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Putting: the Accuracy of the Movement Auditory Perception

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Abstract

The article argues that the targeted development of auditory perception actions, the formation and quantification of sound images, performed technical actions seem to be one of the perspective directions of the further training and mastering the kinesthetic sensitivity in golf. It discusses the opportunities for increasing the efficiency of training impacts in developing the kinesthesia of athletes on the basis of a well-targeted development and the improvement of the ability to analyze sound images of sports movements, training not only traditional methods of the visual, neuromuscular and vestibular systems

Keywords: athletes, auditory perception, auditory sensations, the kinematic parameters, sound, ball.

Introduction

Auditory sensations of movements along with tactile, proprioreceptive, visual and vestibular sensations arise in various types of sports activities. Auditory sensations usually perform an additional supporting anticipating and controlling role in the target oriented movement. The difference of the sound image while taking a movement from the usual "reference" sound contains information about any errors made in it. If a purposeful action is performed at high speed, its auditory sensation is often the only way that allows the sportsman to evaluate its effectiveness. The perception of kinematic trajectory parameters by sound that internalizes in the relevant departments of the Central nervous system usually occurs in sports associated with moving sports equipment, moving on and inside sport devices and with shock interactions.

In golf in the conscious of athletes there are also formed sound patterns of actions in the form of the characteristic sound when a club struck the ball. According to the volume and the pitch of the impact interaction sound of the club and the ball, an experienced player confidently evaluates the quality of the movement: how exact he was to reach the target, how far the ball will move after a strike. However, many studies [2, 3, 4, 5, 7, 8, 9, 10, 11, 13] have established that the more different receptive organs and systems are involved in the assessment and simulation of a purposeful movement, the more different images of the action are internalized in the mind in a quantity, the more effective the action is. This statement opens up opportunities for increasing the efficiency of training impacts in developing the kinesthesia of athletes on the basis of a well-targeted development and the improvement of the ability to analyze sound images of sports movements, training not only traditional methods of the visual, neuromuscular and vestibular systems [9, 10, 12].

Materials and methods

In this regard, we have conducted an experimental study of the peculiarities of the movement auditory perception in golf. In the experiment there participated 12 sportsmen of mass degrees in golf aged from 15 to 20. The studies were carried out at the Department of Golf Theory and Methods of RSUPhCSYT in February 2014. With closed eyes athletes alternately perceived aurally the volume of the token sound that appears when hitting the ball. Then using the same club and ball they tried to reproduce the sound of the same volume. The researchers used golf clubs-putters and balls with the same acoustic properties. Strikes were made on the artificial covering imitating the surface of the green at the distance from 1 to 6 meters. With a measuring tape they measured the distance how far the ball moved with accuracy to a centimeter and with a stopwatch they measured the time of the ball rolling with accuracy to 0.01 second. They calculated the average speed of the ball rolling and the initial velocity of the ball on the assumption that its movement was uniformly decreasing. Each sportsman did 30 strokes having a task to reproduce the volume of the token sound as precisely as possible. Using canonical statistical procedures they defined the type of distribution of differences in distances passed by the token sound ball and by the reproduced by an athlete impact sound volume, the distribution type of the variations of the initial velocity of the ball and the statistical significance of their differences.

The accuracy of the performed estimations and measurements of the auditory perception of the volume of hitting the ball and its comparison with the kinematic parameters of the ball movement cannot be higher than random errors of measurements. In our case these errors are defined by the heterogeneity of the playing surface at different trajectories of the ball, its microrelief, differences in the mutual position of the mass centers of the club head and the ball from stroke to stroke, the impact on the trajectory by the eccentricity of the ball and other random reasons. To assess the impact of these random factors we did measurements of the variations of the rolling ball range under the same medium speed of its movement. It was found that the distribution type of variations of the rolling ball range is subject to the normal distribution law (Fig.1.) that indicates their random nature. The standard deviation in the rolling ball range with the same initial velocity was ± 0.17 m, and the standard deviation in the initial velocity with the same rolling range was ± 0.15 m/s. Thus, the limits of the accuracy for further measurement of accuracy of the auditory perception of golf movements kinematic parameters were defined.

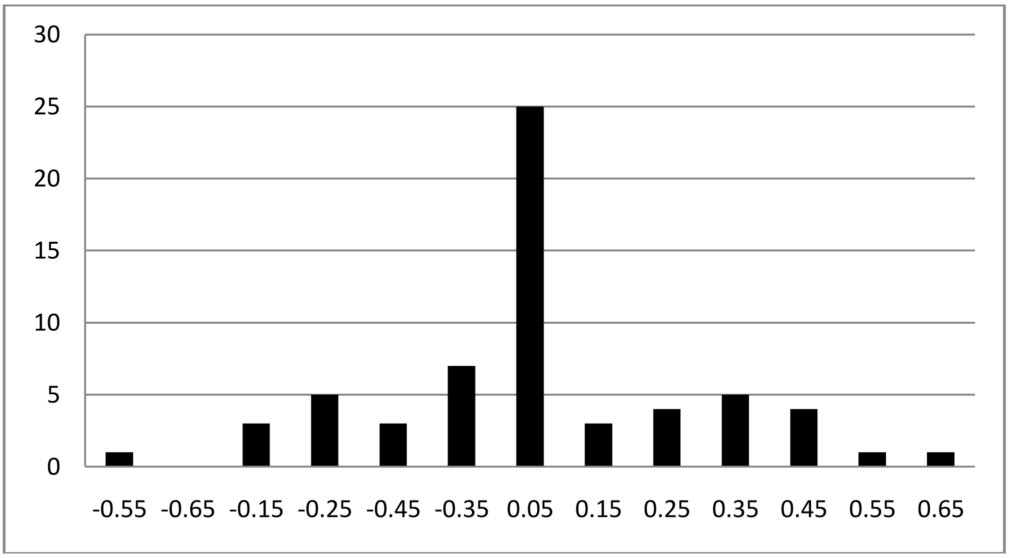

Figure 1. The distribution of variations of the rolling ball range with the constant initial velocity (the x - axis is the variation range, m)

For all players there was established the statistical significance ($p=0.05$) of the indistinction in the reference and performed range of the ball rolling on the criteria Fisher, Student's t-test and Student's paired t-test. It should indicate the adequate perception and imitating the token sound by golf players within the specified accuracy.

Results and discussions

Based on their subjective estimations of the sound volume the players confidently distinguished 4-5 grades of the stoke volume of the ball rolling on the distance from 0.8 to 6 m. That is, subjective tangible differences in the sound volume (about 10 DB at the sound frequency in 3500 Hz) correspond to the distance difference in the ball rolling of 1.2 m and the initial velocity increment of 0.48 m/s. When comparing the accuracy of the distance simulation, the differences of double measurements relative to the given sample, it turned out that the players implement better the token sound than interiorize it in their mind: the standard deviation range became 0.53 m and the initial velocity became 0.34 m/s. Apparently, this is due to the transfer effect of elastic vibrations due to the bone-tissue conductivity and both athlete's acoustic organs and affect-effect proprioreceptive system participation in the image formation of the movement [1, 5, 6, 9, 10].

The distributions difference between the playing and the model range rolling ball differs individually (Fig.2). For players with a low skill level (2-3 degrees) the distribution has negative excesses and a wider range of variable difference change. For first degree athletes and candidate masters the distribution is more peaked with a smaller range of variable change. Regardless of the players' skill, distributions differ in their asymmetry: the number of players underestimate the volume of the token sound and they often do not roll the ball far enough to the model range (Fig. 2a); and on the contrary, the other group overestimates the volume of the token signal and their impact range is often farther than the model one (Fig.2b).

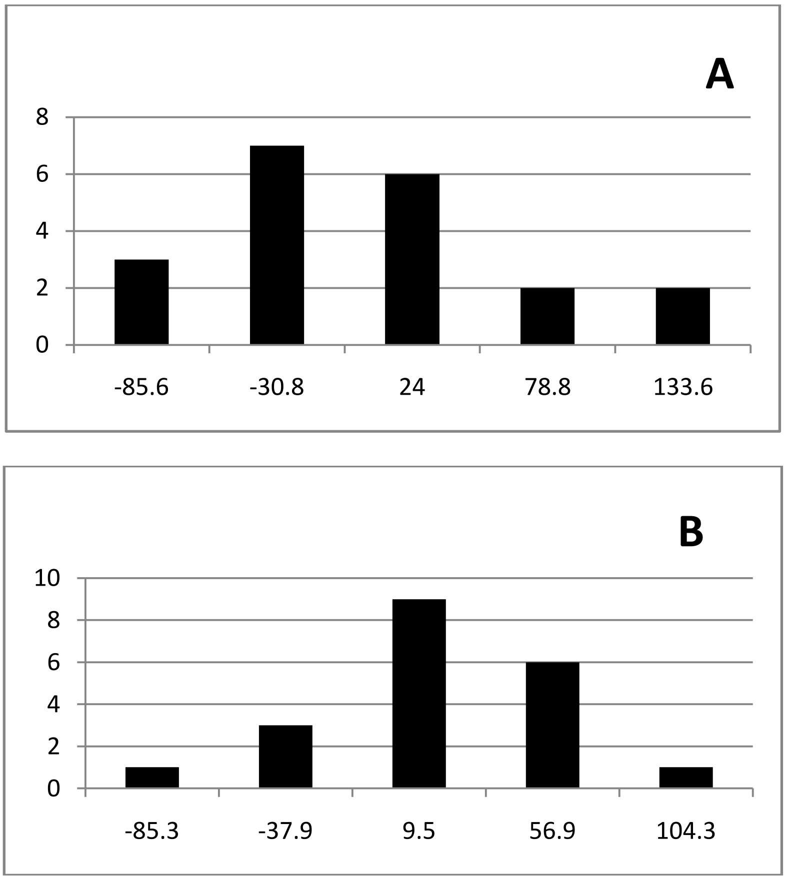

Figure 2. Examples of distribution difference in distances of the rolling ball performed based on the token sound volume (the x-axis is the variation range, cm)

Distribution variations of the initial velocity of the ball are the same as in Fig. 2.

In addition to assessing the perception and imitating accuracy of the kinematic parameters of game actions, a separate pedagogical task is the task of developing their auditory perception of the sound intensity when striking the ball. For this purpose, we carried out three training sessions (one per week) during which the players had to do two jobs. The first was: the players estimated the range of the rolling ball based on striking sound and then they compared it with the actual distance; the latter was: the players had to imitate the token sound by striking the ball with the club. During the trainings there were carried out three series of such jobs, 30 shots each, to evaluate and imitate.

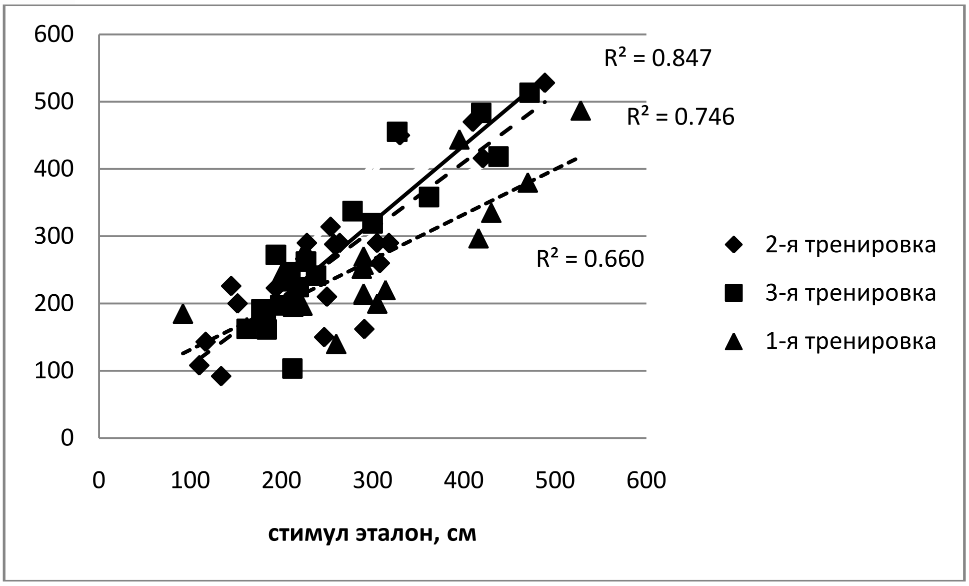

Figure 3. The dependence in imitating the token sound volume of a stroke in golf on the value of the token sound

Fig. 3 shows dependency changes of the performed specified sound from the token sound value for one player that occurred as a result of training effects. In quantity, these changes can be evaluated by the spread of values from the approximating straight line (the determination coefficient R2) and the angle of trend slope to the x-axis. As it follows from Fig. 3, the development of the ability to perform the golf actions on the basis of the auditory perception is very confident: the determination coefficients increased from 0.66 to 0.84. It shows a fast formation in the central nervous system of sound images of performed actions having in mind the quantitative assessment of the impact volume in the form of a range of the ball rolling.

Conclusion

Thus, the targeted development of auditory perception actions, the formation and quantification of sound images, performed technical actions seem to be one of the perspective directions of the further training and mastering the kinesthetic sensitivity in golf. Further studies in this direction are promising in terms of increasing the volumes of representative samples of respondents, increasing the impact range and studying their sound images with help of the special acoustic equipment allowing to record the spectral intensity of the shock interaction sound at short intervals.

Generally speaking, not only a club and a ball can be represented as impact tool, but the athlete himself with some accuracy is often a biomechanical model composed of a finite number of links driven with elastic elements of agonist and antagonist muscles. While performing any action muscles contract and stretch making frequency-determining oscillations. In this sense, the human body itself represents a string instrument that produces oscillations with a frequency of several Hertz that is in the audible low-frequency range and that is not perceived by the human ear.

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