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A COMPARISON OF BASIC RHYTHM MOVEMENT KINEMATICS BETWEEN EXPERT AND NON-EXPERT HIP HOP DANCERS

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Common motion characteristics that may be linked to higher judging evaluations of hip hop dance were investigated. A comparison of the rhythmic movement between ten expert and twelve non-expert dancers was undertaken. Trajectory data was captured using a motion capture system at 120 Hz and kinematic parameters including the time lags of occurrence of peak joint angle in neck, trunk, hip and knee joint were calculated. Smaller time lags between neck and other joints were observed in the expert dancers. Furthermore, the neck motion was delayed for approximately a quarter cycle of the basic rhythm compared with the half cycle delay observed in the non-expert group. Timing differences in the coordination of joint angles is the most likely a factor to explain the higher judging evaluations awarded to the expert dancers.

KEY WORDS: hip hop dance, evaluation, rhythm movement.

INTRODUCTION: One of the major features of the hip hop dance is to bounce (vertically displace) the body up and down repeatedly in order to 'get into' a rhythm of the music. This underlying rhythmic movement forms the foundation of hip hop dance technique, with novice dancers mastering this basic rhythm movement prior to incorporating more complex dance techniques.

The hip hop dance was initially performed in street environments however nowadays dancers more commonly strive for mastery in formal contests. In these contests, the performance of a dancer is evaluated by a subjective rating by an experienced panel of judges. Given the consistency across experienced judges in their evaluation of dancer's technique, it is reasonable to assume that movement signatures may exist which allow judges to consistently discriminate a dancer's skill level. Sato, Nunome and Ikegami (2012) undertook a novel attempt to analyze hip hop dance kinematics and succeeded in extracting motion characteristics that affected the evaluation of judges in wave motion. Likewise, in the current study, we assumed that the basic rhythm movement includes similar key motion, which may have substantial influence on the performance evaluation.

In this study, we aimed to extract the common motion characteristics in a basic rhythm movement exhibited by expert hip hop dancers, that may linked to a higher judging evaluation when compared with non-expert dancers.

METHODS: Ten expert (experts) and twelve non-expert (non-experts) hip hop dancers participated in this study. The experts were prize-winning dancers of national level competitions with 7.4±1.8 years of the hip hop dance experience. The non-experts had 1.8±0.8 years of the experience. Five experienced judges with an average judging history of 10.2±3.7 years evaluated the performance of all dancers. In the basic rhythm movement, dancers were required to bounce their body up and down repeatedly by flexing and extending neck, trunk and lower extremities. There are two different techniques of basic rhythm movement; namely the DOWN and UP techniques. In the DOWN technique, dancers move the body downward synchronizing with the downbeat (the first beat of a measure in music). On the other hand, in the UP technique, dancers get into the rhythm by upward body

movement synchronizing with the down beat. The DOWN technique was selected as an experimental task. Participants were asked to perform the basic rhythm movement to the pulse of the metronome operating at 100 beats per minute (bpm). Ten cycles of bouncing movements by the DOWN technique were recorded for each participant.

Dancer's motion data was captured using a 10 camera motion capture system (Vicon, Oxford Metrics Ltd, Oxford, UK) sampling at 120Hz. Participants wore a black leotard with 49 spherical markers (10mm diameter) attached to the skin or clothing at relevant anatomical landmarks and points of interest.

Following data capture, five experienced judges evaluated each dancer's performance via observation of the stick figure animation of the captured trial. Direct observation of the participant motion was avoided in order to minimize subjective bias. The judges observed each performer in a randomized order and the performance of each dancer was graded on a scale of one to ten, with ten being a perfect score. Judges were also blinded to the evaluations of other judges.

Several kinematic parameters were calculated including neck, trunk, hip, knee joint angles and the displacement of the body center of mass (COM). To look at cyclic delay occurring between the four joint angles, the timing difference (time lag) of occurrence of peak angles between two joints were calculated for all the couples from four joints. An example of a typical time lag between neck and trunk is presented in Figure1. In the figure, T_{ext_tk} and T_{ext_nk} (or T_{flex_tk} and T_{flex_nk}) identify the occurrence of the peak trunk and neck extension (or felxion) angles. The time lag of the neck-trunk couple was computed as the time difference between the T_{ext_tk} and the T_{ext_nk}. Likewise, the time lag was also computed for the timing differences in peak flexion angles (T_{flex_tk} and T_{flex_nk}). The time lags derived from the 10 cycles were averaged.

Statistical differences of the average values between the groups were examined using unpaired t-tests. Significant probability level was set at less than 0.05.

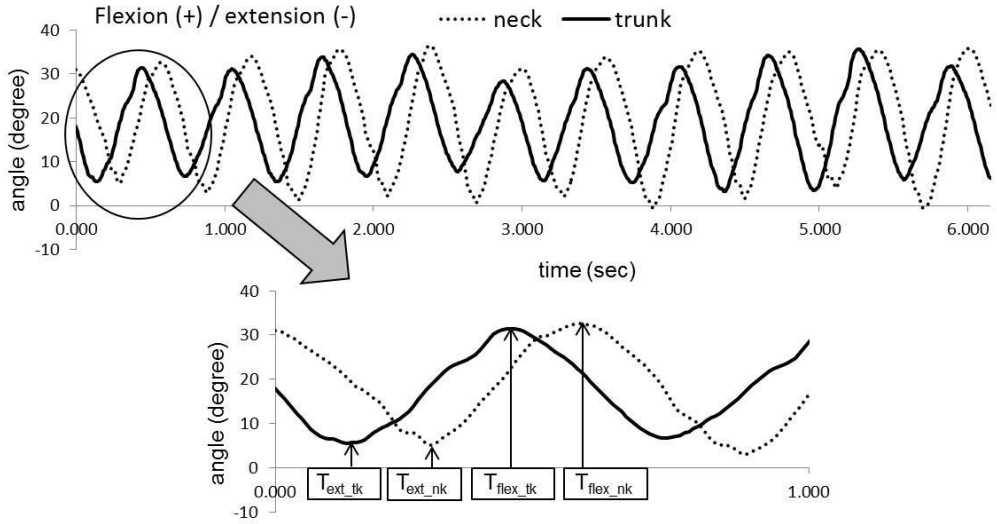

Figure 1: Procedure to calculate the time lag (representative example in neck and trunk joints).

RESULTS: The average rank of the judges' evaluation are shown in Figure 2. The experts got significantly higher ($p<0.01$) evaluation than that of the non-experts. In contrast, the mean vertical displacement of COM of the experts did not significantly differ from that of the non-experts (Figure 3).

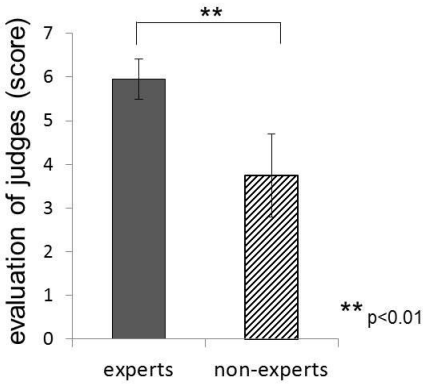

Figure 2: Comparison of scores evaluated by the judges.

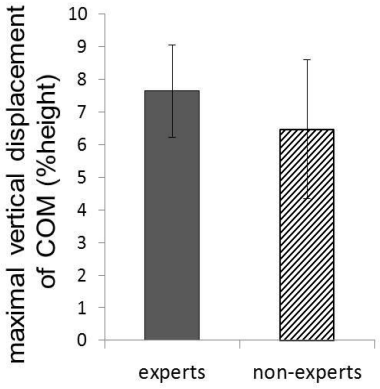

Figure 3: Comparison of the maximal vertical displacement of COM

The average time lags are shown in Figure 4. The experts showed significantly smaller ($p<0.01$) time lags for the neck-trunk, the neck-hip and the neck-knee joint angle couples, when compared with those of the non-experts.

In this study, the pace of the metronome was 100 bpm. Therefore, one whole cycle of the movement yields 0.6 second and a half cycle yields 0.3 second. As shown, the time lags observed for the non-experts correspond to the half cycle of the movement and those of the experts correspond to the approximate quarter cycle.

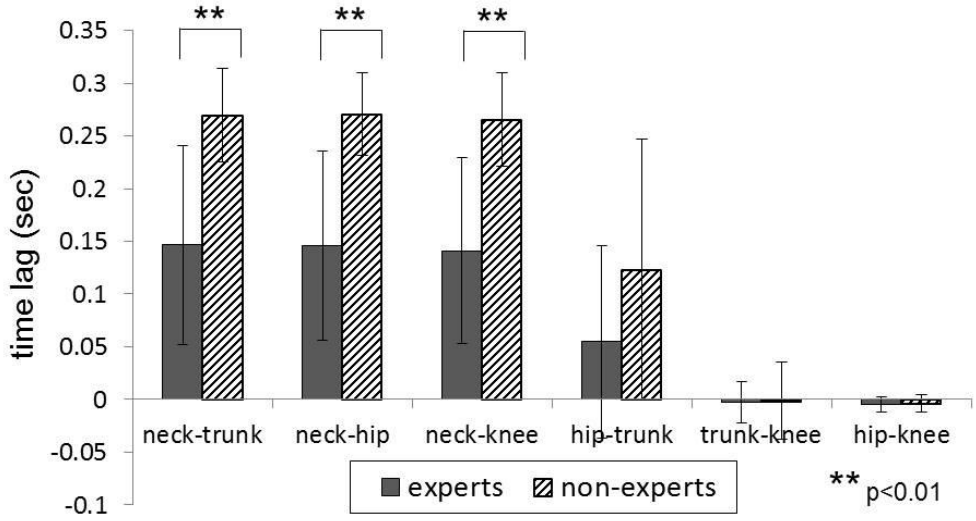

Figure 4: Comparison of the time lag for every joint angle couple (neck, trunk, hip and knee joint).

DISCUSSION: Sato, Nunome and Ikegami (2012) investigated the relationship between motion characteristics and the evaluation of judges in the wave motion of hip hop dance. Except for that study, we could not find any reports discussing a relationship between motion characteristics and judge's evaluation on hip hop dance. In this study, we examined the basic rhythm movement of hip hop dance and hypothesized that some common motion characteristics of expert dancers may underly this fundamental movement skill, and that particular motion signatures are most likely associated with a higher evaluation by judges. As the basic rhythm movement is a cyclic, repetitive movement, its amplitudes and temporal parameters related to the time lag could be derived. Those parameters and the evaluation from the judges were compared between the expert and the non-expert hip hop dancers.

From the judge evaluation scores, experts got significantly higher ($p<0.01$) evaluation compared with that of the non-experts, indicating that the dancers' skill level could be clearly distinguished from the non-experts by the judging panel. In contrast, the average displacement of the vertical movement (amplitude) of COM of the experts did not significantly differ from that of the non-experts. From these results, it can be assumed that the vertical amplitude in rhythm movement was not an important factor distinguishing between expert and the non-expert performers.

Analysis of the time lag data revealed a common, consistent trend among all participants whereby the cycle of the neck angular motion was delayed when compared with the trunk, hip and knee motion. There were significant differences in the time lag between the experts and the non-expert dancers. It is worth noting that the average time lag observed for the non-experts corresponded to approximately a half cycle of the movement, in other words, the trunk, hip and knee angular motions were antiphase to the neck angular motion. In contrast, the average time lag of the experts was smaller and corresponded to nearly a quarter cycle of the movement, suggesting that experts tended to display a smaller time delay of the neck motion against the motion of the remaining body motion (e.g. trunk, hip and knee). Moreover, this slight delay may likely affect the visual observation by the judges resulting in more favorable resultant evaluations.

To achieve a fluent movement in the down technique, coaches often advise dancers to get into a rhythm by flexing their knees. Also similar types of instructions are stated in general hip hop dance manuals and novice dancers tend to follow these instructions of such written texts. The results of the present study have identified small delay of the neck motion relative to those of other body parts displayed by expert dancers. This provides the dance research community with further knowledge surrounding fundamental dance skills via the quantification of an expert dancer's motion signature when performing a basic rhythm movement.

CONCLUSION: In the present study, we succeeded in extracting the motion characteristics of the basic rhythm movement, which can affect the judging evaluations. Expert dancers display small but significant time lags between the motions of neck and other body parts, and this slight delay observed in expert movement patterns does appear to be associated with higher evaluation by judges. Those results provide fundamental information to contribute to the advancement of efficient teaching methods in the jenre of hip hop dance.

REFERENCES:

Sato, N., Nunome, H. & Ikegami, Y. (2012). Motion characteristics in hip hop dance underlying subjective evaluation of the performance. In: *Proceedings of the 30th International Conference on Biomechanics in Sports*, (pp. 17-21). Melbourne: Australian Catholic University.