

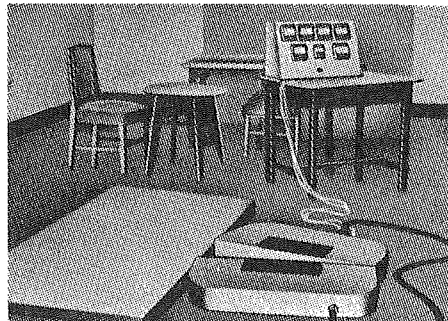
STUDIES ON JUDO TECHNIQUES WITH RESPECT TO DISTRIBUTION OF BODY WEIGHT

Y. MATSUMOTO (Tokyo University of Education)
T. YANAGITA, (Seitai-kyokai) Y. SATO, (Gaku-
shuin University) T. ASAMI (University of Tokyo)

OBJECT OF INVESTIGATION

In a previous paper the authors reported on their observations on the kinetics of the throwing techniques of Judo. The gravitational relationship between the thrower and his opponent during the "Kuzushi" (disturbing balance), "Tsukuri" (preparatory action for attack), and "Kake" (attack) was discussed. In the present paper investigations were made on the distribution of body weight during the "Kamae" (natural position), "Kuzushi" (disturbing balance), "Tsukuri" (preparatory action for attack), and "Kake" (attack). Expert Judo students were selected as experimental subjects, and importance was laid on the results of measurements on each individual subject, and comparisons were made in order to investigate in each individual the relation between technique and distribution of body weight; also, the characteristics and weak points of each individual were thus investigated. It is expected that knowledge obtained from these experiments will contribute to the study of Judo technique and serve as a guide in coaching.

A Differential Transformer Statico-meter



GENERAL PROCEDURE

1) Equipment

A Differential Transformer Statico-meter (a modification of the instrument devised by Dr. Morton) was used.

2) Procedure

a) After filling in a form (name, date of birth, height, body weight, "Dan", favorite technique, weakness, etc.) each individual donned their Judo costume.

b) Observations were made on the distribution of body weight on each 1/6 section of both feet.

- i) First metatarsal region.
- ii) Second~Fifth metatarsal region.
- iii) Heel

Rate of body weight distribution

| Left foot | Right foot |
|---------------------------------|---------------------------------|
| $\frac{2}{3} \quad \frac{1}{3}$ | $\frac{1}{3} \quad \frac{2}{3}$ |

Measurement of body weight distribution (6 sections of both feet)

| front lateral (A) (First metatarsal region) | front medial (B) (Second~Fifth metatarsal region) |
|--|--|
| Back (C) (Heel) | |



EXPERIMENTAL

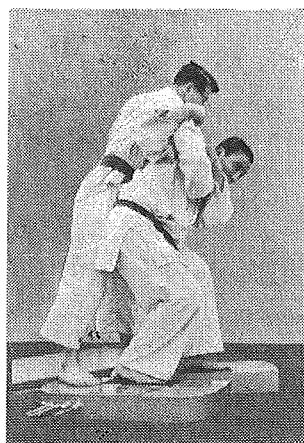
- 1) Observations were made on the following:
 - a) Individually: basic natural posture, basic defensive posture, right natural posture, and left natural posture.
 - b) With opponent: holding the opponent, the process of losing balance to the right front corner; middle, and the left front corner; and the moment of losing balance.

c) Technique: the favorite technique of the experimental subject, his "Tsukuri", his opponent's "Tsukuri", his "Kake", and his weak points.

2) Preliminary experiments were done on many experimental subjects, however, in this paper data from experiments on the following six Judo experts (all of them IVth Dan holders) are described.

- I. Inokuma (Tokyo University of Education)
- H. Yamagishi (Toyo University)
- T. Okumura (Waseda University)
- Y. Kurosumi (Meiji University)
- T. Nagai (Takushoku University)
- Y. Morita (Takushoku University)

A view of experiments



RESULTS AND DISCUSSION

Measurements of distribution of body weight of each individual subject were analysed and compared with one another. The relationship between distribution of body weight and Judo technique was taken into consideration, and the common points and weak points of each subject were discussed.

1) In general, the distribution of body weight was more superfluous in the front than in the rear. As shown in Table 1, this tendency was greater in the defensive posture than in the basic natural posture, and greater in the hold than in the defensive posture.

From the point of view of Judo technique, this "shift to the front" as shown in Table 1 has the following significance.

a) As the posture shifts from the basic natural posture to the defensive posture, and further to the hold, muscle tension is increased, the upper part of the body leans forward and assumes a more dynamic attitude. This quickens the action towards the front and constitutes the starting posture for the attack; also, it defends the rear.

Table 1. Relation between body weight distribution in the front and back

(Denominator indicates % of body weight on heel of both feet. Numerator indicates % of body weight on front aspect of both feet)

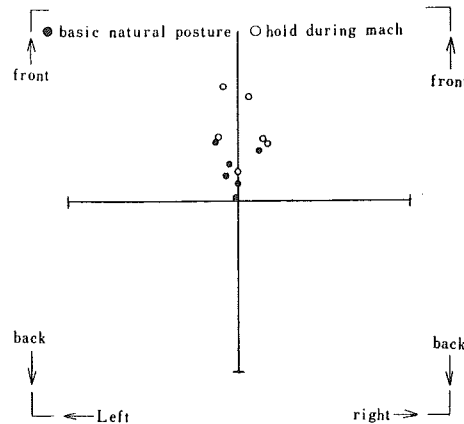
| exp. subject | posture | | basic natural posture | | basic defensive posture | | hold during match | |
|--------------|---------|--|-----------------------|---|-------------------------|---|-------------------|--|
| | | | | | | | | |
| Inokuma | | | $\frac{58}{42}$ (%) | | $\frac{55}{45}$ | < | $\frac{67}{33}$ | |
| Kurosumi | | | $\frac{51}{49}$ | < | $\frac{68}{32}$ | < | $\frac{81}{19}$ | |
| Yamagishi | | | $\frac{65}{35}$ | < | $\frac{68}{32}$ | | $\frac{59}{41}$ | |
| Nagai | | | $\frac{55}{45}$ | < | $\frac{61}{39}$ | < | $\frac{70}{30}$ | |
| Okumura | | | $\frac{69}{31}$ | < | $\frac{71}{29}$ | | $\frac{67}{33}$ | |
| Morita | | | $\frac{61}{39}$ | < | $\frac{65}{35}$ | < | $\frac{83}{17}$ | |

Table 2. Left and right relationship in body weight distribution

(Left side of bar indicates % of body weight on left foot. Right side of bar indicates % of body weight on right foot.)

| exp. subject | posture | | basic natural posture | | basic defensive posture | | hold during match | |
|--------------|---------|--|-----------------------|--------|-------------------------|----|-------------------|----|
| | | | | | | | | |
| Inokuma | | | 53 (%) | 47 (%) | 51 | 49 | 43 | 57 |
| Kurosumi | | | 51 | 49 | 52 | 48 | 51 | 49 |
| Yamagishi | | | 46 | 54 | 50 | 50 | 50 | 50 |
| Nagai | | | 50 | 50 | 52 | 48 | 55 | 45 |
| Okumura | | | 55 | 45 | 51 | 49 | 44 | 56 |
| Morita | | | 52 | 48 | 51 | 49 | 53 | 47 |

Fig. 1 Relation between front-back and left-right



b) This apparently unbalanced forward inclination of the upper half of the body is actually well balanced by holding the Judo costume of the opponent and covers the subject from losing balance toward the front. The stability on the left and right side is very high as shown in Table 2.

c) Using the figures in Tables 1, 2, Fig. 1 illustrates intersections of front-rear, and left-right during the hold and natural basic posture. The dots and circles represent the points of intersection of the gravitational line of each subject and the horizontal plane, and indicate the general tendency of Judo posture.

d) According to T. Ito's study on the frequency of application of the various Judo techniques during Judo tournaments, the order of frequency was as follows:

1) Uchimata, 2) Osoto-gari, 3) Awase-waza, 4) Harai-goshi, 5) Seoi-nage, 6) Hane-goshi, 7) Tsuru-komi-goshi, 8) Kaeshiwaza, 9) Tai-otoshi, and 10) Ouchi-gari—indicating that the technique in which balance is disturbed to the front are the most frequently used techniques.

Table 3. Relation between right Kumi and left Kumi

| experiment subject posture | Inokuma | | Okumura | | Morita | | Nagai | | Yamagishi | |
|----------------------------|---------------|---------|---------|---------|---------|---------|---------|---------|-----------|---------|
| | l. foot | r. foot | l. foot | r. foot | l. foot | r. foot | l. foot | r. foot | l. foot | r. foot |
| basic natural posture | 53(%) > 47(%) | | 55 > 45 | | 52 > 48 | | 50 = 50 | | 46 < 54 | |
| r. natural posture | 50 | 50 | 50 | 50 | 51 | 49 | 50 | 50 | 51 | 49 |
| l. natural posture | 53 > 47 | | 45 < 55 | | 48 < 52 | | 44 < 56 | | 45 < 55 | |

2) The distribution of body weight during the right "Kumi" (holding opponent), generally, shifted to the left foot during the basic natural posture, and when assuming the right natural posture, the right and left sides were well balanced. When assuming the left natural posture the distribution of body weight shifted to the right foot, but no significant change was formed in the balance.

a) It is thought that the tendency to lay importance on the left foot during the right “Kumi” is also manifested in the basic natural posture, and as a result of practice, a highly balanced state is seen during the left natural posture. The differences in the degree of balance during the “Kumi” among the various experimental subjects suggest that there is room for improvement in coaching.

Table 4. Shift of body weight from back (heel) to front

(numbers indicate % of body weight on medial and lateral aspects of the front part of the foot)

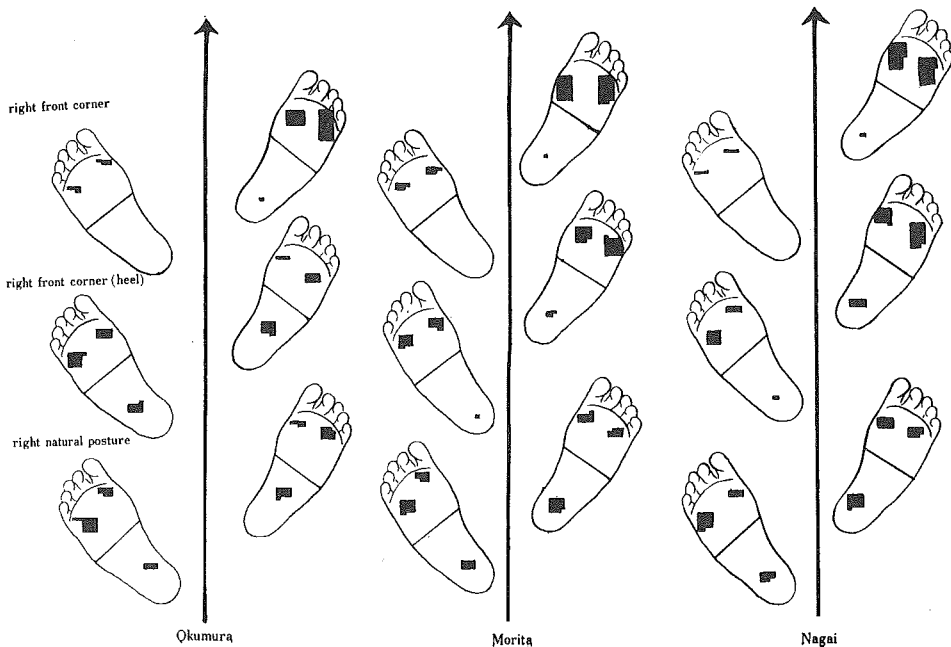
| experiment. subject | Nagai | | Kurosumi | | Yamagishi | | Morita | | Okumura | |
|------------------------|-------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | l. foot | r. foot | l. foot | r. foot | l. foot | r. foot | l. foot | r. foot | l. foot | r. foot |
| | lat. med. | med. lat. | lat. med. | med. lat. | lat. med. | med. lat. | lat. med. | med. lat. | lat. med. | med. lat. |
| front | 22 23 | 31 24 | 21 31 | 25 23 | 13 28 | 38 21 | 25 23 | 25 27 | 34 14 | 24 38 |
| ↑ back (heel) | ↑ 28 12 (%) | ↑ 10 19 | ↑ 21 23 | ↑ 16 24 | ↑ 18 19 | ↑ 18 21 | ↑ 29 20 | ↑ 14 24 | ↑ 25 11 | ↑ 10 18 |

b) The left basic natural posture of an individual with the right “Kumi” is dangerous, because most of the body weight shifts to the right foot which is not the supporting foot.

3) When unbalanced to the front, body weight shifted to the front and medial aspect (in the direction of the big toe).

a) From the following tentative proportion of distribution of body weight: 3 rear, 2 front lateral, 1 front medial, it will be seen from Table 4 that body weight markedly shifted to the front medial aspect.

Fig. 2 Process of losing balance to the front corner



b) From experience, emphasis is made on the medial aspect before a dynamic posture.
 4) When balance was disturbed to the front corner, body weight shifted, in most cases, to the front and then diagonally to the front.

a) Fig. 2 illustrates the magnitude of distribution of body weight during right natural posture, the process of being unbalanced to the right front corner, and after being unbalanced to the right front corner.

b) The process of being unbalanced to the front and then diagonally to the front is in agreement with the coach's guiding principle of "from the big toe to the little toe", and "put the opponent's body weight on his little toe".

5) Some characteristics and weak points of the experimental subjects when performing their favorite technique as seen from the point of view of distribution of body weight were as follows:

a) Kurosumi (Left-tai-otoshi)

The distribution of body weight to the front was marked, and assumed a leaning posture to the front. This characteristic is a weak point, and is in agreement with his own statement that he is vulnerable to Seoi-nage and Tsuru-komigoshi.

b) Yamagishi (Right-tai-otoshi)

The only difference between Yamagishi's Tai-otoshi and Kurosumi's Tai-otoshi was that the former's one was the right, and the latter's the left.

However, Yamagishi disturbed the balance of his opponent by converging the opponent's body weight on the front aspect of the opponent's right foot while putting his own body weight on the front medial aspect of his feet indicating a powerful control of the big toes.

The large proportion of body weight distributed on the axis foot (left foot) and the frontal aspect of the left foot during the "Kake" seem to conceal the decisive force which will ultimately come into action.

c) Inokuma (Right-seoi-nage)

While breaking the posture of the opponent to the front, he put most of his body weight to the rear, and especially the manner in which he stretched his right leg while putting his body weight on the heel of his right leg was peculiar to his "Tsukuri" (preparatory action for attack). From this "Tsukuri" he went into the "Kake", and putting his body weight forcefully to the frontal aspect of both feet, he applied the Seoi-nage. At this moment he distributed the maximum proportion of his body weight on the heel of his left leg. This was probably because he threw his opponent by forcefully twisting him around after shouldering him by turning his own body to the left. The unbalanced state of the performer during the performance of the technique and this forceful "Kake" have room for further considerations.

Table 5. Favorite techniques of each subject.

A. Kurosumi (l. Tai-otoshi)

| a. | | b. | |
|---------|---------|---------|---------|
| l. foot | r. foot | l. foot | r. foot |
| 21 22 | 11 28 | 27 46 | 18 20 |
| (%) | | (kg) | |
| 7 | 11 | 0 | 0 |

B. Yamagishi (r. Tai-otoshi)

| a. | | b. | | c. | |
|-----------|-------------|-------------|-------------|-------------|-------------|
| l. foot | r. foot | l. foot | r. foot | l. foot | r. foot |
| 3.5 7.1 | 39.8 45.5 | 14.9 19.5 | 35.2 23.5 | 20.2 16.7 | 21.4 15.8 |
| (kg) | | (kg) | | (kg) | |
| 0 | 4.2 | | 0 | 25.4 | 0 |

C. Inokuma (r. Seoi-nage)

a.

| l. foot | r. foot |
|----------------|---------|
| 36 22 (%) | 23 16 |
| 2 | 1 |
| 60 | 40 |

b.

| l. foot | r. foot |
|---------------|---------|
| 10 3 (%) | 11 18 |
| 14 | 44 |
| 27 | 73 |

c.

| l. foot | r. foot |
|---------------|---------|
| 18 6 (%) | 13 32 |
| 30 | 1 |
| 54 | 46 |

D. Nagai
(l. Harai-goshi)

a.

| l. foot | r. foot |
|----------------|---------|
| 18 0 (kg) | 12 28 |
| 0 | 43 |

E. Okumura
(r. Tsuru-komi-goshi)

a.

| l. foot | r. foot |
|----------------|---------|
| 23 30 (%) | 30 9 |
| 25 | 2 |
| 59 | 41 |

F. Morita (r. Uchimata)

a.

| l. foot | r. foot |
|----------------|---------|
| 38 12 (%) | 27 22 |
| 0 | 0 |

b.

| l. foot | r. foot |
|----------------|---------|
| 32 12 (%) | 17 20 |
| 7 | 10 |
| 45 | 38 |

A. a) Hold during match. b) Kake

B. a) Tsukuri of opponent. b) Tsukuri of subject c) Kake

C. a) Tsukuri of opponent. b) Tsukuri of subject c) Kake

D. a) Tsukuri of subject

E. a) Tsukuri of subject

F. a) Tsukuri of subject. b) Hold during match

d) Nagai (Left-harai-goshi)

The distribution of body weight was very well balanced. This was due to the fact that he had mastered both the right and the left techniques. However, his putting body weight on the right heel during the "Tsukuri" of the Left-harai-goshi is questionable, because this point acts as the fulcrum upon which the body revolves.

Taking into consideration the fact that body weight is shifted to the frontal aspect of the right foot which is the axis foot and then switched over to the "Kake" by turning the body to the right, more or less of a waste seem to exist, constituting his weak point.

e) Okumura (Right-tsurikomi-goshi)

The effect of his intensive training was very well manifested in the front lateral aspect of his left foot which is the supporting foot. This tendency was also seen when the opponent's balance was being disturbed, and also in his own "Tsukuri". In concert with the front medial aspect of the right foot it contributed to the force behind the strong twist of the body. However, his right heel was lifted somewhat higher than was necessary, and also he put too much weight on the heel of his left foot.

f) Morita (Right-uchi-mata)

The way in which he disturbed the balance of his opponent midway between the right front corner and the middle was very well done. However, from the point of view of distribution of his own body weight, an unbalanced state was observed in the left frontal aspect of the left foot which was the supporting foot. His own statement that his weakest point is the left rear corner was very well seen in his hold during a tournament. Also, some measure must be taken in order to improve the front-to-rear balance.