

12. STUDIES ON THE VISUAL FIXATION POINT OF THE REFEREE DURING A JUDO MATCH

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In a previous paper the authors reported on their studies in the visual fixation point of Judoists during basic posture. Since, so far no scientific approach has been utilized in the study of the technique of Judo referees, in the present study an investigation was made into the visual fixation point of the Judo referee umpiring a match. The experimental subjects, well trained referees and non-trainees were made to observe a cinematographic record of a judo match performed during the Olympic Games on a screen, and the visual fixation point was followed by a table type television eye-camera.

METHODS

1) As experimental subjects 3 veteran judoists (one VI-dan and two VII-dan holders) excelling in leadership and refereeing, and 3 Judoists (one II-dan and two III-dan holders) without training in refereeing were selected.

2) The experiments were conducted in the laboratory of the NHK Scientific Research Institute from 23rd June, 1967 to 23rd September, 1967.

3) The measuring apparatus used was a table type television eye-camera and observations were made in the following manner. Fig. 1 diagrammatically illustrates the general principle of the television eye-camera used in the experiment. Light from a miniature lamp is applied diagonally on the cornea of the experimental subject's eye and the reflection thereof is caught by a convex lens. Since the cornea acts as a convex mirror the real image of the lamp filament is seen as a single bright point. Also, since the cornea is somewhat protruding the position of the bright point moves with the movement of the eye-ball. There is a linear relation within the range of $\pm 15^\circ$ between the movement of the eye-ball, i.e., the change in the direction of the line of vision and change in position of the bright point. The change in position of the bright point is filmed by a Vidicon camera and projected on a screen together with the object of observation of the experimental subject. By giving previous notice to the experimental subject to regulate the point of visual fixation to coincide with the bright point, the former may be directly detected¹. During measurement, observations were made by monitoring, and also, recordings were taken by a 16 mm. cine camera (24 frames per second). Fig. 2 Shows an example of the record.

4) As the object scenes for observation, a few documentary film recordings of Judo matches performed at the Olympic Games were selected. The experimental subjects were told to observe the screen for 10 minutes as if he were performing the actual umpiring.

5) The visual fixation point was followed on each frame from the moment of performing the technique to the decision by using a motion analyzer. The techniques selected for the study were Seoi-nage, Tai-otoshi, Uchi-mata, De-ashiharai, and Sasae-tsurikomi-ashi.

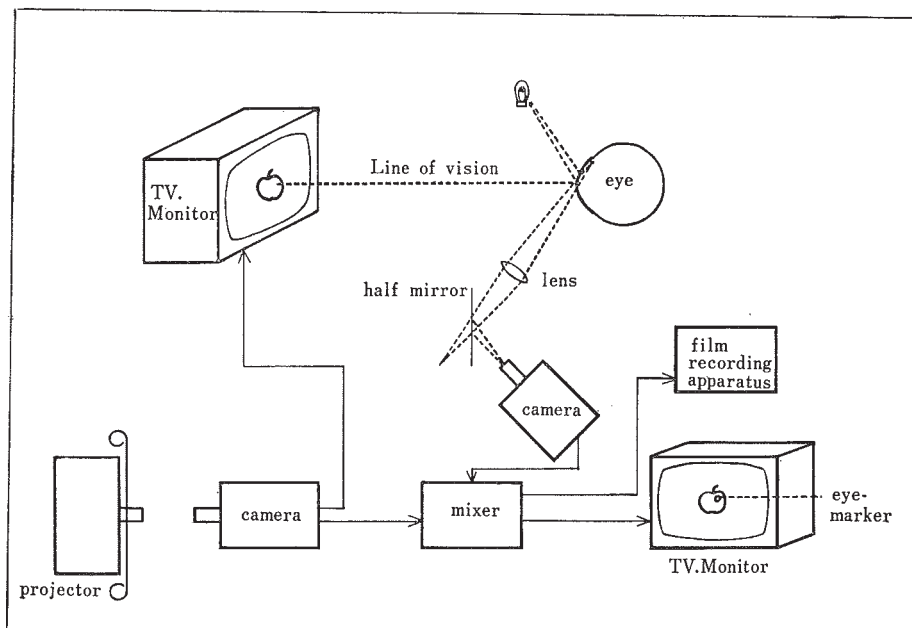


Fig. 1 Principle of the TV eye-camera

RESULTS AND DISCUSSION

Generally, the movements of the visual fixation point were within the visual angle of approximately 12° , vertically and horizontally. Sudden shifts of visual fixation point were made within the visual angle of 3° – 5° . The velocity with which this sudden shift (for example, when shifting the visual fixation point from the hand of the thrower to the buttocks of the thrown partner) is made was approximately 0.05 seconds.

The movement of the visual fixation point took various characteristic forms depending on the experimental subject, and in order to make a comparative study of each experimental subject the change in height of the visual fixation point was followed chronologically. In most of the experimental subjects there was a general tendency, while observing a match, to move the visual fixation point from a high level to a lower level, i.e., in the beginning the experimental subjects fixed their eyes on the upper half of the bodies of the Tori and Uke, however, at the moment the technique was effected the line of vision moved to the Uke, in most experimental subjects. Thereupon, this shift in the visual fixation point was followed chronologically.

Figs. 3, 4, 5, 6, and 7 show changes in height of the visual fixation points during performances of various techniques. The upper graphs show those of well trained referees, and the lower graphs those of the non-trainees. Time is indicated on the transverse axis and the point where the locus of the visual fixation point intersects the transverse axis is the contact point of the back of the thrown Uke and the mat.

Fig. 3 illustrates the shift of the visual fixation point while observing Seoi-nage. Both the well trained referees and the non-trainees fixed their eyes on the hands of the Tori at the moment of performing the technique, i.e., the visual fixation point was at a high level. At the moment the technique was effected, the eyes were fixed on the thrown Uke, and consequently, the level of the point of visual fixation shifted to a lower level. The line of vision of the well trained referee, T.D., already, moved rapidly to the anticipated position of the fall of the Uke, when the Tori began to perform the technique. This shift was accomplished approximately 0.7 seconds before the technique was effected.

The other two well trained referees also fixed their eyes on the anticipated position of the fall of the Uke, immediately prior to effecting the technique. This shift of the eyes is presumably due to the fact that from the movements of the Tori and the Uke the referee anticipates the result of effecting the technique. Also, it is a fundamental movement of the eyes when the eyes pursue a rapidly moving object, as already reported². Non-trainees, H.S. and Y.F. showed similar eye movements to those of the well trained referees. The eyes of the non-trainee, Y.H. constantly followed the movements of the hand of the Tori, and even at the moment of effecting the technique the level of the visual fixation point was high. This is very disadvantageous to the proper judgement of the technique.

Fig. 4 shows the shift of the visual fixation point while observing Tai-otoshi. In this technique, probably due to the fact that the Kuzushi and the Tsukuri were comparatively clearly seen, the level of the visual fixation point began shifting to a lower level, generally, quite early in the performance. The rapid movement of the eyes of the well trained referee, T.D. is noteworthy. The eyes of the well trained referee, K.S. were fixed on movements of the feet of the Tori and at the moment of effecting the technique the eyes were fixed on the back of the Uke, and consequently, the visual fixation point was constantly at a low level. In all the 3 well trained referees the eyes were fixed on the contact point of the Uke's back and the mat at the moment of consumation of the technique. The eyes of the non-trainees were mostly fixed on the elbow of the Tori or on the upper part of the shoulder of the thrown Uke, and from the movements of the Tori and the Uke on the screen, the visual fixation point began shifting comparatively early in the performance, however, at the moment of execution of the technique the visual fixation point was still at a high level.

Fig. 5 shows the shift of the visual fixation point while observing Uchi-mata. The eyes of the

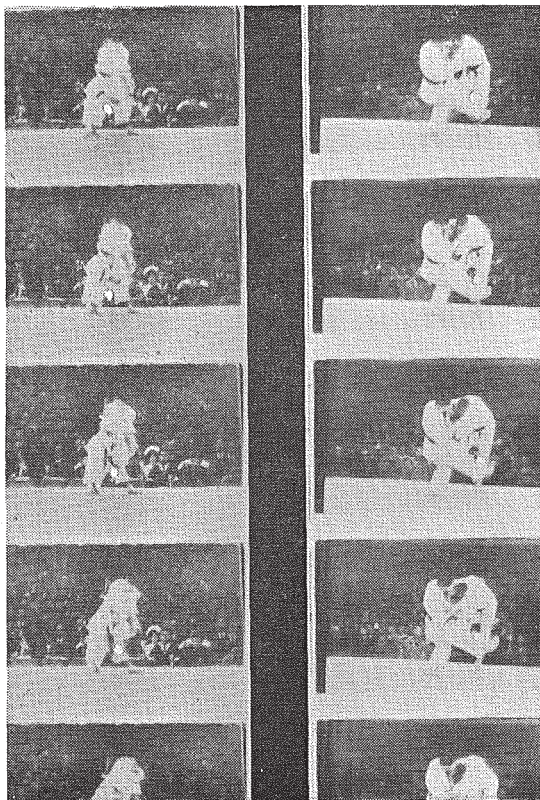


Fig. 2

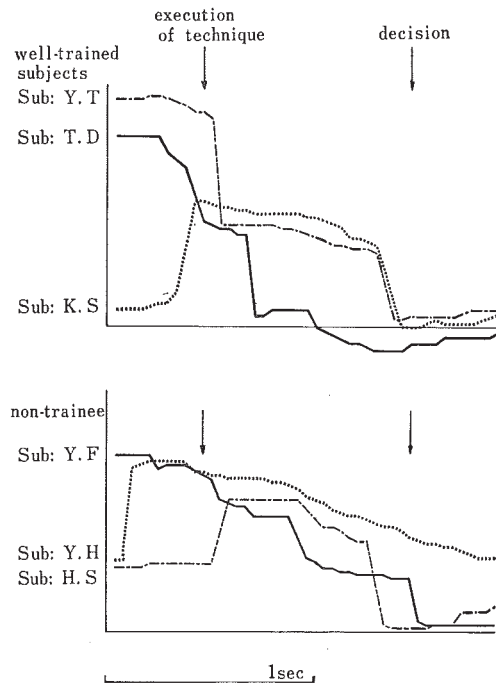


Fig. 3 Seoinage

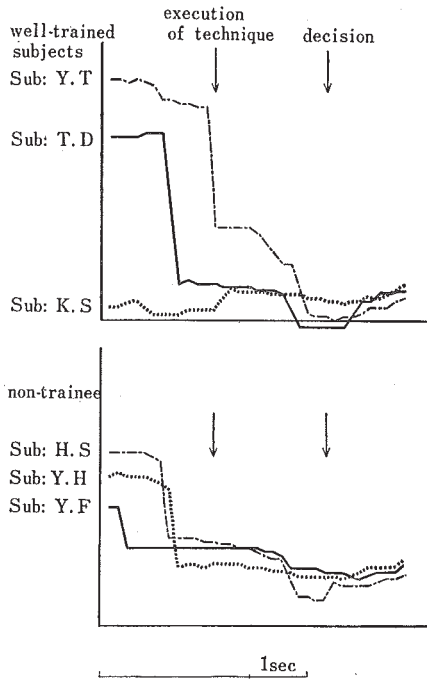


Fig. 4 Tai-otoshi

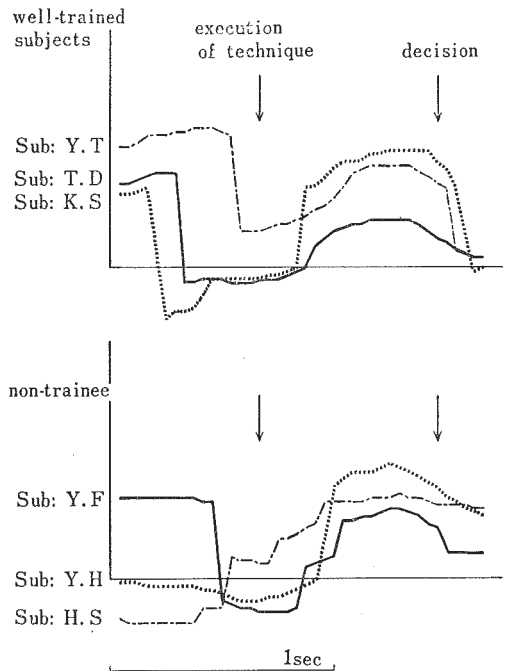


Fig. 5 Uchi-mata

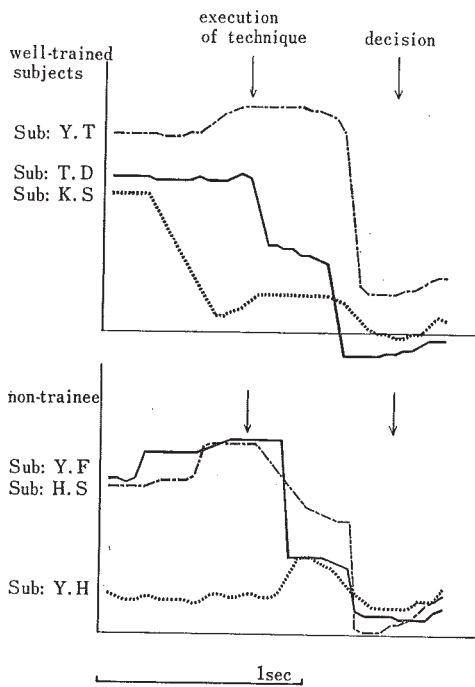


Fig. 6 Deashiharai

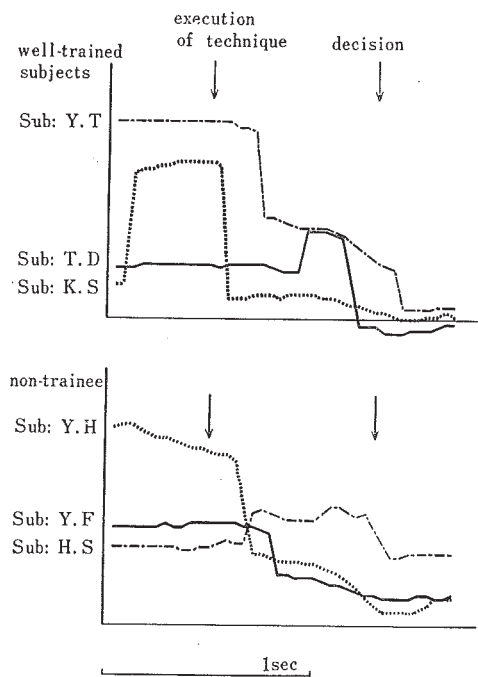


Fig. 7 Sasae-tsuri-komiashi

well trained referees, Y.T. and K.S. were fixed at higher levels than those of the non-trainees at the moment of executing the technique, however, 0.08 seconds and 0.17 seconds subsequently, respectively, their eyes were fixed on the contact point of the belt (dorsal aspect) of the thrown Uke and the mat. The eyes of the non-trainee, Y.F. were fixed on the buttocks of the Uke at the moment of execution of the technique and coincided to the visual fixation points of the well-trained referees, whereas, the eyes of the non-trainees, Y.H. and H.S. were fixed on the abdomen of the Uke and remained at a comparatively high level.

Fig. 6 shows the shift of the visual fixation point while observing De-ashiharai. The eyes of the well trained referee, Y.T. followed the elbow of the Uke from approximately 0.2 seconds prior to the moment of executing the technique, and consequently, the visual fixation point was comparatively high. This was similar to the course of the visual fixation point of the non-trainees while observing the techniques. The eyes of the well trained referees, T.D. and K.S. were fixed on the buttocks and the hips of the thrown Uke at the moment of execution of the technique. The eyes of the non-trainees, Y.F. and H.S. were fixed, respectively, on the belt (lateral aspect) and the thigh of the thrown Uke and followed a similar course to that of the well trained referees. The eyes of the non-trainee Y.H. were fixed on the upper aspect of the hip of the thrown Uke, and consequently, the visual fixation point was at a somewhat higher level.

Fig. 7 shows the shift of the visual fixation point while observing Sasae-tsurikomi-ashi. The eyes of the well trained referees, T.D. and K.S. were fixed on the belt (dorsal aspect) of the thrown Uke at the moment of execution of the technique, and those of Y.T. were also fixed on the same spot 0.12 seconds later than those of the other two referees. The eyes of the non-trainees, Y.H. and Y.F. were fixed on the elbow and abdomen of the thrown Uke, and consequently, their visual fixation points were on somewhat higher levels. The eyes of the non-trainee, H.S. were constantly fixed on the shoulder of the Tori, and consequently, his visual fixation point remained at a high level.

CONCLUSION

In general, the shifts of the visual fixation point, vertically or horizontally were within the range of 12° of the visual angle. Sudden shifts were made, vertically or horizontally, within the range of 3° – 5° of the visual angle, and the time required was presumably approximately 0.05 seconds.

The basic movement of the eyes at the time of performing the technique is to fix the eyes on the hands or the upper part of the bodies of the Tori and the Uke. Immediately prior to and following execution of the technique, in most cases, the visual fixation point suddenly shifted downward in order to observe the condition of the thrown Uke. However, in a few cases the eyes were fixed on the lower part of the bodies of the Tori and the Uke and then from the moment of execution of the technique the visual fixation point shifted to the thrown Uke. This type was common to both groups, i.e., the trained referees and the non-trainees. In general, the well trained referees were quicker to shift their visual fixation point to the anticipated position of the fall of the thrown Uke. Furthermore, in the well trained referees, excepting one case, the eyes were fixed on the contact point of the back of the thrown partner and the mat at the moment the technique was effected, however, in the non-trainee the eyes were fixed mostly on the abdomen or the shoulder of the thrown partner. In 2 cases of the non-trainees the eyes constantly followed the movements of the Tori. This is very disadvantageous to the proper judgement of the technique.

The results of the aforementioned experiments give suggestions as to the proper points of visual fixation of the referee in order to give adequate judgement with regard to the outcome of a Judo match.

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