RELIABILITY OF THE EVALUATION OF HUMANOID ANIMATION AS A VISUALIZING TOOL IN HIP-HOP DANCE

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The purpose of this study was to determine the reliability of the evaluation the humanoid animation by comparing the intra and inter-rater reliability between humanoid animation and stick figure animation of hip-hop dance. The humanoid animation and the stick figure animation were created using motion capture data from 16 hip-hop dancers. Five judges were asked to evaluate the 32 dance trials and they were not informed that they were repeating an evaluation. The intra-class correlation coefficient of the humanoid animation demonstrated very high reliability and was higher than the stick figure animation. There was no difference between the animations in the inter-class correlation coefficient. Humanoid animation may provide a more reliable method for the evaluation of dance movements as a feedback tool.

KEYWORDS: evaluation, judge, dancing.

INTRODUCTION: Although 3D motion capture is usually used to describe human movement in the field of biomechanics, it can also be used to visualize movement and to provide feedback for performance. Visualizing feedback for dance performance is important as dance evaluations require a qualitative assessment of movement aesthetics. Evaluation of hip-hop dance is ambiguous as no systematic method of evaluating the performance of hip-hop dancers has been developed. Evaluation of hip-hop dance performances presumably includes identification of motion characteristics which would lead to a consensus among judges regarding a given dance performance (Sato et al., 2016). Extracting the motion characteristics that affect judges' evaluations of hip-hop dance performance would be helpful to develop efficient methods for teaching and objective evaluation criteria.
When judges evaluate a dancer's performance in competition, their evaluations might be affected by not only the movement but also clothes, facial attractiveness (Cunningham et al., 1990), physical features and shapes (Maisey et al., 1999), and how familiar they are with the dancer. It is considered that these biases should be minimized in order to investigate only the factors of the movement which affect the evaluation by judges. Humanoid animations with accurate movement representations would be one way to investigate the unbiased impression of the movement factor in a given dance performance. In our previous research (Sato et al., 2015), judges evaluated the performances by observing stick figure animations to score the dancer routine. However, stick figure animations were not a faithful reproduction of the dancers' body shapes. Judges' evaluations may differ between the stick figure animations and humanoid figure animations if judges do not perceive the stick figure as a true humanoid shape.
The purpose of this study was to determine the reliability of judges' evaluations of humanoid animation as a visualizing tool by comparing the intra and inter-rater reliability between a humanoid animation and a stick figure animation of hip-hop dance movement. We hypothesized that the humanoid animation would demonstrate higher intra and inter-rater reliability than the stick figure animation.

METHODS: The participants were eight expert hip-hop dancers, eight non-expert hip-hop dancers, and five judges. The expert dancers were prize-winning dancers of national level competitions and had 8.4 ± 3.8 years of hip-hop dance experience. The non-experts had 1.4 ± 0.5 years of the experience. The Nagoya Gakuin University Research Ethics Committee approved the experimental procedure of the study and written informed consent was obtained from each participant before the commencement of the experiment.

The dancers were asked to repeat a basic rhythmic hip-hop movement 10 times. The basic rhythmic movement is a fundamental skill in hip-hop dance where the dancer repeatedly bounces the body by flexing and extending the trunk and lower extremities. Dancers' movements were captured using a ten-camera motion capture system (Oxford Metrics, UK) sampled at 120Hz. Spherical markers (10mm diameter) were attached on the skin or the clothing over 49 anatomical points (Figure 1(A)).

A stick figure animation was created using the 3D motion capture data. The makers within one segment were connected with straight lines in Nexus motion capture software (Oxford Metrics, UK, Figure 1(A)).

The process of creating humanoid animation was as follows. The 3D motion capture data was imported and a skeleton ready for retargeting onto a character was created in Vicon Blade (Oxford Metrics, UK). The humanoid character was adapted from sample trials provided by Motek Entertainment (Motek, NL) and was imported into Maya (Autodesk, USA). The motion capture skeleton was imported into Maya space with the character. The character was scaled and positioned to match the motion capture skeleton. The motion capture skeleton was then retargeted onto the character skeleton (Figure 1(B)).

Both the stick figure animation and the humanoid animation were created using the same motion capture data. Therefore, the number of segments, segment lengths, and joint coordinate systems of each animation were exactly same.

The five judges evaluated the performances by observing both the stick figure animations and the humanoid animation on a computer display. In each observation method, the judges were asked to evaluate 32 dancers (ie, 16 dancers multiplied by 2 observations for each) and they were not informed that they were repeating an evaluation. The judges graded each performance on a scale of 1-10, with 10 being the highest grade. The judges' scores were converted into T-scores to standardise their scores.

The reliabilities of the evaluations were examined using inter- and intraclass correlation coefficients. Inter- and intraclass correlation coefficients higher than 0.80 represent very high reliability, and those between 0.60 and 0.79 represent moderately high reliability. All statistical analyses were calculated using IBM SPSS Statistic (v. 25.0, IBM, USA).

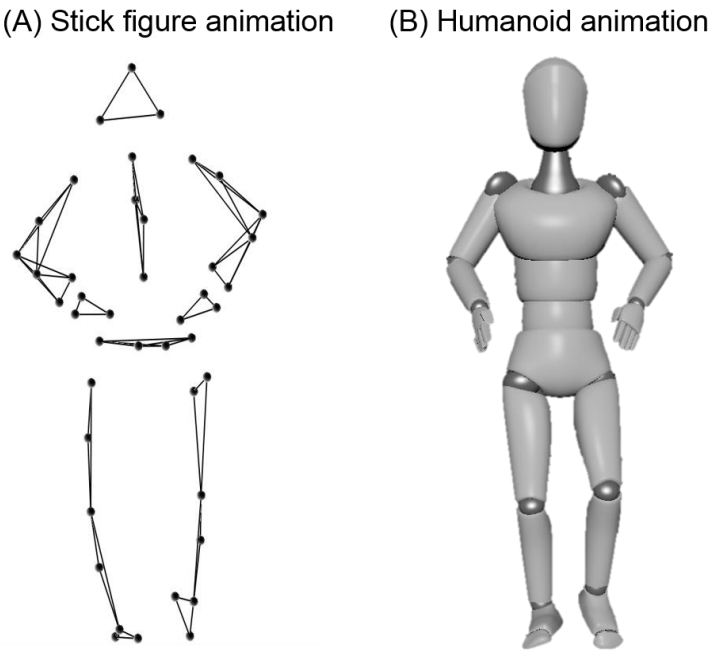

Figure 1. Stick figure animation (A) and humanoid animation (B).

RESULTS: The intraclass correlation coefficient for the humanoid animation ranged from 0.859 to 0.911 (Table 1), and the interclass correlation coefficient was 0.684 (95% confidence intervals, 0.497-0.850). In contrast, the intraclass correlation coefficient for the stick figure animation ranged from 0.605 to 0.814, and the interclass correlation coefficient was 0.671 (95% confidence intervals, 0.480-0.843).

Table 1. Intra- and interrater reliability for hip-hop judges

	Intra-class correlation coefficient					Inter-class correlation coefficient
	Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	
Humanoid animation	0.862	0.859	0.876	0.911	0.887	0.684
Stick figure animation	0.790	0.814	0.794	0.605	0.812	0.671

DISCUSSION: The purpose of this study was to determine the reliability of humanoid animation as a visualizing tool for judges' evaluations of hip-hop dance. The intra and inter-rater reliability between a humanoid animation and a stick figure animation was compared. As described earlier, the evaluation of a dancer's performance might be affected by clothes, facial attractiveness, shapes, and how familiar they are with the dancer. Although both the humanoid animation and the stick figure animation are able to minimize the bias of those factors, it is assumed that judges perceive the humanoid animation more stereoscopically than the stick figure animation. The intra-class correlation coefficient of the humanoid animation demonstrated very high reliability for all judges and higher than the stick figure animation. This suggests that the humanoid animation would be a more reliable observation tool compared to the stick figure animation.

Although the inter-class correlation coefficient of the humanoid animation was higher than the stick figure animation, there was not much difference between the two visualizations. When judges evaluate a dancer's performance, judges may attend to the motion of the distal extremities, the face of the dancer, or fluent motion (Sato et al., 2015, 2016). The inter-rater reliability of the evaluation of both animations would depend on where the judges choose to direct their attentional focus.

A visualizing feedback tool is useful in dance because performance results can be visually grasped and understood more easily. From our results, the humanoid animation provides enhanced intra-rater reliability compared to stick figure animation and may have the potential to be developed into a new teaching tool for dance.

CONCLUSION: In the present study, we compared the intra and inter-rater reliability of judges' evaluations of humanoid animation and stick figure animation of a hip-hop dance movement. The intra-class correlation coefficient of the humanoid animation demonstrated very high reliability for all judges and was higher than the stick figure animation. The results suggest that humanoid animation provides a reliable observation tool compared to stick figure animation and may provide reliable information to dancers.

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