

早稲田大学審査学位論文

博士（スポーツ科学）

概要書

Analysis of Artistic Choreography and  
Postural Control in Aerobic Gymnastics

競技エアロビクスにおける振り付けと姿勢調節の解析

2014年1月

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## ABSTRACT

In this dissertation, two main goals are pursued 1) to sort out the characteristic of successful choreography in elites' routines, in order to provide powerful knowledge for coaches 2) to work out exactly how the human coordinates posture and balance in typical movements, in order to come up with proper plan for participants.

To study those and other fundamental questions about choreographic components and posture control, I pursued a mixed methodology of video analysis and experimental study. A video analysis of the 'difficulty elements', 'artistic choreography' and 'transitions component' were made for the three routines of players in final of the 9<sup>th</sup> World Championships, all final players whose final score was over 19.000 points and Chinese players in three top world competitions in three years in a cycle from 2009-2012 ( they are World Games in 2009, World Championships in 2010, and the World Cup of France in 2011), and the routines performed by the Champion and the eighth ranked player in the final of the 11<sup>th</sup> Aerobic Gymnastics 2010 World Championships in Rodez, France. These routines were recorded by national team of the Republic of China at the game site. Video images at a frame rate of 30Hz were taken of the routines from the warning tone before at the start until the warning tone at the end of the routines. Six baseball players (age=19.3±1.6, height, 174.3±4.0cm, body mass, 71.83±7.4kg) and six soccer players (age=21.5±1.9, height, 171.7±2.2cm, body mass, 64.3±4.8kg) participated in the experiment. Two representative movements in Aerobic Gymnastics were picked up, 'high leg kick' and 'tuck jump'. Participants performed barefoot while their body motion was captured with an 8-camera motion analysis system (Motion Analysis Corp., Santa Rosa, CA). Forty-seven markers were placed on the subject's bony landmarks [Hahn ME, 2004]. A force plate was sampled at 2000Hz (AMTI model OR6-5-1) and low pass filtered with a second-order Butterworth (10Hz).

In part I of dissertation, as for 'difficulty elements' of elites routines (chapter 2), the results showed 1) most elements were concentrated in value 0.5 ~ 0.7; 2) high-scoring element with the value 0.8 and above has evolved into the focus of attention for improving difficulty score; 3) group C has been centralized by selection, striving for balanced development of all sport quality to achieve rationalization of difficulty elements in 4 groups is needed; 4) Specific training on physical fitness would be a breakthrough of innovating personalized element. As for the artistic choreography of elite's routines (chapter 3), the results showed 1) the significant improvement in artistic score proved that China has progressed to artistic choreography comparable to other world's top teams; 2) the aerobic movement pattern sequence was consistent with the unique style of Aerobic Gymnastics, expressing innovative themes with complexity and

diversity; 3) competition area was effectively used with fluent and smooth in diversity of transition and linking; 4) artistic expression and distinctive music melody had been done in harmony with artistic choreography reaching the unity of the athletics and aesthetics. As for the transitions (chapter 4), the results showed 1) the champion's transitions were choreographed with high intensity, diversity and complexity, and with excellent balance for the types of trajectory and usage of all zones within the competition area, and (2) the champion's characteristic transition was choreographed such that evaluated as an independent component it contained rich content.

In part II, the results of experiment 1 (chapter 5) suggest that 1) arm-swing is not helpful to perform a better posture control in terms of segment configuration in both groups than arm-stay and even worse in soccer players; and 2) soccer expertise may contribute the performance of balance control with respect to baseball. The results of experiment 2 (chapter 6) showed that soccer player does have better stable posture control in terms of balance than baseball player in single leg stance. The results of experiment 3 (chapter 7) revealed that 1) arm-swing seems not be highly effective used for tuck jump in two groups at the early leaning, from the perspective of jump performance, and 2) soccer players seem use arm-swing better than baseball player in posture stability as physical contact experience in playing soccer.

In conclusion, the choreography of elites showed that artistic movement could be extended by getting every segment of body involved to accomplish multi-axes change. Personalized difficulty element, distinctive theme deserve to make artistic work. Comprehensive physical fitness would provide the best foundation possible to realize the artistic goal. This dissertation also concludes that the ability of postural control would depend on tasks. The technique of Aerobic Gymnastics should be teaching differently to novices of Aerobic Gymnasts. Technique of arm-stay should be applied to participants regardless of what sport experiences they owned in movements stressing intra-limb coordination. Arm-swing technique could be applied to movements emphasizing inter-limb coordination in those with contact sport experience.