A study on runner's response to presenting tempo sound while running

Anna Yoshioka

School of Knowledge Science,
Japan Advanced Institute of Science and Technology

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In recent years, the growing interest in sports is remarkable. According to a survey conducted by the Sasakawa Sports Foundation, the estimated number of adults performing jogging and running at least once a year is 8.93 million in 2016.

While the running population is on an increasing trend, there is concern that running disorders may occur for beginners.

A survey on running disorders conducted for general citizen runners found that the occurrence of running disorders was concentrated in the lower body.

Furthermore, it was revealed when the running history was less than 5 years the occurrence rate of running disorders was the highest which was 68.4% . Therefore, it is important to reduce the occurrence of running disorders for the beginners.

In previous researches on running disorders, it is said that the occurrence of disorder in the lower body is caused by a large force "landing shock" when the foot lands on the ground. Furthermore, it is also important to reduce the landing shock and mainly reduce the bias of landing shock between two feet.

Besides, coaches are not always available, thus people often end up practicing alone. Sometimes it leads to breakdown at knee or waist by putting a burden on the body without proper knowledge of training.

In response to these circumstances, in recent years, there are many researches on "practice support system" have improves the efficiency of practice by supporting beginners' personal practice with information technologies such as motion capture system and Kinect.

These systems acquire the behavior of the practitioner three-dimensionally, then visualize, audit and feeding back the difference between the behavior and the ideal motion into information such as computer graphics and sound. These information help practitioners perceiving motion better. However, few of these systems are focused on the usefulness of the presented information or the relationship between the presented information and the reaction of the practitioner.

In this research, we aim to verify the influence of various types of auditory information presented to runners on running behavior, concerning the development of practice support system using auditory feedback.

The auditory information presented in this research utilizes the effect of the "pull-in phenomenon" which can use tempo change and the pressure change of the sound, not the voice to make people correct the motion non-consciously.

The target users of this system are runners who are engaged in or plan to do a running for health. Athlete level runners are not considered.

We constructed a system to acquire the behavior of runners and make it possible to continuously present auditory information by repeating phases "acquisition of user's motion", "generation of presenting auditory information", "presentation of auditory information" in real time.

In this research, as a preliminary experiment, we 1) examined whether the characteristics of auditory feedback can be distinguished and 2) verified the influence of presented auditory feedback itself on motion (Pre-Experiment 1). Also, we verified the relationship between visual information and perception of approaching direction of sound (Pre-Experiment 2).

In Pre-Experiment 1, features such as tempo is raised, there are two types of tempo, one is gradually increased to 100 bpm, another one is gradually decreased from 100 bpm. Then subjects are asked to answer how is the beat sound changed while they are stepping.

As a result, it was found that the tempo of presented beat sound matches the stepping tempo, regardless of whether sound change recognized or not. So that we understood that the presented tempo may affect the running tempo.

In Pre-Experiment 2, we asked to subject to listen step sound which is gradually becoming more and more loud first, then gradually becoming more and more low, in the open-eye / closed-eye state. Subjects need to recognize where the step sound is from (front or back).

As a result, there was a tendency that most of subjects perceive the sound in the backward direction in the open-eye state. It is because there is no runner forward by the visual information. On the other hand, compared to the open-eye state, in the closed-eye state where it is impossible to grasp the situation forward from the visual information, there is a tendency to perceive the sound in the forward direction. If someone is running, they may be able to perceive that others will come closer from behind by listen to the step sound which change gradually, when there is no runner forward in the open-eye situation.

In main experiment, we present footsteps of people running at 160 bpm as auditory information. This auditory information was presented in three methods of "no presentation", "continuous presentation" and "intermittent presentation", and the differences in runners' reactions in each method were examined.

As a result, when the auditory information was presented as "intermittent presentation", there was a tendency that the deviation of the landing shock on the left and right became smaller as compared to the "no presentation" case. Regarding the running tempo of subjects, they were able to keep at 160 bpm irrespective of the presentation method of auditory information, so the auditory information had no influence on the tempo. It is thought that 160 bpm was appropriate tempo for beginners.