RELATIONSHIP BETWEEN SIMPLE MOVEMENTS AND KARATE PERFORMANCE

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Abstract:

For methodological reasons two methods of regression analysis (LSR and SRA) were employed parallelly on the test results of a sample of 25 high quality karatekas. A significant relationship between the simple movements of the arm and the leg and the karate combat performance was found. By relating 6 predictor variables of the speed of simple arm and leg movements and a criterion variable of performance in the karate combat - established on the number of victories achieved by each subject over a year - significant multiple correlations of .64 and .69, depending on the method applied, were obtained, respectively. The meta-cause for the relationship between the speed of simple movements and karate performance - characterized by the polystructural acyclic movements - should not be interpreted as its direct influence on the karate performance, but indirectly, through its primary influence on the technique performance speed and explosive power. This, of course, implies that the speed of simple movements, as a fundamental motor skill, during years of training has been successfully transformed into a specific speed-related motor skill of technical efficiency.

Key words: karate, speed of simple movements, combat performance

DIE ABHÄNGIGKEIT DER GESCHWINDIGKEIT VON EINFACHEN BEWEGUNGEN MIT DEM ERFOLG IM LEISTUNGSKARATE

Zusammenfassung:

Aus methodologischen Gründen wurden zwei Methoden der Regressionsanalyse (LSR und SRA) gleichzeitig in der Auswertung der Testergebnisse an einer Stichprobe von 25 Leistungskaratekämpfer angewandt. Es wurde eine bedeutende Abhängigkeit der Geschwindigkeit von einfachen Hand- und Fussbewegungen mit dem Erfolg im Karatekampf festgestellt. 6 Prädiktorvariablen der Geschwindigkeit von einfachen Hand- und Fussbewegungen wurden mit auf Grund von Anzahl der Kampfsiege jeder Testperson im betreffenden Jahr gebildete Kriteriumvariable - Kampferfolg in Beziehung gebracht, woraus multiple Korrelationen 0,64 bzw. 0,69 festgestelt wurden, je nach der angewandten Methode. Die Abhängigkeit der Geschwindigkeit der einfachen Bewegungen von dem Erfolg im durch polystrukturelle azyklische Bewegungen gekennzeichneten Karatekampf sollte nicht als direkter Einfluss der Geschwindigkeit auf Kampferfolg verstanden werden, sondern sie erfolgt indirekt, über primären Einfluss auf Geschwindigkeit in der Ausführung der Karatetechnik und über explosiven Kraftaufwand. Das beinhaltet, freilich, dass die Geschwindigkeit der einfachen Bewegungen, als grundlegende motorische Leistung, im Laufe des langjährigen Trainings, in spezifische motorische, mit dem Erfolg zusammenhängende Geschwindigkeitsleistung erfolgreich umgesetzt wurde.

Schlüsselwörter: Karatekampf, Geschwindigkeit der einfachen Bewegungen, Kampferfolg

Introduction

There is no doubt that the speed related skills, particularly those related to the speed of reaction, speed of movement and frequency of movement, are essential elements in the hierarchical structure of the karate specification equation and that they substantially determine performance in karate combat (Kuleš, 1980; 1990; 1998; Romić, 1994; Fijačko, 1990). In karate combats these skills are manifested in quick reactions during both the defence and attack, in fast movements over the combat area, in a fast performance of arm and leg kicks and in a quick performance of defensive movements such as blockades, defence actions, evasions, etc. (Spain, 1997). It is well known that in the *shobun ippon* competition of two competitors of about the same body size, who both start the attack simultaneously by using the same technique, the one who is faster in a technique performance wins. The speed of the technique performance, the well known fact, depends on three fundamental factors: speed skills (speed of reaction and movement), co-ordination skills (proper performance of technique) and the speed and strength related skills (explosive power) (Kuleš, 1990, 1998; Giampietro et al., 1997). During years of karate training the speed of the technique performance may be improved, however primarily at the expense of the technique performance quality increase, as well as of an increase of explosive power (Sozanski and Vičak, 1980; Kuleš, 1998), while substantially less at the expense of improving the speed skills which are constrained by a high coefficient of innateness and thus hardly affected. It is important to notice here that if the fundamental potential speed of a competitor is low, his/her speed of technique performance is limited, whereby the achievement of top sports results is hindered even with the highest possible compensation with other skills and

characteristics. Hence, speed related skills are fundamental selective skills for the karate competitors.

For a physical education pedagogue and a coach it is of a practical and theoretical importance to obtain information regarding the extent of speed-related skills impact on the performance in the karate combat. This information would not only increase efficiency of the karate training process, thus probably the eventual performance and success in a combat, but would also improve the quality of the selection process in karate and emphasize the necessity of monitoring those skills during years of training (Sozanski and Vičak, 1980; Kuleš, 1990, 1998). This fact instigated this investigation of the relationship between the speed of simple movements and karate performance. The results of the research would have to, along with the already existing insights into the positive correlation between the speed of movement and combat performance (Fijačko, 1990), as well as the speed structure (Hofman, 1979) or certain qualitative features pertaining to speed (Heimer and Medved, 1992), contribute to the comprehension of the impact magnitude of speed, as a general motor factor, on the outcome of the karate combat.

Objectives and hypotheses

The main objective of the investigation is to establish a degree and direction of the relationship between the speed of simple arm and leg movements and the karate combat outcome. The fundamental research hypothesis is that the speed of simple movements has a substantial impact on the outcome of the karate combat.

Methods

Subjects

The investigation of the relationship between simple movements of the extremities and the karate combat performance was carried out on a sample of 25 high quality male karatekas, aged 18 to 32 years. Among the subjects there were 10 current karate junior and senior representatives of the Republic of Croatia. All the examinees have regularly participated in the same number of regional, federal and cup competitions in Croatia and abroad, which allowed for a quality definition of a criterion variable. The age range within the sample used did not have any influence on the value of the results obtained (Layton, 1993).

A sample of variables

Six predictor variables related to the speed of simple arm and leg movements and one performance related criterion variable were used. For the speed of simple arm and leg movements evaluation, speed tests for assessing the physical condition of karatekas, standard in Croatia, were used (Metikoš et al., 1989; Kuleš, 1998). The tests were carried out by means of an electronic photo cell celerimeter, devised at the Faculty of Physical Education (Hofman, 1980) and connected to a computer. The results was expressed in m/s units of measure.

The subjects performed simple movements using the dominant arm or leg, respectively:

- a movement of the arm off the body (MBPLRD) - an examinee performs the abduction movement from the sitting position. The task is to move the open palm as quickly as possible from the marked point on the one side of the instrument in front of him to the other side under the photo cells;

- a forward movement of the arm *yaku zuki* (MBPKUN) - an examinee stands in a stepping-out position with the leg opposite to the dominant arm. Making a fist, with the palm turned downward, he has a stick 20cm long. The task is to push quickly the fist forward, starting the move from the hip, in order to move the stick as quickly as possible under the photo cells;

- a movement of the arm downward (MBPROD) - In a sitting position, an examinee holds his arm extended above the head. The task is to move the arm as quickly as possible from this position downwards and past the photo cells;

- a movement of the leg forward (MBPDNN) - an examinee executes the movement from the standing position. The dominant leg is behind the supporting leg. The task is to perform as quickly as possible the low *maye gery* kick from the marked point past the photo cells;

- a movement of the leg backward

Table 1: Descriptive statistics of the predictor and criterion variables

VARIABLE	MIN	MAX	MEAN	S.D.
1. MBPLRD	5.49	8.47	6.60	.84
2. MBPKUN	4.20	8.33	6.18	1.00
3. MBPROD	5.56	9.43	7.31	.76
4. MBPDNN	4.67	8.47	6.58	1.01
5. MBPDNA	4.07	7.81	5.98	1.11
6. MBPDNS	4.50	6.99	5.85	.74
7. OCJ-1	5.0	10.00	6.84	1.25
8. OCJ-2	5.0	9.00	6.76	1.11
9. OCJ-3	5.0	10.00	6.76	1.11
10. PROCJ	5.0	9.66	6.78	1.04

(MBPDNA) - an examinee executes the movement from the standing position. The dominant leg is in front of the supporting leg. The task is to move as quickly as possible the dominant leg backwards from the marked point past the photo cells;

- a movement of the leg sideways (MBPDNS) - is performed from the standing position. The task is to execute as quickly as possible the *ashi barai* kick past the photo cells.

A criterion variable comprised an average of grades given by three competent judges who rated the performance in the karate combat of each of the 25 competitors in their respective category. The performance of each karateka in competitions over a year was expressed by his rank on a scale of 1 to 25. The rank on the scale was determined on the basis of: the number of victories during that period, number of points attained in a combat, the evaluators' subjective ratings for the technical and tactical performance shown in a combat, as well as a subjective impression of the competitive quality of the competitors. Numerically the rank on a scale was expressed by grades from 1 to 10.

Data processing methods

In order to achieve the fundamental research objective, it was necessary to apply regression analysis. Because of the relatively small sample of subjects, a decision was reached to utilize, along with the traditional regression analysis (Least Square Regression - LSR Method), the Stupid Regression Analysis - SRA (Štalec and Momirović, 1983), which is a special variant of the quasicannonical correlation analysis convenient for its insensitivity to small samples. Both methods ultimately give the same quantity of information about: the intercorrelation of the predictor variables, the correlations of the predictor variables with a criterion variable, a coefficient of the multiple correlation, partial regression coefficients, and the significance of all the obtained coefficients. These two methods allow for a comparative analysis of their values for solving the research problems related both to this investigation, and to similar problems.

Results and discussion

In Table 1 the minimal and maximal results achieved by the karatekas in the tests of simple movements and arithmetic mean and standard deviation of the tests results are presented. The speeds of simple movements performed with the arm are numerically higher than the speeds of simple movements performed with the leg, which is easy to explain bearing in mind the differences in the size of limbs, the distance of their extreme points from the basic body mass and the usualness of movements. Only the speed of the leg movement forward (MBPDNN) is higher than the speed of the movement of the hand forward (MBPKUN). It is interesting to note that both of these simple movements are structural parts of the explosive arm push forward *yaku zuki* and forward leg kick *maye gery* technique. As the *yaku zuki* is definitely faster than the leg kick *maye gery*, a marginal numerical difference in speed in favour of the forward leg kick is explained by the as yet non-

Table 2: Regression variable the combat performance
LSR - analysis: DELTA -.47, RHO -.69, Err -.73, F -2.68, Q -.04
SRA - analysis: DELTA -.40, RHO -.64, Err - 1.53, F -17.85, Q -.00
Correlation LSR i SRA = .93

VARIABLE	r	LSR			SRA		
		beta	t	Q	beta	t	Q
1. MBPLRD	.41	.1129	.4506	.657	.3246	2.1483	.04
2. MBPKUN	.55	.0363	.1201	.905	.4335	3.1245	.00
3. MBPROD	.39	.1297	.5642	.579	.3090	2.2580	.04
4. MBPDNN	.66	.5644	1.8619	.079	.5249	4.2255	.00
5. MBPDNA	.54	.1768	.6002	.555	.4304	3.0938	.00
6. MBPDNS	.49	.0423	.1530	.880	.3878	2.6844	.01

perfected system of measurement of a movement of the arm forward (the use of a stick), as well as by measuring only one sequence of the leg movement in the kinetic chain as defined by the *maye gery* kick. The high speed of the leg in this sequence is due to the acquired acceleration of the leg (swing) before it has reached the first photo cell.

In Table 1 there are the final grades given to the karatekas by the judges for their achievements in combat. The lowest grade was 5.0 and the highest 10.0. Judge number 2 (OCJ-2) was the strictest in evaluating the performance (his highest grade was 9.0). However, notwithstanding the very strict evaluation criteria applied by judge number two, the consensus of all three judges is more than evident, especially in evaluating the poorer results of the competitors. As this research deals with high quality karatekas, the lowest score for the performance being 5.0 is not surprising, neither is the homogeneity of the sample. An average grade of 6.78 for the performance, given by all three judges (PROCJ), supports the aforesaid.

Although the analysis of the relationship between the simple arm and leg movements and the combat performance, as evaluated by each of the three judges, was carried out, in this paper attention is directed to only one relationship established between a group of predictor variables and an average score of all the judges (PROCJ) (Table 2).

By using regression analyses (LSR and SRA) a relatively strong relationship between the simple movements of the hand and the leg and the achievement in the combat was established. Coefficients of multiple correlation (RHO) are .69 and .64, respectively; they are significant at

a level of .05 in the case of LRS regression analysis and at .01 in the case of SRA method regression analysis (Table 2). Hence one can conclude that the predictor group of 6 variables measuring the simple movements speed can explain 47% of a criterion variance (DELTA) by the first regression analysis and 40% by the second regression analysis. From the number of predictor variables' aspect this is an extremely high percentage supporting the hypotheses on the importance of the speed of movements for the performance in karate. It is realistic to assume that the inclusion of the specific speed related tests, aimed at the assessing of movement frequency and the movement speed, into the battery of tests for the assessment of the simple movements speed, would explain an even higher percentage of criterion variance. The answer to the question why the speed of simple movements, a motor ability with no karate specific characteristics, has such an impact on the score of the combat characterized by polysctructural acyclic motions, should be based on the following facts.

The simple movements speed is the most important selective test of karatekas. This general, basic motor skill is successfully transformed by years of training and mastering of the karate technique into a specific speed related skill, which is responsible for the efficiency of the kick and blockade technique. Hence it is obvious that the simple movements speed is the developmental basis for the specific speed related skill and thereby the primary condition for quick performance of the karate technique, which eventually determines performance in the karate combat.

The biomechanic fundamentals display that the simple movements speed, besides

determining the speed of a technique execution, also influences the power of that technique ($F = m \cdot v$) which must be manifested at the completion of performance (*kime*) to produce actual efficiency of the attack or the defence. Assuming the constant body mass, the technique performance power of a blockade or a kick at the end of execution will be greater, the greater the speed of the performance, or the simple movement speed that dominantly determines it.

Keeping in mind the aforesaid, one can conclude that the speed of simple movements influences the performance indirectly through the specific speed-related skills which enables the karatist to perform the karate technique fast and vigorously.

Although the coefficients of multiple correlation obtained from two different methods of regression analysis are of almost identical statistical value, the analyses used give substantially different results when we focus on the analysis of the partial regression coefficients values of the tests applied, which show their value for the combat performance prediction (beta in Table 2). According to the traditional regression analysis (LSR) no significant partial regression coefficient has been established (not even at the level of .05). However, the other method of the regression analysis (SRA) showed that each of the tests employed contributes significantly to the explanation of the criterion variable at a level of both .01 or .05. The difference in significance of the partial regression coefficients in the methods applied was caused by the specificity of the very algorithms. In contrast to the traditional method of the smallest squares (LSR), where correlations are maximized, in the SRA method the co-variances are maximized that are not sensitive to the degrees of freedom (Štalec and Momirović, 1983), thus consequently influencing the magnitude of the partial regression coefficients and their significance.

The predictive value of the tests evaluating the simple movements speed, viewed through the regression analysis for small samples (SRA), changes depending on whether the tests are performed with the upper or lower extremities. A little higher predictive value of the competitors' performance has been shown by the simple movements speed tests performed with the dominant leg than those tests performed with the dominant arm. The simple movements speed of the leg forwards, backwards and sideways definitely predominantly determines the moving speed of the karatekas in combat. Some authors (Lawler, J., 1998) consider the techniques of moving over the combat area extremely important for the combat efficiency because they hinder or prevent the opponent's close approach and precisely attacking the vital points on the body of the fighter, whereas at the same time they facilitate the approach to the opponent and enable a fast performance of leg kicks.

Out of the three simple movements speed tests, performed with the dominant arm, the predictive values of two (the movement with the arm off the body - MBPLRD and the movement of the arm downward - MBPROD) are on the very margin of significance, which means that techniques of a defensive character, the efficiency of which depends on the speed of the arm off or down the body (*shuto uke, soto uke, gedan barai*), still significantly influence the performance of the karate combat. Testing a forward movement of the arm *yaku zuki*, from the *zen kutsu dachi*, is the best predictor of the success in the karate combat. This movement is almost identical to the movement of the *yaku zuki*, the most frequently performed and the most efficient technique in the attack and counterattack. Hence its significant predictive value.

The results obtained by the SRA method are quite acceptable because of a very high congruency with the LSR method (significance of multiple correlations and percentage of the explained criterion variance). The correlation of SRA and the LSR method of .93 and interpretability of the partial regression coefficients ensure the first position of the SRA method from a methodological point of view (to solve similar problems with small samples of subjects). The obtained result is important for evaluating the SRA method of regression analysis in the case of small samples, but also to conclude that, for the selection or control of the transformation processes needs, it is important to apply a whole battery of tests for the assessment of the simple movements speed.

Conclusion

The investigation of the relationship of the simple movements speed, executed by the arm and the leg, and the karate combat performance has been carried out on a sample of 25 high quality Croatian karatekas. Each of them has been subjected to the 6 speed tests of simple movements of the dominant arm and leg by using a photo cell device and has been awarded a rank on the scale of 1 to 25 on the basis of their competitive efficiency. By utilizing the traditional regression analysis (LSR) and the modified regression analysis for small samples (SRA), a significant relationship has been established between the speed of simple movements and the performance in the karate combat. Coefficients of the multiple correlation obtained - .69 and .64 respectively - have been significant: the first at a level of .05 and the other at a level of .01. Only six variables for evaluating the simple movements speed of extremities explain the relatively high percentage of the criterion variable variance of the combat performance (47% and 40%, respectively). By using the regression analysis for small samples (SRA), a significant contribution of each test, used for assessing the speed of simple movements, in explanation of the criterion variable variance was found, whereas by using the traditional regression analysis (LSR) this result was not supported. A significant positive influence of the simple movements speed on the karate combat performance is explained by its impact on the speed of the karate technique performance, which predominantly determines the combat efficiency, and on its explosive nature. Such an interpretation assumes that the long-term process of training has transformed the speed of simple movements successfully into a specific speed-related skill, responsible for the efficient performance of specific movements and motions in karate, as well as being the basic component of the speed strength. One can conclude that the simple movements speed is a necessary prerequisite for the fast karate technique performance, which predominantly determines the combat performance.

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