# Effects of laterality on the technical/tactical behavior in view of the results of judo fights

**Authors' Contribution:**
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

**Stanislaw Sterkowicz**[1ACDE], **Grzegorz Lech**[1ABDE], **Jan Blecharz**[2ADE]

[1] Department of Theory and Methodology of Combat Sports, University School of Physical Education in Cracow, Cracow, Poland
[2] Department of Psychology, University School of Physical Education in Cracow, Cracow, Poland

**Source of support:** Departmental sources

**Received:** 9 May 2010; **Accepted:** 2 June 2010; **Published online:** 26 October 2010

## Abstract

**Background and Study Aim:** Laterality plays an important role in sports, especially in ball games or combat sports. High level of skills in athletes with left-side dominance allows them to have a tactical advantage over the opponents and to increase their chances of success. The awareness of this advantage boosts athlete's self-confidence in fighting. The purpose of this study was to determine: (a) laterality of upper and lower limbs and the effect of laterality on preferred directions of attacks in fight; (b) effect of preferred direction of attack and the variety of techniques used in fight on the level of achievement among judoists.

**Material/Methods:** Ninety judoists aged 13–14 with average training experience of 4.5 years participated in the International Judo Tournament in Bochnia. The data on their handedness or footedness while performing judo techniques were collected from an interview with study participants. 428 combined technical and tactical actions were recorded and then analyzed.

**Results:** The most common actions included throws (86.2%). Left-handed athletes, who preferred forward left throws, were more effective than the right-handed ones. Technical profile of the right-footed athletes was similar to right-handed ones. The left-footed athletes differed in terms of attack profile. The profile was characterized by frequent use of back left throws, forward right throws and forward left throws. The least frequently used techniques were back right throws in all groups.

**Conclusions:** Laterality of upper and lower limbs shows significant correlation with the choice of dominant directions of attack in fight. Left-sided athletes show significantly better chances of winning medals compared to their right-sided counterparts.

**Key words:** laterality • grip engagement • attack direction • judo techniques • sports achievements

**Author's address:** Stanislaw Sterkowicz, Department of Theory and Methodology of Combat Sports, University School of Physical Education in Cracow, Cracow, Poland; e-mail: wtsterko@cyf-kr.edu.pl

## Background

Laterality (Latin: lateralis) is an ongoing process that takes place during human motor development and results in the dominance of one side of the body over the other one. Laterality manifests itself as a preference for using a particular hand, leg, eye or ear, which, in turn, reflects the dominance of one of the cerebral hemispheres [1]. Symmetrization process involves balancing motor abilities in both sides of the body [2].

Previous studies examining handedness have quantified the reaction time, movement time, and final position accuracy of rapid aimed arm movements. Such performance measures were expected to differentiate 'open loop' mechanism, which by definition are unaffected by sensory feedback, from 'closed-loop' mechanisms, which by definition are mediated by sensory feedback [3]. For right-handed people a left-sided predominance of turns during physical exercise has been documented by Starosta [4]. In judo, this kind of correlation is likely to result in the use of throws with rotation of the trunk,

**Laterality** – a component of body awareness by which a person perceives that he or she has two different sides which are capable of making independent movements [19].

**Grip engagement** – face-off with matched stances occur when opponents in a match engage one another using the same left or right grips. Opposing stances occur when they present a mirror image of one another using opposite grips [20].

which begins with swinging the opponent forward right, like in *Seoi-nage.* Since many coaches are right-sided, young left-sided athletes receive more instructions concerning the right side of the body during regular trainings in their clubs. Therefore, they may be affected by unintended symmetrization, which, in turn, may promote mastering of a greater number of techniques and ensure the use of multidirectional attacks. These skills can be developed through training. The transfer of movement techniques from one side of the body onto another increases athlete's effectiveness, and makes him or her win by taking the opponent by surprise [2].

The purpose of this study was to determine: (a) laterality of upper and lower limbs and the effect of laterality on preferred directions of attacks in fight; (b) effect of preferred direction of attack and the variety of techniques used in fight on the level of achievement among judoists.

## Material and Methods

The study covered 90 boys under 15 years of age (U15 age category) who participated in the International Judo Tournament (Bochnia 16.06.2006). Their average age and training experience were 13.5± (SD) 0.5 and 4.5±1.8 years, respectively. The tournament involved nine weight categories. The height of participants ranged from 142 cm to 185 cm, body mass was from 37kg to 92kg, with an average of 161.3±10.0 cm and 53.2±12.54 kg, respectively.

An informed consent from all the coaches and the contestants was obtained before the tournament. Basic demographic data and information about the athletes' upper or lower limb preference were collected. The measurement of weight and body height was taken in cooperation with the committee of judges (weighing commission). The course of 90 fights was recorded and analyzed. 428 technical and tactical actions were registered. The results for upper and lower limbs laterality were considered independent variables and the authors evaluated the relation between these variables and balance-breaking (*Kuzushi*) direction of preferred attack and the use of throws such as FL – forward left; FR – forward right; BL – back left; BR – back right. The correlation of direction of attack and level of achievements in the tournament was also considered: M – medalists (n=35), N – non-medalists (n=55).

### Statistical calculations

In cross tabulation, due to the expected small sample size, hypotheses of independence of traits were verified by means of Chi-square test in the logarithmic form (G-test) [5]. Fisher Exact Test (FET) was used in four-way tables. Odds Ratio was also calculated in order to evaluate chances of winning a medal in relation to direction of attack. The significance level of $p<0.05$ was adopted for testing of the hypotheses.

## Results

*Nage-waza* (86.2%) throws showed to be the most frequently used. Horizontal position techniques, i.e. pinning (*Osaekomi-waza*) and joint (*Kansetsu-waza*) techniques, comprised 8.7% (of actions in total), whereas opponent's penalty points accounted for 5.1%. Table 1 shows the incidence of the declared handedness. The frequency of multidirectional, dominant throws co-occurred with handedness. Significant correlation between the distribution of the number of techniques and handedness was observed ($Chi^2=15.2$, $Df=3$, $p<0.01$). Left-handed boys used mainly forward left (FL) and back left (BL) techniques, whereas the right-handed preferred forward right (FR) option.

**Table 1.** Incidence of the declared handedness by directions of throws preferred in attack.

| Direction | Left-handed (n) | Right-handed (n) | Total (n) |
|---|---|---|---|
| FL | 8 | 11 | 19 |
| FR | 3 | 50 | 53 |
| BL | 4 | 6 | 10 |
| BR | 2 | 6 | 8 |
| **Total** | **17** | **73** | **90** |

FL – forward left; FR – forward right; BL – backward left; BR – backward right.

**Table 2.** Incidence of the declared footedness by directions of throws preferred in attack.

| Direction | Left-footed (n) | Right-footed (n) | Total (n) |
|---|---|---|---|
| FL | 9 | 10 | 19 |
| FR | 7 | 46 | 53 |
| BL | 9 | 1 | 10 |
| BR | 2 | 6 | 8 |
| **Total** | **27** | **63** | **90** |

FL – forward left; FR – forward right; BL – backward left; BR – backward right.

Table 2 illustrates the incidence of the declared footedness. Lower limb laterality showed a correlation with the direction of throws. This correlation was statistically

significant ($Chi^2$=26.8, df=3, p<0.001). Forward left (FL) and back left (BL) throws dominated among left-footed boys. Right-footed group preferred forward right (FR) techniques, but back left (BL) throws were used marginally.

The profiles, which were illustrated by the number of dominant techniques among the left-sided boys in percentage terms, looked more regular than the profiles of the right-sided athletes (Figures 1,2).

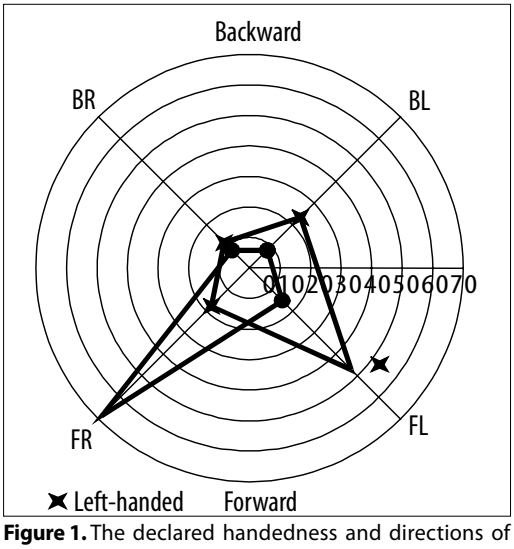


**Figure 1.** The declared handedness and directions of throws preferred in attack (%). FR – forward right, BR – backward right, BL – backward left, FL – forward left.

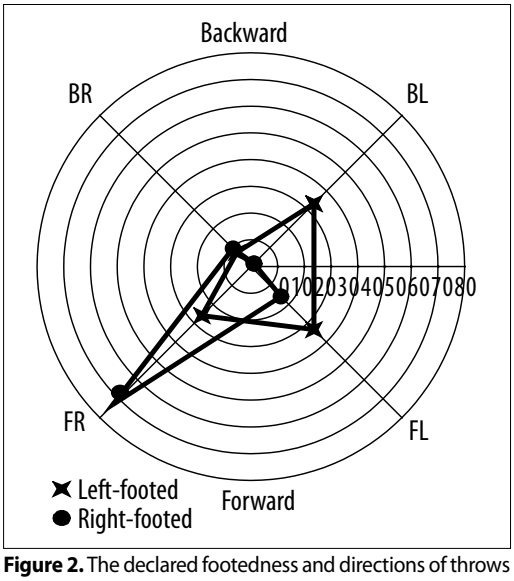


**Figure 2.** The declared footedness and directions of throws preferred in attack (%). FR – forward right, BR – backward right, BL – backward left, FL – forward left.

Table 3 shows the directions of dominant techniques and the level of sport achievements. Techniques used in BL group improved the chances of winning a medal (Odds Ratio=3.5). It was also found that athletes

**Table 3.** The directions of dominant techniques vs. level of sport achievements.

| Direction | Medalists (n) | Non-medalists (n) | Total (n) |
|---|---|---|---|
| FL | 11 | 8 | 19 |
| FR | 17 | 36 | 53 |
| BL | 6 | 4 | 10 |
| BR | 1 | 7 | 8 |
| **Total** | **35** | **55** | **90** |

FL – forward left; FR – forward right; BL – backward left; BR – backward right.

whose dominant throws were forward left (FL) tripled their odds compared to the right-sided competitors (FET <0.05, Odds Ratio=3.2). In general, the distribution of the number of throws in L or R direction significantly differed between the medalists and the non-medalists (FET <0.01; Odds Ratio=3.4). Forward and back throws did not play any significant role in medal winning.

Figure 3 indicates the direction of attack(percentage) by sports level of judoists.

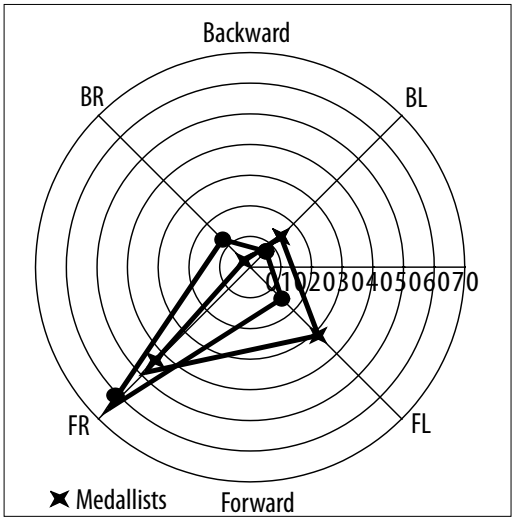


**Figure 3.** Direction of attack by sports level of judoists (%). FR – forward right, BR – backward right, BL – backward left, FL – forward left.

The analysis of the variety of techniques used in fight by medalists showed that they used, on average, 4 different throws in vertical position (from 1 to 9), and 1 or 2 actions in horizontal position. However, eight participants used neither pinning nor joint techniques. In the non-medalist group, 2 throws (1–7) were observed on average, and 1 action in horizontal position. One athlete in this group was unable to perform any action, and as many as 22 participants could not perform any effective technique in horizontal position.

**Direction of attack** – balance-breaking action in preparation for throwing opponent in chosen direction, for instance: forward, back, to the side.

**Judo techniques** – Judo techniques are classified as throws, grappling techniques, or strikes. Throwing and grappling techniques can be used during matches (*Shiai*). Striking vital points are practiced only as formal exercise (*Kata)* [20].

**Sports achievements** – The level of performance attained by an athlete in match [19].

## Discussion

In consideration of the analysis of the collected data, the profiles of the techniques preferred among the left-sided athletes show a more even distribution than the profiles observed in the right-sided contestants. The left-sided judoists seemed to be more difficult to fight with as they performed techniques using the stronger, so-called opposite stance i.e. facing opponents with left side of the body and they used opposite grip called *Kenka-yotsu*. It is not considered a typical strategy; however, it enhanced effectiveness of attacks, and increased the control over opponent's actions. It also exemplifies a difficult situation (element of novelty, unpredictability, and feeling of lack of control over the situation). Furthermore, for the athlete fighting on the other side, the same situation might positively affect his or her self-confidence, and make it seem to be an optimal state [6]. Thirty-five boys won medals in nine weight categories. As expected, left-handed athletes with left foot dominance used the opportunity to win medals more effectively than their right-sided counterparts. The study indicated that the medalists used a greater variety of throws in vertical position and actions in horizontal position compared to the non-medalists. Similar findings have been reported by researchers during competitions at different levels. A higher number of throwing techniques and directions of attacks were found significant for increasing unpredictability (entropy) during judo matches [7,8].

Previous studies which employed Zazzo test [9] have reported less frequent occurrence of left-handedness (24.4%) compared to left-footedness (38.9%) and left-eyedness (37.8%). These values fitted within the extensive limits established by international research, from 3% in former USSR to 50% in the Republic of South Africa [10]. Furthermore, the authors also reported the discrepancy between the declared and actual handedness and footedness. Boys' misconception about their right handedness was less profound than about their footedness. This misconception could have been instilled by cultural, home, school and sport environments, as boys probably were forced to use their right hands or feet more often than the left ones. This kind of symmetry in school and sport education may result in better versatility of technical/tactical activities in judo fights and also influence their level of achievements in tournament [11]. In modern psychology, sport techniques are considered optimal solutions for motor tasks [12]. The level of performance is determined by physiological, psychological and coordination factors, which might combine to develop specific configurations, depending on individual differences. It seems worthwhile to discuss the phenomenon concerning the inaccurate indication of limb dominance. Previous investigations [13] focused on Zazzo test [9] revealed that the frequency of improperly perceived laterality among the left-handed and the left-footed was significantly higher than among the right-sided. Furthermore, 34 boys (37.8%) were characterized by left-eyedness. The majority of the left-eyed won medals, whereas the subjects with right eye dominance were less frequently successful.

A clear correlation between the number of medalists as well as non-medalists, and left and right-eyedness confirmed by Zazzo test [9] turned out to be statistically significant.

Data of Mikheev et al. [14] show an increased symmetry regarding judoists motor functions. High-skilled and well-trained judoists showed higher symmetry in arm and leg movements compared to the persons in control group, which points to the increased activity of right cerebral hemisphere during motor activities. The actions performed by these competitors, especially the left-sided, are less predictable and are conducive to medal winning [8,14].

Biological development should be principally taken into consideration when coaching young judo athletes. Early specialization is unacceptable. However, in consideration of the results obtained from previous research [15] and according to experienced coaches and experts[16] it can be argued that widely perceived thorough technical and tactical development should be promoted among young judokas since their earliest years in order to guarantee a high sport level in the future. Athletes with the specific laterality should be given an opportunity to master techniques which are controlled by the opposite hemisphere. This study focused on the external phase of the performed actions. From the standpoint of coaching and performance of techniques, the internal phase of motor activity is of fundamental importance and can be improved and developed through imagery training, based on a polysensory experience.

Imagery refers to all sensory experiences we are aware of and which exist in the absence of the real stimulus conditions that are known to produce their genuine sensory or perceptual counterparts [17]. Imagery applied to mental training of athletes can be either creative or re-creative in its nature. It consists of sensoric, perceptual and emotional elements controlled by the athlete. Imagery should include the environment an action takes place in (e.g. mat in the case of judo) and the level of actual skills. It should also concern a well-described task and take into account the emotions desirable for performing the actual task. Mental practice of an athlete can be performed from either internal or external perspective. In the case of internal imagery, an athlete imagines being inside his or her own body and they experience the

sensations which might be expected in the actual situation. Feelings and perceptions are similar to those we experience in natural conditions. In the case of external perspective, a person views himself from the perspective of an observer – as if they were watching themselves on television. The effectiveness of the chosen perspective depends on the type of a task [17]. Internal imagery is recommended when visualizing throws, whereas the external perspective might be useful for mastering an optimal strategy of combat. According to Sacripanti [18, p.266] video recording might be used in mental training, including typical behaviors and polysensory signals (comment of J.B.), particular methods of throwing, and opponent's body posture before they actually performs throws. Imagery enhances athlete's preparation of counterattacks.

## Conclusions

1. Handedness and footedness significantly correlate with the choice of preferred attack directions in combat situations.
2. Left-handed attack, symmetrization and wider variety of the techniques used in fight in boys under 15 years of age (U15 age category) significantly improve chances of winning medals during competitions.
3. Imagery training can be considered an innovative form of symmetrization.

## References:


1. Bogdanowicz M: Leworęczność u dzieci. Warszawa: WSiP; 1992 (in Polish)
2. Starosta W: Motoryczne zdolności koordynacyjne (znaczenie, struktura, uwarunkowania, kształtowanie). Warszawa: Międzynarodowe Stowarzyszenie Motoryki Sportowej, Instytut Sportu; 2003 (in Polish)
3. Bagesteiro L B, Sainburg RL: Handedness: Dominant Arm Advantages in Control of Limb Dynamics. J Neurophysiol, 2002; 88: 2408–21
4. Starosta W: Genetic or social determination of the direction of turns during physical exercises. Kineziologija, 1986; 18: 33–40
5. Stupnicki R: Biometria. Warszawa: Margos; 2005 (in Polish)
6. TomaszewskiT: Człowiek i otoczenie. In: Tomaszewski T (ed.), Psychologia. Warszawa: PWN; 1976; 13–36 (in Polish)
7. Calmet M, Ahmaidi S: Survey of advantages obtained by judoka in competition by level of practice. Perceptual and Motor Skills, 2004; 99: 284–90
8. Franchini E, Sterkowicz S, Meira CM et al: Technical variation in a sample of high judo players. Perceptual and Motor Skills 2008; 106: 859-69
9. Zazzo R: Metody psychologicznego badania dziecka, Warszawa: PZWL; 1997 (in Polish)
10. Starosta W: Science in Sport Team Games. Biała Podlaska: Academy of Physical Education in Warsaw – International Association of Sport Kinetics, 1995; 69–104
11. Adam M, Drabik J: Wszechstronność działań judoków w świetle obserwacji ich walk. Sport Wyczynowy, 1988;12: 35–38 (in Polish, English abstract)
12. Blumenstein B, Lidor R, Tennenbaum G (eds.): Psychology of Sport Training. New York: Meyer & Meyer Sport, 2007
13. Sterkowicz S, Blecharz J, Lech G, Kaczmarczyk K: Lateralizacja młodych judoków. Ann. UMCS, sect. D. – Vol. 62, supl. 18; Promocja zdrowia w różnych okresach życia. 2007; 8: 36–39 (in Polish, English abstract)
14. Mikheev M, Mohr C, Afanasiev S et al: Motor control and cerebral hemispheric specialization in highly qualified judo wrestlers. Neuropsychologia, 2002; 40: 1209–19
15. Lech G, Sterkowicz S: The commencement age of training and its effects on technical preferences and achievements attained by judo contestants. Human Movement, 2004; 5(1): 42–47
16. Czajkowski Z: Nauczanie techniki sportowej. Warszawa: COS, 2004 (in Polish)
17. Morris T, Spittle M, Watt AP: Imagery in Sport. Champaign, Il: Human Kinetics; 2005
18. Sacripanti A: Advances in Judo Biomechanics Research – Modern Evolution on Ancient Roots. Saarbruecken Deutschland: VDM Dr. Müller Aktiengesellschaft & Co. KG; 2010
19. Kent T: The Oxford Dictionary of Sports Science and Medicine. Oxford-New York-Tokyo: Oxford University Press, 1994
20. Kawamura T, Daigo T: Kodokan New Japanese-English Dictionary of Judo. Tokyo: The Foundation of Kodokan Judo Institute, 2000