

Research of the hand motion dynamic characteristics of the women boxers with different types of functional asymmetry

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Abstract

Purpose: to determine the features of the hand motions speed characteristics of female boxers with different types of functional asymmetry during dynamic work performing.

Material and methods

Participants: 50 highly qualified female boxers (masters of sports, world-class athletes). The study of boxer's psychomotor functions was constructed according to a certain pattern. The motor component of the motional response was investigated with the help of a tapping test. The time of simple and two complex visual-motor responses was determined. The study was completed by determining the time of identification of visual stimuli with various degrees of complexity without a motor response. It was assumed that this would allow considering the visual-gnostic component in a “pure” form. Such a construction of the study made it possible to evaluate the contribution of each component of the psychomotor response to the speed of boxer's response with different types of functional interhemispheric asymmetry (FIA) profile.

Conclusions: Ambidexters perform work at a faster speed than right-handers in a convenient mode. In this case, their right hand is faster than the left. The total quantity of motions which have been made by left-handers was greater than that of right-handers and ambidexters (both on the right hand and on the left one). The speed characteristics of female boxers with different types of functional asymmetry in the accelerated mode were the same. The tempo stability in right-handers and left-handers is high, but worse than in ambidexters. Boxer-ambidexters who use the right stance are in a better position than right-handed ones. Left-handed female athletes perform motions with greater speed than right-handed ones. Keeping the optimal tempo for right-handers and left-handers is worse on the right hand than on the left one. Maintaining an optimal tempo for ambidexters is worse on the left hand. Left-handed athletes are faster than right-handed ones.

Keywords: boxing, psychophysiology, female boxers, functional asymmetry.

Introduction

The growth of the achievements level in modern sports proposes high demands on the development of qualities and abilities that determine the success of sports activities. The significance of various qualities in specific sports is not the same (Platonov, Bulatova, Kosminina, 2012; Filimonov, 2009). Specific qualities have paramount importance in each sport. The success of the main competitive exercise (Baranov V., Baranov D., 2008; Favre, Mass, Aminian, 2007) depends on the level of specific qualities development. The leading role is assigned to psychophysiological parameters: sensorimotor responses, operational thinking, properties of attention (Chen, Tseng, Hung et al, 2013; Martsiv, 2014; Ostyanov, 2011). Psychophysiological indicators form the tactical abilities of athletes and determine the effectiveness of competition in changing situations of a combat (Larson, Sherlin, Talley, Gervais, 2012).

In boxing, there are all possibilities for the successful demonstration of the most diverse psychical and physical qualities. Each athlete has an original combination of psycho-physiological properties. They are decisive in shaping the individual style of combat (Rodionov, 2001; Korobeynikov, Korobeinikova, Latishev, Shackih, 2017).

The growth of technical and tactical skills in boxing is due to the use of actions in situations that require the demonstration of types of motor response, options for readiness to intentions implement (Syshko D, Kroviakov, Savina, Syshko G., 2011; Korobeynikov, 2008). The success of competitive combat conducting is due to a wide range of individual-typological properties of athlete's organism (Chen, Tseng, Hung et al, 2013; Kessler, Smith, 2008). Effective implementation of the majority of combat actions is associated with high rates of boxer's motor skills. To diagnose sports abilities, it is important to have comprehensive information on the composition of operations of competitive activities. It is necessary to know the level of boxer's physical fitness, to take into account the individual characteristics of his psychomotor activity (Chadli, Ababou N., Ababou A., 2014; Kozina, Iermakov, Cretu et al, 2017). Human psychomotor activity is a complex functional system consisting of sensory, motor, and cognitive-mental controlling subsystems of complex motional activity.

The success of training in a particular sport corresponds to a certain type of individual profile of asymmetry (Gorbachev, 2007; Kiprich, Berinchik, 2015). This is due to the natural selection of individuals. Attempts to regulate congenital asymmetries can lead to a delay in the growth of the sports result due to the negative transfer of motor skills and the irrational use of the time limit (Alexandrov, 2013; Kiprych, 2014). The probability of reorientation of evident right-handers and left-handers to another lateral dominant is small compared with ambidexters. This is important in terms of choosing a strategy for planning and organizing the training process in various sports (Aksutin, Korobeynikov, 2014,5; Kiprych, Donets, Makhdi Omar Ali, 2013). Changing the functional asymmetry to the opposite in terms of urgent adaptation leads to its increase in the process of long-term adaptation. Strengthening the initial asymmetry under conditions of urgent adaptation leads to symmetry of physical development under long-term adaptation (Aksutin, Korobeynikov, 2014,12; Korobeynikov, Pristupa, Korobeynikova, Briskin, 2013).

It is perspective to research the types of functional asymmetry as a factor that determines various aspects of sports activity. The study of functional asymmetry in boxing is a great importance for identifying the prerequisites that determine the characteristics of motor development, psychical and physical state of boxers (Aksutin, Korobeynikov, 2014,12; Kiprych, Donets, Makhdi Omar Ali, 2013). It is also important for the individualization of athlete's training process.

The functional asymmetry of athletes was researched in fencing, wrestling and male boxing. The study of functional asymmetry in female boxing was not conducted.

The objective is to determine the features of the hand motions speed characteristics of female boxers with different types of functional asymmetry during performing dynamic work.

Material and methods

Participants: 50 highly qualified female boxers (world-class athletes, masters of sports, candidates to master of sports). Testing was conducted individually.

Procedure (research organization). The study of psychomotor functions of female boxers was constructed according to a certain pattern. Initially, the motor component of the motional response was researched with the tapping test. It was assumed that the absence of visual stimulus in this test will allow to consider this component in a "pure" form. Then, the time of simple and two complex visual-motor responses was determined. This made it possible to assess the specificity of the response in the "eye-hand" system, depending on the complexity of the visual impact. The research was completed by determining the time of identification of visual stimuli with various degrees of complexity without a motor response. It was assumed that this would allow to consider the visual-gnostic component in a "pure" form. Such a construction of the research made it possible to evaluate the contribution of each component of the psychomotor response to the speed of response of female boxers with different types of functional interhemispheric asymmetry (FIA) profile.

Statistical analysis. We processed the experimental data by descriptive and parametric statistics. We used the Pearson χ^2 -test to assess whether the data are accurately modelled by a normal distribution. As the received data were normally distributed, we calculated arithmetic mean and standard error ($X \pm m$). The statistical significance of the difference between characteristics of female boxer's groups was determined by means of t-test for independent samples at the level of $p = 0.05$. The data have been processed by Statistica Software (www.statsoft.com). Complex pedagogical and biological researches with the participation of athletes were conducted under the legislation of Ukraine on health care, the 2000 Helsinki Declaration, the European Society Directive No. 86/609 about the human participation in biomedical research.

Results

Testing results of the total quantity of motions which have been made by the female boxers during 2 minutes of work are presented below.

When working in a convenient mode, right-handed boxers do not have a difference between the quantity of motions which have been made by the right and left hands (Table 1).

Table 1. The quantity of motions that female boxers made in 2 minutes under working at the optimum tempo

Asymmetry type	Right hand	Left hand	p
Right-handers	379±10	381±12	>0.05
Ambidexters	472±14	442±15	<0.05
Left-handers	483±13	464±11	<0.05

In ambidexters, the right hand performs more motions than the left one (by 30 strokes on average, $p < 0.05$). In general, the quantity of motions which have been made by ambidexters was greater than those which have been made by right-handers on both hands (the ambidexters made 472 motions with the right hand and right-handers made 379 motions with the right hand; with the left hand – 442 and 381 motions respectively). In a convenient mode, ambidexters perform work at a higher speed than right-handers, while their right hand is faster than their left hand.

In left-handers, the right hand also performs significantly more motions than the left hand (483 and 464 motions respectively, $p < 0.05$). However, this difference is not as pronounced as in ambidexters. The total quantity of motions which have been made by left-handers was greater than those made by right-handers and ambidexters on both the right and left hand.

Work in the accelerated mode

Both right-handers and ambidexters have a significant difference between the quantity of motions which have been made by the right and left hands (Table 2). In right-handers, the right hand performed an average of 618 ± 24 motions, and the left one only 571 ± 22 motions. In ambidexters, these indices are 632 ± 23 and 589 ± 28 motions respectively. For left-handers, this difference is also present, although it does not reach the level of confidence – 639 ± 23 and 618 ± 21 motions, $p > 0.05$. Therefore, the right hand performs more approximately by 20-50 strokes on average than the left hand in two minutes of work at an accelerated tempo, regardless of the lateralization type. Significant difference between the quantity of motions that right-handers, ambidexters and left-handers made by right hand, is not detected, $p > 0.05$. The speed characteristics of female boxers with different types of functional asymmetry in the accelerated mode are the same.

Table 2. The quantity of motions that female boxers made in 2 minutes when working at the maximum tempo

Asymmetry type	Right hand	Left hand	p
Right-handers	618±24	571±22	<0.05
Ambidexters	632±26	589±28	<0.05
Left-handers	639±23	618±21	>0.05

Dynamics of the quantity of motions that are made by female boxers for every 10 s of the work

In the group of right-handers, the quantity of motions that are made with both hands almost coincides in the first 10 s. This situation is generally kept within 2 minutes of work: the difference between the quantities of motions in every 10 s does not exceed 2 strokes. However, the tempo instability in the leading hand is greater than that of the non-leading one: the speed drop is greater on the right hand to the end of the work (the difference between the maximum and minimum quantity of motions is 4 strokes).

In ambidexters, the quantity of motions which have been made by the left hand is some larger than by the right hand in the first 10 s. Subsequently, the speed of motions on the left hand decreases (the difference between the maximum and minimum quantity of motions is 10 strokes, $p < 0.05$), and on the right hand, it retains its initial level as a whole.

The left-handers have almost the same quantity of motions that are made with both hands in the first 10 seconds. This situation persists long enough. The tempo in both hands decreases only at the end of the work. A comparative analysis of the quantity of motions by the right hand shows that the greatest speed is observed in left-handers when operating in optimal mode. At the same time, it was significantly higher than that of right-handers, by 10 strokes ($p < 0.05$). In ambidexters, speed indicators are slightly lower than those in left-handers only at the initial stage of work. After 40 s of work, their performance becomes the same due to a decrease in the speed of work in left-handers. This ratio between all three groups is maintained throughout the work. The tempo stability in right-handers and left-handers is worse than that in ambidexters.

The picture is more diverse with regard to the speed of athlete's left hand when working optimally. In right-handers, the left hand works at a lower speed than in left-handers and ambidexters. This difference is significant (32 strokes are recorded for right-handers in the first 10 s, 42 strokes – for ambidexters, 41 strokes – for left-handers). The speed of the left hand in right-handers practically does not change throughout the work duration.

In ambidexters and lefties, the quantity of strokes which have been made by the left hands is almost the same at the initial stage of work. Here there is a tendency to reduce the tempo of work for ambidexters. After the 20th second of work, the curves that reflect the dynamics of the motions of ambidexters and left-handers diverge. This discrepancy is not very large for certain time. These curves converge again after one and half minute of the

work due to the gradual decrease in speed in left-handers. Immediately after this, the speed of work in ambidexters drops noticeably. At the end of the work, the speed indicators of the left hand in ambidexters become almost the same as those in right-handers.

The quantity of motions and their dynamics when working at maximum tempo

In right-handers, the difference between the quantity of motions which have been made by the right and left hands in the first 10 s is not observed. The tempo of both hands decreases within 2 minutes of work. This decline is especially noticeable in the first 40 s (by the right hand by 7 strokes, by the left by 9 strokes). After 40 seconds, the tempo of both hands stabilizes for a while. The tempo begins to decline again until 20 seconds before the end of the work. The overall drop in tempo of the right hand was 9 strokes, and of the left hand – 13 strokes. If the difference between the hands was not observed at the beginning of work, then the right hand began to exceed the left hand by 5 strokes by the end of work.

In ambidexters, the difference in speed of the hands is not observed in the first 10 s. The tempo of work of both hands decreases in the first 20 seconds. Then the right hand begins to accelerate and returns to the initial level for a while, but gradually decreases again and it reaches the level of the left hand in a one minute. At this time in the left hand, the tempo stabilizes for a full one minute. At the end of work, the tempo decreases even more with both hands. The total drop in tempo of the right hand in 2 minutes was 6 strokes, and of the left hand – 9 strokes.

In left-handers, the tempo of both hands is almost the same in the first 10 s. Then the tempo of the right hand begins to decline, reaching a minimum on 20th second of the work. After that, the tempo of the right hand fluctuates, generally remaining at the same level up to the end of the work. The tempo of the left hand does not change in the first 20 seconds. After this, its decline begins, which lasts up to 40th second of the work. Then the tempo stabilizes for a while. In the end of the work, the tempo decreases again. For left-handers, the general decrease in the tempo of the right hand was 4 strokes, and of the left hand – 9 strokes.

A comparative analysis of the performance of each hand shows that at a convenient tempo, the right hand of ambidexters and left-handers works faster than the left one, and for right-handed female boxers, both hands work the same way. When working at the maximum tempo, the right hand works faster for right-handers and ambidexters, while for left-handed female boxers, the differences, although present, are not statistically significant, $p > 0.05$. Keeping of the optimal tempo in right-handers and left-handers is worse on the right hand, and in ambidexters – on the left hand. Keeping the maximum tempo in all groups is better on the right hand than on the left one.

To determine the relationship between the asymmetries of different systems with the speed of hand motions when performing the tapping test, an analysis of the representation of the asymmetries of the hands, feet and vision in female boxers groups with a fast and slow comfortable and maximum tempo was performed. To do this, all female boxers were divided into two groups: one group with a higher speed of optimal tempo and the other group – with a lower speed. A comparison of these groups showed the following.

The group with a high speed of motions performing at the optimum tempo of the work included 77.7% of left-handed female boxers, 50% of equal-handers, and only 25% of right-handers (Table 3). The temporal parameters of the speed of optimal tempo are associated with manual lateralization: left-handers perform motions with greater speed than the right-handers ($p < 0.05$).

Table 3. Representation of different types of manual asymmetry in female boxer groups with different speeds of a convenient tempo of work, %

Asymmetry type	High speed group	Low speed group
Right-handers	25.0	75.0
Equal-handers	50.0	50.0
Left-handers	77.7	22.2

The group with a high speed of optimum tempo included half of the right-footed female boxers (46.6%), half of the equal-footed ones (50.0%), but then 75.0% of the left-footers (Table 4). However, a small number of left-footers in female boxer group do not allow to determine the connection between the asymmetry of the feet and the speed of the optimal tempo.

Table 4. Representation of different types of foot asymmetry in female boxer groups with different speeds of a comfortable tempo of work, %

Asymmetry type	High speed group	Low speed group
Right-footers	46.6	53.3
Equal-footers	50.0	50.0
Left-footers	75.0	25.0

Visual asymmetry does not affect the speed of work when performing a tapping test. The temporal parameters of the motor action are reliably associated only with the lateralization of the hands ($p < 0.05$): the left-handed female boxers are faster than the right-handed ones.

Discussion

The difference between the total quantity of motions which are made by female boxers in the convenient and maximum modes shows that this “effect” is more pronounced in right-handers than in ambidexters and left-handers. It would be premature to speak of a greater degree of arbitrary regulation in right-handers on the basis of this fact alone. Such a statement would be legitimate if the initial indicators in all groups would be the same, and the final indicators (the quantity of motions at the maximum tempo) would be different. However, we see the opposite picture. It is possible that the accelerated tempo that female boxers demonstrate is the maximum possible. We assume that it cannot increase further. The smaller value of the “acceleration effect” in ambidexters and left-handers can be due to the fact that they also cannot overcome this physiological barrier. This confirms the fact that in ambidexters and left-handers the “acceleration effect” on the right hand is almost the same. We cannot speak of a less arbitrary regulation of motions in ambidexters and left-handers.

We assume that ambidextral female boxers who use the right stance are in a better position than right-handers who use the right stance. Their leading hand either surpasses or is equal in speed to the hand of the opponent, but not inferior to it. The same applies to the sustainability of the tempo of its work. For right-handers, the picture is less favourable. They can only be equal to or give in to an ambidextrous opponent.

The right hand of right-handed and left-handed female boxers maintains the tempo of optimal performance worse than the right hand of ambidexters. The left hand of right-handed and left-handed female boxers maintains the tempo better than the left hand of ambidexters (Kiselev, 2006).

Neither right-handers, nor ambidexters and nor left-handers keep the maximum tempo for 2 minutes, for all of them it decreases by the end of the work. At the same time, the tempo stability of the right hand is greater than that of the left hand in all groups. When comparing the performance of the right hands of female boxers, it is found that the greatest decrease in tempo is observed in the right hand of right-handers, the smallest one – in left-handers. The greatest decrease in tempo is also observed in right-handers, while in ambidexters and left-handers it is the same. Both hands of right handers hold the tempo of maximum performance the worst. Regardless of the type of lateralization, the tempo stability is greater with the right hand than with the left one (Kolesnik, Osipov, 2013).

There are certain differences in the tapping test performance between right-handers, left-handers and ambidexters (Kolesnik, Osipov, 2013; Syshko D., Kroviakov, Savina, Syshko G., 2011). The difference in the speed of motion is determined by the initially chosen tempo of activity (Khusiajnov, 2007; Savchin, 2013). If the tempo is the most convenient, then ambidexters and left-handers are superior in speed to right-handers in this case. If the tempo is set to the maximum, then there is no difference in speed between the groups. Keeping the maximum tempo is better for left-handers, and worst of all for right-handers (Kolesnik, Osipov, 2013; Korobeynikov, Aksutin, Smoliar, 2015; Pavelec, Ostyanov, Maydanyuk, 2013).

To make unambiguous conclusions based on the obtained data is impossible. The presented results only form a problem, but do not solve it. Further comprehensive and in-depth study of this aspect is required. The obtained data can be used as a source of information for creating complex motor portraits of representatives of various types of functional asymmetry and their use in choosing the right or left-sided stance.

Conclusions

In a convenient mode, ambidexters perform work at a faster speed than right-handers. In this case, their right hand is faster than the left one. The total quantity of motions that are made by left-handers is greater than that by right-handers and ambidexters (both on the right and on the left hand).

The speed characteristics of female boxers with different types of functional asymmetry in the accelerated mode are the same. The tempo stability in right-handers and left-handers is high, but worse than in ambidexters. Ambidextrous female boxers who use the right stance are in a better position compared to right-handers with right-sided stances. Left-handed female boxers perform motions with greater speed than right-handed ones.

Keeping the optimal tempo in right-handers and left-handers is worse on the right hand than on the left one. Maintaining an optimal tempo for ambidexters is worse on the left hand. Left-handed female athletes are faster than right-handed ones.

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Conflict of interest

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