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PREFERENCE FOR AESTHETIC PRINCIPLES IN DANCE

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Abstract
In this study aesthetic preference in dance is investigated from the perspective of dancers and non-dancers. Aesthetic principles were sought out that, when applied to a choreography, generatea positive experience for the audience, and it was investigated whether the experience depends on the artistic qualification of the spectators. Based on the literature, we assumed that the preference for the golden ratio, good continuation and symmetry has an advantage over works that do not have embedded aesthetic principles, and that this preference would be mostly general and not dependent on the viewer's level of education. Photographs and video clips were used in the present study, some of which had an embedded aesthetic principle and some of which did not. As a measurement tool, a questionnaire was used to gauge participants' opinions along the dimensions of liking, impact and excitement. The results suggest that people do indeed like it more when they perceive these aesthetic principles in dance than when they do not, and that the quality of the responses does not depend on artistic qualifications. Furthermore, it turns out that if the goal is the greater impact or excitement, it is more appropriate to incorporate the golden ratio into the choreography. Good continuity and symmetry are more likely to cause a sense of pleasure than impact or excitement in the audience.

Keywords: good continuation, symmetry, golden ratio, aesthetic experience, dance

1. INTRODUCTION

The present research aims to investigate dance performance preferences from the perspective of dancers and non-dancers in order to integrate psychology into the work of dance artists. We discuss, beyond the artistic message, what motifs can help to engage the viewer's attention by providing an intense aesthetic experience.

We sought to find out whether there are aesthetic principles that can be applied on stage to create a positive experience for the audience, and whether the experience is influenced by artistic background. After introducing the concepts

surrounding the topic, this paper presents some psychological studies on artistic aesthetics, and then presents the design and results of the research. We have narrowed down the number of aesthetic principles in the research, as the preparation of stimulus materials for each aesthetic principle as well as their evaluation with experimental subjects would have exceeded the goals of our research. Thus, of the Gestalt principles, we examined only three: good continuation, symmetry based on Ramachandran and Hirstein's (1999) theory, and a much older but controversial effect, the golden ratio (golden section). As far as we know, it has not yet been investigated whether these principles actually increase the aesthetic experience of dance.

Our aim with this study is to explore a detail of choreography-making that can help artists to understand the non-verbal ways they can speak to the audience if they want to create an enjoyable performance. We seek to to achieve this aim by exploring the cognitive aspects of movement perception and aesthetic principles.

1.1 Detection of movement

The perception and interpretation of the movements of the human body are realized through complex neural processes. From the point of noticing the presence and movement of one or more people to the moment we attribute meaning to that movement, a series of neural activities take place in the human brain. Even natural movements in everyday life are constantly observed, interpreted and analyzed. Understanding the actions and interpreting the intentions of creatures in the environment (both humans and animals) is an essential tool for survival. Avoiding danger, getting food and building trust are all important factors in daily life, and considering that humans are social beings, without this form of communication, the existence and preservation of the species could hardly have developed.

In order to process information effectively, it is not only necessary to know the location of objects and creatures in the environment, but also their movements. Since the beginning of the 20th century, many researchers have studied the perception of motion, which has led to the development of fundamental concepts to explain the phenomenon.

Much is known about stroboscopic motion from the study of the Gestalt psychologist Wertheimer (Kardos, 1974). This phenomenon occurs when lights that are very close to each other in time and space are flashed one after the other in the dark, causing the viewer to sense movement from the given figure. This is the basis of the frame technique used in film production. Induced motion is associated with the work of Duncker, who in 1929 noted that when a smaller object is surrounded by a larger object that is moving, the viewer perceives that the smaller object moves in the opposite direction (Atkinson et al., 1999).

The perception of real movement is quite sensitive and complex. The eye itself can move while the image remains still (e.g., reading), but can also experience the movement of an object in a still background (e.g., a car passing by). If the viewer follows the object with their eyes, the retinal image of the object remains still, but it is perceived to be moving. Absolute motion is detected when an object

moves against a monochrome background, and relative motion is detected when the background is segmented. The latter case was investigated by Johansson et al. (1980), who found that a presentation of a few moving light points in the right proportion is enough to be perceived as a three-dimensional human figure. (In their original study, they placed lamps on joints and recorded their motion in the dark.) A further interesting aspect of this perception of biological motion is that it is not only the viewing of moving persons that activates the prefrontal cortex in the brain, but also the viewing of biological motion induced by light spots (Saygin et al., 2004). This may be due to the presence of mirror neurons located in this part of the brain which are activated both when motion is perceived and when motion is planned. The recognition of emotional states solely from motion is supported by Sakata et al.'s study (2004), so it is not surprising that a person's emotional state can be recognized based on the motion of the dots alone (Brownlow et al., 1997). The recognition of emotional state from dance movements was investigated by Lagerlöf and Djerrf (2009). They asked 4, 5, 8-year-old and adult spectators to identify different emotions from the facially expressionless movements of professional dancers. The four-year-olds performed poorly, but the five-year-olds were as accurate as the 8-year-olds and adults.

The mirror neuron system is an intriguing part of motion perception which has attracted the interest of several researchers (Gallese, 2017; Rizzolatti & Arbib, 1998; Rizzolatti & Craighero, 2004; Rizzolatti & et al., 1996). Neurons have been discovered in the premotor cortex (F5 area) of monkeys which fire both when an individual performs an action and when it observes another individual performing an action. Researchers have claimed that understanding how mirror neurons work may bring us closer to understanding motor events. Experiments have shown that this system is not only found in the previously mentioned primates, but also in humans as well (Kemény, 2007; Rizzolatti & Arbib, 1998; Rizzolatti & Craighero, 2004). These neurons can create a form of connection or even a non-verbal form of communication between the actor and the observer, which may be particularly appropriate in the art of movement.

1.2 Presentation of the examined aesthetic principles

Gestalt psychology, which appeared at the beginning of the 20th century, emphasizes that in regard to mental processes our experience of the world around us depends on patterns of stimuli and the organization of our experiences gained from them. The whole that we perceive is different from the sum of its parts. In fact, it is determined by the relationship of the parts to each other. In addition to the perception of shapes, sizes and colors, Gestalt psychologists have also paid attention to the perception of movement. Their explanations have helped lay the foundations for later cognitive research (Kardos, 1974).

Gestalt psychology claims that in the visual system the image projected onto the retina is a mosaic of dots of varying brightness and color. The perceptual system organizes these dots to form uniform shapes and objects separating them from each other and from the background. Such principles of organization include figure-ground organization and the grouping principles of proximity

(when the distance between certain adjacent elements is reduced), similarity (when elements of similar color and shape are perceived as a group), closure (when a part of space is enclosed by elements) and good continuation. The latter principle states that when elements are seen as forming a continuous line, our perceptual system arranges them into a group. When we see two intersecting lines, we mentally separate them into two groups as they run in their most common continuation (straight or perhaps slightly curved), rather than as two unusual lines at sharp angles (Atkinson & Hilgard, 2005).

Gestalt psychology has formed the basis of numerous studies. The general validity of the principle of good continuation has been confirmed by the study of Geisler, Perry, Super and Gallogy (2001), which analyzes the perceptual quality of natural contours. They found that people perceive visual contours according to the statistical frequency of shapes in nature. That is, contours that we see more often in everyday life are more eye-catching and pleasing than those that are unusual. It can therefore be concluded, even in the art of dance, that audiences perceive stimuli that are structured with good continuation as friendlier than those that are angular and more unusual (Gervasio, 2012). There is, however, a much earlier approach to what helps trigger positive emotion from the viewer: the golden ratio.

1.3 Golden Ratio

The first definition of the golden ratio was given by the Greek mathematician Euclid around 300 BC. Accordingly, golden ratio occurs when dividing a section into two unequal parts, the smaller part being proportional to the larger part in the same way as the larger part is proportional to the whole section (Falus, 1982). The ratio is 1:1.618.

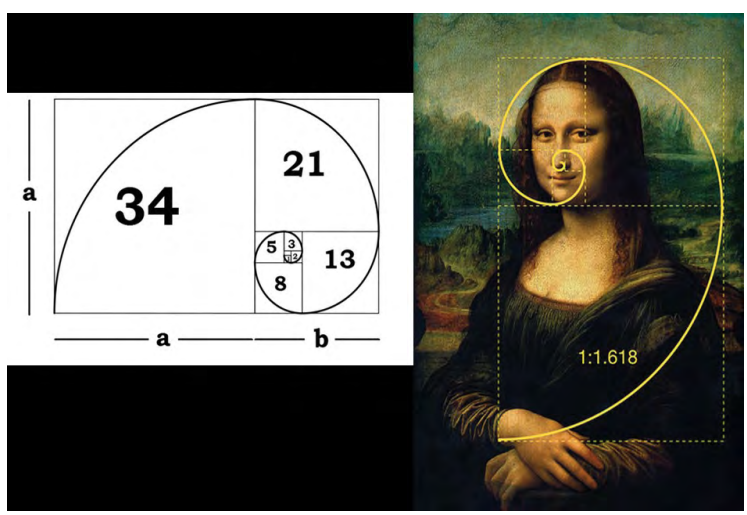

Figure 1. Example of the golden spiral based on the Fibonacci sequence and its representation in Leonardo da Vinci's Mona Lisa: (a+b)/a = a/b = 1.618

A thousand years later, in the 13th century, Fibonacci discovered the eponymous Fibonacci numbers. The essence of the arithmetic sequence is that any member is equal to the sum of the two members before it (1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...), and its peculiarity is that the ratio of two consecutive numbers approaches a given value:1.618. If squares with side lengths of Fibonacci numbers are placed next to each other, the golden spiral is created, a popular tool in art *(Figure 1).*

An early psychological experiment examining the golden section was conducted by Gustav Theodor Fechner in 1876 in which he presented 347 participants 10 rectangles of different ratios, asking them which they liked best and those which they liked the least (McManus et al, 2010). Fechner was primarily inspired by Zeising's statement 20 years earlier that the beauty of artistic creations is that their components fit together according to the proportion of the golden ratio. The results of the research indeed showed that the majority of the experimental subjects preferred the rectangle corresponding to the golden ratio, and almost none of them marked it as their least favorite. This suggests that the golden ratio as a central motif has an impact on the preference of those viewing artwork, but subsequent research has tended to suggest that the ratio only plays a minor role in the preference for the rectangle (McManus et al, 2010). In his experiments, McManus concluded that although the population preference is weak (so there is no dominatingaesthetic ratio), he found statistically strong, stable and highly variable individual preferences. This was made more interesting by the fact that the preferences did not show any correlations with the personality traits tested. The findings highlight that individual differences are real phenomena, but that they also need further explanation, as the factors influencing their variability were unclear to the researchers (McManus et al., 2010).

In 1995, Christopher D. Green summarized empirical studies on the golden ratio published from the mid-19th to the late 20th century and concluded, due to the rather varied nature of the results, that although there seemed to be a real psychological effect related to the golden ratio, the majority of studies tended to only find weak effects. This suggests that there is uncertainty about the measurement tools used in such studies and that standardization would be needed to reach a consensus.

1.4 Determinants of aesthetic experience, following Ramachandran and Hirstein

In researching the laws of aesthetic experience, Ramachandran and Hirstein (1999) searched for principles that are universal and that, when applied, cause a positive, pleasing response in all people. They also emphasize that art becomes more attractive to spectators when it includes enhanced activity along a certain dimension (such as symmetry). Their theory, which they call the "eight laws of artistic experience", includes symmetry, peak shift, isolation, perceptual grouping, contrast, perceptual problem-solving, generic perspective and metaphor. These represent possible tools for art creation that stimulate the visual areas of the spectators' brain in a positive way. Of these, symmetry is presented in more detail, as it was examined in the present study.

We can find symmetry in many areas of life, such as in natural constructions (e.g., snowflakes), architectural solutions (e.g., pyramids) or works of art (e.g., Vasarely's Vega series). In geometric terms, mirror symmetry is used to denote a shape which is mirrored on an axis or plane, with its geometric properties remaining unchanged during the process (Darvas, 2009). The literature offers two non-mutually exclusive explanations for the preference for symmetry: the theory of evolutionary advantage and perceptual bias (Treder, 2010).

Symmetry is a dominant motif in human evolution, as there is a tendency for both men and women to prefer a mate with symmetrical features (especially facial features). Such symmetry acts as a fitness indicator, indicating that the individual has excellent genetic qualities and high resistance to pathogens (Bereczkei, 2003). This is supported by a study which found that when symmetry is artificially increased by digitally editing facial images, the attractiveness score increases in proportion (Rhodes et al., 1998). Another explanation derived from evolution is that apart from humans, other organisms of biological significance to humans have symmetrical structures, such as prey animals or predators that stalk humans, which have also influenced human perception over time, demanding long-term attention to such features in order to obtain reward or avoid danger (Ramachandran & Hirstein, 1999).

When interpreted in a different theoretical framework (i.e., perceptual bias), the preference for symmetry is due to its simplicity of processing, also called perceptual fluency: processing symmetric objects requires less effort due to the mirroring and repetition of features (Monteiro et al., 2022). This makes the processing of information faster and thus more perceptually fluent, while the experience it causes is less exciting.

Symmetry is also given special attention in art. Those viewing art often find symmetrically structured works of art to be pleasing to the eye. Such symmetry creates a feeling of well-being and harmony.

Doris Humphrey (2000), one of the pioneers of modern dance in the 20th century, wrote that the task of the choreographer is to communicate one's message in the most appropriate way. Symmetry, which creates a sense of calm and beauty, and asymmetry, which emits a sense of dynamism or conflict, are great help in this. Humphrey also spoke about the interior design of the theater, believing that asymmetry is preferable in the stage set, while the auditorium should be simplified and symmetrical so it will not distract attention of the audience away from the stage.

2. NEUROAESTHETICS IN ARTN

The combination of cognitive and neurological research with art studies has led to an interesting and currently developing field called neuroaesthetics. Neuroaesthetics investigates the biological basis of aesthetic experience and seeks to understand aesthetic experience by understanding the mechanisms of the brain. A distinction can be made between descriptive and experimental neuroaesthetics. Descriptive neuroaesthetics aims to explore the parallels between the visual world of artists and the visual processing of the brain. An example can be seen in the shape and contour of a shadow in a painting that is not accurate but its

lightness is; the painting remains aesthetically pleasing as the human brain is sensitive to the lightness of a shadow but not its contour (Cavanagh, 2005). Experimental neuroaesthetics, on the other hand, performs quantitative tests to test various theories and hypotheses relevant to the field (Chatterjee & Vartanian, 2014).

Neuroaesthetics itself studies the brain functions that underlie aesthetic experiences. Previous studies on the subject have mainly focused on paintings and music, but nowadays knowledge of neural functions in relation to other domains is expanding. Thus, movement as a method of artistic communication has also been studied and the neuroaesthetics of dance have been examined. In a pioneering study, the parts of the experimental subject's brain which became activated during the passive observation of dancers was observed (Calvo-Merino et al., 2008). The brains of the participants were examined using fMRI while they watched dancing and non-dancing movements. Later, subjects were asked to rate each movement along certain aesthetic dimensions. Using this methodology, they were able to identify the brain areas that were active while watching movements of varying aesthetic value. Bilateral activity in the occipital cortices and in right premotor cortex was identified based on whether the movements were found to be aesthetic or not by the participants. The results suggest a hypothesized role for visual and sensorimotor areas of the brain involved in automatic aesthetic responses to dance (Calvo-Merino et al., 2008).

In a similar study, brain activity was measured while subjects were asked to make judgments according to aesthetic and affective criteria about images that were presented to them (Ishizu & Zeki, 2013). The results of this study showed that aesthetic judgments are associated with medial and lateral parts of the orbitofrontal cortex, and affective motor planning with subcortical areas. The motor, premotor, supplementary motor areas, the anterior insula, and dorsolateral prefrontal cortex are all activated in relation to decision making. The important role of the prefrontal cortex in perception, memory and action representation has also been analyzed in other studies (Ochsner et al., 2002; Wood & Grafman, 2003). Presumably, this is where the perception of movement and the formation of judgements about movement are linked. Thus, in the case of a dance performance, these are the areas of the viewer's brain that are most likely to be activated.

In their study, Skarda and Freeman (1987) showed that when at rest, neurons in the brain fire irregularly due to low metabolic activity. However, as soon as the brain detects a familiar shape, attention is drawn and the neuron system begins to converge towards it. Solso (2001) used fMRI to compare skilled artists and non-artists who were asked to draw faces. He concluded that activity in brain areas associated with face processing was higher in non-artists. He explained this by the fact that, probably because of their advanced skill level, artists process faces more efficiently and therefore require less effort. However, he also noticed that the right prefrontal cortex was significantly more active in the skilled artist. This suggests that the artist is likely not focusing on the individual features of the face, but rather on the overall effect and composition. In this way, evidence was obtained that education can influence the way a person approaches artistic creation.

However, in the context of neuroaesthetics, there may be a linguistic barrier between disciplines stemming from different conceptual systems. Different

terms associated with pre-existing phenomena can lead to difficulties in mutual understanding. Salah and Salah (2008) responded to this problem, proposing that "technoscience art" could be an area where a common terminology could evolve, an audience skilled in art and science can be created, and where a new and educated generation of artists and scientists can have a mutually positive impact on each other's work.

2.1 Dance aspects

If we look at movement from a more specific perspective, dance is an excellent example of a means of imparting meaning to movement compared to how it is treated in everyday life. A dancer's body awareness and developed musculature can be an ideal tool for enhanced non-verbal communication, a dialogue is created between the performer and the audience. The recipient is the spectator, ready to process the information, while the performer is a mediator, presenting the messages of the choreographer who creates.

In the last decades, many researchers have focused on the perception of movement and the psychological interpretation of (dance) art. For example, dance can be compared to evolutionary psychology in the sense that virtuoso solos are loved by the audience because they demonstrate the outstanding physical condition, health, special physical abilities and cheerfulness of the individual (dancer), just as in the animal world, in which individuals attract attention with their movements (Miller, 2000). In a 2004 study, Sakata et al. focused on the mechanisms of perception of information conveyed by the body. They concluded that people perceive emotional information from body movements even when they do not see facial expressions (Sakata et al., 2004). Their results showed that the movement of the human body does not only have a secondary function but also an independent mediating role in human communication. Stevens and Glass, on the other hand, present various empirical methods and analytical tools for investigating the cognitive processes that take place during the creation of choreographies and the psychological effects that can be measured during live contemporary dance performances (Stevens & Glass, 2005). One such tool is the ART (Audience Response Tool), which measures psychological reactions to dance.

Although the love of dance can have a community-forming effect on participants and on those watching the dance from the audience, it is worth considering that each viewer perceives a dance choreography a little differently. Viewing an artistic creation is an individual experience which depends on the individual's neural system, perception and senses. The experience can also be shaped by memories, impressions, desires, expectations, and emotions. An individual's reception of art can even be influenced by the current physical state. However, regularities can be examined nonetheless, such as in principles that can apply to all creators and spectators in a general way. However, it is important to bear in mind that each individual may differ from the average (Hagendoorn, 2005).

The aesthetic experience of dancers and non-dancers has also been investigated by Vukadinović and Marković (2012). In their pilot study, they asked two groups of participants to collect adjectives that they thought could be used to describe

different forms of dance while watching dance performances. On this basis, they asked dancers and non-dancers for their own opinions of the dance performances using 35 unipolar and bipolar seven-point scales. The study aimed to explore the factors involved in the evaluation of the aesthetic experience of dance performances. Three distinct factors were identified from the results of the two groups' equal ratings: the Dynamism factor, which included adjectives such as "expressive","powerful" or "exciting"; the second Exceptionality factor, which included adjectives such as "unique" and "exceptional"; and the Affective Evaluation factor, which included adjectives such as "subtle" or "seductive". In addition, significant results were obtained when the groups were separated, with different factor contents. Thus, the study revealed that there are traits along which dancers and spectators similarly perceive and evaluate dance performances, but also a qualitative difference between the aesthetic experience of the two groups which can be related to different aspects of body activity. In other words, professional dancers mostly make use of their bodies and proprioception in the creation of their work, while spectators passively receive what they see, mainly through vision and hearing.

A possible reason for these findings is that artistic training determines mental representations. In another study, beginner, amateur and professional dancers were asked to identify easy (Petit pas assemblé) and difficult (Pirouette en dehors) dance movements presented on video. The easier movement was equally marked as such by the groups, but while beginners could not mark the harder one the professionals marked it well (Blasing & Schack, 2012).

3. OBJECTIVE AND RESEARCH QUESTIONS

The literature dealing with the examined topic suggests that there are aesthetic principles in art that, when applied in a composition, attract the attention of the viewer and are appealing. Examples include the principle of good continuation (Gervasio, 2012), the golden ratio (Fechner, 1876), and symmetry (Ramachandran & Hirstein, 1999). Although different studies show different strengths for the correlations between preference and a given principle, in general good continuation, symmetry and the golden ratio have proven to be useful for the purpose of this study.

Scientific opinion is divided on whether aesthetic perception is similar for all individuals (Ramachandran & Hirstein, 1999; Vukadinović & Marković, 2012) or whether there is a difference between the perception of artists and non-artists (Solso, 2001; Vukadinović & Marković, 2012). In the present study, we did not investigate a complex set of artwork which would exclusively be encountered in art education, but rather small elements of artworks that are present in everyday life regardless of the spectator's education, and are thus likely to be familiar to everyone in a nearly equal way through visual perception.

We examined preferences using three types of questions (i.e., liking, excitement, and impact). The three aesthetic principles (due to their specificities) do not result in the same experience, so it can be assumed that differences between the aesthetic principles are reflected in the responses, which in turn may provide a more nuanced picture which can have implications for choreographers.

Based on these considerations, our study sought to answer the following questions:

1. Do respondents prefer compositions which contain one of the aesthetic principles over those that contain none?
2. Does the preference for aesthetic principles depend on the artistic education of the participant?
3. Is there a difference in the participants' responses regarding each aesthetic principle based on the question types?

4. METHODS

4.1 Experimental subjects

A total of 100 participants completed the online self-report questionnaire, of which 87 were women and 13 were men. The average age of the participants was 31.2 years (SD=11.2), with 83 young adults (18-40 years) and 17 middle-aged individuals (41-65 years). With the aim of the study in mind, the researchers sought to achieve a diverse sample, sampling participants who had received secondary or higher education in arts as well as those who had not. Thus, the sample can be divided into two main groups, one group (n = 36) which includes non-artists and another group (n = 64) of artists. In the artist group, 36 are dance artists and 28 have other artistic qualifications (i.e., fine arts, drama, and music).

4.2 The instruments

A self-designed questionnaire was used to assess the aesthetic preferences of the respondents. The questionnaire contained an initial section collecting demographic information (i.e., gender, age, and artistic education) followed by an additional 24 questions which collected data regarding the aesthetic principles and the extent to which viewers evaluate a dance work as impactful, appealing and exciting. This was aided by materials related to the general components of a dance performance (i.e., dancers located in the given space as well as images of poses and short movement materials that follow the aesthetic principles). Such materials are necessary to create a staged choreography.

The 24 questions were structured in such a way that 4 still images (see *Figure 2*) and 4 moving images (videos of a few seconds) were each accompanied by 3 questions. The first two questions (*How does it affect you? How exciting do you find it?*) were chosen based on a study by Vukadinović and Marković (2011). The third question (*How much do you like it?*) was adapted to the purpose of the present study. Using a two-pole, seven-point Likert scale, respondents were able to indicate how much they liked the material (not at all - very much), how much of an impact it had on them (very weak impact - very strong impact), and to what degree they found the stimulus to be exciting (very relaxing - very exciting). By stimulus we therefore mean the visual material provided to the participant, which is either a picture or a moving image.

The stimulus materials (*Figure 2*) were produced by the first author of this study who, in collaboration with three trained dancers, created images and videos of static poses or short movement combinations.

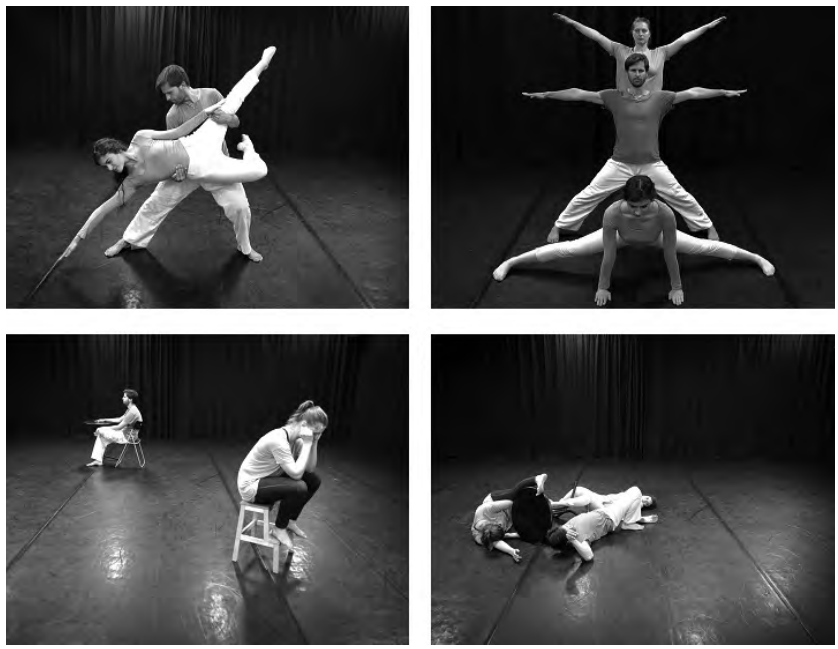

Figure 2. The still images containing the principles of good continuation, the symmetry, the golden ratio and one images that contains no principle

The principle of good continuation is illustrated in the top-left image in *Figure 2*, where the dancers' legs pointing in different directions represent two lines that can be seen as a continuation of each other. In the top-right image of *Figure 2*, the symmetry formed by the bodies and limbs of the three dancers can be observed. In the bottom-left picture, the golden ratio appears as a Fibonacci spiral projected imaginatively onto the space of movement, indicated by the position of the dancers in space and the position of their bodies. The bottom-right image in the *Figure 2* is a stimulus that tries to avoid all three of the above-mentioned aesthetic principles.

In the four video sequences presented to the participants (15 seconds on average) good continuation appears as a dancer starting from the bottom left corner of the field of view, from the ground, and moving organically, concentrating on the diagonal direction to the top right corner of the space. This forms an imaginary line for the viewer that progresses forward in time and space. The symmetry in video is represented by two dancers on either side of the space performing a series of movements that are the same but mirror-symmetrical to each other. The representation of the golden ratio in motion was achieved by using the Fibonacci arithmetic series. Three dancers stood motionless in a place corresponding to the proportions of the space. The video starts with a pause. The first dancer does

one move, then another after a short pause. There is again a pause and then the second dancer joins in; together, they continue the sequence of movements with two movements being performed simultaneously. There is another pause, and then finally the third dancer joins in, with three movements being seen at the same time, followed by yet another pause. In the imagination of the spectators this sequence of movements may represent the Fibonacci numbers (1;1;2;3...), where the quotient of two consecutive numbers approximates the value of 1.618, the value of the golden ratio. The line and the choreography formed in this way can of course be continued by increasing number of dancers. In the video illustrating a lack of an aesthetic principle, the three dancers perform a short choreography constructed from random movements. While one of the dancers sometimes moves in and out of sight, the other two dance a short contact section that purposely interrupts the good continuation. The video ends with one dancer in a static position and another dancer in engaged in repetitive movement.

The images and the videos were made in such a way as to contain as little additional stimuli as possible. This was achieved by minimizing the scenery and lighting, removing color, eliminating sound, and ensuring that the dancers' faces did not show any expressions that could influence the participants' responses to the questions. In addition, there are no objects in the pictures and videos that could be used as scenery to distract the viewer's attention, and the dancers' clothing is also simple and free of attention-grabbing features. However, regardless of these measures, it is necessary to take into consideration the fact that these are complex stimuli. They might contain other types of information in addition to the examined aesthetic principles, and even the mentioned deprivations of stimuli may influence the formation of opinions.

For the evaluation of the results, the stimuli were grouped in such a way that, since each aesthetic principle was associated with two stimuli (a picture and a video), the average of the responses to the stimuli containing the same aesthetic principles for all of the question types was taken as the final value of a principle. For example, the value of the symmetry effect is the average of the answers to the questions responding to the symmetry-based image and video effects.

4.3 The procedure of the research

Participants were asked to complete the online questionnaire which could be completed by the respondents using an electronic device and Internet connection without a timeframe or need for special supervision. All of the necessary instructions were included in written form, so that experimental subjects were also informed that their participation would remain completely anonymous. The questionnaire took approximately 10 minutes to complete, and the results were analyzed using the statistical software Jamovi version 1.6.

5. RESULTS

The data were analyzed on the basis of aesthetic principles (i.e., good continuation, symmetry, golden ratio, and no principle), question types (i.e., excitement,

impact, and liking) and groups (i.e., artists and non-artists) using mixed analysis of variance (ANOVA). One of the assumptions underlying the use of ANOVA, homogeneity, was met; as the assumption of normality was not met, the Greenhouse-Geisser correction was applied.

There were no significant differences between the perception of the image and video stimuli [$F(1,99)=0.212$ $p=0.646$ $\eta^2p=0.002$], so the two were combined for analysis. In addition, no significant differences were found between the sexes [$F(1,96)=2.93$; $p=0.09$ and $\eta^2p=0.030$] and none of the interactions were significant, so the sexes were combined and not taken into account for further analyses. When examining the effect of age, it was found that the age groups did not significantly differ [$F(1,96)=0.025$ $p=0.877$ and $\eta^2p=0.000$] and that none of the age group interactions were significant, so the age groups were combined and not considered for further analysis. The artist and non-artist groups also did not significantly differ from one another [$F(1,98)=1.60$; $p=0.209$ and $\eta^2p=0.016$]. The effect size was also low, suggesting that no significant value is expected in this respect even with a larger sample size. Thus, there is no statistically measurable difference between the answers of the artist and non-artist groups.

However, the aesthetic principles were shown to differ significantly from each other [$F(2,6;255,02)=19.19$; $p<0.001$ and $\eta^2p=0.164$], which is explained by the fact that higher values were measured for symmetry and the golden ratio than good continuation based on Tukey's pairwise comparison. Furthermore, all three aesthetic principles were rated more favorably than when no embedded aesthetic principle was used. The results are shown in *Figure 3*.

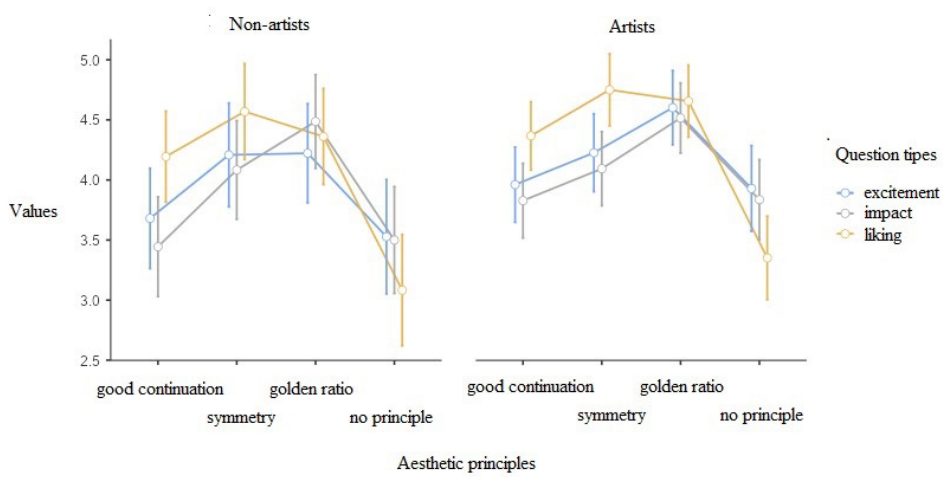

Figure 3. Scores by aesthetic principles, question types and groups

The question types (i.e., liking, impact, and excitement) were also shown to be significantly different from each other [$F(2;196)=7.428$; $p<0.001$ and $\eta^2p = 0.070$] with a moderate effect. Based on Tukey's pairwise comparison, this difference is due to liking received higher values than impact. There is also a significant

interaction between the aesthetic principles (i.e., golden ratio, symmetry, good continuation, and no aesthetic principle) and the question types (i.e., liking, impact, and excitement) [$F(4.52;442.87)=26.685$; $p<0.001$ and $\eta^2p=0.214$], which is caused by several factors according on Tukey's pairwise comparison. Stimuli featuring the golden ratio were rated by respondents to be more exciting and impactful than stimuli with good continuation. Furthermore, stimuli with good continuation and symmetry caused more liking than excitement or impact. Stimuli which contained none of the aesthetic principles were rated as exciting and impactful rather than liking. Further interactions were not significant.

6. DISCUSSION

In this study, we investigated to what extent the golden ratio, symmetry and good continuation embedded in the various elements of moving performance artwork cause liking, impact, and excitement from artist and non-artist viewers. Previous research has shown that the aesthetic principles under investigation, namely the golden ratio (Fechner, 1876), good continuation (Gervasio, 2012), and symmetry (Ramachandran & Hirstein, 1999; Bereczkei, 2003) impact attention in different but positive ways. Although there are studies that focus on the fact that artistically trained and untrained individuals evaluate artworks differently, in those experiments the participants were asked to make judgements by engaging in active activities such as drawing faces (Solso, 2001), collecting adjectives (Vukadinović & Marković, 2012), or noting dance moves (Blasing & Schack, 2012). In these actions, it is assumed that the more efficient processing resulting from proficiency leads to the artist and non-artist groups producing different results, and thus the separation of the two groups is relevant. However, in the case of the passive reception of artwork (as in the present research), the two groups can be considered as viewers or spectators of the artistic experience, and it can be assumed that aesthetic preference does not depend on the artistic education of the recipients (Fechner, 1876; Ramachandran & Hirstein, 1999; Vukadinović & Marković, 2012).

In our study, we showed that the spectators prefer compositions featuring one of the aesthetic principles as opposed to cases those featuring none. The results show that although the difference in values is low, for the question *"How much do you like it?"*, respondents gave significantly higher scores to pictures and videos composed with the golden ratio, good continuity and symmetry as opposed to those stimuli that lacked these principles. Thus, it can be said that viewers prefer when these aesthetic principles are incorporated into the composition. This is consistent with the theories and research findings analyzed above.

We also investigated whether the preference for aesthetic principles depends on artistic education. Based on the answers to the survey given by the respondents, the results show that there is no significant difference between the preferences of artistically trained and non-artist respondents. Thus, statistically the different dance stimuli are equally valued by those who have received secondary or higher artistic education and those who have not. There is also no effect of gender or age on preference, showing that women and men make the same aesthetic judgements regardless of age. This provides evidence for what Fechner (1876) and Ramachandran

and Hirstein (1999) have argued: that aesthetic principles are essentially universal in the population.

We also examined whether there were differences in the responses to the items related to the aesthetic principles across question types. That is, whether each aesthetic principle causes different levels of impact, liking, and excitement. There is also a significant difference between the question types, namely that liking received higher scores than impact on average. This result may be due to the fact that the images and videos were designed to minimize stimulus to the viewer in order to narrow down the experimental conditions to examine the aspect under investigation. Therefore, black and white stimuli which were free of scenery and lighting effects, as well as emotionless and expressionless stimuli were viewed by the subjects. The aesthetic principles hidden in these stimuli are appealing because of their proportions and lines. The impact of the stimuli may also depend on the lack of additional information listed, which is why they may have been rated lower in impact than in liking.

It was also found that stimuli containing the golden ratio were rated as more exciting and impactful than those with good continuation. This correlation can be justified by the fact that good continuation is preferred due to its generality and familiarity (Geisler et al., 2001), and therefore understandably is less preferred than the golden ratio, which is a more dynamically attractive ratio due to its asymmetry, in terms of impact and excitement. The fact that good continuity and symmetry cause liking rather than excitement or impact can be similarly explained. Both of these aesthetic principles reflect harmony and familiarity from an evolutionary point of view and also according to perceptual bias (Geisler et al., 2001; Bereczkei, 2003; Monteiro et al., 2022); therefore, their preference is primarily expressed in liking, with less perceived excitement and impact. In turn, images and videos that did not incorporate either principle were rated as exciting and impactful rather than likable. This result represents a kind of framework reflecting the answer to the first question, revealing that viewers generally like it when they discover such principles in artistic works. However, the fact that they do not rate it as pleasing may trigger other effects, as the perception of art is a rather complex and subjective process (Hagendoorn, 2005).

One limitation of the present research is the small sample size. Although a low effect size was obtained when examining the differences between the artist and non-artist groups, and therefore it is not expected that a larger sample would show a significant value, the other questions posed by the research may be worth investigating with a larger sample. Although a strong emphasis was placed on simplifying the stimuli, a number of factors other than the individual aesthetic principles may have influenced decision-making in the study (such as the physical appearance of the dancers, background, lack of colors or music, etc.).

Overall, the results of the study were in line with the theories laid out in the literature. It can thus be concluded that when a choreographer is in the process of creating a new dance performance, it is worthwhile to consider the principles of the golden ratio, symmetry and good continuity. In order to please the audience aesthetically, beyond the dramaturgy, technical execution and other factors of the performance, any of the principles examined in this study can be embedded

in a choreography. The research has shown that if the choreographer wants to use these principles as a tool of expression, it is worth considering the following: symmetry and good continuity suggest harmony, balance, and familiarity. If the story of the performance is based on such a narrative, incorporating these tools will enhance the desired effect on the audience. However, if the choreographer wishes to increase the impact even more, and to support the excitement with asymmetrical but appealing motifs, it is worth taking advantage of the golden ratio, including the Fibonacci numbers.

But no matter how an artist creates, it is important to keep in mind that the reception and evaluation of the final artistic product are individual and subjective evaluations, regardless of the principles. There will always be people who interpret and perceive what they see and hear differently from others. Moreover, it is conceivable to apply the results of this research in a way that explicitly focuses on the opposites. Indeed, if the choreographer deliberately deviates from the appropriate balance during the application of the aesthetic principles presented above, he or she may achieve the opposite effect, thereby enriching the experience of the performance. Symmetrical elements that are too drawn out in time, or sequences of movements that seem to be predictable and relient on good continuation, may at some point create tension and confusion. A dance composed which features the golden ratio can also lose its impact and become boring if the audience has to watch it for too long. From this point of view, therefore, we think it is worth taking the aesthetic principles into consideration, and also trying them out and shaping them. In this way, the creator will be able to use them appropriately to achieve his or her own goals. However, it is worth keeping in mind that one of the beauties of art is that, while it is possible to seek common ground, everyone can develop their own slightly different points of view.

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