Support for choreographers by semi-automatic dance analysis and the generation of new creative elements

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ABSTRACT

Creative support for the performing arts is prevalent in many fields, however, for the art of dance, tools supporting automatic creativity have been scarce. In this research, we investigate to what extent choreographers can be supported by semi-automatic analysis of choreographies through the generation of new creative choreography elements. We conducted an online questionnaire among 54 choreographers. The results show that a significant sub-group is willing to use an automatic choreography assistant in their creative process. We further identify requirements for such an assistant, including the semantic levels at which should operate and communicate with the end-users. The requirements are used for a design of a choreography assistant "Dancepiration", which we implemented as a mobile application. The tool allows choreographers to enter (parts of) a choreography and uses multiple strategies for generating creative variations in three dance styles. We evaluate the tool in a user study where we test a) random variations and b) variations based on semantic distance in a dance ontology. The results show that this latter variant is better received by participants. We furthermore identify many differences between the varying dance styles to what extent the assistant supports creativity.

Keywords

Semi-automatic analysis, dance choreographies, automatic creativity

1. INTRODUCTION

The arrival of digital media and computational tools have opened up new possibilities for digital creativity (Plucker, Beghetto & Dow, 2017). Where it used to be widely accepted that creativity cannot be copied by machines, creativity by computers now is not uncommon anymore in particular fields of arts (e.g. the music industry). The true value of computers in enhancing creativity, however, is still often unclear. Especially for the art of dance, information and tools supporting automatic creativity are scarce.

According to Calvert, Wilke, Ryman and Fox (2005), making choreographies in the traditional way is very costly and time-consuming. That is due to repeating dance steps many times and the fact that dancers need dance studios to practice. When an initial outline of a choreography is made, it is also important to test it with dancers to see the final result and eventually change steps within the choreography. The use of accurate computer software can be really helpful to make it less costly and time-consuming. Another difficulty dancers can come across, is lack of inspiration for making a new choreography. They use steps over and over again with small variety or keep thinking about old ideas for new choreographies (Van Dyke, 2011). With the use of smart technology providing suggestions for next steps or more variety in steps, this problem can disappear and more creative choreographies can be generated. One method for this is analyzing human movements capturing in 3d, but that turned out to be very difficult due to the inherent complexity and multidimensional nature of whole body movement (Calvert, 2016). With the use of video mining, which makes it possible to detect dance steps and styles automatically, it can be possible to see dance patterns in the future (Ramadoss & Rajkumar, 2008). Furthermore, ontologies of dance steps from different dance styles can be taken into account to give varieties based on the type of step. In this research, the possibilities for automatic creativity based on semantic distance in a dance ontology is examined.

There is a sceptical view on computers to ever achieve transformational creativity (Boden, 2009). The view is based on the believe that "a computer does what its program tells it to do – and no more". However, this is not completely true because when using rule based approaches, genetic algorithms or machine learning, new and unexpected dance sequences can be generated. In this paper we investigate to what extent choreographers can be supported by semi-automatic dance analysis and the generation of new creative elements. For this, we focus on three different aspects. First, we outline specific requirements for a new tool through a questionnaire. The questionnaire is based on findings of literature. The questionnaire gives more insight in the way choreographers make choreographies and how they think of technological help in this work. The results show the level of acceptance for technology and helped us to identify requirements that are processed in the developed choreography assistant named "Dancepiration". Using the application, choreographers can enter (parts of) their choreography in three dance styles: modern dance, street dance and classical ballet and the assistant will make variations based on the original choreography. These variations are based on different strategies: random and based on ontologies, as mentioned before. We evaluate the tool and the variations with students from dance academy Codarts, Rotterdam[1] and the ontology-based variations are significantly perceived as more helpful in their variations. Furthermore, suggestions were obtained in order to improve the application in the future.

2. RELATED WORK

In this section, background information about the art of dance and the link to existing tools and automatic creativity is discussed. This is divided in three sections: dance representation, tooling and automatic creativity.

[1] http://www.codarts.nl/

2.1. Dance Representation

In order to communicate dance, a helpful representation in a structured way is crucial. There are in general two ways to represent dance: notated (written or digital) or videotaped. The main function of dance notations is to "store choreographic works and knowledge of dance techniques by translating movements into specific ways as abstract symbols, letters, abbreviations, stick figures, etc." (Laumond and Abe, 2016). Dance notations are developed to store choreographies for the long term. For the western culture alone, there are over 90 dance notation systems. One of the most known dance notation is Labanotation[2]. It is a way of writing which tries to record every aspect of motion as precisely as possible. Labanotation uses abstract symbols to define the direction and level of the movement, part of the body doing the movement, duration of the movement and dynamic quality of the movement. The Benesh Movement Notation is another well-known dance notation. Benesh is written like a music score: on a five line stave that is read from left to right and from the top of the page to the bottom[3]. Quite a disadvantage of these notations is that most dancers cannot read or write it and therefore not use the notations (Herbison-evans, 1980).

According to Bianchini, Levillain, Menicacci, Quinz and Zibetti (2016), the movement notations Labanotation and Benesh are not capable to be integrated into a software environment. It is also hard to analyze dance movements within the existing dance notations. Both notations are quite comprehensive and therefore difficult to learn (Herbison-evans, 1980).

A more common way of communication among dancers is the "language" of dance, which we will refer to as dance terms from now on. Dance terms can vary by dance style and can also be used as dance notation. For example in classical ballet, common terms like the *third position, pas-de-deux* and *plié* are terms all educated western dancers understand, but non-dancers do not. For non-dancers, the third position can be explained as: "One foot is placed in front of the other so that the heel of the front foot is near the arch". In the case of dancing, showing how the third position look like is often the most understandable way to explain dance. This is also what happens in beginners dance classes: the teacher shows a step, the student imitates it. Videotaping is therefore a widely used tool to store dance nowadays; everyone can see it easily and one can interpret steps differently. There is, however, also a disadvantage to videotaping: the huge amount of videos that is created by dancers. Furthermore, it is a *blind medium*, meaning that the video is meaningless until one watches it. According to Ramadoss and Rajkumar (2007), a semantically annotated way to store videos can be a solution for this. When a video is semantic annotated, it will become a source of information that is easy to interpret, combine and reuse by our computers. Using the right annotation will result in clear divided and easily search within all different videos. Dance terms, videotaping and human memory are in general the three ways for remembering choreographies (Ramadoss & Rajkumar, 2008).

There are already some tools developed for annotation of dance videos. These tools, however, contribute to existing choreographies and their storing. In the next section, the existing tools and their working are explained in order to see what aspects of dance are covered in software tools yet.

2.2. Tooling

There are several software tools designed for dance, which serve different needs (e.g. annotation, visualization, multiple dancers etc.) for users. The most relevant software tools for dance are discussed in this section based on research from Calvert et al. (2005). At the end of this section, an overview of the different tools and their functionalities are shown in Table 1.

Kinect: camera with corresponding software for gaming system Xbox. It recognizes human movements up to four people simultaneously. Multiple studies have been conducted with the camera, for example to recognize human gesture divided into three classes: stand, sit down, and lie down (Patsadu, Nukoolkit & Watanapa, 2012). In terms of video mining, this camera can be promising for the future since it can recognize movements.

LabaNotator[4]: software that allows users to write and retrieve Labanotation without no visualization. Before using this tool, the user has to understand the working of Labanotation. LabaNotator is easily accessible for Windows and for notation purposes only.

DanceForms 2.0[5]: software that lets the user try out ideas before meeting with live dancers. The result can be showed in video 3D form. DanceForms provides a) a stage window for composing multiple dancers, b) a studio window for creating particular body positions, c) a score window to show how each dancer moves over time, and d) a rendered performance window (Calvert et al., 2005).

LabanEditor 2: interactive graphical editor for writing and editing Labanotation (Kojima, Hachimura & Nakamura, 2002). There is no public access towards the software.

Table 1. Overview of tools with functionalities

	Visualisation	Multiple Dancers	Operative	Dance language	Automated creativity	Annotation
LabaNotator	No	Yes	Yes	Laban	No	No
LabanDancer	Yes	No	No	Laban	No	No
PM2GO	Yes	Not applicable	Yes	Video	No	Yes
Web3D Composer	Yes	No	No	Dance terms	Partly	No
DanceForms 2.0	Yes	Yes	Yes	Dance terms	No	No
BalOnSe	No	Not applicable	No	Video	No	Yes
Kinect	Yes	Yes	Yes	Video	No	No
LabanEditor 2	No	No	Yes	Laban	No	No
LabanWriter	No	No	No	Laban	No	No

[2] http://user.uni-frankfurt.de/~griesbec/LABANE.HTML
[3] https://www.rad.org.uk/documents/benesh-docs/benesh-movement-notation-score.pdf/view
[4] http://www.labanotator.com/
[5] http://charactermotion.com/products/danceforms/

LabanWriter: lets the user create one or more staffs on the virtual page and provides a palette of Labanotation symbols that can be selected and placed on the staff in the columns representing the appropriate body part. LabanWriter treats symbols strictly as 2D graphical objects that fall loosely into two subclasses: stretchable and fixed sized (Calvert et al., 2005).

LabanDancer: a stand-alone application that is developed to translate LabanWriter files into animation for a single human figure. It contains an implementation for all of the algorithms required for the translation (Wilke, Calvert, Ryman & Fox, 2005). There is no public access towards the software.

PM2GO: multi-user application for use in dance creation and education. It allows the user to (live) annotate videos with texts.

Web3D Composer: 3D dance animation database on the Web. It offers e-learning for ballet and Laban motif. The system consists of an online archive and user-editable simulation system for ballet steps and step sequences (Soga, Umino, & Longstaff, 2005). It include partly automatic creativity since it gives suggestions for next steps, however the user does have to choose the option themselves. It was not successful to run the program, it seems depreciated.

BalOnSe: an ontology-based web interface for ballet that allows the user to annotate classical ballet videos. The interface integrates a hierarchical vocabulary based on classical ballet syllabus terminology (Ballet.owl) implemented as an OWL-2 ontology (El Raheb, Papapetrou, Katifori & Ionnidis, 2016). The ontology consists of steps in dance terms and indicates the corresponding type of step.

The dance notation Laban is used many times in tools despite the fact most dancers cannot work with this notation. However, Fox, Ryman & Calvert (2001) does see opportunities in a combination between Laban and DanceForms 2.0, which does not yet make use of Laban. When this combination is possible, notators and students will be able to check their notation by translating it and seeing it performed by the animated figures. Fox et al. (2001) has made a start with this combination but it cannot be used yet. It can be highly valued by dancers who want to learn Laban in an easy way. Taken all tools into account, it turned out there are no working tools for the creation of choreographies including automatic creativity while there are many tools for annotating, storing, writing and visualizing choreographies. We discuss automatic creativity in the next section.

2.3. Automatic Creativity

Creativity is considered to be an essential component of human intelligence. Many feel that whereas computers can excel in well-structured areas of problem solving, they cannot ever produce truly creative work (Reingold & Nightingale, 1999). It turned out this is not completely true anymore. For example in the music domain, Cope (2004) wrote algorithms which made computational creativity possible. His algorithms have produced classical music ranging from single-instrument arrangements all the way up to full symphonies by modeling the styles of composers like Bach and Mozart. People started to believe the works were written by human composers. This indicates computational creativity is indeed possible. For the art of dance, automatic creativity is less researched but still there is some knowledge about it.

More than 30 years ago, Gray (1984) already suggests to design algorithms to computerize the teaching of dance improvisation and composition. However, after all these years this is still quite an unknown area. Burton et al. (2016) researched the Laban Movement Analysis (LMA) and the way the notation could be useful for artificial agents. They came up with the first step towards more expressive human-machine interaction within Labanotation. They proposed an "approach for quantifying LMA components from measurable movement features, and using the proposed quantification approach within an expressive movement generation framework". This is contradictory to previous results from Bianchini et al. (2016), discussed in section 2.1, where they stated that Laban and Benesh are too difficult to be integrated with technology. Considering the research of Burton et al. (2016), it turned out LMA can be integrated with software.

Jadhav, Joshi, and Pawar (2015) did similar research in the field of automated choreography, focusing on a typical Indian dance: Bharatanatyam Dance. Their goal was a computer program that generate new experimental steps for them. With that, they face two main challenges:

- To avoid impracticable (not doable) as well as impractical (not practiced) dance steps, and
- To generate steps that had surprise value or novelty

In the end, they were able to successfully model the major limbs of the body to represent the dancer's final position at the end of a beat. They have used the genetic algorithm, as mentioned before, for generating choreographies. This is a search process that follows the principles of evolution through natural selection. In order to model the dance steps, a classification was needed whereby there is a clear representation of human movements. They worked with specific dance terms belonging to the Indian dance style, so there was no notation as Laban included. For this research, we also use dance terms because its simplicity to work with. In the next section, the design of our research is discussed.

3. METHOD

Analysis of prevailing literature showed how automatic creativity in the dance world is developed so far. Furthermore, existing tools and dance representations were being discussed in the previous section. In this paper, we want to discover to what extent choreographers can be supported by semi-automatic dance analysis and the generation of new creative elements in choreographies. It is first necessary to get insight in how choreographers make choreographies nowadays and what their general attitude towards technological help in this area is. For this reason, a questionnaire has been set up. This gives us the opportunity to identify requirements for an assistant in dance analysis to generate new creative elements in choreographies. The requirements become the basis for designing a prototype of the choreography assistant. The prototype called 'Dancepiration' is evaluated with dancers from dance academy Codarts. The following aspects are taken into account when evaluating Dancepiration: correctness, creativity, helpfulness and meaningfulness. Correctness is about how executable the new suggestion is. With creativity, the surprise effect of the new steps is meant. When there are

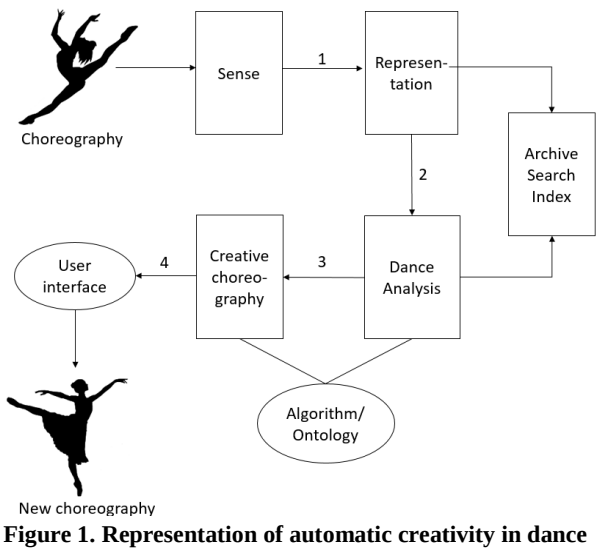

Figure 1. Representation of automatic creativity in dance

a lot of unexpected (but physical executable) new steps, creativity is considered high. Helpfulness indicates to what extent the dancers can be assisted in a good way by the program. Meaningfulness is the most subjective aspect, and is about how dancers think the program give extra meaning to their choreographies.

This paper can be seen as a starting point for an ideal situation whereby the whole process of generating variations for a choreography is automated. Figure 1 shows the complete overview of this situation. A dancer execute a choreography, while being monitored by sensors for example (arrow 1). The monitors automatically translate the choreography into representation and analyzes the choreography (arrow 2). Next, with the use of automatic creativity, variations of the choreography will be generated (arrow 3). With the use of visualization, the variation can easily be shown or told (in dance terms) to the dancer (arrow 4). The dancer evaluates the suggestions and with the use of artificial intelligence, the algorithm becomes increasingly better in giving suggestions. In this research, we focus on arrow 2 (from representation to dance analysis) and 3 (from dance analysis to a new variant in choreography) in particular, where arrow 1 and 4 are simplified.

4. USER STUDY

From section 2, it turned out dance and automatic creativity can be seen as an unfamiliar combination. Furthermore, it was investigated what dance representations and tooling exist. To get insight in the attitude of dancers towards the use of technology within the process of creating choreographies, an online questionnaire was conducted. The results of the questionnaire indicates how dancers make their choreographies nowadays and what attitude they face towards technological help. The design of the questionnaire is discussed first, followed by the results. Finally, there is a discussion which indicates what results are taken into account while designing the application.

4.1. Design

The questionnaire starts with introduction questions focussing on how choreographers make choreographies and asks for opinions about their own choreographies. Special attention is given to dance notations, where the respondents has to indicate how they store their choreographies. Dance notations Laban and Benesh are furthermore included in the questionnaire in order to know their knowledge about these notations. At last, technological support in the dance world is addressed. Respondents were asked about their opinion to use technology in their process of making choreographies and what aspects they value the most in this. In general, the following questions were asked:

- What kind of notations do dancers use?
- Can dancers work with notations as Laban and Benesh?
- How innovative do dancers find themselves?
- How satisfied are dancers with their own choreographies?
- How do dancers store and remember their choreographies?
- What aspects in a choreography do dancers value the most?
- What do dancers think of technological help in the process of making choreographies?
- What aspects in a dance tool do dancers value the most?

The exact questions that has been asked to the respondents can be found in Appendix A (in Dutch). The questionnaire was spread within dance communities through social media. Besides these channels, it is further distributed among dance teachers by owners of several well-known dance schools. As only requirement for participating, the respondents must have experience in making choreographies.

The questionnaire has been filled in by 54 choreographers (9 male and 45 female) from the Netherlands. Almost 75% of the respondents did follow a certificated dance education. Among the respondents, the main reason for making choreographies turned out to be for giving dance classes. Another reason turned out to be for performing dance arts. In the next section, the results from the user study are being discussed.

4.2. Results

This section shows the results of the user study and is divided in three subsections: own choreographies, dance notations and technological support. The raw data of the questionnaire (and other data for this research) is available online[6].

4.2.1. Own choreographies

At the start of the questionnaire, respondents were asked how they store and remember their choreographies. It turned out that, in general, they store their choreography in three ways: memory, video & dance notation (Figure 2), this confirmed the findings of Ramadoss and Rajkumar (2007), as discussed in section 2.1. With the option 'other' in Figure 2, combinations of the three ways are meant in general.

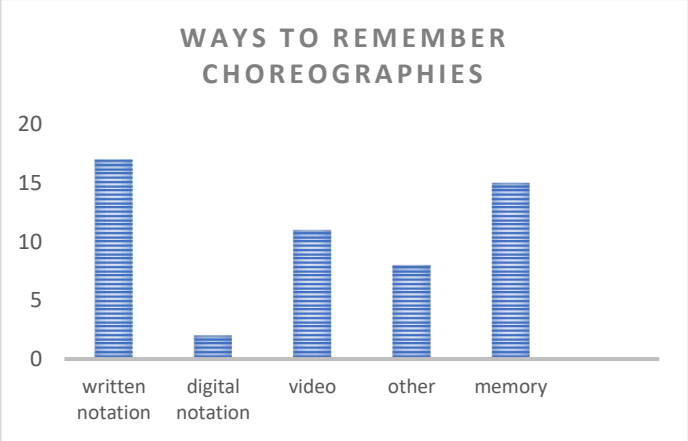

Figure 2. Ways to remember choreographies

More than 95% of the respondents is satisfied with the way they remember choreographies. This implies assistance for remembering choreographies does not have to be one of the requirements, because dancers are already quite satisfied about this. On average, dancers rate their choreography with a 7.3 based on a scale from 1 to 10. It seems all respondents are quite satisfied with their own choreographies. However, while the respondents are satisfied with their choreographies, they rate the innovativeness of the same choreography on average a 3.1 out of 5. This is a quite average result which we want to improve with the use of automatic creativity in a tool.

4.2.2. Dance notations

From section 2.1, it turned out dance notations as Laban and Benesh are too difficult to use for the ordinary dancer. As a result of the questionnaire, it turned out almost 80% of the respondents cannot work with dance notations as Laban and Benesh (Figure 3). This result corresponds to the findings from literature.

[6] https://doi.org/10.6084/m9.figshare.5110051.v1.

However, as discussed in section 2.2, these notations are often used in tools which is remarkable. Besides that, 61% of the respondents does use dance terms for making and remembering their choreography while Laban and Benesh notation usage is the lowest. The distribution of preferred notations from the respondents can be found in Figure 4.

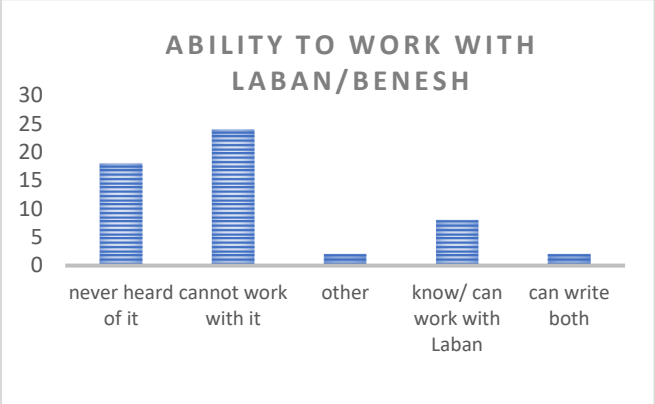

Figure 3. Ability to work with dance notations Laban & Benesh

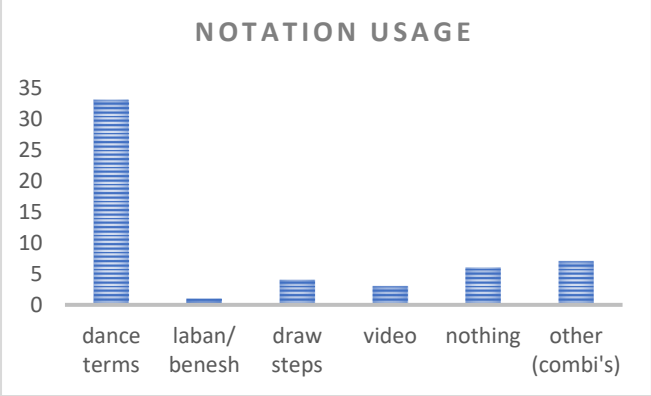

Figure 4. Preferred ways to notate choreographies

Another aspect being questioned in the questionnaire was inspiration for making choreographies. Dancers can have difficulties with having inspiration at certain moments. It can be problematic to not have inspiration at times it is highly needed and having inspiration at times it is not necessary. When a dancer 'has to' have inspiration but the dancer does not have it, it can be helpful to use a tool for assistance in getting inspiration. Based on the questionnaire, the most important things to get inspiration from are music and other choreographies. Furthermore, some respondents indicate they see suggestions from computers as cheating. Their perception is that a choreography does not belong to themselves anymore if changes are made by a computer. However, looking at other existing choreographies for inspiration is basically the same. The goal of both is only to use it for getting inspiration, not for blindly copying dance steps. However, this is not the mindset of dancers now.

In order to get insight in the imagination of dancers with respect to their choreography, a question about the imagination of their choreography with multiple dancers was asked. This is done by means of a video of DanceForms 2.0, as discussed in section 2.2, and a short explanation. Dancers can well imagine how choreographies will look like when executed by multiple dancers. Over 80% of the respondents find themselves capable of this imagination. Taken into account the fact that there are existing tools for this and that dancers are able to imagine this themselves, it is not necessary to implement this feature as a requirement for the new tool.

4.2.3. Technological support

After showing the video of DanceForm 2.0, respondents were asked if they like the idea of such a tool. Two-thirds of the respondents does like the idea of the tool and thinks it can be useful in real-life situations. The follow-up question here was about willingness to adopt a tool that, for example, gives new variations based on an existing choreography. A significant sub-group (55%) of the respondents does have a positive attitude towards such tools. However, the dancers with a negative attitude are often very negative. This results in two different sub-groups. The positive sub-group arguments are the following:

- One can easily see how a choreography will look like as 'big picture'
- It is easy to see small changes and its effect (simulation)
- It is nice to have an overview of choreographies
- It is helpful to show the purpose of the choreography to the dancers
- It can only help a choreography, the choreographer can always decide what parts to use

The negative sub-group arguments are the following:

- Dance is human thing to do, no need to involve technology
- Dancers will lose ownership of the choreography
- A dancer should be able to do all this himself
- It is very time-consuming to actively use the tools
- It is difficult to work with such tools
- There is no interaction with dancers
- Reduction of personalization

At last, two questions were asked about important aspects in a choreography and a software tool. The respondents had to rate different aspects on a scale. First, the important aspects in choreographies will be discussed. The respondents had to rate the following aspects: originality, musicality, creativity, technique, symmetry, message behind the choreography and emotion. In Table 2, the average ratings per aspect can be found. This is based on a Likert-scale from 1 to 5, where 1 is very important and 5 is not important. Musicality, creativity and emotion turned out to be the most important aspects in choreographies according to the respondents, with a score below 2.0.

Table 2. Important aspects of choreographies based on Likert scale from 1 (very important) to 5 (not important)

Dance aspects	Average Likert scale rating
Originality	2.15
Musicality	1.57
Creativity	1.78
Technique	2.30
Symmetry	2.41
Message behind choreo	2.59
Emotion	1.89

Furthermore, the respondents were asked to rate aspects for a software tool as top five, whereby the first place is the most important one, and the fifth place the least important. The results can be found in Table 3. The two most preferred aspects turned out to be a clear and easy to use tool. The respondents rate a tool which can work with multiple dancers as third most. This is contrary to the answer they gave earlier in the questionnaire; which gave the result of dancers being able to imagine multiple dancers in their choreography. However, it turned out dancers still value this more than annotation options or new suggestions for choreographies. Although the

respondents value annotation and new suggestions the less, it will be taken into consideration while developing the new tool. This is because a self-contained tool that only is clear and easy to use does not have any added value. More functions are needed to make it a useful tool, for example the implementation of automatic creativity, which is discussed in section 4.3.

Table 3. Ranking of 5 important features

Top 5	
Clear program	1
Easy to use	2
Multiple dancers	3
Dance notations	4
New suggestions	5

To end the questionnaire, an open question was asked about how dancers imagine a tool that gives the user variations based on an existing choreography. The negative sub-group indicated (again) they will never start to try such a tool. However, the positive sub-group did come up with suggestions. We developed a list of requirements according to the MoSCoW method and the must-have requirements of the developed tool are shown below.

- The tool must work with different dance styles
- A dancer must be able to add their existing choreography to the tool
- The tool must be able to give new suggestions for variations of the choreography
- The suggestions must be based on different, rule-based strategies including different ontologies
- The dancer must be able to see the whole choreography at any moment in time (written)
- The dance notation used are dance terms
- The tool must be "easy to use", which means getting variations may take no longer than 2 minutes
- The tool does have simplified body movements (legs, arms, belly, knees, hips and head)

All requirements, including should haves, would haves and could haves can be found in Appendix B. Literature research, the results from the questionnaire and time constraints are taken into consideration while setting up the requirements.

The respondents express their concerns about two things with respect to automatic assistance in making choreographies: the amount of time it cost in its usage and the loss of human creativity. It is a challenge to overcome the fear to lose human creativity when using tools like this. In section 4.3, we discussed the results from the questionnaire and what results will be taken into consideration in the further research.

4.3. Discussion

The results from the questionnaire gives insights about how to develop a tool that can help choreographers in the creative process of making choreographies. There is a significant sub-group that turned out to be very interested in assistance of choreographies. This group wants the program to be very clear and easy to use, so they do not waste time using the tool. The respondents did express their concerns about losing own creativity in the tool. They explicitly stated they want to stay the 'owner' of the choreography. Creativity and originality are highly valued aspects of choreographies and have to be of importance in the application. Based on sections 2 and 4.2, MoSCoW requirements has been set up. The most important must haves are the rule-based strategies for creating variations of choreographies (including multiple ontologies), the usage of dance terms and the specific dance styles in the tool. This decision for dance terms as way of notation is based on the fact dancers use dance terms as way of communication the most. Laban will not be used in the application because of its inability to work with it. Furthermore, automatic creativity in different dance styles is included in the tool since we want to explore the options in this field.

5. DANCEPIRATION: A CHOREOGRAPHY ASSISTANCE TOOL

Based on the requirements being set up in the previous section, the application named "Dancepiration" is developed for the use of choreography assistance for experienced choreographers. The must-haves from the MoSCoW-requirements, discussed in section 4.2.3, are implemented and its result is a working prototype giving variations on four different ways. The design of Dancepiration is first discussed, followed by the pseudocode of the multiple rule-based strategies in order to clarify the working of created variations. At last, the evaluation of the application is discussed with corresponding results.

5.1. Design

Dancepiration is a mobile application for dancers where its simplicity and easiness in use are important features. The main feature is assistance in variations for choreographies in order to give choreographers more inspiration. As mentioned before, the communication for this tool is based on existing dance terms. Within Dancepiration, there are four different options to get a variation on the existing choreography. In three out of four options, the dancer have to add (parts of) their choreography in order to get a variation on that choreography. The dancer can choose which dance style is used: classical ballet, modern dance or street dance. Steps are related to a specific dance style and always belong to a particular type of step. In the dataset with all dance terms, the following types of steps are included: starting position, jump, turn, general and battement. For classical ballet, the steps are based on the BalOnSe ontology from El Raheb et al. (2016), as explained in section 2.2. In the dataset, 78 ballet steps from BalOnSe were implemented. For modern dance, an ontology from Phyllis Eckler[7] was used to implement steps for this dance style. This ontology exists of 57 modern dance steps. For street dance, this was more difficult. There were no existing ontologies for street dance steps found, so a partial ontology for this dance style was made. The partial ontology is based on steps found on the internet and help from Codarts students. This ontology is restricted to 31 dance steps. The complete dataset including all ontologies used in Dancepiration can be found online[8].

5.1.1. Representation

In Figure 5, the structure of the ontologies is shown. Each step consists of a step name, a dance style, description of the step and the type of step. The type of steps are based on the ontologies as discussed in the previous section.

After the dancer entered their choreography, which has to be steps from the dataset, to the application in the form of 10 steps (see Figure 6), the dancer can choose three different ways to get variations. The first variant creates a random new step for one step in the choreography. It is completely random, which means the ontology is not taken into account. The variant, however, consists of an existing step from the same dance style. The second variation is based on the ontologies of the dance styles. This means a step is replaced by another step from the same type of step. The expectation is that the variations based on the ontologies will be more appreciated by the dancers than the completely random option. However, the ontology-based variation can maybe be less surprising because it is all based on 'safe' steps (e.g. the same type of steps). Therefore, the third

[7] http://faculty.lacitycollege.edu/ecklerp/modern_dance_terminology.htm

[8] https://doi.org/10.6084/m9.figshare.5110051.v1.

variant is developed. This variant combines ways to create variations and is further explained in section 5.1.2.

Pasnaam	Style	Beschrijving	TypePas
Arabesque	Ballet	Arabesque	Startpositie
Arabesque a terre	Ballet	Arabesque a terre	Startpositie
Arabesque de facé	Ballet	Arabesque de facé	Startpositie
Arabesque Ouverte	Ballet	Arabesque Ouverte	Startpositie
Assemblé	Ballet	Assemblé	Jump
Assemblé Battu	Ballet	Assemblé Battu	Jump
Assemblé Coupe Devant	Ballet	Assemblé Coupe Devant	Jump
Assemblé Derriere	Ballet	Assemblé Derriere	Jump
Assemblé Dessous	Ballet	Assemblé Dessous	Jump
Assemblé Dessus	Ballet	Assemblé Dessus	Jump
Assemblé Grand	Ballet	Assemblé Grand	Jump
Assemblé Petit	Ballet	Assemblé Petit	Jump
Balancé	Ballet	Balancé	General
Balançoire	Ballet	Balançoire	General
Balloné	Ballet	Balloné	General
Balloné Grand	Ballet	Balloné Grand	General
Balloté	Ballet	Balloté	General
Battement Fondu	Ballet	Battement Fondu	Battement
Battement Frappé	Ballet	Battement Frappé	Battement
Battement Jeté	Ballet	Battement Jeté	Battement
Battement Tendu	Ballet	Battement Tendu	Battement

Figure 5. Part of ontology dataset

Besides existing dance steps, it is also possible to add a 'Free step' to the choreography. This is not an existing dance step but can be something made up by the dancer itself. It is possible to get a 'Free step' back, based on three different static movement from different body parts. Furthermore, a fluent dance step can also be given (e.g. loosely move your hips). This function is only implemented at dance styles modern and street dance. Ballet is a very strict dance style, often based on existing steps and therefore not included in this function.

With the fourth and last option to get new variations, the user can select an existing dance step and get variations for this specific step. This variant is not in particular based on an existing choreography but more specific on a step chosen by the user. The idea behind this is that a choreographer can already have a particular step they are quite unsatisfied with within their choreography. With this function, they can get inspiration to replace the step by another step of the similar type.

5.1.2. Creativity

The different rule-based strategies for creating variations are developed for different levels of creativity. The expectation for different variants is that the random variant gives us an higher rate for creativity than the ontology-based variant since more options can be shown to the user. However, there is more chance to create undoable variations which will result in a lower correctness. The ontology-based is created in order to get insight in the working of ontologies, to what extent they create more doable variations and how creative the variations are. The third variant is a combination for this in order to hopefully increase both creativity and correctness. By choosing this variant, it creates a random number between 0 and 100. Based on that number, the type of variant will be decided. There is 65% chance the ontology-based variation will be executed by choosing the third variant. Besides, there is 10% chance to get a completely random option to include the surprise effect and 25% chance the user gets variations for two existing steps at the same time. For variant 1 and 2, one existing step is changed at the time. This is implemented to overcome the argument of the respondents from the questionnaire whereby they indicated to be afraid for cheating on creating choreographies with the use of a computer.

The fourth variant can also be interesting for variations regarding creativity. The user has to select one step of the choreography and get all dance steps from the similar type back. This variant gives the user a lot more possibilities to variate their choreography. The user will probably choose for an alternative step that fits the current choreography and therefore correctness can end very high. The expectation is that there is higher satisfaction for the choreography in terms of general satisfaction, correctness and creativity while using the fourth variant to get variations.

The four variants are now shown as pseudocode:

```
Variant 1: Random variations
// Get a step from existing choreography
// Go through dataset of the particular dance
style
// Choose one of the steps from the dataset
// Show it to the user with an Alert Dialog

Variant 2: Ontology-based variations
// Get a step from existing choreography
// Check the type of step
// Go through dataset of the particular dance
style
// Check for each step if type of step is the
same as the chosen step from the choreography
// Save the same types of steps in an array
// Choose one of the corresponding steps
// Show it to the user with an Alert Dialog

Variant 3: Combination of different strategies
// Get a random number from 1 to 100
// For a number between 0 and 65:
    // Execute the ontology-based variation
// For a number between 65 and 80:
    // Execute the randomized variation
// For a number between 80 and 100:
    // Get two steps from existing choreography
    // Create variations based on the ontologies
    // Show it to the user with an Alert Dialog

Variant 4: User chooses steps to variate
// Get all steps from particular dance style in
a list
// User can choose one step
// Get all steps from the same type of step
based on the ontology
// User can choose the step he wants to include
in the choreography
```

5.1.3. UI

Dancepiration does have an easy-to-use design and is not time-consuming in its use. When opening the application, the user has to choose a (preprogrammed) dance style in which they want to get variations. Within this application, three dance styles are implemented as mentioned before: classical ballet, modern dance and street dance. The user continues in a new screen where they can enter their choreography in ten steps, which looks like Figure 6.

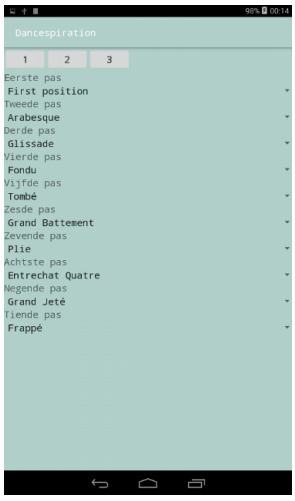

Figure 6. Ballet choreography

Figure 7. Variation for Ballet where Frappé is replaced by Cecchetti Third Arabesque

After entering their choreography, the user can choose for the three different variants with different strategies. The output is an AlertDialog, shown in Figure 7.

The alert includes the current choreography as well as the one with a variation in it. For the fourth variant, the user can select the dance style and corresponding dance step in one screen and there is one button to select for getting variations. The same alert will pop-up, only now with variations for particular steps instead of a whole choreography. The user can get infinite variations for choreographies.

5.2. Implementation

Dancepiration is developed as a simple Android application with Android Studio 2.1.3. The used programming language is Java 1.8. The application can be used with a minimum Sdk version of 17. The code repository is on Github and can be found by the following link: https://github.com/josienj/MasterThesis

5.3. Evaluation

We evaluated Dancepiration in a user study done with six Dutch students from dance academy Codarts. They were asked to choose at least one dance style and the dataset with existing dance steps was sent to them forwards. They were asked to make a choreography and rate their choreography on a scale from 1 (very bad) to 10 (excellent). After that, the choreography was added in Dancepiration by the student and the student tested variants 1 (random-based) and 2 (ontology-based) both three times. Each variant, the same questions were being asked. First, the student had to rate the new choreography in general again on the same scale (from 1 to 10). Second, the variation was compared to the original choreography. The student had to indicate if the variation was worse, as good as or better than the original choreography. Third, the student indicated how executable the variation was and answered on a Likert scale from 1 (very bad) to 5 (very good) how correct, creative, helpful and meaningful the variation was. When finished all variations for variant 1 and 2, the students were asked to select one step in the choreography they dislike the most and then they used the fourth variant. The students did not know the working of the buttons in advance, this was told to them after all dancers did the experiment. After a dancer was finished with all variants, they were asked directly what their opinion about the application in general was and what variant they prefer the most. The student had to choose between variant 1 and 2, and among all variants (including variant 4).

5.3.1. Results

In this section, the results of the evaluation of Dancepiration are discussed. We compared the results based on differences between variants and dance styles. First, the random-based variations are compared to ontology-based ones in Table 4 based on different aspects. It turned out that in every single aspect variant 2 (based on the ontologies) is performing better compared to variant 1, which gives random variations.

Table 4. Average ratings of variant 1 and variant 2

	Variant 1	**Variant 2**	**Difference**
Average grade of variation	5.50	6.35	+0.85**
Correctness	2.89	3.37	+0.48*
Creativity	3.19	3.37	+0.18
Helpfulness	2.59	3.00	+0.41
Meaningfulness	2.70	2.96	+0.26

* = statistically significant at α=0.10 (t-test)
** = statistically significant at α=0.05 (t-test)

The biggest positive difference is for correctness, which is not a big surprise. For variant 2, a jump will become another jump within the choreography while for variant 1, a starting position can become a jump and therefore the correctness of the variation can be graded lower.

In Table 5, the ratings of the prototype itself are shown including the average grade the dancers give their own choreography. Dancers rate their choreography on average with a 6.17 on a scale from 1 to 10. When getting variations from variant 1, the choreographies are rated with a 5.5 on average. This means the dancers like their own choreography more than when they try variations from variant 1. However, when dancers try variations from variant 2, they rate the choreographies on average with a 6.35. This is higher than the original rating, which imply the ontology-based variations does make more valuable choreographies than the dancers make themselves. For the prototype in general, all aspects are rated above 3.0 based on a Likert scale from 1 to 5, which can be seen as good result. Especially creativity is rated very high with a 4.22, this implies Dancepiration is doing a good job in creating creative new elements when analysing the choreography.

Table 5. Results of prototype in general

	Prototype average ratings	**σ**
Grade of choreography	6.17	0,745
Grade of program	7.28	0,786
Correctness	3.67	0,471
Creativity	4.22	0,416
Helpfulness	3.1	0,737
Meaningfulness	3.56	1,066

The standard deviations of correctness and creativity for the prototype are the lowest in comparison to the other aspects. Meaningfulness has a standard deviation above 1, which is the highest of all. The lower the standard deviation, the more unanimity in answers there was among the respondents. For correctness and creativity, the respondents were most unanimously.

Table 6. Comparison of variations to original choreography divided in dance styles and variants

		Variant 1	**Variant 2****	Total
Ballet	Worse	4	3	*7*
	No difference	4	6	*10*
	Better	1	0	*1*
Streetdance**	Worse	5	0	*5*
	No difference	3	6	*9*
	Better	1	3	*4*
Modern**	Worse	3	0	*3*
	No difference	5	4	*9*
	Better	1	5	*6*
Total*	*Worse*	*12*	*3*	
	No difference	*12*	*16*	
	Better	*3*	*8*	

* = statistically significant at α=0.10 (t-test/anova)
** = statistically significant at α=0.05 (t-test/anova)

Table 6 shows results of dance styles and variations in comparison to the original choreography. Looking at the differences in variant type, it turned out variant 1 often is worse or as good as the original version

while variant 2 is as good or better as the original choreography. For variant 1, 12 variations are worse, 12 as good as the original choreography and only 3 are better. While variant 2 has 3 variations indicated as worse, 16 as good as and 8 variations as better than the original choreography. This again shows variant 2 is performing better in giving variations.

When looking at the results from dance style perspective, it seems ballet is the worst performing dance style; only one variation is considered to be better than the original version. On the other hand, modern dance is performing very well; 6 variations are better than the original choreography, whereby 5 of the variations are coming from variant 2. Street dance is also performing similar to modern dance. It is quite interesting that the dance style with the most complete ontology is performing the worst. As one student indicates for ballet variations: "These variations are not logic and fitting, however they are very creative."

In Table 7, the four aspects per dance style are shown including the differences between variant 1 and variant 2. The correctness of ballet is the lowest in comparison to the other dance styles. It is also the only dance style whereby variant 1 performs better than variant 2. Interesting is the rating of creativity, whereby ballet is the highest ranked in terms of creativity. This is exactly what the remark of the student implies.

Furthermore, the differences in variant 1 and 2 for all aspects are very high for street dance and modern dance, and in no case for ballet. The assumption here is that for ballet the existing dance terms are well-known by the dancers and there is not much flexibility in the dance style. For correctness and meaningfulness, the differences between the dance styles for variant 2 are significant with α=0.05.

At the end of the evaluation, each dancer was separately asked which variant they prefer the most when getting variations from variant 1 and 2. More than 90% have preference for variant 2, the ontology-based one instead of the random option.

Table 7. Average ratings per aspect based on dance styles

		Variant 1	Variant 2	Difference
Correctness	Ballet	2.89	2.56	-0.33
	Streetdance	2.78	3.56	+0.78*
	Modern	3	4	+1**
Creativity	Ballet	3.44	3.56	+0.12
	Streetdance	2.78	3.11	+0.33
	Modern	3.11	3.44	+0.33
Helpfulness	Ballet	2.67	2.67	0
	Streetdance	2.44	2.89	+0.45
	Modern	2.89	3.44	+0.55
Meaningfulness	Ballet	2.89	2.78	-0.11
	Streetdance	2.33	2.67	+0.34
	Modern	2.89	3.44	+0.55

* = statistically significant at α=0.10 (t-test)
** = statistically significant at α=0.05 (t-test)

The fourth variant of the prototype allows dancers to select one particular step of their choreography. When evaluating this variant with the dancers, more than 90% indicates they prefer this way of getting variations more than the other way (where a random step of the choreography changes). This is because they can self-select steps instead of the computer doing it for them. This was also a result from the questionnaire: dancers wanting to choose and vary their choreographies themselves while making use of an assistance tool. At last remark, the students indicated they would use some kind of program for making choreographies because it can be very helpful in the creative process.

The evaluation gives us great insights in the working of Dancepiration. Furthermore, there are a lot of ideas to improve similar applications with respect to higher creativity and correctness of the choreographies.

5.4. Discussion

In this section, the results of the evaluation of Dancepiration are being discussed. First, the differences in dance styles are discussed, which gave surprising results. It turned out classical ballet performed the worst in general among the included dance styles. However, classical ballet is the most researched dance style with the most extended ontology. We tried to find a reason for this: classical ballet is the most strict dance style in terms of existing dance terms. The other dance styles are very flexible in their steps and there are a lot more possibilities for follow-up steps. This can be a reason that variations are considered to be more helpful and meaningful with street dance and modern dance in comparison to classical ballet. Interestingly enough, creativity is considered to be the highest for classical ballet. This indicates high creativity does not naturally correspond with useful variations. It was not expected to have significant differences between the dance styles in advance. The result of ontology-based variations performing better than random variations was exactly what was expected though. It turned out the application can be very helpful for dancers. For now, it is most useful for dancers to just choose a step they want to change in the choreography themselves and get multiple suggestions for this (variant 4). This way, dancers remain the owner of the choreography while getting more inspiration through automatic creativity with the use of Dancepiration.

Due to significant results, it is not necessary to try to improve automatic creativity for a dance style like ballet; a style with very strict steps and no space for loose and inspirational movements. Dance styles with more freedom to move, like modern dance, can be very promising in the future.

The aspect correctness can be seen as one of the most important aspects of this application. When a suggestion is not doable, the whole choreography will be considered to be bad. As Jadhav et al. (2005) also found out, it is a challenge to create doable steps. When suggested steps are not doable, the variation will also score very low on helpfulness and other factors. This now happens too often in the created variations by Dancepiration. If the suggestions are becoming better by more efficient algorithms for example, the expectation is that creativity and all other aspects will be rated higher.

In the evaluation, the third variant where multiple strategies for the creation of variations were implemented was not tested. This is because this variant depends too much on coincidence in an evaluation where n = 6. With the creation of the third variant, the intention was to increase creativity by the little chance to get a random option but also increase the effect of the suggestion by changing two steps instead of one. In order to show the working of variant 3, more tests with multiple dancers should be done.

6. CONCLUSION

Our results show that choreographers can be assisted by semi-automatic analysis of choreographies and the creative generation of new choreography elements. However, it turned out there are some conditions to this. From the questionnaire we identify two sub groups of choreographers. The first sub-group considered themselves as very creative and see this as the most important characteristic for a dancer. This results in a clear opinion about a tool for (semi)automatic creativity: they do not want to use such a tool in no case. The second sub group, however, is very positive about the idea of choreography assistance as can be seen in section 4.2. Especially after the evaluation of Dancepiration in 5.3, it turned out the dance students from Codarts, are very enthusiastic about the application and indicated they would for sure work with the tool for preparing dance lessons when it was open for use. The decisions to use dance terms as way of notation and use rule-based strategies for creating variations are based on literature studies and the

results from the questionnaire. This design had the highest chance to succeed in this paper.

This paper can be seen as further exploration in the field of semi-automatic analysis of dance and creative generation of new elements in the choreography. The application gives good insight in how aspects as correctness, creativity, helpfulness and meaningfulness are influenced by different strategies for creating variations. For strict dance styles as classical ballet, the rule-based strategy based on ontologies does not work well while for more flexible dance styles as modern dance and street dance, the results turned out to be very positive. As discussed in section 5.4, a reason for this can be that ballet is more about existing steps, in which experienced dancers know them all and therefore they can use them more conscious. The dancer probably chooses a particular step in ballet because they value that one the most and therefore there are not many options rated as better. In a dance style like street dance and modern dance, there is more flexibility in the variety of steps. There are way more flexible dance options where the dancer maybe has not thought about before. Furthermore, steps can be executed way more creative so there are less impossible steps and this can lead to a higher correctness of the variations. Nevertheless, creativity was considered to be the highest for variations in ballet while in general, the variations in ballet performed the worst in terms of correctness. This means that high automatic creativity does not automatically corresponds with valuable variations.

In general, the variations based on the ontologies are considered better than the original choreography. In comparison to random variations, the ontology-based variations are significantly performing better for correctness. However, users value variations wherein they can select a step themselves to most because they want to remain the main producer of the choreography and they do not want to be replaced by computers.

To conclude, this research gives new insights in automatic creativity for the dance world, because it is now known that the results can depend on the type of dance style and the way variations were created, as discussed before. Based on the questionnaire and evaluation, there are various recommendations for future work. This is further explained in the next and last section.

7. DISCUSSION AND FUTURE WORK

In this section, various options for research in the near future will be discussed as well as a critical discussion about the gained results. This paper was globally about exploring many things in the field of (semi)automatic dance analysis and creativity. In this paper, three different topics were highlighted: current choreographers, the application Dancepiration and the evaluation of the application. Although Dancepiration gives us great insights about the working of the application, its design is somewhat restricted with four ways to get variations, three dance styles and dance terms as only way to communicate. Furthermore, for the evaluation of Dancepiration, it is possible to have a personal influence in the results, since n = 6, which is not very high. However, there are significant results for the experiment but it could be more convincing when more dancers tested the prototype. The purpose of the application and evaluation was to see if there were any differences between different ways of getting variations, different types of dance styles and to get general comments about the application. There turned out to be significant differences which gave us new knowledge to address automatic creativity for the art of dance in the future.

For following projects, more extended ontologies can be helpful to get better insights in differences between dance styles. Although there were already significant differences between the dance styles, the main reason for this difference can be explored further. Besides, the application could be extended a lot more. One can think of other dance styles, extend it with other ways to communicate dance and give the dancer more options to retrieve variations. For example, it would be desirable for dancers to just add there 'own' steps (e.g. steps that are not in the ontology) into the dataset. For the scope of this project, the suggestions are only random-based, ontology-based or a combination of this. In the future, it can be really interesting to further extend this with suggestions based on machine learning, as explained in section 3. Dancers should rate their suggestions within the tool, also with factors like creativity and correctness and the tool should learn from this feedback and gives increasingly better suggestions within time. For the ontology-based version, it can be really helpful to not only look at the step itself and its type of step, but also to look at the step before and after the selected step. This can make the dance analysis much better and consequently create better variations. The students, who evaluated the application, prefer an option where they can so-called 'lock' a particular step so that the step is not allowed to be changed in a variation. The aspect of creativity can be researched more in future work. We now do have an idea of how automatic creativity is perceived among dancers but the automatic creativity in itself can be extended further. After all, it will be of great added value to add visualization to the application. All these ideas and future work suggestions will bring us closer to an ideal way for the usage of automatic creativity. But to reach this state of creativity, more research must be done first including recognition of dance movements and machine-learning based creation of variations.

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Appendix A – Questionnaire questions

In this appendix, the questions being asked in the online questionnaire are showed in chronological order. The questions were all in Dutch. The questions are split up in three sections: introduction, dance notations & inspiration and technological help.

Introduction:

Geslacht: M/V

Leeftijd

Volg je een dansopleiding of heb je een dansopleiding gevolgd?: Ja / Nee

Maak je zelf met enige regelmaat dansstukken/choreografieën?: Ja / Nee (indien nee, stop survey)

Wat is de voornaamste reden dat je choreografieën maakt?: Open vraag

Hoe vaak maak je een nieuwe dans? : Verschillende opties

Heb je een standaard proces dat je volgt met het maken van een nieuwe dans?: Ja / Nee

Hoe zou je je eigen gemaakte stukken beoordelen?: Schaal van 1 tot 10

Hoe onthoud je je eigen choreografieën? : Verschillende opties

Vind je dat een fijne manier van onthouden? : Ja / Nee

Waarom vind je dat wel/niet een fijne manier van onthouden? : Open vraag

Dance notations & inspiration:

Heb je ooit gehoord van dansnotaties als Laban en Benesh? : Verschillende opties

Gebruik je zelf dansnotaties voor het maken/onthouden van choreografieën? : Verschillende opties

Hoe vernieuwend vind je je eigen gemaakte stukken? : Likert schaal (1 tot 5)

Hoe ervaar je het maken van nieuwe choreografieën? : Likert schaal (1 tot 5)

Heb je altijd inspiratie om nieuwe stukken te maken? : Verschillende opties
Waar haal je doorgaans inspiratie voor nieuwe choreografieën vandaan? (Denk bijvoorbeeld aan inspiratie vanuit een dansopleiding of bepaalde situaties) : Open vraag

Kan je jezelf goed inbeelden hoe je choreografieën er straks met meerdere dansers uitziet? : Ja / Nee
Wat voor feedback wil je graag van anderen op jouw choreografieën? : Verschillende opties

Technological help:

Gebruik je op dit moment technologische hulp van je smartphone of computer bij het maken van choreografieën? : Ja / Nee

Lijkt het je handig om via zo'n soort tool een dans te maken en gelijk te zien wat het resultaat wordt door visualisatie? Ja / Nee

Waarom wel/niet? : Open vraag
Zou je er voor open staan als een computer programma je helpt met choreografieën maken door bijvoorbeeld suggesties te geven voor volgende danspassen? Hierbij kun je aannemen dat de suggesties passen bij de al gemaakte choreografie. : Ja / Nee

Waarom wel/niet? : Open vraag

Geef per aspect aan hoe belangrijk je het aspect vindt in een choreografie [Muzikaliteit] : Likert schaal (1 tot 5)

Geef per aspect aan hoe belangrijk je het aspect vindt in een choreografie [Creativiteit] : Likert schaal (1 tot 5)

Geef per aspect aan hoe belangrijk je het aspect vindt in een choreografie [Symmetrie] : Likert schaal (1 tot 5)

Geef per aspect aan hoe belangrijk je het aspect vindt in een choreografie [Originaliteit] : Likert schaal (1 tot 5)

Geef per aspect aan hoe belangrijk je het aspect vindt in een choreografie [Boodschap erachter] : Likert schaal (1 tot 5)

Geef per aspect aan hoe belangrijk je het aspect vindt in een choreografie [Techniek] : Likert schaal (1 tot 5)

Geef per aspect aan hoe belangrijk je het aspect vindt in een choreografie [Emotie/Inbeelding] : Likert schaal (1 tot 5)

Zijn er aspecten die je mist in het rijtje? Zo ja, welke zijn dat? : Open vraag

Zet de aspecten op volgorde van wat jij belangrijk vindt aan een ondersteunend computerprogramma voor het maken van choreografieën (een top 5) [Duidelijk programma] : Rating (top 5)

Zet de aspecten op volgorde van wat jij belangrijk vindt aan een ondersteunend computerprogramma voor het maken van choreografieën (een top 5) [Makkelijk te gebruiken] : Rating (top 5)

Zet de aspecten op volgorde van wat jij belangrijk vindt aan een ondersteunend computerprogramma voor het maken van choreografieën (een top 5) [Werkend met meerdere dansers] : Rating (top 5)

Zet de aspecten op volgorde van wat jij belangrijk vindt aan een ondersteunend computerprogramma voor het maken van choreografieën (een top 5) [Dansnotities maken] : Rating (top 5)

Zet de aspecten op volgorde van wat jij belangrijk vindt aan een ondersteunend computerprogramma voor het maken van choreografieën (een top 5) [Vrijblijvende, nieuwe suggesties voor danspassen] : Rating (top 5)

Zijn er nog aspecten die missen in het rijtje? Zo ja, welke? : Open vraag

Stel je voor dat er een programma is dat jou suggesties kan geven voor variaties op je gemaakte choreografieën of voor vervolgstappen op een bepaalde dans, wat verwacht je van zo'n programma? Hoe zou het moeten werken zodat je het zou gebruiken? Wat moet het allemaal kunnen? Beschrijf dit zo gedetailleerd mogelijk. : Open vraag

APPENDIX B– Requirements

The following requirements, based on the MoSCoW-method, are setup based on the results of the questionnaire and the literature study. The requirements are the basis for the tool Dancepiration. Furthermore, the goal and target group of the application are discussed.

Functional requirements

Must haves:

- A dancer must be able to add their dance style to the tool
- A dancer must be able to add their existing choreography to the tool
- The tool must be able to give new suggestions for variations of the choreography
- The suggestions must be based on different strategies
- The dancer must be able to see the whole choreography at any moment in time (written)
- The communication of the tool is all written dance language
- The tool must be "easy to use", which means getting suggestions may take no longer than 2 minutes
- The tool does have simplified body movements (legs, feet, arms, hands and head)

Should haves:

- The tool should start with giving the dancers an option to start with an existing or new choreography
- The tool should avoid impossible dance steps
- The dancer should be able to add dance steps herself
- The tool should work with the dancers' music
- The tool should work based on counts
- There should be the option to ask the dancers' feedback and learn from this
- The dancer should be able to choose a suggestion and move on with the new variation
- Dancers should be able to lock particular steps if the dancer do not want that step to change.
- The choreography should be saved and accessible within the tool
- The dancer should be able to always change the choreography after adding it

Could haves:

- The tool could have a nice user interface
- The tool could have annotation possibilities
- The tool could have an option to export the choreography to, for example, a PDF
- The tool could have a web application too

Would haves:

- It would be nice to add visualisation to the tool
- It would be nice to be able to add multiple dancers to the tool
- It would be nice to show the suggestions by a dancing person

Goal

The goal of the tool is to help dancers with making inspirational, new choreographies based on already existing pieces of choreographies and own creativity. It hopefully extends the creativity of the dancers in order to make more innovative choreographies but the purpose is never to replace human creativity with computational creativity.

Target group

With the new tool, the target group is dancers who:

- Do make choreographies once in a while
- Face some difficulties making choreographies because lack of inspiration
- Are willing to get some new suggestions based on their existing choreography
- Also are creative enough to make the suggestion perfectly fit in the existing choreography