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Does a Player whose Ball Juggling Skill is the Best shows the Best Ability in a Soccer Game?: A Consideration of the Validity of Skill Tests from a New Viewpoint keeping Utility in Mind

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While much research has been conducted on skill testing in soccer, little attention has been paid to skill test validity in teams composed of players with similar years of soccer experience. In addition, almost no research mentions practicality as an aspect of skill testing. The purpose of this research was to investigate the relationship between skill test scores and abilities rated in match situations. Further, the practical use of skill testing was discussed. Subjects are fourteen players each of a university and an elementary school team (U12) excluding goalkeepers. The players of the respective teams have similar years of soccer experience. Skill test items evaluated were ball juggling, dribbling, trapping, and continuous kicking. Ability evaluations were performed by peer assessment (coach's assessment for U12) from various perspectives using the rank order method and a one-on-one dribble match using a 7m X 7m square court. Correlation coefficient matrix between skill test items indicated stronger relationships between the items for the U12 Team than for the University Team. Skill test items excluding continuous kicking showed a tendency toward correlation with objective ability evaluation indices; however, this correlation was less pronounced for defensive aspects. Correlation Coefficients between dribble test score and dribble ability, and between the score and winning score in the one-on-one dribble game was marginal. Furthermore, ball juggling showed almost no relation to ability evaluation indices. This indicates that the juggling test score obtained by this method was not an effective index of good players. On the other hand, it was confirmed that continuous kicking skill reflects defensive abilities.

Keywords: skill test, ball juggling, validity of test, evaluation of soccer ability

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1. Introduction

In their 1978 book on skill testing, Collins & Hodges included nine perspectives (p.4-5) on the use of skill testing in physical education. These perspectives are the measurement of achievement, grading or marking, classification, diagnosis, increasing motivation, improving practice, heightening competition, and use of the score as a teaching aid or interpretive tool. Collins & Hodges (1978) outlined skill testing in a number of sports, including soccer, from the 1920s, focusing on its use in physical education classes. The validity of such skill testing is often examined in relation to educational evaluation in PE class. Due to the large individual differences in skill levels within cohorts, there is a natural tendency for teachers to give higher evaluations to students with higher scores in every skill test, which strengthens the correlation between test scores and teacher evaluations. This suggests the applicability of skill testing to the wide range of purposes described above.

Meanwhile, a number of studies have focused on skill testing in competitive soccer. Soon after WWII, for example, Takenokoshi et al. (1961, 1963a, 1963b) conducted skill testing on top-level high school, university, and All Japan team players for comparison with Russian standards. They noted that Japanese soccer player skills were substandard. Asami (1970), one of the researchers involved in the Takenokoshi et

al. studies, applied skill testing based on the previous study to University of Tokyo soccer club members. Other skill testing has been created by Yokoi (1960), Isokawa et al. (1978), and others.

In regard to the validity of skill testing for soccer, however, many studies have focused on the correlation of technical skill and years of experience with test scores (Asai et al.; 1995, Otake et al.; 2007), and on correlation among test items (Ohta & Hattori; 1981), while with the exception of studies on the correlation between skill testing scores and abilities evaluated by 5-point scale in a single item conducted by Ohta & Hattori (1982) and Nagahama et al. (1995), little interest has been shown in the relationship between soccer skill evaluations in match situations and skill testing scores. Research targeting classes with significant inter-individual variability includes Yokoi's (1960) examination of the correlation between evaluation scores by in-class observers and test items, and Heath & Rogers' (1932) examination of correlation coefficient of total skill testing scores. However, no research has focused on the direct relationship between skill evaluation exhibited in games and abilities measured by skill testing. There exist, for example, almost no analyses on the correlation between dribbling test results and the dribbling skill of individual players in games. Isokawa & Ohashi (1984) examined the correlation between trapping test scores and 5-point evaluation of the same skills by instructors to discuss reliability. However, the data was obtained from a team consisting of players with experience ranging from one to nine years, and individual difference in basic skills may have been as large as individual differences in class. Therefore, this research was considered one targeting a group of players with a certain difference in skills similarly to the above-mentioned physical education classes. No studies are available on the correlation between individual differences in skill testing and individual differences in soccer abilities in a group consisting of players with similar years of experience and basic skills.

According to the 1983 Japan Football Association Scientific Research Division Report, testing was performed on skills as well as physical fitness and capabilities in elementary and junior high school students who played in national tournaments, and a 5-point scale was created (Taki et al, 1984). In subsequent reports, however, while the same measurements have been conducted, there has been no mention of analyses on skill testing results. In addition, we have not seen instructors who are motivated to conduct skill testing on players and use the data in teaching players. After the study presented by Isokawa & Ohashi (1984) at the 4th Meeting of Medicine and Science in Soccer, no reports on skill testing have been forthcoming. This emphasizes the lack of interest in the efficacy of skill testing from the above-mentioned viewpoint.

Traditional skill testing was valuable because comparison of average values obtained in Japan with those in advanced countries and regions made it possible to evaluate Japanese skill level at the time. However, the development of soccer in Japan to the same level as advanced countries and the spread of information technology have lead to the possibility of clarifying how skill tests could be used in coaching. For this purpose, research to answer the following questions is needed: How dribble test using static cones reflects dribbling ability in matches and the degree to which ball juggling test, which is simple and often measured but seldom used in actual games, reflects soccer ability. If we assume the ability of players capable of juggling a soccer ball 100 times to be superior to those capable of juggling a soccer ball 10 times, is it also possible to say that the ability of players who can juggle a soccer ball 200 times is superior to those who can juggle a soccer ball 100 times?

This study was carried out to examine the validity of soccer skill testing from a new perspective. Specifically, we investigated the relationship between certain skill tests that have been developed and the numerical values obtained by objectively calculating the abilities rated in match situations, and discussed the desirable use of skill testing.

2. Method

2.1. Subjects

Subjects of this study were fourteen players each of a university and an elementary school team (U12) excluding goalkeepers. The university soccer club is a mid-level member of the Japan University Football Association that practices five days per week. All members have been involved in soccer since they were in an elementary school. With the exception of two subjects with 7 and 9 years' experience, all members have more than 10 years of experience

playing soccer. The U12 soccer club is a mid-level club in the prefecture consisting of two 4th graders, one 5th grader, and eleven 6th graders. This U12 soccer club was established only two years ago; therefore, the experience of playing soccer of each member was between two and four years. It was not always the case that performance of the younger students was inferior to that of the older students; therefore, we used all member data for analysis. As a practical consideration, experiment and investigation were performed targeting fifteen members, including goalkeepers, on both teams, and data from fourteen members, excluding that of goalkeepers, were used for aggregation.

2.2. Skill Test Items

2.2.1. Ball Juggling

The number of ball juggles per minute was measured. The method by Isokawa et al. (1987) and Fumoto (1981) was used. When the ball fell on the ground, players picked it up and continued juggling. Use of chest and thighs was allowed; however, the number of juggles by foot was counted for analysis only. However, in order to obtain more accurate data to reflect individual differences in ability, the number of all consecutive juggles was recorded, and the top three records in one-minute were summed for use as the individual's record. This score (Juggling 1) was used as an index of ball juggling ability. The number of misses during one minute (Juggling 2) was also used as a preliminary index.

2.2.2. Dribbling

There are two types of dribbling, straight line dribbling, which focuses on speed, and non-straight line dribbling, which focuses on touch and control. We applied dribbling practice combining zig-zag and straight line dribbling used by Isokawa et al. (1978) to measure the dribbling skill of players. The circles shown in **Figure 1** indicate 50cm-high cones, all of which were placed at 3m intervals. Failures such as cone strikes that caused the ball to change direction, or balls moving out of course, were excluded to obtain data that accurately reflected ability. Measurement was performed twice and the better time was used as the score. The time was measured from when a player touched the ball at the starting line to when both the ball and the player reached the goal line. This record was set as the index of dribbling ability.

2.2.3. Ball Control (Trapping)

Ball control test is used mainly to measure trapping ability. The trapping test given to junior high school students by Isokawa & Ohasi (1984) was used. In this test, as is shown in **Figure 2**, a player kicked the ball from Area A (1.5m×1.5m), which was 3 meters away from a wall, to the wall, trapped the ball bouncing back from the wall in Area A, brought the ball to

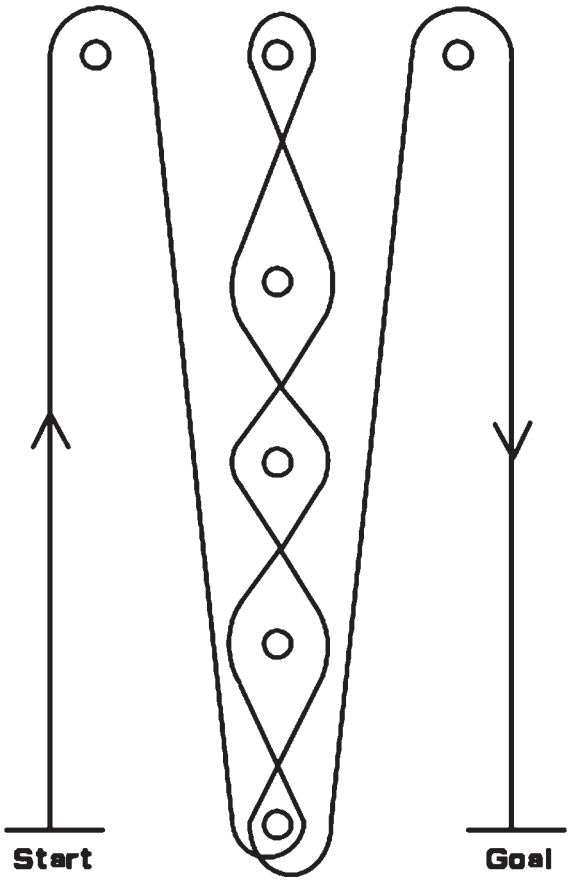

Figure 1 Course of dribble test.

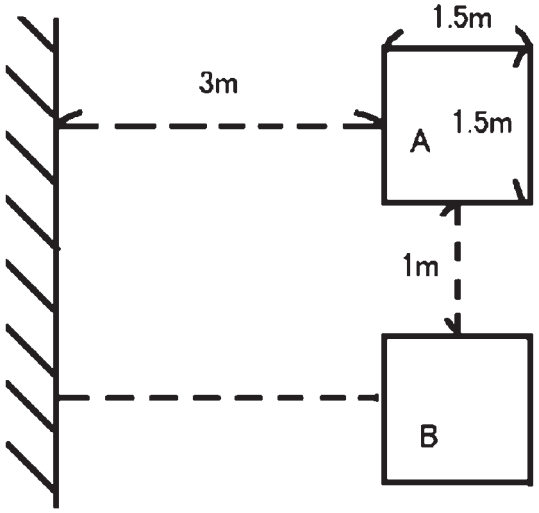

Figure 2 Situation of trap test.

Area B (1.5m×1.5m), which was 1 meter away from Area A, kicked the ball from Area B to the wall as before, trapped the ball bouncing back from the wall in Area B, and dribbled the ball to return to Area A. Kicking and trapping needed to be performed within the area. When the ball bouncing back from the wall did not return to the inside of the area, the player had to bring the ball back to the area and move to the next area. When we first gave this test to elementary school students, the setting of 3m distance to the wall was too long and the accuracy and strength of kicking affected performance, which made it difficult to measure individual trapping ability accurately. Therefore, setting a priority on measuring trapping ability, the distance to the wall was changed from 3 to 1.5m for the group of elementary school students. The students were asked to kick and trap between Area A and B alternately and consecutively as fast as possible to measure the number of times the ball hit the wall during one minute. The number of times the ball hit the wall was used as an index of trapping ability.

2.2.4. Continuous Kicking

The kicking test conducted by Fumoto (1981) was applied. The task is to hit a ball to a 1m x 1m target set below the shooting board from a point which was 5 meters away from the target. The students were asked to directly kick the ball that bounced back from the wall or kick the ball after trapping (continuous kicking). A line parallel to the shooting board 5 meters from the target was drawn. If the non-kicking foot was on the wall side from the line, or if the ball did not hit the target, it was not counted. This test targeted university students. When we gave this test to elementary school students, they could not hit the target with frequency, and we could not obtain the data we expected. Therefore, the distance was changed from 5m to 3m for elementary school students. The number of kicks that hit the target within one minute was recorded as successful kicking, and the number of continuous kicks that hit the target continuously as successful continuous kicking. The students were asked to attempt to kick continuously as much as possible and as many times as possible. Students could kick the ball as they preferred. Total number of valid kicks that hit the target (Kick 1) was used as an index for kicking ability. The largest number of continuous kicks (Kick 2) was used as a preliminary index.

2.3. Evaluation of Soccer Skills

2.3.1. Subjective Evaluation of Skills in Match Situations

In order to quantify comprehensive evaluation of soccer skills in actual games, peer assessment was conducted using the study carried out by Fumoto & Kamata (1999) as a reference. Assessment consisted of seven aspects such as dribbling, ball control, kicking, offensive abilities in a one-on-one situation (offense evaluation) and defensive abilities in a one-on-one situation (defense evaluation), situational judgment (decision), and total ability.

A questionnaire was delivered to all players and they were asked to classify their teammates into three groups on the seven sepacts; very good, good, or normal. Players were also asked to set the condition that each group should be five players of similar ability. After that, the players were asked to rate their teammates from the top to the fifth in each group. By this procedure, total rank was obtained for each aspect. The score (rank) given to each player was summed for each aspect and the total score was used as an index of the ability of the player for each aspect. The order is the score; therefore, a lower score indicates a superior player. For example, an outstanding player in a team is evaluated as “1” by all teammates, and receives 15 points in total (1 point×15 evaluators on the team).

However, as reported in a study targeting elementary school students conducted by Fumoto (1983, 1989), this assessment is not appropriate for elementary school students, who have shorter experience playing soccer and are not capable of evaluating either themselves or others accurately. Therefore, for elementary school students, we asked two U12 team instructors (one with 19 years’ experience playing and 12 years’ experience coaching, and the other with 20 years’ experience playing and 9 years’ experience coaching) to evaluate all players, and the scores given by both coaches were summed to determine the ranking of the players for each aspect inside their team.

2.3.2. Objective Evaluation of Skills in Match Situations

Individual skills measured in this study were thought to reflect personal skill in one-on-one situations in games. Therefore, one-on-one dribbling games were planned to measure the skill. This

measures skill in situations where players cannot pass the ball. Games on different size fields were tried before deciding that a 7m x 7m area would be most appropriate. The actual game was conducted as described below.

Two players face each other on the center of opposite lines. The player on the defensive side passes the ball to the player on the offensive side. The start of the one-on-one situation was set as the point at which the player on the offensive side touches the ball (traps the ball). If the player on the offensive side passes through the line where the player on the defensive side is standing at the beginning, the offensive side player wins. If the defensive side player steals the ball from the offensive side player or the ball goes out of the 7m x 7m area, the defensive side player wins. In order to reproduce a situation as close to the actual game as possible, the defensive side player was asked not to wait at the line, but to move forward and try to steal the ball.

Subjects were asked to play against all players. Each subject played both defensive and offensive sides three times. Winners received 1 point, and losers received no points. There was one goal keeper each on the elementary and university student teams. The maximum possible score was 42 points (1 point×3 times×14players). We ranked players objectively based on these scores (defensive score and offensive score).

2.4. Procedures

The skill test and one-on-one experiment took place at an indoor facility. The floor of the facility was artificial turf, and all subjects wore indoor shoes. After all players were sufficiently warmed up, Time was provided to practice each technique for skill testing, and one-on-one practice in which subjects played both offensive and defensive sides once. Subjects were also given time to check instructions to ensure the proper conditions. Testing for elementary school students was conducted over four days, with one day being used for each technique. Testing for university students was conducted over two days, with one day being used for two techniques. The one-on-one games took place over three days. A subjective evaluation questionnaire to both elementary school and university students was delivered and collected one week later.

2.5. Data processing

Because non-normal distribution was seen in some cases, Spearman's rank-correlation coefficient was calculated among measurement items using STATISTICA5.5 . Level of significance was set at 0.05.

3. Results

3.1. Skill Test and Defensive and Offensive Scores in One-on-One Situations

Table 1 shows the results for each skill test and one-on-one games by group. Skill test performance was obviously higher for the University Team. In t-test differences between teams were significant at 1%, except for trapping test (NS) carried out after changing the distance to the wall.

Because the one-on-one game scores were relative valuation, no significant differences were seen between teams. However, defensive side tended to

Table 1 Results of skill tests and one-on-one games.

	U12		University	
	Mean	SD	Mean	SD
Juggling1	46.1	27.0	108.6	17.5
Juggling2	4.4	4.0	1.1	1.1
Dribble*	29.2	2.5	24.8	1.3
trap	25.2	2.0	25.4	2.8
kick1	17.0	1.6	21.1	2.0
kick2	5.1	2.8	9.4	1.2
Offence 1-1	18.2	8.2	18.4	4.9
Diffence 1-1	25.9	5.5	24.1	5.6

Units of "*" is second and unit of the others is number of times

Juggling2: number of misses

kick2: muximum number of continuous kicks

win with greater frequency than offensive side did. In paired t-test for both teams defensive side scores were significantly higher than offensive side scores at 0.5% level (U12: t=3.75, DF=13, University students: t=3.61, DF=13).

3.2. Correlation among Measurement Items

Table 2 shows rank correlation coefficients between skill test scores, and **Table 3** shows rank correlation coefficients between skill evaluations. The upper right shows the results for the University Team, and the lower left shows the results for the U12 Team. According to the correlation coefficients between the skill tests (Table 2), the values of the U12 Team were higher overall. In addition, the correlation coefficient between two indices in the same skill test was significantly high in juggling; however, it was not significant in continuous kicking, and the values were near -0.5 for the U12 Team.

No significant correlation was seen between juggling and other test items for the University team though Juggling 1 was significantly correlated with Juggling 2. However, for the U12 Team, Juggling 1 showed significant correlation with all test items except the Trapping test.

Skill evaluations (Table 3) showed high overall correlation for both teams. However, the defense evaluation shows relatively low correlation with the other evaluations. The University Team alone showed a significant correlation coefficient between the defense evaluation and the defense score in one-on-one games.

Correlation between the skill test scores and the skill evaluations for the University Team is shown in **Table 4** and the correlation for U12 Team is shown in **Table 5**. Few significant correlation coefficients were observed. For the University Team, however, Juggling 1 revealed a slightly high correlation with evaluation for the dribble and the defense evaluation. However, for the U12 Team, no skill evaluation score showed significant correlation with Juggling 1.

On the other hand, the dribble test for the University Team showed significantly high correlation, exceeding 0.7, with the evaluations for dribble and offense. The U12 Team also showed a slightly high correlation with those evaluations. The University Team trapping test showed no significant correlation with any objective evaluation and significant correlation coefficient was seen only with the offense score. Meanwhile, for the U12 Team, it revealed a slightly high correlation with the ball control evaluation, and high correlation with offense score exceeding 0.7. Furthermore, the University Team continuous kicking test showed a slightly high correlation for Kick 1 with total ability and offense

Table 2 Correlation coefficients between skill test scores.
(right upper half shows university data and left lower U12)

	Juggling1	Juggling2	Dribble	Trap	Kick1	Kick2
Juggling1		−0.581 *	−0.348	0.088	0.122	0.118
Juggling2	−0.925 *		0.348	−0.065	−0.020	0.059
Dribble	−0.801 *	0.846 *		−0.466	−0.563 *	−0.263
Trap	0.398	−0.604 *	−0.694 *		0.635 *	0.607 *
Kick1	0.657 *	−0.705 *	−0.544 *	0.314		0.395
Kick2	−0.524 *	0.555 *	0.571 *	−0.308	−0.493	

*: P<0.05

Table 3 Correlation coefficients between skill evaluations.
(right upper half shows university data and left lower U12)

	Dribble-ev	Control-ev	Kick-ev	Offence-ev	Diffence-ev	Decision-ev	Total-ev	Offence-scr	Diffence-scr
Dribble-ev		0.877 *	0.604 *	0.955 *	−0.035	0.371	0.763 *	−0.768 *	−0.029
Control-ev	0.838		0.763 *	0.796 *	0.145	0.503	0.803 *	−0.859 *	−0.236
Kick-ev	0.342	0.515		0.590 *	0.383	0.886 *	0.904 *	−0.814 *	−0.331
Offence-ev	0.908 *	0.732 *	0.376		0.004	0.407	0.772 *	−0.732 *	0.033
Diffence-ev	0.130	0.329	0.235	−0.033		0.477	0.419	−0.379	−0.721 *
Desition-ev	0.709 *	0.735 *	0.357	0.580 *	0.674 *		0.843 *	−0.701 *	−0.348
Total-ev	0.710 *	0.778 *	0.408	0.548 *	0.660 *	0.869 *		−0.893 *	−0.373
Offence-score	−0.800 *	−0.808 *	−0.342	−0.777 *	−0.185	−0.557 *	−0.658 *		0.484
Diffence-score	−0.432	−0.627 *	−0.321	−0.117	−0.522	−0.641 *	−0.653 *	0.269	

*: P<0.05

Table 4 Correlation coefficients between skill test scores and skill evaluations (University).

	Dribble-ev	Control-ev	Kick-ev	Offence-ev	Diffence-ev	Decision-ev	Total-ev	Offence-scr	Diffence-scr
Juggling1	−0.634 *	−0.507	−0.046	−0.558 *	0.437	0.278	−0.128	0.224	−0.261
Juggling2	0.476	0.299	−0.165	0.436	−0.393	−0.291	0.051	−0.096	0.426
Dribble	0.732 *	0.481	0.327	0.704 *	−0.064	0.253	0.570 *	−0.465	−0.139
Trap	−0.404	−0.484	−0.435	−0.416	−0.318	−0.357	−0.493	0.551 *	0.293
Kick1	−0.462	−0.355	−0.415	−0.476	−0.512	−0.458	−0.556 *	0.598 *	0.451
Kick2	−0.256	−0.236	−0.213	−0.196	0.141	−0.234	−0.187	0.303	−0.094

*: P<0.05

Table 5 Correlation coefficients between skill test scores and skill evaluations (U12).

	Dribble-ev	Control-ev	Kick-ev	Offence-ev	Diffence-ev	Decision-ev	Total-ev	Offence-scr	Diffence-scr
Juggling1	−0.345	−0.374	0.061	−0.320	0.164	−0.035	−0.222	0.291	−0.001
Juggling2	0.414	0.516	0.047	0.376	−0.056	0.187	0.365	−0.437	−0.043
Dribble	0.551 *	0.593 *	0.150	0.574 *	−0.073	0.190	0.468	−0.719 *	−0.013
Trap	−0.488	−0.633 *	−0.523	−0.503	−0.177	−0.365	−0.502	0.729 *	0.063
Kick1	−0.103	−0.172	−0.170	−0.290	0.323	0.100	0.045	0.080	−0.351
Kick2	0.104	−0.032	−0.251	0.265	−0.438	−0.324	−0.096	−0.226	0.617 *

*: P<0.05

score. For the U12 Team, however, only Kick 2 showed slightly high correlation with defense score.

4. Discussion

4.1. Correlation between Skill Test Items

The correlation coefficient matrix shown in Table 2 reveals that for the U12 Team the majority of the coefficients were significant, exceeding 0.5, and that even the lowest correlation coefficient is greater than 0.3. These results show that U12 players who receive higher scores in one test tend to receive higher scores in other tests, which indicates large individual differences in overall ability. However, the University Team showed slight correlations among kicking, dribbling, and trapping tests. This may be because trapping test contains elements of kicking and dribbling, and dribbling includes accurate forward kicking as a technical element.

As was mentioned above, the trapping test includes the element of kicking and dribbling in addition to trapping technique. According to the correlation coefficients between the trapping test score and three personal skill evaluation scores (Table 4 & 5), while neither team shows large difference, correlation coefficients for the ball control evaluation are higher than those for the dribbling and juggling evaluations. This suggests that the trapping test reflects trapping technique to a certain extent.

We used two indices for continuous kicking, which are total number of valid kicks that hit the target (Kick 1) and the greatest number of continuous kicks (Kick 2). For the U12 Team, relatively high negative correlation between the two indices was observed, though not significant. This may be because some players trying to kick strongly sacrificed accuracy while some other players trying to kick accurately sacrificed kicking speed. Therefore, as we describe later, Kick 2 showed relatively high correlation with defense evaluation.

4.2. Correlation between Skill Evaluation Indices

While correlation coefficient matrix (Table 3) shows high correlations on the whole, only few evaluation items show high correlation with defense evaluation and defense score. This is consistent with a study by Fumoto et al. reporting a higher correlation between personal skill evaluations and offense evaluation than with defense evaluation (Fumoto, 1981, 1984, 1989; Fumoto & Ishigouka, 1983; Fumoto & Kamata, 1996, 1999). Dribbling, ball control, or kicking evaluations were part of personal skill; therefore, these aspects showed low correlation with defense evaluation.

The University Team showed high correlation coefficient between defense evaluation and defense score (0.721); however, there was no significant correlation coefficient between defense evaluation and any other evaluation aspect. Defense evaluation correlates slightly higher with decision and total ability compared with other valuations, though the coefficients were not significant. In reference to the series of studies by Fumoto et al. quoted above, this indicates that this team focused greatly on offense because the values were obtained by peer assessment. The fact that the defense evaluation showed high

correlation only with the defense score for one-on-one games that was measured objectively may indicate that many players simply tried to prevent the opponent from passing through without deeply considering the elements of delay or attack, or the direction of one-side-cut. This inference was fortified by the coaches' team evaluation, who stated that this team had some problems in defense during the season in which this study was conducted. This analysis is based on the above-mentioned series of studies by Fumoto et al.; however, because team analysis is not the objective of this study, it will not be addressed here.

Meanwhile, defense evaluation for the U12 Team showed high correlation (near 0.7) with total ability and decision. This indicates that players who were given higher evaluations in defensive ability by the coaches were also given higher evaluations for their decision and total ability. This means that the coaches evaluated the defensive ability of each player in one-on-one situation taking into account the knowledge that must be considered in one-on-one situations.

According to the correlation between kicking evaluation and other evaluations, while, for the University Team, kicking showed significant correlations with all evaluations except defense evaluation and defense score, the U12 Team showed no significant correlations. This may be because players on the University Team evaluated kicking ability by not only considering strong kicking and shooting, but also considering ball speed control ability suitable to the situation, including passing play. Meanwhile, U12 Team players are still in an immature state of development and it is also difficult for the coach to evaluate the same way university students evaluated one another. In addition, kicking ability is not prioritized to the same degree (kicking evaluation showed lower correlation with total ability than other evaluations did with total ability). All these facts reduced the correlation of the kicking evaluation with the other evaluation aspects for the U12 Team.

4.3. Correlation between Skill Test Scores and Skill Evaluation Scores

In Tables 4 & 5, decision shows no significant correlation with any skill test for either Team. This suggests that skill testing measures personal skill maturity and that decision in match situations is a completely different ability from personal technique. When individual difference in ball control is pronounced, for example, higher-ranking players in dribbling test may only have leeway to look around the pit, and, as a result, correlation between the dribble test and the decision might be high. However, when individual difference in skills is small, as was the case in this study, it is natural for there to be no significant correlation with decision (see the series of studies by Fumoto et al.).

Observing correlations between the four skill tests and evaluations in game situations in these Tables, dribble test shows the highest correlation coefficients to evaluations in general. This means that dribbling test reflects soccer ability in games to a high degree. However, referring to the offense score, which are objective evaluation of offensive skill in one-on-one match situation, the University Team showed higher correlation coefficient between offense score and trapping test or total number of continuous kicks (kick 1) than that between the score and dribbling test. This may be because the ability of passing through the opponent while dribbling in a 7m x 7m area requires different abilities whereas the dribbling test measures ability in speed dribbling. In addition, offense score showed higher correlation with total number of kicks than with trapping test. The reason for this fact remains unclear. However, considering that trapping test is closely related to defense evaluation, as we describe later, it may be because the intention of players to play carefully was reflected in total number of kicks and also in offense score.

U12 Team offense score showed higher correlation coefficient with dribbling test compared with the University Team. However, the value was lower than the correlation coefficient between offense score and trapping test for U12 Team. This may be because trapping test includes multiple elements such as kicking, trapping, and dribbling. This suggests that the dribbling test is appropriate for use in the evaluation of comprehensive ball control for elementary school students. However, it is not appropriate for use in the evaluation of university student dribbling skill in crowded situations, and another test should be developed. It may, however, reflect dribbling ability in situations where high speed dribbling is necessary.

Juggling test scores for the University Team showed significant correlation with dribbling and offense evaluations; however, those for the U12 Team showed no significant correlation with any evaluation item. Both Teams showed relatively low correlations

with total ability, which suggests that juggling test scores in the method we applied are not appropriate in evaluating competitive ability in actual games. If the number of continuous juggles does not have correlation with competitive ability, it is possible that in order to increase performance in match situations, it is necessary to practice a different technique rather than to practice juggling itself after a player reaches a certain level.

Trapping test for the U12 Team showed high correlation with ball control evaluation and the highest correlation with offense score. Trapping test itself reflects many abilities in soccer. Therefore, it is recommended that this test be conducted monthly with the goal of increasing test scores. In fact, trapping test scores for the U12 Team showed the highest correlation with total ability; therefore, such practice is very reasonable.

Next, we discuss the continuous kicking test. Since this test was first conducted (Fumoto, 1981), the results have shown that the continuous kicking test reflects defensive abilities (Fumoto, 1981, 1989). The experiment in this study also showed that total number of continuous kicks (Kick 1) had the highest correlation with defense evaluation and defense score for the University Team. This test demands continuous hits; therefore, players need to focus on carefully kicking the ball continuously, which reflects the abilities required for defense. However, for the U12 Team, which is inferior to the University Team in physical constitution and power, this test seems to show that if the younger players try to increase kick frequency, they must kick hard and their kicking accuracy is sacrificed. Therefore, the continuous kicking test may be an index that does not reflect the ability of careful performance for U12 team.

Considering the above, it is natural to think that careful performance tendency may be reflected in Kick 2, which showed the highest correlation with defense scores for the U12 Team. In order to examine this, however, it is necessary to conduct an experiment that investigates the changes in performance in the test under the instruction to carefully hit a target.

4.4. Possibility of Juggling Score Used as an Index for Evaluating Competitive Ability

As shown in Fig. 1, number of juggles varies more for the U12 Team than for the University Team, and coefficient of variance for the U12 Team is 3.6 times that of the University Team. While, for the University Team, the number varies from 67 to 138, for the U12 Team, it varies from 16 to 96, which reveals that a large individual difference in skills results among elementary school students even with a difference of only a few years' experience. Considering that the range in dribbling test performance was small (26.03 seconds to 34.01 seconds), it is possible that juggling test scores overvalue differences in soccer ability. It is difficult to believe that an elementary school student whose juggling score is 100 has ability five times greater than a player whose juggling score is 20 or lower.

In addition, this large difference in individual players may reflect individual difference in potential ability that influences the learning of overall athletic skills, not only the soccer skills (readiness, which is the base for learning athletic skills such as the ability to stand on one foot, which is in turn the base for juggling ability, and ability to recognize the positioning of moving objects and feet, and moving a foot to the moving object and so on). From this perspective, it is necessary to carefully evaluate the juggling scores of elementary school students. However, using rank correlation coefficient to calculate correlation coefficient raises the possibility that correlation coefficient matrix is meaningful, and that an element influencing high correlation among skill tests for the U12 Team is individual difference in the above-mentioned potential abilities. This element is also one of the reasons for the higher correlation coefficient between juggling test and other skill tests for the U12 Team than for the University Team.

Juggling scores for the University Team showed no significant correlation with other skill tests, and both teams showed lower correlation coefficients for juggling scores with offense evaluation and offence score than the correlation coefficient for dribbling scores with the same offensive items. These suggest that the juggling test, which is usually practiced and applied in this study, does not sufficiently reflect the actual competitive abilities of players.

Of additional interest, the juggling scores in this study are similar to those of teams playing in a national tournament reported in the 1st National Junior High School Soccer Tournament Report (1972) published by the Japan Foot Ball Association Scientific Research Division (varied from a minimum of 3 to a maximum of 121). The juggling scores for top ranked junior high school teams at that time

showed almost the same individual differences as normal elementary student teams at present. However, it is difficult to say that the juggling scores of those junior high school students did not reflect their soccer abilities as in this study due to a lack of data.

Furthermore, in the study carried out by Takenokoshi et al. (1963a) mentioned above, subjects were instructed to use their feet, thighs, chest, etc. in a designated order of use. Under such difficult juggling conditions, it is also possible that large individual difference could be observed in university students and that these could differentiate certain abilities. Although the results of this study suggest the inadvisability of concentrating on juggling for increasing number, the evidence is insufficient to enable the conclusion that juggling is meaningless. When coaches teach students to dribble, they instruct them to dribble without looking at the ball in consideration of game situations but give no instruction for juggling. Therefore, the greatest benefit of this research may be an understanding of the need to consider what instructions are necessary for effective juggling practice to enhance competitive ability in games.

5. Conclusion

In this study, four types of skill tests, ball juggling, dribbling, trapping, and continuous kicking, and evaluation of soccer abilities from subjective and objective perspectives that are possibly associated with these skill tests were conducted. These data were used to examine the relationship between the skill tests and the evaluations. Correlation coefficient matrix between skill test items indicated higher correlation of dribbling test with other skill tests for both University and U12 Teams; however, correlation between dribbling test and offense score in one-on-one situations was low for the University Team, which suggested that use of the dribbling test score as an index for evaluating ability directly related to games by periodically measuring performance requires the development of a test capable of measuring dribbling skill in crowded situations. For the U12 Team, trapping test, which showed higher correlation with ball control skill evaluation, was considered to be the best test and one that should be conducted periodically. It was also revealed that continuous kicking is a test that reflects defense skill to a certain extent. Meanwhile, ball juggling test showed almost no correlation with competitive skill evaluations. This suggested that practice for the sole purpose of increasing the number of juggles may be ineffective for players whose skills are relatively high.

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