Original Article

The aesthetics of the experts - On the relationship of observers' and performers' expertise when perceiving motion aesthetics in freerunning skills

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ABSTRACT

An observer's perception of motion aesthetics strongly relies on the interplay between aspects of the motion stimuli, the sensory and motor expertise of the observer, and the context in which the stimuli are perceived. However, whether a fit in observers' and performers' sensory and motor expertise can boost aesthetic motion perception when observing complex motor skills, is still to be investigated. Thus, it was hypothesized that a fit between observers' and performers' sensory and motor expertise could boost aesthetic motion perception of complex motor skills. Expert and intermediate freerunners performed three different freerunning skills. Observers with varying levels of expertise were asked to indicate their perception of motion aesthetics when observing video sequences of expert and intermediate freerunning skill performances. Results indicate that a fit between observers' and performers' sensory and motor expertise levels does not boost aesthetic motion perception. In contrast, motor skill performances of expert freerunners are perceived as more aesthetically than intermediate freerunning performances from all three observer groups: expert freerunning observers, intermediate freerunning observers, and laypeople. Instead of a fit between the performer's and the observer's sensory and motor expertise, it is argued that object-driven parameters of a complex motor skill performance seem to be related to a rather universal embodied aesthetic motion perception.

Keywords: Biological motion perception; Empirical aesthetics; Likert-scales; Artistic sports.

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INTRODUCTION

Imagine, you observe a group of freerunners passing an urban obstacle. Some of them seem to pass the obstacle with speed and ease, others with strength and exhaustion, and some may be additionally able to integrate specific tricks. Anyway, you may perceive some techniques as more astonishing or even aesthetically as others, while probably relating them to your abilities and skills in passing (urban) obstacles. One may debate whether such motor skills, performed in the given context, attract which observer's aesthetic eye. With this in mind, the central question of this study is to investigate if and how a fit in performer's and observer's sensory and motor expertise can boost the perception of motion aesthetics in complex motor skills.

If and how an observer perceives (motion) aesthetics depends on the specific circumstances of the observed object, which is perceived in a given context, and studied in research on (empirical) aesthetics. Properties and features of aesthetic objects, the resulting response-mechanisms to such objects in the observer, as well as the resulting interplay between the object and the observer in a given context are investigated (Brielmann & Pelli, 2018; Chatterjee & Vartanian, 2014; Jacobsen, 2006; Leder & Nadal, 2014; Pearce, Zaidel, Vartanian, et al., 2016; Redies, 2015). Additionally, embodiment-specific aspects and their relationship to motion aesthetics must be taken into account when studying biological motion, as it is typical in artistic sports and performing arts (Calvo-Merino, Jola, Glaser, & Haggard, 2008; Christensen & Calvo-Merino, 2013; Di Dio & Gallese, 2009; Kirsch, Urgesi, & Cross, 2016; Montero, 2012; Orgs, Calvo-Merino, & Cross, 2018; Ticini, Urgesi, & Calvo-Merino, 2014).

It is argued that action perception and action production share common neural representations (Blake & Shiffrar, 2007; Calvo-Merino, Glaser, Grezes, Passingham, & Haggard, 2005). A person's visual, motor, and social experiences influence how he/she perceives and observes his/herself and others' motion. For example, observers are most sensitive to perceiving actions that are most familiar to them (Loula, Prasad, Harber, & Shiffrar, 2005). Furthermore, motion stimuli performed on a higher expertise level seem to be perceived as more aesthetic compared to motion stimuli performed on a lower expertise level (Bronner & Shippen, 2015; Zamparo, Zorzi, Marcantoni, & Cesari, 2015, Zamparo, Carrara, & Cesari, 2017). When asked to rank aesthetic proficiency and movement smoothness, expert dance observers, for example, perceived motor skills performed at higher expertise levels as more aesthetically than the same motor skills performed at lower expertise levels (Bronner & Shippen, 2015).

Additionally, observers with different expertise levels seem to perceive motion aesthetics of complex skills differently (Zamparo et al., 2015; Zamparo et al., 2017) while argued to implement different strategies when watching (Stevens, Winskel, Howell, Vidal, Latimer, & Milne-Home, 2010), discriminating (Calvo-Merino, Ehrenberg, Leung, & Haggard, 2010), and evaluating (Cross, Kirsch, Ticini, & Schütz-Bosbach, 2011) complex motor skills. For example, watching a dance sequence in two consecutive viewing sessions changes novice dance observers' gaze behaviour. Fixation duration was significantly reduced and thus getting closer to expert dance observers' fixation time (Stevens et al., 2010). An observer's amount of visual input and expertise concerning the motion stimuli to be observed may thus be related to what observers perceive - in general (Iglesias Gallego et al., 2010;), and concerning their perceived motion aesthetics, in more detail (cf. aesthetic triad, Chatterjee & Vartanian, 2014).

Research investigating both, observer's and performer's expertise level, compares different qualities of motion aesthetics by investigating, for example, technical and aesthetic qualities (Zamparo et al., 2015; Zamparo et al., 2017). However, the relationship of a fit between an observer's and a performer's sensory

and motor expertise concerning their general perception of motion aesthetics is still to be investigated. It thus remains open, whether such a fit can boost the perception of motion aesthetics as it can be observed when aspects of the context fit to object- and observer-related circumstances (Kirk, Skov, Hulme, Christensen, & Zeki, 2009; Millis, 2001; Seidel & Prinz, 2018). For example, Seidel and Prinz (2018) investigated the bidirectional relationship between spatial magnitudes and the aesthetic value of artworks. Artworks presented as work from a master artist are perceived as larger when compared to the same artwork but presented as a work from a student. Furthermore, increasing the size of a painting and the height on which it is placed on the wall, both increase naïve observer's aesthetic ratings (Seidel & Prinz, 2018).

Labelling and presenting a potentially aesthetic stimulus can boost its aesthetic perception by using observer- and context-related biases-aspects that are implemented in biological motion stimuli, such as artistic sports and performing arts, too. Performers and choreographers use specific body positions, ornamentation, and aesthetic features such as symmetry and synchronization to boost a dance stimuli' aesthetic perception (cf. Christensen & Calvo-Merino, 2013). In freerunning and parkour, performed motor skills do not primarily aim at serving as an aesthetic stimulus but focus on motor acuity, economy, and functionality (Witfield, Gerling, & Pach, 2013) and can be judged upon their execution, composition, and difficulty (FIG, 2019). Thus, freerunning skills seem to be promising candidates to broaden the knowledge on motion aesthetics by reducing, for example, aesthetically (Christensen & Calvo-Merino, 2013; Cutting, 2006; Palmer, Schloss, & Sammartino, 2013; Ticini et al., 2014) and contextual (Kirk et al., 2009; Millis, 2001; Seidel & Prinz, 2018) biases.

Different motor learning stages on a continuum between first attempts and the mastery of a motor skill are distinguished (Schmidt & Lee, 2017). Thus, it is argued that the quality and mastery of a motor skill performance correlates with its aesthetic perception (Bronner & Shippen, 2015; Montero, 2012; Sato, Nunome, & Ikegami, 2014). However, research investigating the perception of motion aesthetics and observers' expertise levels reveals inconsistent results (Kirsch, Drommelschmidt, & Cross, 2013; Zamparo et al., 2015; Zamparo et al., 2017). For example, Kirsch et al. (2013) asked participants who were trained physically, visually and auditory, or auditory-only, to indicate affective aesthetic responses before and after training. Participants of the physical training group reported higher aesthetic ratings in the dance sequences after training, whereas participants of the other two training groups showed no increase in aesthetic ratings (Kirsch et al., 2013). Zamparo and colleagues found that observers' expertise is related to ratings of the technical and aesthetic abilities of Tai Chi (Zamparo et al., 2015) and front crawl swimming performances (Zamparo et al., 2017). Authors found that expert observers, in contrast to non-expert observers, can differentiate between technical and aesthetical qualities, whereas non-expert observers seem to equate the technical to the aesthetic skill (Zamparo et al., 2015; Zamparo et al., 2017).

When aesthetic ratings of observers before and after physical training change and expert and non-expert aesthetic ratings differ, observers' sensory and motor experience to the observed stimuli seems to shape the perception of motion aesthetics. However, different methodologies of measuring motion aesthetics were implemented in the studies outlined so far (cf. Cross et al., 2011; Kirsch et al., 2013; Zamparo et al., 2015; Zamparo et al., 2017). Consequently, asking observers to indicate their perceived motion aesthetics as unbiased as possible while investigating observers' and performers' sensory and motor expertise, may answer the following question: Is a fit between observers' and performers' sensory and motor expertise related to the perception of motion aesthetics and thus can boost the perception of motion aesthetics? Consequently, observers' aesthetic perception of motion aesthetics should either be related to their own sensory and motor expertise, thus underlining the embodied assumptions outlined so far (Blake & Shiffrar, 2007; Calvo-Merino et al., 2010; Loula et al., 2005). In contrast, if an observer's perception of motion

aesthetics is related to the expertise level of the performer, this may underline the importance of object-driven aesthetic features within a motor stimuli where perturbation and arousal of embodied representations in the observer may be able to boost aesthetic (motion) perception (cf. Aglioti, Minio-Paluello, & Candini, 2012; Candini & Aglioti, 2015).

Additionally, it is assumed that aesthetic (motion) perception is related to stimuli' exposure rates and observers' familiarity with the given stimuli (Cutting, 2006; Orgs, Hagura, & Haggard, 2013; Palmer et al., 2013; Tinio & Leder, 2009). It is argued that aesthetic ratings increase with increased exposure rates, and observers aesthetically prefer such stimuli they have been exposed to more often (Cutting, 2006; Orgs et al., 2013; Palmer et al., 2013). However, Tinio and Leder (2009) asked participants to indicate aesthetic ratings of simple and complex black and white patterns. Interestingly, participants familiarized with complex stimuli reported higher aesthetic ratings for simple stimuli and vice versa (Tinio & Leder, 2009). Consequently, there seems to be a relation between aesthetic perception, familiarization, and an object's ability to challenge our perception (Candini & Aglioti, 2015; Cross et al., 2011). Thus, it can be argued that an observer's expertise level is related to the aesthetic perception of motor skills and may differ when observing motor skill performances that are either similar or different to his/her expertise level.

Thus, it remains open whether a fit between observers' and performers' sensory and motor experience can boost aesthetic motion perception. Studying the perception of motion aesthetics in artistic sports such as freerunning and parkour can address if motion perception is rather observer- or stimuli-related. Especially in freerunning and parkour, because those disciplines do not primarily focus on creating and performing aesthetically pleasing motor skills, thus reducing aesthetic and contextual biases. However, the freerunning skills implemented in this study serve different aesthetic and functional requirements, thus addressing potential generalization effects of the perception of motion aesthetics.

In sum, previous research, on the one hand, suggests that observers perceive motor skill performances which fit their own sensory and motor experience as more aesthetic compared to motor skill performances where the sensory and motor experience of observers and performers differ (cf. Blake & Shiffrar, 2007; Calvo-Merino et al., 2010; Loula et al., 2005; Ticini et al., 2014). On the other hand, it is argued that motor skill performances which perturb and arouse the observers' motion perception are perceived as more aesthetic when compared to motor skill performances to which an observer is quite familiar (cf. Candini & Aglioti, 2015, Tinio & Leder, 2009). Investigating aesthetic motion perception in freerunning and parkour as an artistic sport without a primary aesthetic aim has the potential to reduce aesthetic biases. Thus, enabling to investigate whether a fit between observers' and performers' sensory and motor expertise can boost aesthetic motion perception. Additionally, laypeople's perception of motion aesthetics while observing complex motor skills can give insight into whether freerunning and parkour performed at different expertise levels can be perceived aesthetically different by naïve observers (cf. Jola, Abedian-Amiri, Kuppuswamy, Pollick, & Grosbras, 2012; Loula et al., 2005).

Consequently, the following is hypothesized. First, expert observers perceive motion aesthetics of expert performances as more aesthetic when compared to intermediate performances. Second, intermediate observers perceive motion aesthetics of intermediate performances as more aesthetic when compared to expert performances. Third laypeople's perception of motion aesthetics does not differ when observing expert and intermediate performances. Fourth, it is explored whether the previous hypotheses can be generalized to three different freerunning skills with different kinematic and functional structures: a) the double-kong as a passing freerunning skill without salto rotation, b) the wallflip as a non-passing freerunning skill with salto rotation, and c) the webster as a passing freerunning skill with salto rotation.

MATERIAL AND METHODS

Participants

The study sample consists of N_{obs} = 36 observing participants from one of three groups: n_{obs1} = 12 freerunning experts (male and female 24 ± 3 years), n_{obs2} = 12 freerunning intermediates (male and female, 22 ± 10 years), and n_{obs3} = 12 laypeople (male, female, and other, 28 ± 9 years). Freerunning experts reported to have an average freerunning experience of 8 ± 2 years and indicated a visual input of freerunning with 72 ± 46 minutes per week. Freerunning intermediates reported possessing an average freerunning experience of 2 ± 1 years with a visual input of 40 ± 40 minutes per week. Laypeople reported possessing, if any, only minor freerunning experience indicated as less than ten hours of freerunning experiences, for example, from participating in a single freerunning or parkour trial course. Laypeople indicated a visual freerunning input of 22 ± 17 minutes per week. Indicated freerunning related visual expertise resulted from watching, for example, video clips in social media platforms or for training purposes. Observers' task was to indicate their perceived motion aesthetics when watching video sequences of three different freerunning skills.

Additionally, N_{perf} = 13 performing participants were recruited as a stimuli group. n_{perf1} = 7 expert (male, 24 ± 4 years) and n_{perf2} = 6 intermediate freerunning performers (male and female, 19 ± 5 years) were invited to generate video stimuli. Experts reported having an average freerunning experience of 8 ± 2 years and a weekly training amount of 10 ± 7 hours. Intermediates reported having an average of 6 ± 4 years of freerunning experience while practicing 7 ± 3 hours per week. Inclusion criteria for the freerunners was the ability to perform and execute each skill successfully, stable (Schmidt & Lee, 2017), and according to the experimental settings of this study (cf. Fig. 1). Expert and intermediate freerunners' task was to perform three different freerunning skills: the double-kong, the wallflip, and the webster.

The study was conducted according to the local University's guidelines and ethics committee. All volunteering participants signed informed consent.

Instruments

Stimuli generation

Stimuli generation occurred along with the following phases: Expert and intermediate freerunners of both stimuli groups were separately invited to the gymnasium to perform the different freerunning skills double-kong, wallflip, and webster. Freerunning performers were informed about the process of video stimuli generation, but blind to the general purpose of the study concerning the perception of motion aesthetics, thus ensuring typical motor skill performance. Each freerunner gave his/her informed consent to voluntarily participate and fill in a short questionnaire about his/her freerunning experience. They were asked to individually warm-up, prepare for the task ahead, and practice each skill in the given experimental setting. Video stimuli generation for the freerunning skills, namely the double-kong, the wallflip, and the webster, occurred randomly for each freerunner. Freerunners were asked to perform, if possible, different variations of each freerunning skill by, for example, varying flight width, flight height, and body posture(s). After performing and capturing the first freerunning skill, the process of freerunning skill performance and video capture was repeated twice for the remaining freerunning skills. When each freerunner performed his/her variations of each freerunning skill, he/she was debriefed.

Freerunning skills were videotaped with a digital camera (Panasonic Lumix G7) operating at 50 Hz (1920 x 1080 pixels). The camera was positioned on a tripod, approximately ten meters away, and orthogonal to the experimental setup. Overall, 60 video sequences were captured from the freerunning performers. To achieve a sufficient variety within the stimuli skills, and to reduce bodily biases, video sequences with uniform skill

variations were grouped, and one video sequence was randomly selected for the stimuli sample. Furthermore, video sequences with insufficient movement quality or failure and perceptual distractions, such as background irritation or emotional expressions, were excluded. In the end, the stimuli sample consists of 16 video sequences per freerunning skill: eight performed by expert freerunners and eight performed by intermediate freerunners, totalling eight expert double-kongs, eight intermediate double-kongs, eight expert wallflips and eight intermediate wallflips, as well as eight expert websters and eight intermediate websters. Finally, the video sequences were transferred into grayscale colour to reduce contextual visual biases.

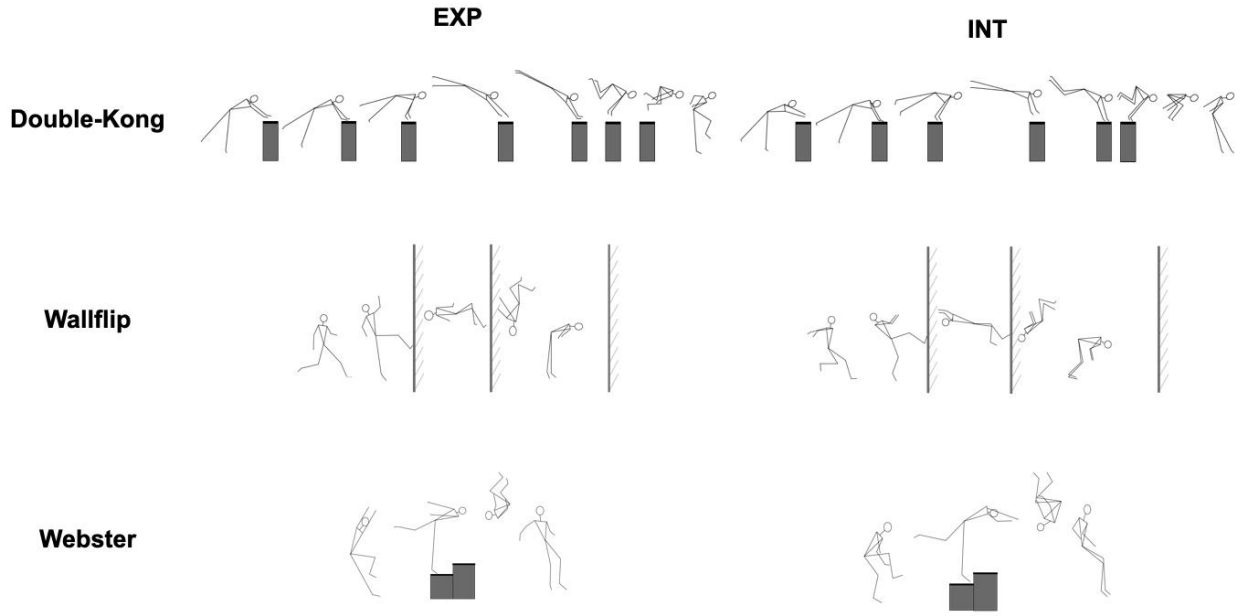

Illustration of the freerunning skills, namely the double-kong, the wallflip, and the webster. Stick-figure sequences represent exemplarily motor skill executions of the expert and the intermediate freerunning performers and the experimental settings.

Figure 1. Freerunning skills.

Stimuli evaluation

Presentation and evaluation of the video sequences occurred via an online questionnaire (*SoSci Survey*; Leiner, 2018). Participants were instructed to execute the questionnaire on a 13-inch laptop or computer monitor to ensure sufficient size and scaling. Participants were blindfold concerning the expertise level of the freerunners in the video sequences (expert vs. intermediate freerunners). Participants of the expert, intermediate, and laypeople group were asked to indicate their perceived motion aesthetics on a seven-point Likert-scale labelled "aesthetic" and ranging from "-3" to "+3" (Thomas, Nelson, & Silverman, 2015) by ticking the number representing their answer. Presentation and evaluation of the freerunning skills double-kong, wallflip, and webster occurred blockwise and in randomized order, while video sequences of each freerunning skill (eight expert and eight intermediate performances) were randomized within each skill block. Overall, the self-paced stimuli evaluation took approximately 25 minutes. Neither the term "aesthetics" nor "aesthetic(ally)" were instructed, ensuring to leave their meaning to the participants as unbiased as possible (cf. Jacobsen, Buchta, Köhler, & Schröger, 2004). Sixteen responses were recorded per participant and freerunning skill, leading to a total of 1728 values used for later data analysis.

Procedure

Evaluation of freerunning skills occurred following three phases: First, each participant of the observing expert, intermediate, and laypeople participants was invited via e-mail to participate in the online questionnaire (*SoSci Survey*; Leiner, 2018). They were informed about the general purpose of this study, agreed to an informed consent form, and completed a short questionnaire about their freerunning experience. Participants were instructed to indicate their perceived motion aesthetics of different video performances of the freerunning skills double-kong, wallflip, and webster. Likert-scale ratings were done blockwise for each of the three freerunning skills, while double-kongs, wallflips, and websters were presented randomly over participants.

Second, and in order to collect the study data, video sequences of eight expert and eight intermediate performances of the first freerunning skill, for example, the double-kong were randomly presented to each participant in the original tempo. Participants were blind to the expertise level of the freerunners performing in each video sequence. Each video sequence was presented in the middle of the screen, whereas the Likert-scale labelled "aesthetic" was presented below. Responses were recorded online, and the online survey's progression was only possible when an answer occurred. After making his/her response, the next double-kongs' video sequence was presented. This procedure was repeated for each of the 16 double-kongs. After evaluating the first freerunning skill, participants were allowed to take a short break and proceed with the self-paced survey. The same procedure was repeated twice for the remaining freerunning skills, for example, wallflips and websters. There was no time pressure, but participants were instructed to indicate their response spontaneously.

Third, and after data collection, each participant was debriefed and received contact details when interested in future studies and research.

Data analysis

An α = 5 % significance level was used for all results reported. Shapiro-Wilk test, as well as Levene test, were used to evaluate the assumptions of the analysis of variance. Tests indicated that the assumptions to calculate analysis of variance were met. For testing the main hypotheses of this study, three separate analyses of variance with repeated measures were calculated for each freerunning skill, namely the double-kong, the wallflip, and the webster. In all ANOVAs, Group (expert freerunners vs. intermediate freerunners vs. laypeople) was treated as a between-subject factor. Performer group (expert vs. intermediate freerunners) was treated as a within-subjects factor. Observers' responses indicating their perceived motion aesthetics of the video sequences were treated as the dependent variable. *Cohen's f* was calculated as an effect size for all significant results.

RESULTS

It was hypothesized that a fit between observers' and performers' expertise levels is able to boost aesthetic motion perception in such a way that expert observers perceive expert performances as more aesthetically compared to intermediate performances, and intermediate observers perceive intermediate performances as more aesthetically when compared to expert performances. Additionally, it was hypothesized that laypeople's perception of motion aesthetics does not differ when observing expert and intermediate performances.

Figure 2 illustrates observers' perception of motion aesthetics for the three different freerunning skills performed by expert and intermediate freerunners.

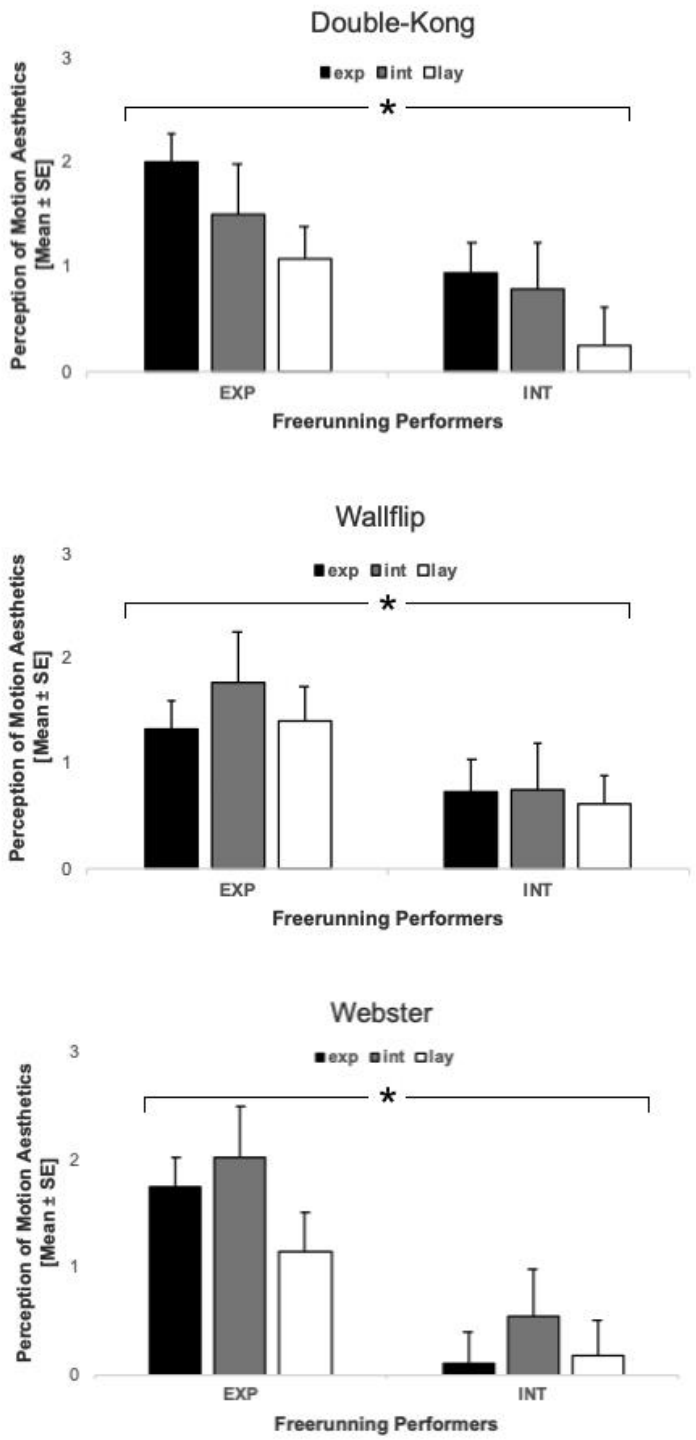

*Illustration of perceived motion aesthetics for the three freerunning skills, namely the double-kong, the wallflip, and the webster. There is a significant difference in the perception of motion aesthetics between expert freerunning performances (EXP) and intermediate freerunning performances (INT) for the three observer groups, namely expert freerunning observers (exp), intermediate freerunning observers (int), and laypeople (lay). * denotes p < .05.*

Figure 2. Perception of motion aesthetics.

Results of the analyses of variance revealed significant main effects of performer group (expert vs. intermediate freerunners) on perceived motion aesthetics in all three freerunning skills, $F_{double\text{-}kong}(1, 33) = 92.60$, $p < .01$, *Cohen's f* = 1.68, $F_{wallflip}(1, 33) = 52.68$, $p < .01$, *Cohen's f* = 1.26, $F_{webster}(1, 33) = 109.65$, $p < .01$, *Cohen's f* = 1.82. Video sequences of expert freerunners performing either the double-kong, the wallflip, or the webster were perceived as more aesthetic compared to video sequences of intermediate freerunners performing any one of the freerunning skills mentioned above.

There was no significant main effect of observer group on perceived motion aesthetics for any one of the three freerunning skills. Furthermore, there was no significant interaction effect of observer group (expert freerunners vs. intermediate freerunners vs. laypeople) and performer group (expert freerunners vs. intermediate freerunners) on perceived motion aesthetics for any one of the three freerunning skills.

DISCUSSION

This study aimed to investigate whether a fit in observers' and performers' sensory and motor expertise can boost aesthetic motion perception when observing complex motor skills. Expert and intermediate freerunners performed three different freerunning skills and observers with varying levels of expertise, namely expert freerunners, intermediate freerunners, and laypeople were asked to indicate their perceived motion aesthetics. It was hypothesized that a fit between observers' and performers' sensory and motor expertise could boost aesthetic motion perception. Observers who are blind to the performer's expertise level should perceive motor skills performed on an expertise level similar to their own expertise level as more aesthetic when compared to motor skills performed on an expertise level that is different from their own expertise level. Furthermore, it was hypothesized that laypeople's perception of motion aesthetics does not differ when observing expert and intermediate motor skill performances. However, results indicate that expert performances are perceived as more aesthetically compared to intermediate performances for all three freerunning skills and from all three observer groups, whereas observers were blind to the performers' expertise level.

Interestingly, a fit between observers' and performers' sensory and motor expertise levels does not boost aesthetic motion perception. In contrast, motor skill performances of expert freerunners are perceived as more aesthetically than intermediate freerunning performances, thus being independent of the observer groups' sensory and motor expertise concerning the observed motor skills. Contrasting previous research suggesting a skill-dependence of aesthetic motion perception (Calvo-Merino et al., 2008), observers' perception of the freerunning skills investigated in this study reveals no skill-dependency. The mechanical complexity of freerunning skills is not related to observers' perception of motion aesthetics. Passing freerunning skills without salto rotation (cf. double-kong), non-passing freerunning skills with salto rotation (cf. wallflip) and passing freerunning skills with salto rotation (cf. webster) are perceived similar thus favouring expert over intermediate performances.

It is argued that freerunning skills with different aesthetic and functional requirements such as the double-kong, the wallflip, and the webster can be perceived as aesthetic stimuli. However, their primary aim is to achieve acute, economic, and functional motor skill performance (Witfield et al., 2013). One may argue that potentially aesthetic motion stimuli should be perceived as more aesthetically when observers' and performers' sensory and motor expertise fits, and observers are most (aesthetically) sensitive to motor skills which are familiar to them (cf. Blake & Shiffrar, 2007; Loula et al., 2005). However, expert motor skill performances may have the potential to perturb and arouse an observer's aesthetic motion perception in such a way that object-driven performance parameters 'overwrite' observer-related parameters (cf. Candini

& Aglioti, 2015). This aspect may be related to previous research findings on familiarization and peak-shift. Familiarization with a stimulus has the potential to decrease its aesthetic perception (Tinio & Leder, 2009), whereas exaggerating familiar properties (cf. peak-shift, Ramachandran & Hirstein, 1999) of an object has the potential to increase its aesthetic perception (cf. Pelowski et al., 2017). Expert freerunners motor skill performance may, for example, exaggerate mechanical and physical properties and parameters such as flight time, flight height, rotational and translational velocities, as well as specific body postures. By doing so, expert freerunners' ability to challenge physical laws during their motor skill performances can perturb and arouse an observer's aesthetic motion perception in such a way that expert freerunning performances are perceived as more aesthetically compared to intermediate freerunning performances. Intermediate performances may be sufficient to skilfully perform the skills but lack the 'special something' that arouses an observer's aesthetic eye.

In line with the results of this study and previous research on the perception of (motion) aesthetics, one could argue that the quality of the motion stimuli when performing complex motor skills weighs stronger than a fit between the sensory and motor expertise of the performer and the observer. Consequently, when observing complex motor skills, objective aesthetic features of the stimuli seem to have the potential to boost aesthetic motion perception (cf. Vinken & Heinen, 2020). Thus, arguing for a rather universal embodied aesthetic motion perception seems more applicable than the assumption that observers perceive motion stimuli that fit their own sensory and motor performance. Furthermore, a performer's expertise level appears to be related to the stimuli's potential to be perceived as an aesthetically pleasing motor skill.

When interpreting the results of this study, the following limitations should be taken into account. First, aesthetic motion perception was measured behaviourally by asking observers to indicate their perception of motion aesthetics via Likert-scales (cf. Calvo-Merino et al., 2008; Cross et al., 2011). Whether subjective measures, such as interviews or reports, reveal similar results should be investigated in future studies. The same is true for additional objective measures which enable to broaden the understanding of underlying strategies implemented by observers with different sensory and motor expertise concerning the observed motion stimuli. For instance, one could argue that although behaviourally perceiving aesthetic motion perception similarly, observers with different sensory and motor experience (expert vs. intermediate observers) implement different perceptual or cognitive strategies when evaluating motion aesthetics (cf. Stevens et al., 2010; Calvo-Merino et al., 2008).

Second, performance measures of the expert and intermediate freerunning skills were not implemented in this study. The expertise level of the two performer groups was assessed concerning participants' previous sensory and motor experience, their weekly training amount, and the experimenter's coaching experience, ensuring participants' ability and expertise to perform the freerunning skills adequately. Subsequent studies should investigate in what sense expert and intermediate freerunners' performance differs, thus examining objective aesthetic features that seem to be related to the perception of motion aesthetics in freerunning, artistic sports, and performing arts. However, this study underlines the need to investigate such aesthetic features and their relationship to aspects of the performer, the observer, and the context in which aesthetic motion perception occurs.

When transferring the results of this study, the following practical implications can be derived. Freerunning and parkour skills, in general, have the potential to be perceived as an aesthetically pleasing stimulus by observers with different sensory and motor experiences in freerunning and parkour. Expert freerunning performances are perceived as more aesthetically compared to intermediate freerunning performances even when observers have only minor sensory, and almost no motor experience to the observed motion stimuli.

The results of this study underline the strong influences of object-driven aesthetic features within biological motion stimuli. Performers who can exaggerate perceptual relevant parameters of motor skills can potentially boost observers' aesthetic motion perception, even when observers do not possess exceptional expertise concerning the performed and observed motor skills.

CONCLUSION

An observer's perception of motion aesthetics strongly relies on the complex interplay between aspects of the motion stimuli, the sensory and motor expertise of the observer, and the context in which the stimuli are perceived. When perceiving and evaluating motion aesthetics of three different freerunning skills performed by expert and intermediate freerunners, observers perceive expert performances as more aesthetically compared to intermediate performances. A result which is independent of the observers' own sensory and motor experience. Expert freerunners, intermediate freerunners, and laypeople similarly perceive expert motor skill performances as more aesthetically as intermediate performances, although they are blind to the performers' expertise levels. Instead of a fit between the performer's and the observer's sensory and motor expertise, it is argued that object-driven parameters of a complex motor skill performance seem to be related to a rather universal embodied aesthetic motion perception. Future studies should investigate which object-driven parameters within the expert and intermediate motor skill performances are promising candidates, thus having the ability to potentially boost. By doing so, collaborations between researchers and artists seem quite promising.

AUTHOR CONTRIBUTIONS

Pia M. Vinken: study design, data collection, statistical analysis, manuscript preparation, and funds collection; Vincent Stirling: study design, data collection, and statistical analysis; Thomas Heinen: study design, statistical analysis, and manuscript preparation.

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