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On the Aesthetic Perception of Gymnastic Body Postures and Their Corresponding Figural Shapes

Pia M. Vinken and Lia Bernewitz

ABSTRACT

Object's, observer's, and the context's characteristics contribute to the aesthetic perception of motor skills. Whether non-biological and biological objects are perceived similarly or differently when based upon the same motor stimuli remains open. Different gradations of body angles within gymnastic body postures and their corresponding figural shapes are investigated in relation to the aesthetic perception of observers with different sensory-motor experiences. Results indicate that observers' aesthetic perception scores of body postures increase the larger the split angle, while observers' aesthetic perception scores of figural shapes interact with observer group and stimuli gradation. The observer's different sensory-motor experiences seem less related to the aesthetic perception of body postures than to the aesthetic perception figural shapes. Although the overall shape of body postures and figural shapes is the same, additional perceptual and contextual information within and beyond those stimuli seem to be related to an observer's aesthetic perception.

Keywords: aesthetic ranking, complex motor skills, empirical aesthetics, handaxe shape, sensory-motor expertise, visual perception.

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P. M. Vinken*
Georg-August-University Göttingen, Institute of Sport Science, Germany (e-mail: pia.vinken@sport.uni-goettingen.de)
L. Bernewitz
Georg-August-University Göttingen, Institute of Sport Science, Germany (e-mail: lia.bernewit@stud.uni-goettingen.de)

****Corresponding Author***

I. Introduction

Imagine the climax of an artistic performance. Often the performer in such a climax seems to freeze in an excellent posture by challenging the laws of physics and achieving a perfect body shape and body posture, demonstrating perfect body control. When observing such a posture, on the one hand, we observe the body performing this posture. But on the other hand, we observe the shape which is created by the body posture.

This study investigates how different gradations of body angles within gymnastic body postures and their corresponding figural shapes are related to the aesthetic perception of observers with different sensory-motor experiences.

Characteristics of the object, the observer, and the context contribute to the perception, observation, and performance of motor skills (Newell, 1986; SteMarie *et al*., 2012; Vickers, 2007). Research in empirical aesthetics differentiates between knowledge-meaning, emotion-valuation, and sensory-motor components while observers perceive and estimate the aesthetics of objects in a given context (Chatterjee & Vartanian, 2014). Research on the aesthetic perception of biological objects, such as complex body postures and movements, investigates the role and amount of specific (kinematic) parameters and their relationship to the aesthetic perception of objects, as well as the sensory-motor experiences of the observer (Calvo-Merino *et al*., 2008; Christensen & Calvo-Merino, 2013; Daprati *et al*., 2009; Vinken *et al*., 2020). However, it is still to be investigated whether non-biological objects, such as figural shapes, and biological objects, such as body postures, are perceived similarly or differently when they are based upon the same biological motor stimuli.

When aesthetically perceiving biological or non-biological stimuli, so-called *aesthetic fundamentals* (Brielmann & Pelli, 2018; Christensen & Calvo-Merino, 2013) seem to be related to an observer's aesthetic perception and estimation. Furthermore, it is argued that specific evolutionary-grounded shapes (e.g., handaxe shape) are aesthetically and functionally relevant when perceiving, performing, and implementing postures and shapes (Mithen, 2003; Wynn & Gowlett, 2017). Based on the findings on aesthetic fundamentals of biological and non-biological (shape) parameters, we predict the following: Body postures are perceived aesthetically similar to their corresponding figural shapes (Christensen & Calvo-Merino, 2013; Daprati *et al*., 2009; Vinken & Heinen, 2020; Wynn & Gowlett, 2017).

Previous research further suggests that figural shapes, based upon biological dance skills, are perceived more aesthetically when being more vertical, thus being based upon larger elevation angles of the gesture leg. Naïve dance observers aesthetically ranked figural shapes which were defined by the limb endpoints of classical dance postures (e.g., *arabesque penchée*, *développé à la seconde*, and *arabesque sur la pointe*). Observers perceived more vertical figural shapes representing dance postures with a larger elevation angle

in the gesture leg more aesthetically than figural shapes representing dance postures with smaller elevation angles of the gesture leg, thus being less vertical (Daprati *et al.*, 2009). Furthermore, non-expert dance observers aesthetically judged stick-figures of original contemporary dance skills. Additionally, the authors performed a multiple factor analysis on kinematic data of those skill-specific kinematic parameters. Results indicate that kinematic parameters related to the amplitude of dance skills are perceived as more aesthetical by non-expert dance observers (Torrents *et al.*, 2013). Interestingly, researchers found strong associations between higher aesthetic scores and specific kinematic parameters when asking experienced dance teachers to aesthetically judge stick-figures of contemporary dance skills and performing a multiple factor analysis. Skill-specific parameters such as turning speed in turning ability, balance duration in balance ability, jump height in jumping ability, and range of motion in falling ability have been found to be related to the perceived aesthetics of a skill (Torrents *et al.*, 2015).

Vertical lines, large split angles, and a large amount of joint flexibility are considered universal features in cross-cultural dance vocabulary and repertoire, thus contributing to dance aesthetics (Christensen & Calvo-Merino, 2013). Additionally, participants rated figural, non-biological shapes, which are oriented vertically, as most aesthetically, followed by oblique and then horizontally oriented shapes (Friedenberg, 2018). Furthermore, healthy, right-handed participants perceive vertical lines more aesthetically than lines tilted clock- or counter-clockwise (Gallagher & Ferrè, 2018). Based on these findings, we predict that more vertical body postures and their corresponding figural shapes are perceived more aesthetically than less vertical body postures and their corresponding figural shapes (Daprati *et al.*, 2009; Torrents *et al.*, 2013; Friedenberg, 2018).

However, the perception of (aesthetic) stimuli is related to the contextual, visual, and sensory-motor experiences of the observer (Chatterjee & Vartanian, 2014; Christensen & Calvo-Merino, 2013; Marković, 2012). Furthermore, the mechanisms underlying the (aesthetic) perception of biological stimuli differ from those of non-biological stimuli (Blake & Shiffrar, 2007). Especially because embodied visual, sensory-motor, affective, and multisensory information depend on the observer's experiences and may *perturb* its body representations (Candini & Aglioti, 2015). For example, when a motor skill is learned, contextual, visual, and sensory-motor experiences change its aesthetic perception. Participants perceive motor skills they previously learned, dancing or observing, as most aesthetically compared to motor skills participants neither danced nor perceived visually (Kirsch *et al.*, 2015). Additionally, dance experts are better able to recognize dance skills within their motor repertoire than dance skills that are not in their motor repertoire: An aspect that could be related to the aesthetic perception of dance skills within or beyond an observer's sensory-motor repertoire and thus allowing a distinction between expert's, novice's, and laypeople's aesthetic perception of motor skills (Calvo-Merino *et al.*, 2010). Furthermore, expert and novice Tai Chi practitioners can differentiate good from mediocre Tai Chi performances. However, only experts could distinguish between the technical and the aesthetic component (Zamparo *et al.*, 2015). Based on these observer-specific results, we predict that observers with different contextual, visual, and sensory-motor experiences perceive gradations of body postures and their corresponding figural shapes aesthetically differently (Calvo-Merino *et al.*, 2010; Kirsch *et al.*, 2015; Zamparo *et al.*, 2015).

Taken together, it is still to be investigated whether the aesthetic perception of body postures and their corresponding figural shapes are perceived similarly or differently. The same is true for exploring whether systematic gradations of body angles and their corresponding figural shapes are perceived systematically differently from observers with different sensory-motor, and thus contextual, experiences.

The following three hypotheses are conducted: First, it is hypothesized that the aesthetic perception of body postures and figural shapes representing those postures do not differ. Second, the aesthetic perception of body postures and their figural shapes is hypothesized to increase the larger the elevation angle of the gesture leg, and thus the more vertical the body posture and the figural shape are. Third, it is hypothesized that the contextual and sensory-motor expertise of the observer is related to the aesthetic perception of postures but not to the aesthetic perception of figural shapes: It is hypothesized that the aesthetic perception of postures differs among experts, novices, and laypeople, whereas the aesthetic perception of figural shapes does not differ among experts, novices, and laypeople.

II. Material and Methods

A. Participants

N=42 participants were recruited for the following three groups: n_{EXP}=14 expert gymnasts (7 females, 7 males; 25±6 years), n_{NOV}=14 novice gymnasts (7 females, 7 males; 24±3 years), and n_{LAY}=14 laypeople (7 females, 7 males; 24±3 years). A power analysis (Type 1 error probability= 0.05, Type 2 error probability=0.20, *Cohen's f*=0.25) derived the given number of participants. Expert gymnasts reported having a gymnastics experience of 8±7 years, training on average 17.5±12.5 hours per week in a gymnastics club or elite sports center. Novice gymnasts reported having 1.15±0.85 years of gymnastics experience,

which they required, for example, by attending gymnastic training courses at the university or training club and averaging 2.75±1.25 training hours per week. Laypeople reported having no gymnastic experience at all.

Participants' task was to aesthetically rank body postures and their corresponding figural shapes, representing body postures with different gradations of body angles. All participants signed informed consent, and the study was conducted according to the guidelines of the local university's ethics committee. Participation occurred voluntarily.

B. Instruments

Stimuli Generation. First, stimuli of the body poses were generated. A model gymnast performed the backward standing split pose with seven different split angles (90°, 105°, 120°, 135°, 150°, 165°, and 180°). A photo camera (Sony alpha7 III) was placed approximately three meters away and orthogonal to the model gymnast performing in front of a white screen. Pictures were cut off and edited with a picture editing software (*Adobe Photoshop*, version 22.0).

Second, stimuli of the figural shapes were generated from the corresponding body poses. The following body-shape-relevant and most distal body parts in the body postures were selected and used: 1) foot of the standing leg, 2) foot of the gesture leg, 3) head, and 4) hands. In each of the seven different figural shapes of the backward standing split pose, those body-shape-relevant and most distal body parts were marked and then connected with straight lines (cf. Daprati *et al.*, 2009 and Fig. 1).

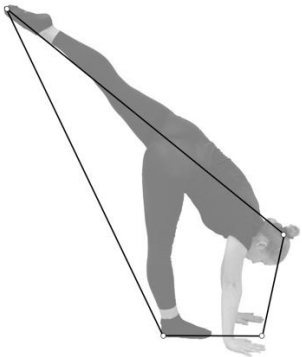

Fig. 1. Representation of Stimuli Generation.
Representative representation of stimuli generation from photos of body postures to their corresponding figural shapes. The white dots represent the body-shape relevant body parts (heal of the standing leg's foot, tip of the gesture leg's toe, crown of head, intersection of hands parallel to heal of the standing leg) which were marked in the photos and then connected with straight lines.

Finally, body postures of the backward standing split pose with seven different split angles and their corresponding seven figural shapes were generated for stimuli evaluation.

Stimuli Evaluation. Stimuli evaluation was done via an online questionnaire (*SoSci Survey*; Leiner, 2019). Stimuli of body poses, and figural shapes were presented separately and counter-balanced to the participants, who were asked to aesthetically rank the different gradations of the body poses and the figural shapes. Participants were instructed to aesthetically rank the pictures by dragging each picture in corresponding rank order from one to seven. Here, rank one corresponds to the most aesthetically ranked position, and rank seven corresponds to the least aesthetically ranked position (Palmer *et al.*, 2013). The instruction given to the participants for the aesthetic ranking was as follows: "Please drag each picture to one of the seven boxes. The picture you like most aesthetically should be placed in the first box, the picture you like second-most aesthetically should be placed in the second box, and so on until each picture is dragged into one corresponding box. You can change the order of the pictures as you like and need to until you have a rank order you are satisfied with. There is no right or wrong rank order, and you can place and order the pictures as you personally like them aesthetically." When the first stimuli set (e.g., body postures) was ranked, the participants could progress the questionnaire in a self-paced manner to continue with the next stimuli set (e.g., figural shapes). The ranking of body postures and figural shapes was done separately and occurred randomly to the participants. Furthermore, the order of display of the seven stimuli gradations for body postures and figural shapes was presented randomly, too. Additionally, we performed a manipulation check asking participants to indicate whether they found possible relations between the two stimuli sets. However, none of the participants reported any such indications.

Data collection occurred directly in the online questionnaire, and each participant's aesthetic ranking of each stimulus was assigned as follows: 1=most aesthetically to 7=least aesthetically. By doing so, an aesthetic score for each stimulus and each participant was determined. Then means and standard errors of the aesthetic scores were calculated for each stimulus of the seven body postures and each stimulus of the seven figural shapes.

C. Procedure

The online questionnaire was released for the participants from November 30th to December 22nd, 2020. A link was sent to the participants from the local university (laypeople) and two gymnastic clubs (expert and novice gymnasts). When following the link, participants were first welcomed and introduced to the general topic and the goal of the study. Second, participants were asked to sign an informed consent and privacy statement before starting the aesthetic ranking. The questionnaire had three parts: questions about socio-demographics (1), questions about the gymnastic experience (2), and the aesthetic ranking (3). Before the aesthetic ranking, participants were given exemplary stimuli to adjust to the ranking procedure. When performing the aesthetic ranking, participants should ensure sufficient scaling and manageability by ranking on a private or laptop computer with at least 12 inches of screen size. After each part was finished, participants were thanked for their participation and could close the browser.

D. Data Analysis

A significance level of α=5 % was chosen. A 7 (stimulus: seven gradations of body postures/figural shapes) × 3 (group: expert gymnasts vs. novice gymnasts vs. laypeople) × 2 (art of stimuli: body postures vs. figural shapes) factor repeated-measures ANOVA was calculated. The scores of participant's aesthetic rankings of each stimulus were treated as the dependent variable. *Cohen's f* was calculated as an effect size for each significant result and a post-hoc analysis (Fisher LSD) was done to further explore the significant results. The assumptions of normality, homogeneity, and sphericity for calculating the ANOVA were evaluated. In case of violating the sphericity, Greenhouse-Geisser correction was calculated to adjust the degrees of freedom.

III. RESULTS

Fig. 2 shows means and standard errors of aesthetic scores of expert gymnasts', novice gymnasts', and laypeople's aesthetic perception of the seven gradations of body postures (Fig. 2a) and figural shapes (Fig. 2b). The pictures on the x-axes represent the gradations of the seven different body angles and their corresponding body postures (Fig. 2a) and figural shapes (Fig. 2b).

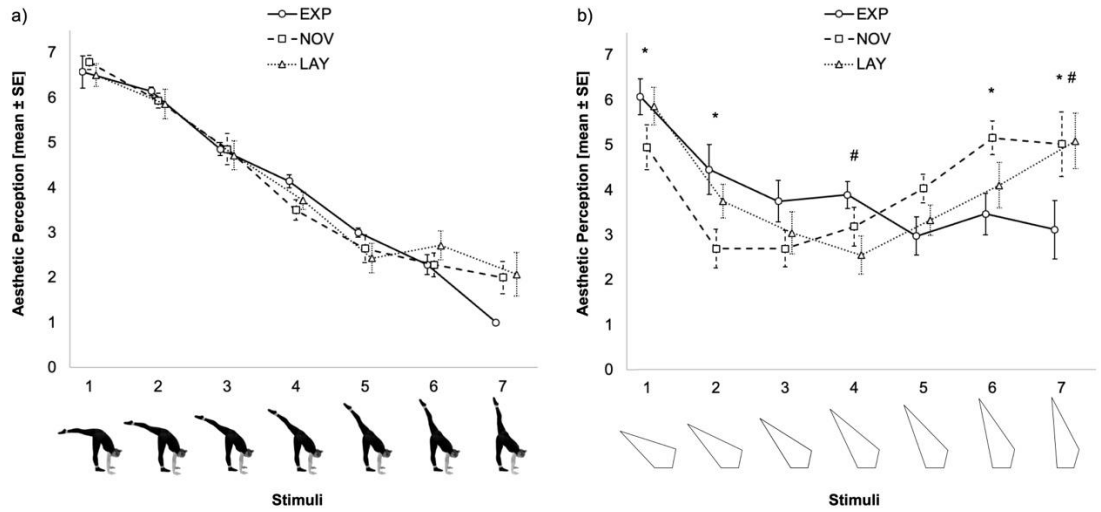

Fig. 2. Observers' Aesthetic Perception of Body Postures and Figural Shapes.
Means and standard errors of expert gymnasts' (EXP), novice gymnasts' (NOV), and laypeople's (LAY) aesthetic scores for the body postures (a) and the figural shapes (b). The smaller the means of observers' aesthetic perception, the more aesthetically observers perceived the corresponding stimuli. * Denotes a significant difference between EXP and NOV (post-hoc).
# Denotes a significant difference between EXP and LAY (post-hoc).

Gradations of body postures and figural shapes are aesthetically perceived differently, per se and concerning the observer groups. There is a significant main effect for stimuli gradation, F(3.12, 121.71)=43.34, p<0.01, *Cohen's f*=1.05, a significant interaction effect for stimuli gradation x group, F(6.24, 121.72)=3.02, p<0.01, *Cohen's f*=0.39, as well as a significant interaction effect for art of stimuli x stimuli gradation, F(2.76, 107.77)=30.85, p≤0.01, *Cohen's f*=0.89. Additionally, there is a tendency of significance for the three-way interaction for art of stimuli x stimuli gradation x group, F(5.53, 107.77)=1.71, p=0.06, *Cohen's f*=0.30.

For body postures, expert gymnasts, novice gymnast, and laypeople perceive different gradations of body postures similarly. Aesthetic perception of body postures is larger the more vertical the gradations of body postures and the larger the split angles of these gradations are (see Fig. 2a). For figural shapes, expert

gymnasts, novice gymnasts, and laypeople perceive different gradations of figural shapes aesthetically different.

In order to further explore the role of the factor group in evaluating aesthetic perception in body postures and figural shapes, a significant interaction of group x stimuli gradation was found for figural shapes, $F(5.44, 106.18)=2.72$, $p<0.01$, *Cohen's f*=0.37, but not for body postures, $F(7.25, 141.42)=1.31$, p=0i.22. Post-hoc analysis (Fisher LSD) revealed that expert gymnasts perceive more diagonal gradations of figural shapes (stimuli 1 and 2) as less aesthetically compared to novice gymnasts, whereas more vertical gradations of figural shapes (stimuli 6 and 7) are perceived as more aesthetically from expert gymnasts compared to novice gymnasts. Furthermore, expert gymnasts' aesthetic perception of stimuli 4 and 7 is significantly different to laypeople's perception of these stimuli of figural shapes (see Fig. 2b).

IV. Discussion

This study investigated the following: how different gradations of body angles within a gymnastic body posture, namely the backward standing split and their corresponding figural shapes, are related to the aesthetic perception of observers with different sensory-motor experiences, namely expert gymnasts, novice gymnasts, and laypeople. We hypothesized that the aesthetic perceptions of body postures and figural shapes do not differ in general but concerning different gradations of split angles and their corresponding gradations of the body postures and figural shapes, in more detail. Furthermore, it was hypothesized that the observer's sensory-motor experience is related to the aesthetic perception of body postures but not to the aesthetic perception of figural shapes. In contrast to the hypothesis, results indicate that the aesthetic perceptions of body postures and figural shapes differ per se and related to the observer's sensory-motor experience: while observers' aesthetic perception of body postures increases the larger the split angle and thus the more vertical the body postures are, observers' aesthetic perception of figural shapes corresponding those body postures differs and interacts with the observers' sensory-motor experience and the stimuli gradation. The aesthetic perception of body postures was similar in the three observer groups, with more vertical gradations of body postures being perceived more aesthetically. However, observers differ in their aesthetic perception of figural shapes. For example, expert and novice gymnasts differ in their aesthetic perception of more diagonal and more vertical stimulus gradations as well as expert gymnasts and laypeople do regarding their perception of stimuli gradation four (most similar to hand axe shape) and seven (most vertical shape). Noteworthily, stimuli gradation four and the shape gradations perceived more aesthetically by novice gymnasts and laypeople, are similar to the so-called hand axe shape, an evolutionary grounded aesthetic fundamental (Mithen, 2003; Wynn & Gowlett, 2017).

Interestingly, body postures and their corresponding figural shapes are perceived aesthetically differently, in general, and in relation to the observer's sensory-motor experiences and stimulus gradation, in more detail. Larger split angles in the body posture are perceived as more aesthetically than smaller split angles. And this is related to more vs. less vertical overall shapes and thus is in line with previous findings on the aesthetic perception of figural shapes representing original biological motor skills (cf. Daprati *et al.*, 2009). The results of this study add that this vertical preference is apparent for all observer groups, thus arguing for an aesthetic fundamental of *verticality* when aesthetically perceiving complex body postures. However, this aesthetic feature of verticality seems to be aesthetically less fundamental for observers who perceive figural shapes that correspond to these body postures but lack the biological information of the model gymnast. This result seems to contradict previous research findings assuming that vertically oriented lines (Gallagher & Ferrè, 2018) and shapes (Friedenberg, 2018) are perceived most aesthetically compared to tilted and rotated lines and shapes.

Consequently, those findings may lead to the following suggestion of different aesthetic fundamentals, which may lead to different aesthetic perceptions depending on (previous) experiences of the observer concerning the perceived stimuli. For example, one may argue that expert gymnasts, whose sensory-motor expertise with regard to figures and shapes focuses on vertical shapes that are prominent in their sports' motor repertoire, thus valuing verticality or alignment higher than diagonality or misalignment. In contrast, observers without or with minor motor experience, namely laypeople and novice gymnasts, may rate diagonality and symmetry of a shape as most aesthetically, which may thus be related to evolutionary grounded aesthetic preferences (cf. Mithen, 2003; Wynn & Gowlett, 2017). However, when biological information is included in the stimuli material, observers perceive such stimuli material similarly and detached from their individual sensory-motor experiences related to the pictured motor skill.

Although this argument seems speculative considering the results of this study, there are previous studies dealing with familiarity, symmetry, complexity, and order in aesthetic perception and estimation (cf. Orgs *et al.*, 2018; Tinio & Leder, 2009; Van Geert & Wagemans, 2020). For example, perceptual and motor familiarity seems to be differently related to the aesthetic perception of dance observers. On the one hand, observers aesthetically prefer simple and easy dance stimuli with large familiarity and low complexity. On

the other hand, the same is true for very complex and skilled dance stimuli with low familiarity and high complexity (Orgs *et al.*, 2018). Furthermore, it is argued that an optimal balance between order and complexity of an aesthetic stimulus contributes to the highest aesthetic perception and estimation (cf. Baumgarten, 1750; Fechner, 1876). This balance may be related to perceptual abilities, processing abilities, and expertise (Marković, 2012; Van Geert & Wagemans, 2020) and thus seems to depend on the relationship between the object, the observer, and the context in which aesthetic perception and estimation occur.

Given these results, observers in this study perceive those stimuli of body postures as more aesthetic that have large split angles and a vertical alignment. This aspect seems less related to the observer's sensory-motor experiences concerning those stimuli. One may thus argue that conceptual and sensory-motor experiences are differently related to an observer's aesthetic perception (Orgs *et al.*, 2018). Common knowledge of large split angles, indicating more experienced and more difficult motor performance, may mask the effects of sensory-motor experience in the aesthetic perception of postures. Furthermore, sensory-motor experience, for example, due to familiarity with and knowledge of specific postures and their shapes, seems to be related to an observer's aesthetic perception of shapes in general (cf. Calvo-Merino *et al.*, 2006; Orgs *et al.*, 2013).

Interestingly, the observers in this study perceive those stimuli of figural shapes as more aesthetically, which, depending on their level of expertise, match familiar shapes. For expert gymnasts, such matched shapes may be vertically oriented and quite stable concerning the area of support and the figure's ability to be balanced and aligned, which is typical for artistic gymnastic poses. For novice gymnasts, such matched shapes may be diagonally oriented, whereas horizontally and vertically oriented shapes are perceived as less aesthetic. Similarly, for laypeople, such matched shapes are strongly diagonally oriented and very similar to the so-called hand axe shape: Thus, it seems to be an evolutionary-grounded shape that is perceived as strongly aesthetic and, unlike experienced gymnasts, does not contradict the aesthetic principles of novice gymnasts and laypeople.

When interpreting the results of this study, the following four limitations should be considered. First, only observers with different amounts of sensory-motor expertise in artistic gymnastics were recruited for this study. Whether observers with different amounts of expertise in, for example, other sports disciplines, arts, design, or evolutionary contexts, as well as from different cultures, yield similar results (cf. Monroy *et al.*, 2022), remains to be investigated. Second, static stimulus material was implemented for the aesthetic ranking: This was done to be sufficiently able to distinguish different gradations of body angles and their relationship to the aesthetic perception of gymnastic poses. However, these findings may be specific to static stimuli only. Aesthetic perception of different gradations of movement stimuli may result in different results, especially when taking further kinematic parameters of motor skill performance into account (cf. Torrents *et al.*, 2013; Torrents *et al.*, 2015; Zamparo *et al.*, 2015). Third, observers in this study behaviorally indicated their aesthetic perception by aesthetically ranking body postures and their corresponding figural shapes. Further measures, for example, observer's gaze-behavior or electromyographic measures, could further deepen knowledge and insight into the aesthetic perception of body postures and figural shapes. Fourth, two sets of stimuli material containing either biological or non-biological information were used. In future studies, it should be of particular interest to systematically add and integrate additional sets of stimuli, such as stick-figures, avatars, or humanoid characteristics, to confirm the results of this study and deepen the understanding of aesthetic (dis-)embodied perception.

The practical implications that might arise from the results of this study are as follows: Aesthetic perception of body postures and their corresponding figural shapes seems to be different. However, the figural shapes aesthetically ranked in this study were generated from the corresponding body postures. Larger split angles of the backward standing split pose and, consequently, more vertical body postures are perceived as more aesthetically than smaller split angles by observers with different levels of sensory-motor expertise. Interestingly, this finding on the aesthetic perception of the body postures cannot be transferred to the aesthetic perception of figural shapes corresponding to those body postures. Instead, the aesthetic perception of figural shapes seems to be related to the observer's experience, knowledge, and familiarity with the figural shapes. This aspect may point to different aesthetic features within the given object, which seem to be weighed, possibly perturb each other, and depend on the relationship between the object, the observer, and the given context.

V. Conclusion

The aesthetic perceptions of body postures and their corresponding figural shapes differ. Interestingly, the different sensory-motor experiences in the observers seem not related to the aesthetic perception of different gradations of body postures but to the aesthetic perception of different gradations of figural shapes. Therefore, it is concluded that observers' aesthetic perception of different gradations of body postures

increases the more vertical and the larger the split angles of those body postures are - an aspect independent of the observers' sensory-motor experiences. However, the observer's aesthetic perception of different gradations of figural shapes seems to be related to the observers' experiences and evolutionary-grounded aesthetic preferences concerning figural shapes (cf. hand axe shape). In other words, it is argued that there are different aesthetic fundamentals within body postures and figural shapes, which potentially seem to perturb each other when it comes to the aesthetic perception and estimation of such postures and shapes.

Although the overall shape of body postures and their corresponding figural shapes is the same, additional perceptual and contextual information within and beyond those shapes seem strongly related to an observer's aesthetic perception of such shapes. Future research should thus emphasize further observer- and context-related information. For example, the observer's gaze behavior during the aesthetic perception of body postures and figural shapes, the observer's and the performer's expertise while perceiving and performing and observing biological and non-biological postures and shapes, as well as evolutionary and cultural relationships and preferences in the aesthetic perception of body postures and figural shapes. In this way, researchers and practitioners will be even better able to explain and objectify the potentially unexplained subjectivities in the aesthetic perception of beautiful body postures and figural shapes.

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CONFLICT OF INTEREST

We have no known conflict of interest.

REFERENCES

Baumgarten, A. G. (1750). Aesthetica. In H. R. Schweizer (Ed.), *Texte zur Grundlegung der Ästhetik.* Meiner. German.

Blake, R., & Shiffrar, M. (2007). Perception of human motion. *Annual Review of Psychology*, *58*(1), 47–73. https://doi.org/10.1146/annurev.psych.57.102904.190152.

Brielmann, A. A., & Pelli, D. G. (2018). Aesthetics. *Current Biology*, 28(16), 859–863. https://doi.org/10.1016/j.cub.2018.06.004.

Calvo-Merino, B., Ehrenberg, S., Leung, D., & Haggard, P. (2010). Experts see it all: Configural effects in action observation. *Psychol Res.*, 74(4), 400–406. https://doi.org/10.1007/s00426-009-0262-y.

Calvo-Merino, B., Grèzes, J., Glaser, D. E., Passingham, R. E., & Haggard, P. (2006). Seeing or doing? Influence of visual and motor familiarity in action observation. *Curr Biol.*, 16(19), 1902–1910. https://doi.org/10.1016/j.cub.2006.07.065.

Calvo-Merino, B., Jola, C., Glaser, D. E., & Haggard, P. (2008). Towards a sensorimotor aesthetics of performing art. *Conscious Cogn.*, 17(3), 911–922. https://doi.org/10.1016/j.concog.2007.11.003.

Candini, M., & Aglioti, S. M. (2015). Visual and sensorimotor contributions to the esthetic appraisal of body form, motion, and emotion. *European Psychologist*, 20(1), 16–26. https://doi.org/10.1027/1016-9040/a000221.

Chatterjee, A., & Vartanian, O. (2014). Neuroaesthetics. *Trends in Cognitive Sciences*, 18(7), 370–375. https://doi.org/10.1016/j.tics.2014.03.003.

Christensen, J. F., & Calvo-Merino, B. (2013). Dance as a subject for empirical aesthetics. *Psychology of Aesthetics, Creativity, and the Arts*, 7(1), 76–88. https://doi.org/10.1037/a0031827.

Daprati, E., Iosa, M., & Haggard, P. (2009). A dance to the music of time: Aesthetically relevant changes in body posture in performing art. *PLoS ONE*, 4(3), e5023. https://doi.org/10.1371/journal.pone.0005023.

Fechner, G.T. (1876). *Vorschule der Ästhetik.* Leipzig: Breitkopf & Härtel. German.

Friedenberg, J. (2018). Perceived beauty of elongated symmetric shapes: Is more better? *Psychology of Aesthetics, Creativity, and the Arts*, 12(2), 157–165. https://doi.org/10.1037/aca0000142.

Gallagher, M., & Ferrè, E. R. (2018). The aesthetics of verticality: A gravitational contribution to aesthetic preference. *Quarterly Journal of Experimental Psychology*, 71(12), 2655–2664. https://doi.org/10.1177/1747021817751353.

Jacobsen, T. (2004). Individual and group modelling of aesthetic judgment strategies. *British Journal of Psychology*, 95(1), 41–56. https://doi.org/10.1348/000712604322779451.

Jacobsen, T. (2006). Bridging the arts and sciences: A framework for the psychology of aesthetics. *Leonardo*, 39, 155–162. https://doi.org/10.1162/leon.2006.39.2.155.

Kirsch, L. P., Dawson, K., & Cross, E. S. (2015). Dance experience sculpts aesthetic perception and related brain circuits. *Ann N Y Acad Sci.*, 1337(1), 130–139. https://doi.org/10.1111/nyas.12634.

Leiner, D. J. (2018). *SoSci Survey* (Version 3.0.00) [Computer software]. https://www.soscisurvey.de.

Leder, H., & Nadal, M. (2014). Ten years of a model of aesthetic appreciation and aesthetic judgments: The aesthetic episode - Developments and challenges in empirical aesthetics. *British Journal of Psychology*, 105(4), 443–464. https://doi.org/10.1111/bjop.12084.

Marković, S. (2012). Components of aesthetic experience: Aaesthetic fascination, aesthetic appraisal, and aesthetic emotion. *i-Perception*, 3, 1–17. https://doi.org/10.1068/i0450aap.

Mithen, S. (2003). Handaxes: The first aesthetic artefacts. In E. Voland & K. Grammer (Eds.), *Evolutionary aesthetics* (pp. 261–275). Springer. https://doi.org/10.1007/978-3-662-07142-7_9.

Monroy, E., Imada, T., Sagiv, N., & Orgs, G. (2022). Dance across cultures: Joint action aesthetics in Japan and the UK. *Empir Stud Arts*, 40(2), 209–227. https://doi.org/10.1177/02762374211001800.

Newell, K. M. (1986). Constraints on the development of coordination. In M. G. Wade & H. T. A. Whiting (Eds.), *Motor development in children: Aspects of coordination and control* (pp. 341–360). Martinus Nijhoff.

Orgs, G., Calvo-Merino, B., & Cross, E. S. (2018). Knowing dance or knowing how to dance? In B. Bläsing, M. Puttke, & T. Schack (Eds.), *The neurocognition of dance* (2nd ed., pp. 238–257). Routledge. https://doi.org/10.4324/9781315726410-13.

Orgs, G., Hagura, N., & Haggard, P. (2013). Learning to like it: Aesthetic perception of bodies, movements and choreographic

structure. *Conscious Cogn.*, 22(2), 603–612. https://doi.org/10.1016/j.concog.2013.03.010.

Ortlieb, S. A., Kügel, W. A., & Carbon, C.-C. (2020). Fechner (1866): The aesthetic association principle-A commented translation. *i-Percept.*, 11(3), 1–20. https://doi.org/10.1177/2041669520920309.

Palmer, S. E., Schloss, K. B., & Sammartino, J. (2013). Visual aesthetics and human preference. *Annu Rev Psychol.*, 64(1), 77–107. https://doi.org/10.1146/annurev-psych-120710-100504.

Pelowski, M., Markey, P. S., Forster, M., Gerger, G., & Leder, H. (2017). Move me, astonish me… delight my eyes and brain: The Vienna integrated model of top-down and bottom-up processes in art perception (VIMAP) and corresponding affective, evaluative, and neurophysiological correlates. *Phys Life Rev.*, 21(3), 80–125. https://doi.org/10.1016/j.plrev.2017.02.003.

Ste-Marie, D. M., Law, B., Rymal, A. M., O, J., Hall, C., & McCullagh, P. (2012). Observation interventions for motor skill learning and performance: An applied model for the use of observation. *Int Rev Sport Exerc Psychol.*, 1(1), 1–32. https://doi.org/10.1080/1750984X.2012.665076.

Tinio, P. T. L., & Leder, H. (2009). Just how stable are stable aesthetic features? Symmetry, complexity, and the jaws of massive familiarization. *Acta Psychologica*, 130(3), 241–250. https://doi.org/10.1016/j.actpsy.2009.01.001.

Torrents, C., Castañer, M., Jofre, T., Morey, G., & Reverter, F. (2013). Kinematic parameters that influence the aesthetic perception of beauty in contemporary dance. *Perception*, 42(4), 447–458. https://doi.org/10.1068/p7117.

Torrents, C., Castañer, M., Reverter, F., Morey, G., & Jofre, T. (2015). Dance teachers' aesthetic perception of kinematic parameters. *Psychol Aesthet Creat Arts*, 9(4), 442–450.https://doi.org/10.1037/a0039757.

Van Geert, E., & Wagemans, J. (2020). Order, complexity, and aesthetic appreciation. *Psychology of Aesthetics, Creativity, and the Arts*, 14(2), 135–154. https://doi.org/10.1037/aca0000224.

Vickers, J. N. (2007). *Perception, cognition, and decision training*. Human Kinetics.

Vinken, P. M., & Heinen, T. (2020). Perceived aesthetic features differentiating between complex artistic dance skills of varying style. *Science of Gymnastics Journal*, 12(2), 119–134.

Wynn, T., & Gowlett, J. (2017). The hand axe reconsidered. *Evolutionary Anthropology*, 27(1), 21–29. https://doi.org/10.1002/evan.21552.

Zamparo, P., Zorzi, E., Marcantoni, S., & Cesari, P. (2015). Is beauty in the eyes of the beholder? Aesthetic quality versus technical skill in movement evaluation of Tai Chi. *PLoS ONE*, 10(6), e0128357. https://doi.org/10.1371/journal.pone.0128357.