:14-4#

3rd - This was a hard one as well. This was the most awkward, I think. I don't know why. I rated the display with 5; for the second one, as well, 5; third one - too. It was not too complicated because I am still a dancer but it was awkward and hard. Then four, number four - it was not really familiar. In a sense of what I have done and seen. Both. Because anyway, for here, I was thinking whether I have seen it already. Because I haven't really done anything with hip-hop. So this is actually connected with if I have seen it. Number 5 "how awkward". It was. Yes, it was awkward (laughs). All in all in was number 5, yeah. ["I didn't feel really comfortable" + first reaction "Oh, this was the most awkward one!". Why?] I would say, maybe as position - what she did. I don't know. The whole movement was... Already when I saw it I thought "yes, this is hard". I don't know how to explain it. [You felt like this when you saw it, but when you did it?] Aswell. I thought that it was awkward. [did you feel like you performed well?] Not really. #00:08:42-5# [You say that that was the most awkward one but you have "somewhat awkward".] Sure. This is true. Because I was not sure yet whether the next ones are gonna be more awkward than I was. I put 3 because I thought that for sure worse is coming. Because it was just the third movement so I expected that it is not the worst one yet. [How would you have scored it if it wasn't the **3rd** move?] I would put 4, I think, because the last one was very awkward. #00:09:56-3# [What the aspect of the movement that contributed most to your difficulty rating? Or was it a combination of all?] All of them, I think. ["not very familiar"? In what context have you seen it?] I haven't seen anyone performing it. Live. I wouldn't say that it's "not familiar at all" like "I have never seen something like this". Just like, not really... Perhaps it was a long time ago or I didn't pay much attention to it. Don't remember the setting. #00:11:55-5# ["not comfortable" was this about your stiff body again?] Yes. Sure, sure. It was. And that's why the coordination... but this will come later, my problem with coordination. Coordination of the arms, the whole and the head, too. Full body coordination. [But do you understand the movement separately?] Sure, it was not that hard. #00:12:49-0#

4th - Display speed was 5. Because I couldn't put "just right". I still had to think about which arm goes up first and which down. Otherwise it was ok. But for me it was a bit hard to understand. But no big deal actually. Physically, I put 6. Because of the coordination of legs and arms: which leg goes up, which arm goes down. And the legs - how they turn - right or left. "How simple or complicated?" I put 6 here, because I was still waiting for the

most complicated ones. And I didn't give it the maximum grade because I've seen it. It wasn't like "what, on Earth, is this?". It was the move. I have seen it and with the legs, I have done it. [Is the familiarity one a compound of "seen it + done it with the legs"?] Yeah. But I haven't done the arms. Together. "How awkward?" It was awkward. Yeah, but not like really awkward. [You said that the previous one was the most awkward. What is the difference between these two movements?] My stiff body, for sure. Because I was kind of sure about the legs, but moving the body it's again my nightmare. It's just the upper body. [When was the point when you felt that this may be a problem for you? You saw the movement. What were you thinking then?] I was thinking, ok, the legs I have been doing in elementary school. I just have to coordinate with the arms. How to put it together. [At which moment did the movement become awkward for you?] At the very beginning and ending. What is the position of the arms in the beginning and what in the ending? Either right one is up or the left one. Because this is why I did two times - because I messed up the arm. I finished down and I should have finished up. Not sure. [You also wrote it in the description.] Aha! Coordination, sure, sure! "It was hard to coordinate arms and legs together". Overall difficulty of the movement was 5. Because legs I've done already but arms... And I am still waiting for the hardest one. This expectation was the reason to rate it like this. [What would you put now?] For sure, I would put everything different. It's hard to judge 1, 2, 3, 4, 5 but for sure, I would put 6. [what if you compare to the last movement? (I see the facial expression coming.) Was the source of awkwardness similar or different?] It was different. The previous one (3rd) was maybe "slutty" or something. Maybe like this way. For the clubs or something. Not appropriate maybe. That was the awkwardness and why I was not feeling comfortable. [So the awkwardness in those two movements? With one word.] I would say again, it's moving the upper part. [Did you perceive this move as slutty because of the movement of a particular body part or was it overall?] Overall impression from her face and from her arm here. Position of her right arm and facial expression. [Your task was to copy the move so this was why... I see. How about your performance?] I didn't do it well. That's why I too 2 tries anyway. Because I didn't feel comfortable with performing it. But after the 2nd try I just left it as it is. #00:22:32-4#

5th - It was just right (speed). Physically demanding - just right. I am not sure how I performed it, how it looked like but I felt like it's ok. I was "just right" complexity because it was very familiar for me. [How come?] From movies or I just thought that this is hip-hop step. I mean, how I would imagine hip-hop - I would include this step. I have never done it before but it was familiar. Yeah. As simple as that. Nothing really... [Movies? What movies?] You know like dance battles. When they're dancing and just fighting. In one of our shows this year one girl was doing a similar move. It was not really hip-hop but it was like arms up. It was familiar to me. [But was it the first time you've done it?] Yeah. I think so. Sure. #00:24:21-9# It was not really awkward. I could not say "not at all awkward" because I am not sure if I am doing it correctly. Also how do I look. I was not really confident in myself and my whole performance, but I thought that it was not really awkward. I've seen it so I just tried to copy it. [In this case awkwardness was connected to...] Not being sure about how I look like. [Overall?] This one was just right and I have seen this move in movies or something. [even though you haven't done it, it wasn't awkward] Apart from not been sure how it looked. [Difference between thinking about the move when you first saw it and feeling while doing it?] Yeah. Kind of. It was all really positive, actually, but I am not a hip-hop dancer so I can't put "oh it's really... not at all awkward". [How did you feel while doing it?] It felt ok. Nothing special. #00:26:38-5#

6th move - Aha. This one was very familiar to me as well. It's like the previous one (**5th**) because it is a typical hip-hop movement, I'd say. Actually, I've put here: just right; just right; everything from 1-3 was just right. It was somewhat awkward. That's why I did it twice. I thought that my arm didn't go up as much as hers. So I didn't fulfil the move. Probably, it wasn't that much in me. I should perhaps do it more times. So that's why it was... This one actually was different than the previous one. Although here it may be the same but ... Maybe I should relax more while doing it so that I can feel better. That's why I did it two times. [What would you like to relax more?] To go deeper down. [In terms of body parts?] Legs and the whole body should go on another level. It means that the whole posture would be looking different. [So you've seen it but you haven't done it?] Mhm. True. [For you it's the same as the previous? A real hip-hop movement? Is it also from the movies?] I have seen it in the movies and in one performance where they were doing street dance (here in Sloveia). My friends, actually, they were doing it. It was kind of improvization but still they've put this movement. That's why I think that it's a hip-hop movement. #00:29:24-1# [How did you feel in the move] I felt kind of cool to try it. [what does that relate to: body motion, your mood, something else] To the body motion which is cool. [So in terms of likability?] Sure, in terms of "hip hoop is cool". Maybe like this. [The previous one? Is it similar in terms of likability?] Sure, sure, those two were kind of similar. I would say so. For those two, I would say I do like them? [So what do we have here?] I saw this one before as well. So I'm familiar. It's kind of the same like the previous. #00:31:31-7#

7th - It was just right. For the second just right as well. This one was actually familiar to me because it is a turn and turning. It was not very awkward. [Where from is it familiar?] I would say that this is the step that in this way - kind of turning in plier... uhm in the... we are using as well. Maybe not with these arms. [With "we" you refer to?] In ballet. But really, it's classical. But in the performances, not really as classical as ballet. But in the shows. About the awkwardness, I didn't put "not at all awkward" because I kind of thought that I will do it well but then I didn't really do it well. "I can do this, it's ok" turned into "maybe it was not... could do it better". Already in between I was thinking this. "She didn't really move the legs like this". #00:33:23-9# [You're very familiar in terms of seeing or doing?] Doing as well. We could say doing. [Difficulty?] I put "just right". It's because I've seen it and I've done it. ["It's not really classical but we've done it in shows". Are those only ballet?] It can be ballet but it's just the choreographer does his own style. They can put... It depends on the choreographer. How did I... I liked it because I like everything connected to turning. I like turning the most. That's why... [How did this influence you? Until now we've seen different dispositions towards the movements: you didn't like the move; with the other - you haven't done it but you thought it was cool to try them out. What about this one?] When I saw it you mean? I thought "Oh I can do this, it's turning". [This changed a bit later?] Yes, it changed, in between already. Yes, in between doing it. This is the reason why I put 2 then. #00:36:13-1#

8th - This one was one of the "have seen" already. And "have done", with the arms. [Both?] Just kind of like this movement. As a difficulty level, I've put 4 for everything because I thought it was... I have seen it already. It was not at all awkward, as well. Nothing special. I thought that this one is the easiest of all so far. But you can see that I am still waiting: I said that it's easier than the previous one. That's why I didn't say it was the easiest move. I was thinking that it can be harder or easier. [What about now?] How many do we still have? Two, right? Yeah, this was the easiest one. [Nothin special? That's

interesting. It wasn't awkward, it was somewhat familiar, it's just right when it comes to complexity. What were the parts that you were focusing on. In the movement. Did you feel like a lot can go wrong with this movement?] No, just go for it. Nothing. No. Nothing much, was I thinking. [You were not thinking much?] Nothing really. I just decided to do it and then nothing much. #00:39:33-8#

9th - [Does it ring a bell?] This one is hard. Faster - slower, it was just right. It was just about me. I cannot do this. I think. I can't blame the presentation (too fast or too slow) for not being able to do it. Physically, it was 6. Now I can put 7, I think (#pre-last move so she is more comfortable with giving ratings: she recruits the memory about the moves that we have just discussed + the preserved impression of the last move). How simple or complicated? Here I made a mistake. I could even put 6. Actually, I don't know why I put 5 here. Sometimes, I was actually confused with these ones. I thought they may be the same [physically demanding or light vs. complexity]. Confused how to rank it. [You got this differently?] Not sure. It's ok, I think. [Why could you even put 6 here?] Because it's complicated. It's a hard one. Here it's all about coordination and I am not good at it. Either the arm comes from behind or front. You know, how to wrap this around. I felt somewhat awkward. I could actually put "awkward" here. [Why?] The same thing. I took two of these. So first time I got wrong arm, I put it from... Coordination is the hardest thing for me: e.g., where the arms come from. This is coordination - to put two arms together. Thank God we don't have more. Would be harder with more arms and legs. [Like motion capture with octopi. That would be...] Yeah. [All of these degrees of freedom... So awkwardness in this case is connected to coordination?] Sure, sure. And the difficulty was 5. I could put six actually. I don't know what was going on with me. Yeah, 6. Definitely 6, I would put here. I also wrote it: "I had a hard time coordinating". [Familiarity?] Ah this one. I can't recall where I've seen it. But I cannot have never seen it. It is kind of familiar but I could never... I couldn't remember where I saw it. Don't know. But it was both seeing and doing. Actually, maybe I never did it. #00:45:13-2#

10th - Again, I wouldn't blame the display - neither fast, not slow. It's just a little fast because it's a long movement. That's why I thought that it maybe could be slower. I put 6 because it is long, it's not as short as the previous one. How simple/ complicated? How to put them together, meaning coordination is the problem for me. For sure. Cause it's long movement. You have to be careful about the different body parts"which part goes where. Legs, arms, the head was not that bad but yeah. It is somewhat familiar. I have seen either the arms or the legs. It is half. Half of it I have seen somewhere. And half of it I have seen somewhere else. Maybe in some shows. Just in some performances of some school for contemporary dance. It was very awkward. It was the hardest one, this one. For sure. The last two ones were, as I expected, the most difficult. This time I could say that it was very difficult. 7, I could say here. It was very awkward and very difficult. I never really want to go to the edge. But now when I've seen it all and we've seen them again, I can say. I am certain now. [Why "very awkward"?] I think I was not feeling good while doing it. I was not feeling fine already while watching it. I was feeling stressed out whether I will remember everything. So awkwardness was everything put together. Awkwardness already happened while you were watching it. Yes, and it stayed there for the whole time. I would say that this is very awkward everything together (stress how I will perform and remember). [This was a long move?] Sure it is connected to remembering. Long and stressful because it is hard to remember. [Did you have something similar with the previous ones?] Maybe a bit with the previous move. Move 9

was kind of long. [Long? Is this one different (9)] No, sorry, it's not the right way to say "long". At movement 9 it was just the arms coordination. No, especially if we're comparing the two moves. It a different type of stress. N10 is the long one. Complicated one. [I show the **8th** one again]. #00:51:59-3#

[What could have helped you perform better? Feedback on the setting.] The only thing is a mirror. Perhaps it's just me. Mirror brings a self-confidence. #00:52:51-6# Top 3 most difficult: 9 (complicated) and 10 (long) and the slutty one. [what was that reaction about?] I just saw it, I did it completely wrong (laughs). [Reaction was about your performance of the movement?] Yeah, I tought "oh snap!". Top 3 most easy ones: the 2 hip-hop ones (5, 6 - the cool ones), this one when I didn't have any thinking. #00:55:54-1# I thought that it would be more difficult, in a sense "more dancy". I thought that I will have to learn a small choreography. I kinda liked it that it was one move only. I enjoyed thying out whether I will remember and how easy or how hard it would be for me. So this is a good thing, I say. I thought that it will be, dance-wise, more demanding.

EC

1st - It was pretty fast because it has so many components in the move. Actually, in the first two planks you're not sure about the hands and the legs. Maybe in the third it was better because I tried to remember where to put my hands and legs. And with which leg should I start. [pretty fast, many components? The display of the movement you described as "just right"] Yes, as I said but I needed 3 times. "Just right" meant that I see all the components. [Physically demanding: 5] Yeah, it was not that easy. Because I am not used to. [Complexity: 4] It was not that complicated. I should do it more properly. ["it was not that complicated" but "there were so many components"?] If I would train, it shouldn't be that complicated, but it still has many components. [Familiarity?] In terms of doing it. I have seen this move but it is not very familiar to me because I have not done it. I've probably seen in on youtube, maybe. [Awkwardness] That one was not so awkward (laughs). [awkward?] Meaning strange, that I feel strange. [Overall: 5, which component?] This with shoulders? I can't do that. "I learned a new hip-hop move and hope that I will be able to use it". Maybe one day. [was this new?] Yeah, it was new for me. I didn't practice it, I haven't done it. I've seen it on video clips. I thought it would be easier. When I saw it I thouhgt it would be easy but when I did it, it was "huh, no". [was it a feeling or a thought?] I saw it "ok it is easy", when I started doing it, it was not that easy anymore (because you're not sure about the hands, about the legs) and that was that difficult thing. In mind, you can repeat it properly but with the body. [did you like the move?] Yeah, actually it was pretty cool. Almost all the moves were cool but difficult to show. #00:06:53-4#

2nd - Again those shoulders. I should be more soft here. I think. [You felt more stiff?] Yeah, yeah. I guess it came from too much sitting, no idea. [connected to physical

condition?] Yes, I am sure that it is not something else because I don't have any injuries or anything. Actually, I think that we are not doing anough things with hands. We are all the thime in front of exercise books, we just write, we never do those stuff. [Physically light?] It wasn't that difficult. The problem is that we're not soft enough. I think that was the biggest problem. [Physically demanding and complicated?] Not so hard. [Familiarity] It was more familiar than the first one. Maybe I have seen it more often. On youtube, in videos, on TV, don't know. But it was more familiar to me. [Familiar in terms of seeing. How did it influence your doing?] It didn't influence the doing because I do this. Or maybeI did. Maybe I don't remember. But I see it because in all of the choreographies this component is in. Choreographies of hip-hop songs. But I don't know the artist. Actually, I don't listen to hip-hop. But I see videos. Yes, sometimes I do, of course. Ok, maybe in "Bailando" I am sure that they had this move. I am sure. [See videos but don't listen to hip-hop] But those moves are in other videos as well, I am sure they are. "This one was pretty cool". But you know, with some of them that were awkward, I would never do that. But this one, maybe. Maybe not that much movmement. [How did this one feel initially and after?] Initially, it was easier but then... Like with all of those movements. First time: ok, I need to put my legs there; ok, my hands are there; shoulders, I don't know. But then... the mind was clear about the move but when I started doing it, it was not that clear anymore. And then you just feel that your leg is doing something wrong there. #00:12:44-4#

3rd - It's like a parrot. That was my first thought. "What's that? I'm trying to fly? But I can't. I am stuck". [When did this thought occur to you?] I don't know, it was a strange move. Because of the hands and the position. And there is no music. It's so difficult to do it without music. [More fast?] Yes, it was more difficult to remember. [But you parroted it.] That's true. [What was more difficult to remember?] The correct position of the hands, I think. How low should I go. For the leg - I need to push it forward -> how large is the step. Is it 1 meter or maybe just 70cm. That was the problem. Sort of like finding the size of the movement. [Does that relate to how complicated the move was?] Yes, of course. #00:15:15-3#

[Familiarity? You've seen parrots but apart from that?] Not very familiar. I catch it. I remember something. Some of them I remember from our high school's events. Every time a hip-hop group would come and perform. Maybe from there, sure it is. We were just looking, we didn't do it. [Awkwardness?] Awkward. Because of my first association and because I was not sure about it. "Like, OMG, what am I doing? That's not proper...". [Which type of awkwardness was first?] Because it look weird. And even without the music... Perhaps with the music all of this awkwardness wold not be present. Or at least, with music each awkwardness rating would be lower by one grade. [What about the research setting?] Yeah, of course. Awkwardness was most influenced by the setting: all this equipment, no music, two researchers are watching you. And you're sure that you're doing everything but the right thing. I was trying to calm myself down by saying "relax, it's just a research thing. Nobody would remember you. Nobody would laugh at you." [we

would laugh with you but not at you. So you woudl never use this move?] No. Because of the awkwardness ranges. The people on party would be "wow, what is she doing?!". #00:19:34-9#

4th - Now I see, I didn't yuse legs. I was trying to do something with hands but the feet I forgot. Ok, whatever (laughs). It was fast. I didn't remember anything, even the hand moves. But physically it was not so difficult. I would be able to do it with practice but it was hard to remember. So that's why it's difficult. Not because I should, e.g., jump one meter in the air. Legs and arms, both were hard to remember. You remember in parts: now I do this with one of them, then what's with the other... [did you remember things separately?] Yes, at first, I was trying to remember at least the arms. Then the second time - the legs and feet. And then when I tried to repeat it, I saw that I don't remeber anything. In the third time, I was forcing myself to remember but I did not. ["Not at all familiar?"] Nope. Nope, nope. Never seen that one. I am not sure but no because there is too much hand movement going on. [Awkwardness?] Awkward. But not because I felt so strange but it was so unfamiliar to me. And I was so not sure about the hands position and the leg position. So that's 5. "I should practice". Yes, really. Maybe for one day. [Do you like it?] Yes! It looks great! It looks great but it's difficult to show. It looks easier than it is. [Difficulty: 6/7. What was the major component of difficulty] Hands and legs coordination. If I would be able to de them more properly, perhaps I would put a 5. I don't know. #00:23:23-1#

5th - This one was the easiest. But I think that on the third time, I forgot to use my hands. But otherwise it was cool. And more familiar because we all rotate on the dance floor. So in the club. [What music?] Most often, it's balkan because I go out with the students organization. It's familiar in terms of doing. Not those things with the hands but the legs and rotating. This is familiar to me. [Awkwardness?] Not awkward. It was cool. I feel cool. It was the easiest one. I would use it. [Were there any differences between seeing it and doing it?] There was no such big difference like with the previous ones. It was not hard to remember. I still didn't do all the components. #00:25:41-3#

6th - Actually, when I saw it, it didn't seem that difficult. Ok, I need to raise my hands.But then when I did it, I always forgot to... I always had hands like that and I didn't release them. I think I needed to do that, just that. It was funny to me. I was not impressed with myself that I can't do it. It seemed easier. But there was this issue again with the scope of the movement - how long it needs to be, how far to go. And the shoulders. She is doing something like that and I didn't. [Physically demanding: 5] It was not that easy - you needed to go low. [Complecated?] Just right. It was not so complicated. [Familiarity] Not very familiar. Because I don't do it. But I've seen it. Maybe even in the movies. Sure. "Highschool musical" had many of those components. They had dance all the time and always hip-hop. Almost always. [...Romance in hip-hop but it looks different. "Somewhat awkward"?] it was not that awkward bu tsomehow. I didn't feel really comfortable. Perhaps because I've done so many movements previous to that so this one was not that

much (like the parrot thing). Because I don't do it. It was the feeling not being comfortable. [It just happened that you haven't done it or you mean that it doesn't fit you?] Yeah, I would do this move if I would practice hip-hop but otherwise in club or something NO. (laughs - exagerated). I guess that I would slap somone if I would do that in the club. It's not that much me. No. Never.(laughs). "There should be music". [What sort of music?] Maybe, 50 cent. Hip-hop, maybe rap. It would be cool. Eminem. [slow/ fast? romantic?] Fast music. Not romantic. Rude. Violent. Would be better. Violent rap. That would be cool. [How did you feel when you saw it and then when you had to do it?] When I saw it it ws strage because I knew that I will have to do something strange with the arm. And it was also strange when I was doing it. Maybe it was a thought and the whole move was strange because of the hands being raised. You need to do something and while doing it, raise your hands. #00:33:22-9#

7th - The arms. They are difficult. On the video tape everything looks smooth and almost elegant. And then when you try to do it, everything is so rough. Her arm was so soft and mine wasn't. The display was fast. I didn't remember the right arm position. I really wanted to see how the arms are and then I forgot to remember the legs as well. [Physical demand? - 5] Not very demanding, but not "just right" something in between. Maybe between 5 and 6. [Complicated?] The legs and arms. [Familiar?] Not at all familiar. I have never used it and I think that I have seen it nearly never. It looks very cool. I like it. I would use the move but I don't want to punch somebody. [Always in the club situation?] Yes. I like to dance at home. Home alone. But that would be for home so that nobody can be injured. Not very awkward. Actually, even not at all awkward. It looks cool. She looks cool when she's doing it. [Overall difficulty: 5] Because of the arms. "It's too difficult for us who are not practicing because of this elegance". This smoothness. [Initial impressions that changed later] When I saw it I thought that there will be no problem with this elegance and smoothness aspect of the move. But when I did it, it not the correct position. #00:37:27-2#

8th - A lot of components. There are two arms which are doing different things. You need to remember one then the other and everything needs to be smooth and elelgant. It was just rough and not elegant. Even when she grabs her leg it looks cool. But when I was doing it it just doesn't feel cool. I felt strange. Like I am not doing the right thing. With the arms. She looks so cool when she's doing that but I thought that it's so awkward what I'm doing. [Like the previous one? "she does it so smooth but when I do.."] It's similar. The problem is the arms. The arms are wrong. The legs are cool. [Too fast?] Yes,I didn't remember everything. [Physically demanding] No, it was not that hard. [Failiarity] I've seen it but I don't do it. I don't know. You know when I was younger I would really like to be a hip-hoper and today when I am looking at that I see "Ok, if I would practice it, it would look much better". I didn't train, I just wanted. Actually, I was doing nothing because I was living in the country side and there was nothing at all. You can't practice almost nothing. Maybe guitar and that's it. [Harmonikas?] Yeah! Actually in every house there was somebody who could play the harmonika. Just in ours there wasn't. That was

the only thing but I didn't want to. [Wanna-be hip-hop thing?] Yeah, it was so cool, you know. It was really cool to be a hip-hoper. All of us, we were trying to dress like them. **7th** - **8th** class. We got the ideas from the school mates. At that point we didn't even have internet. [Somewhat awkward?] Yes, but not that much. I didn't feel so awkward. Maybe after the previous few ones, this one was not awkward anymore. Maybe it would be different if that move would be the first one or the last one. [Awkwardness] The arms and the right position of the arm. Because you are not sure about the move and then you feel awkward. You start thinking "All those previous participants were better". And then I know that you know how they were doing. [Was that contributing to the awkwardness scale] Yes. The whole time I was thinking too much about that. "Ah, it's awkward, I am not doing it right". I wasn't that relaxed as I shoulf have been. For this research it would be nice that the participants are really relax. [Too many components in one move] Yes, because of the arms. One goes up, the other one goes down... #00:44:39-3#

9th - Oh, this one looks really cool. I think that if you're a ballet dancer you can do it really well. I am sure that they can do it. Everything was cool, and quite familiar and not awkward at all. [Familiar] Girls do that. Even in club they do something with hands all the time. Even me. Not exactly the same move but some sort of it. When you use hands you always do something like that. Some waves. "That one was the best one, just I am too awkward". I didn't feel like it's smooth and elegant... like her. [Did you have this feeling while you were doing it or...] While. When I started I felt "no, no, no, it's not cool". [Did something change?] When I saw it, I knew it in a second that I will not be able to do it so smoothly. So actually, there was no change. #00:46:51-9#

10th - Last one. Oh, yeah. This one was hard. That one was difficutl, not awkward and not not familiar but difficult. Because there were not only hands but even the legs - you needed to jump as well. I should put a 6 there. Demanding or not - not difficult to show. You just need a little bit of jumping. That's not hard to do. But to remember all those stuff. That was hard. [Not at all familiar] I haven't seen this one and nobody does that. I was trying to remember whether I've seen anybody jumping in front of me in a club or something. Nobody did that, ever. [Not very awkward] No, it looks cool. I like it. But it's difficult. Especially without the music you can't do your best. Yeah, I am sure it would be better. [Did something change?] Nothing changed, I knew that it would be hard. #00:49:05-9#

FJ

1st - It's the first movement. That's why I put "just right". It's not that fast, but not that slow. Physically, it was light like almost all the others. I didn't get that tired because we are used to doing something worse. To all moves, I put "very light" because in the end I didn't get any problems (breathing deeply). [We're not going to discuss this for the next ones.] How complicated - it was a simple movement. Yes, you have to figure out how to do it but it's not complicated. With this "familiar"... I interpreted it how I felt, if it was in

my body. Not something strange... That's why I put "very familiar" because coordination was good. Actually, for all the others I didn't put "not at all awkward" because it was not awkward. I just do ballet, I just dance and for me there is nothing... well there is something awkward for example in a choreography but this was not awkward for me at all. I didn't feel embarassed. All in all, it was easy as movement. And I put "ha-ha" because that's what it sounds to me. I didn't know how to explain with one sentense. It's cool. #00:03:19-4#

2nd - Slow. Not fast. Light because of the same as before. Simple, it's not that difficult. Familiar, for the same reason as before. It was in my body and it felt familiar as a movement. Not at all awkward. Complex/ easy? It was easy. And then "Fly" because it was ending in this position with two hands and it reminded me of wings so that's why I put "Fly". [And airplanes? Ok. So it fits you.] #00:04:11-7#

3rd - Like movement was not super fast but at the same time it's not slow. I mean, the arms were changing fast. That's why I put 2. It was not super fast but it was not super slow. Then the next one - light for the same reason as before. Simple, this was more difficult because I had to get how the arms are moving. Like the first was going from back to front and the other one - from front to back. That's why it was complicated. Because I needed to get in the first place. Just with this. Because with legs and everything. [I remember, you were like "Oh!"] Oh yeah, I'm always like this. When I see it, in normal life when I do ballet and we have some choreography... In the first look it's like "ok, how am I going to do that?". It's a matter of practicing. That's my usual reaction. But then you just need to get in the mind and the body and then it's fine. [How do you get in the mind?] Now in this moment, it's just one movement. But in ballet, it's usually a combination that we need to get. And maybe the step that is coming after the other one is not so connected. It's a little bit... Like if you're turning on the right side and then you suddenly need to change to the left side. For the body it's... you have to control so many muscles and everything to stop. #00:06:40-4#

Then not very familiar. That's why. Because it was not like in my body. I didn't feel so good. I could do that but I didn't feel it really in my body. That's why I put "not very familiar". [Did that change? Because you said that in the beginning you had the "Oh, ooook" moment.] Yeah. It changes a little bit. Like in the beginning if I would do just one time, it would be "not at all familiar". Like repeating a little bit more was "not very familiar". Of course, not at all awkward. "Just right" because if you see this "not very familiar" and you put together with the other stuff... I mean for me, actually, this "familiar" part is like the most important as dancer. Really, when you feel it in your body what are you doing, then you feel sure. The teacher from my academy sais "look, first you learn the technique and when you have it, then you start to put yourself". Like expressivity or whatever you want to do. But first you have to know the technique. Because when you would be in the company, then nobody is teaching you the technique. And so you have to know the technique by yourself and then you can improve as an artist. In the school, you're learning about how to be a dancer but more in the sports way. You have to close fit positions.. and all these stuff. And that's why for me this "familiar" part is the most important because when you have one movement in your body and know how to do it, then you can do whatever you want. I mean, not that the other things are less important but for me, it's more important the familiarity with the movement. Because it's based on it. If you're not sure about something, then how can you do that? #00:09:01-8#

Then, of course, not at all awkward. For the moment the most strange one. It's like "Ok, how to do that?" (demonstrates confusion). Because it was the third one. For the moment, it was the most strange movement. [Have you seen the movement somewhere else?] Now, I've seen so many choreographies and I don't remember what they're doing but like movement it's not that strange like... doing piruette on their nose. It's not like this. It's a common movement but for me, for what I'm doing it was a bit you know... For ballet. Because I've never studied hip-hop. I've always been learning choreograhies of hip-hop but never did classes. iI'm watching youtube and I'm trying to learn it. But you know, there you can watch thousand times more and here of course, I could watch thousand times more, but otherwise we would be still there in this moment. #00:10:56-1#

4th - This one was the most cool one. Because I like this turn. I remember when I was little I was always doing this. Sometimes I was playing and doing choreographies by myself with my friends and I was putting this turn everywhere. Like these crossed feet and turn. Everywhere. It was a little bit faster than the other one because they were all slow. Light, as I said before. It was simple because I've been doing this move since 20 years, almost. And very familiar, of course. As already said. Super familiar. And it was easy. And it reminds me of Michael Jackson style. With all of his turning and this "Au!". He was always doing it. That's why I put 'Michael Jackson'. #00:12:17-3#

5th - It was a little bit faster. Light. Complicated because... a little bit complicated because... not very simple. Again the same thing. There is a strange coordination of the legs and the arms together. With the first arm that is going up the legs are bending. And then with the next arm that is going up the legs are stretching. This is why I was a little bit like "1-2" and that's why it was a little bit harder. Not that much, but still. Familiar because once that I got it it was like ok. I felt it in my body. Difficult for this reason because it was a little bit complicated. "I'm sexy and I know it" because this move is super sexy. I like it. It's like "Yes!". [You say you've felt it, but have you seen the movement before?] Well, yes and no. Because I haven't seen anybody doing it but this hand is on "tho lower part of our body" it's like Michael Jackson again. So actually this part can be MJ, apart from this hand that it's going back to the hair and it's more like Pussycat Dolls. I like it so much. #00:16:33-4#

6th - This one was faster because there is this accent when the arms are going up. And that's why then I wrote "Yo!" because it's really like it. And then it was light, simple and here "familiar" I interpreted like my character. I am not such a "Yo!" character. I'm more like "easy-peasy". Relaxed and calm, sometimes more funny and this "yo" is a little bit aggressive. I am not this kind of person. That's why I put a little bit less familiar. I could do "yo" but in the ironic way because I'm not really that. [I can see your arms going into that particular shape. Do you refer to hip-hop?] Yeah, exactly. That's why it's really not my character. I didn't put "not at all familiar" because I could immitate it so it's like "yo, motherfucker". It's for the same. But not really "very familiar" because it's not really my character. [Have you immitated it before?] yeah! Always. When someone is saying something and then you're like "yo!". [Where do you get this attitude from?] Immitating with my friends. It's like "yeah man, do you want to go out?" "yeah, yo!". #00:19:59-9#

7th - Not very slow. Because there is this block that actually makes slow the movement. But in the same time it's making faster because there is one-two. That's why I wrote that. It's divided in 2 parts. Actually, almost all other movements are divided in 2 parts, too, but this is clearer. The previous movements were more fluid. And here it is like two different

blocks. That's why I wrote 1-2. Familiar for the same reason as the Yo1 move. Because it's a little bit aggressive movement. It's not "mine" [but you can immitate it?] yeah. [now awkward and overall] Yeah, a little bit. Not super easy because it was a mixture of everything together. In the end, I was more mathematical. I was like: "this is 2, this is 1, this- 1, this-4, ok so..." So the 6 was a mix of everything. #00:21:43-8#

8th - Easy. Slow. Not hard. Simple. Because when I was doing modern jazz they were teaching us how to do waves. Shoulders and elbow, wrist and hands. Actually, I knew how to do it. Familiar for this reason because I knew already how. It was already mine, this way. Not at all awkward and super easy. And then actually I don't know why I wrote "flowing". Perhaps, I just didn't want to write "wave". It's obvious. So I wrote something more, but I didn't need to. [How does that mvoe go with your ballet training?] Waves? We're not doing waves actually. Our arms... In ballet we can have softer arms. For example, in Swan lake, the girls are doing kind of waves. But it's not really a big movement. Like, "this is a wave". It's more like a matter of breathing. My Russian teacher would always say that we have this ball of energy under our arms and this is what makes our arms breathe. Otherwise, we are super stiff. To have this ball of energy is actually making arms softer and with this movement you create waves but it's not like in hip-hop. Softness, a wave of it. #00:24:04-3#

9th - [I remeber your reaction "oh, sh*t!"] Of course, I didn't put "very familiar" because in the first moment hard to get the movement. But then I saw it again and again. This movement is very simple, it's not that hard to get it. The point is to see it not so long and then to do it right after... I had to do it somehow. That's why it's not "very familiar". And that's why the last one was the worst. It was like left-right because I thought about dance. So that's why I put this. [But you still have "familiar"] Not super familiar because I was not in my body. But in other way, it was in my body but not that much. That's why I put familiar. #00:25:43-6#

10th - Last one was the worst. Slow movement, light and everything. But it was not that easy because of the coordination of the feet. Because the arms are doing left-is-up-right-is down and then change three times. But it was not so simple, not so familiar. And in the end it was just right because the coordination of the feet. She is doing first open, then closing and then... She's doing the heel. A little too hard to understand with just two frames. The arms were fine but then the legs were like "1-2-3.You have to practice a little bit more. This one was the worst especially for coordination. Arms and legs together. #00:27:21-5#

[How did it feel for you to learn from a video?] For me, it's normal. As already said, I know all the choreographies of Lady Gaga, Madonna and all of this. Because I'm watching from the videos. But not just the, For example, if you have to learn a variation or a solo, you're watching ont he internet. I remember last year, I had to learn a variation for my exam and I was watching from youtube. because I was desperately searching for one male variation that I liked. But they were full of some stuff that I couldn't do - all the common one. I had to find something. And then in the end I found a variation from Esmeralda and I had to learn it from the video and there I couldn't do mirroring. I had to be like I was on stage. So I had to learn and then out it ont he other side. Now I was mirroring most of the time. Just because it was more easy. #00:28:57-8#

[Ballet training? How did it feel to do the moves after your training today?] For me there is

not much difference. I think that I am quite multi-cultural dancer. Like I wrote in the paper that you gave us in the beginning, I did so many different types of dance. When I started, when I was little I was not so focused on ballet. In the beginning I was more focused on modern dance than on ballet. In the beginning, it was more fun. In the end, it became a passion and a job and my life. Also in disco, I am super getting crazy. You will never say that I am a ballet dancer. I know many of my friends- ballet dancers who did just ballet and they are super stiff. They are like 1-step-1step. And disco is different from ballet, I need it to get free. Ballet world is super tough and not rude but precise. And in this moment, with commercial music or the music you like (without classic) it's the only time in the life of a ballet dancer where we can relax. And actually, be ourselves. Well, wenn we do ballet we also are ourselves. Otherwise, we wouldn't do it. You feel it. But you need to relax and to go out of this stress. It is stressfull for the muscles, like every sport, I guess. Ballet world and ballet people is so bad for the mind it's reall tiring and stressful. For example, you never feel... 1 day completely in shape. Never. One day pain on the heel, then in the back. There is not a single day when you feel completely comfortable or super. If you feel super then while you're doing class then you get injured. It's always like that. And this thing of never being in shape and relaxed... [With hip-hop it's different?] Yes, because I am not doing it as a professional hip-hop. Hip-hop is more fun. it's like getting free and naturally. I don't care if I am doing it wrong or right, just to move.

7. Academic CV

DAYANA HRISTOVA

EDUCATION

University of Ljubljana, Ljubljana, Slovenia — 2013 – 2015
Cognitive science- CEEPUS & Erasmus Plus mobility

University of Vienna, Medical University of Vienna, Vienna, Austria — 2012 – 2015
Cognitive science, M.Sc.

Brunel University, London, UK — 2011 – 2012
Anthropology - ERASMUS mobility year

University of Vienna, Vienna, Austria — 2009 – 2012
Cultural and social anthropology, B.A.

First Language School, Varna, Bulgaria — 2013 – 2015

Bulgarian National Diploma: overall average 5.97 out of 6 (Bulgarian: A, English: A* A-level equivalents)

RESEARCH & TEACHING EXPERIENCE

Research Intern at Robolab, University of Ljubljana, Slovenia — 2015 - Present
Project: Assessment of upper limb performance in reaching tasks
- Experiment design (Simulink, Unity), motion capture (Optotrak);

Student researcher, Artificial Intelligence Lab, University of Ljubljana, Slovenia — 2013 - Present
Project: Task difficulty of tactical chess problems
- Experiment design (Experiment Builder), eye tracking (EyeLink 1000), obtaining difficulty rankings and retrospective reports; data analysis;

Research Intern at the Measurement and Quality Lab, University of Ljubljana, Slovenia — 2014 – 2015
Project: Sources of difficulty in dance style acquisition
- Experiment design, 3D motion capture (IGS-190 by Synertial), design of difficulty assessment scales and movement rating scales, qualitative interviews, data analysis;

Postgraduate teaching assistant in Cognitive Science, University of Vienna, Austria — 2014 – 2015
- Led parts of the seminar; provided support via online forum and Skype;

Student representative of the Dept. Cultural and social anthropology, University of Vienna, Austria — 2010 – 2011
- Organized and co-chaired two tutorials: “First semester brunch”; “Anthropologie bewegt”.

RELEVANT RESEARCH BACKGROUND

Peer reviewing
- International Conference on Agents and Artificial Intelligence (ICAART) 2014: 1 review — 2014
- Middle European MSc program in Cognitive science (MEi:CogSci) conference: 6 reviews — 2013, 2014

The effects of task irreversibility on the subjective perception of difficulty, empirical project — 10.2013-01.2014

Dynamic Difficulty Adjustment (DDA) in first person shooters, theoretical paper — 03.– 07.2013

The effects of prolonged sitting on cognitive task performance, empirical project — 03.–07.2013

The impact of stress on creativity, theoretical paper — 10.2012–02.2013

Democratization of art through Google Art Project, empirical project — 03.2011–01.2012

ADDITIONAL EXPERIENCE

Co-creator of the art & science project ‘Dynamic Difficulty Adjustment’ (Australia & Slovenia) — 2015

Performer at TEDxUL, Ljubljana, Slovenia 2014

Volunteer at the Hillingdon Refugee Support Group, London, UK 2011 – 2012

Social coordinator of the Brunel University Anthropology Society, London, UK 2011 - 2012

Student collaborator of the Center for Teaching and Learning, University of Vienna, Austria 2010 - 2011

CONFERENCES & SUMMER SCHOOLS

Pioneers Festival 2015, Vienna, Austria 2015

SiNAPSA neuroscience conference, Ljubljana, Slovenia

24nd High Education Conference of the Austrian exchange service (OeAD), Vienna, Austria 2014

Summer school in Dynamic Field Theory 2014, Bochum, Germany

Summer school in Cognitive science 2014, Sofia, Bulgaria

Meeting minds 2014, Towards Embodied Science of Intersubjectivity (TESIS), Midhurst, UK

VIII MEi:CogSci conference, Krakow, Poland

COGNITIVE 2014, International Academy, Research & Industry Association, Venice, Italy

AWARDS & GRANTS

Pioneers festival scholarship (€300) 2015

Performance scholarships of the University of Vienna (€3,000) 2011- 2015

ERASMUS (€3,500) and ERASMUS internship grants (€4,300) 2011 – 2015

Participation grant by the School in Dynamic Field Theory 2014 (€1,100) 2014

Best paper award, COGNITIVE 2014 for the paper 'Toward Modeling Task Difficulty: The Case of Chess' 2014

CEEPUS mobility grants (€5,500) 2013 – 2014

SKILLS

LANGUAGES Native Bulgarian, Fluent English, German and Russian, Conversational French and Slovene

ACTIVITIES Competitor and award winner for: - the rhythmic gymnastics club 'Char - DKS', Varna 1997 – 2002

- the classical and modern ballet studios 'Dance classic', 'Leader dance', Varna 2002 – 2005
- the academic dance theatre of the Varna Free University 'Chernorisetz Hrabar', Varna 2005 – 2008

IT SKILLS Eye tracking (EyeLink 1000, Experiment Builder, DataViewer); Motion capture (AnimaZoo, Optotrak, Unity); Microsoft Office (Word, Excel, PowerPoint), Wordpress blogging; Basic: Python, SPSS, E-prime, Matlab

PUBLICATIONS & CONFERENCE PAPERS

D. Hristova, M. Guid, and I. Bratko, "Assessing the Difficulty of Chess Tactical Problems", International Journal on Advances in Intelligent Systems, vol. 7, no. 3 & 4, 2014, pp. 728- 738.

D. Hristova, J. Zabkar, and G. Gersak, "The persistency of Motor Programs as a source of Difficulty in Motor Learning," in: P. Hochenauer, C. Schreiber, E. Zimmermann, Igor Farkas (eds.), Proceedings of the MEi: CogSci Conference 2014, Bratislava: Commenius University, June 2014

D Hristova, M. Guid, and I. Bratko, "Toward modeling task difficulty: the case of chess," in COGNITIVE 2014, The Sixth International Conference on Advanced Cognitive Technologies and Applications. IARIA, 2014, pp. 211- 214

D. Hristova, "Qualitative study of prolonged sitting's effects on cognitive task performance," in: S, Khosravipour, B. Roemmer- Nossek, E. Zimmermann, I. Farkas (ed.), Proceedings of the MEi: CogSci Conference 2014, Bratislava: Commenius University, June 2013