ANALYSING ROLES OF POSITION IN CURLING BASED ON SHOT-SCORES

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This paper reports on the analysis of the characteristics for each position based on shot-scores in curling. We computed average shot-scores for each position from 26 curling game information, and analyzed the correlation between the differences in average shot-scores and the differences in final game scores. The results show that strong correlations appeared for the position of the lead and the fourth, and weak correlations for the second and the third. It indicates that the roles of the lead and the fourth relate to game score directly, but the roles of the second and the third relate to the game progress. We were able to confirm the relationship between the score and each position of the target team.

KEY WORDS: curling, shot-score, game score, position, difference in shot-scores, difference in game scores, correlation

INTRODUCTION: Curling, the winter sport often referred to as "chess on ice", became a Winter Olympics Official Event in 1998. Since then, the national curling team of Japan has participated in this competition. However, in recent years along with a rapid improvement of China and South Korea. Therefore, there are fears that Japan loses an advantage.

As one of the new support measures, Masui et al. (Masui et al. 2012) conceptualized the Curling Informatics project. This project aims to make full use of Information and Communication Technology (ICT) to support curling not only from tactical side and players' individual tactical skills but also to put the team tactics into the field of view.

As the first step in the Curling Informatics, we have developed a digital score book system "iCE" which enables to collect, analyze, and visualize game information. Utilizing the system, we can plan tactics based on the game information, and objectively look back on the game information immediately after games.

In the database accumulated by iCE, game progress is recorded shot-by-shot. Individual shot information includes the "shot score" that indicates how effectively the shot was performed for tactical instruction.

Therefore, if analysis the shot-score from the past of the game information in detail, it should be possible to objectively understand about the shot performance level of each team and players, and individual team tactics, the role according to the tactics of each position and players' individual tactics performance skills. Analysis of the rivals' performance will contributes to enhance Japanese tactical advantage.

This paper, describes shot-scores of curling in Section 2, and describes the observations and analysis method of the object of game data in Section 3. Furthermore after showing the results in Section 4, this paper describes a conclusion and future prospects in Section 5.

SHOT-SCORE: Each shot in a game of curling is evaluated on a five-point scale (shot-score), which indicates how player complies with the instructions of the skip player (game captain). According to the curling experts, "shot accuracy" is calculated as percentage of quartiles with the shot-scores, which is conventionally utilized to describe shot effectiveness.

There are possibilities that analysis with small sample set makes errors. Therefore, to measure the shot performance as an operational capability of players and needs to deal with situations when the shot accuracies are 85%, 80%, and 75%. The 5% difference is too insignificant and could be misleading making all such score percentages to be treated as equivalent.

Moreover, additional features such as each position analysis and another player analysis, the sample population object of analysis, increase the possibility of error when applied in

calculations. To solve these problems, we used the shot-score rather than shot accuracies to analyze operational capabilities of positions.

METHODS: In this section, we describe in the game data and our analysis method. The data contains 3,621 shots extracted from 26 games of all four tournaments by iCE in the 2014-2015 season and the 2015-2016 season.

The above data contains team information, player information, shot type and shot-scores thrown by players, stone placement of each shot, end numbers of each shot, and the score of each end.

As mentioned above, we focused on tactical elements such as series of states that support operating games, and their combinations. The game is considered as a main element of tactics. In addition, it can be regarded that shot-score means total tactics, tactics for each end, for each position, and operational capabilities. Therefore, analysis of correlation between each tactical element and shot-score will suggest objective consideration about effectiveness of end-by-end tactics in total tactics, and tactical contribution of operational capability for each position on each player.

We analyzed the correlation between the position and the shot-score. As an analysis method, we studied the distribution of individual shot-scores, investigated the correlation between shot-score and each element with the average value of the shot-score, and performed a comparative analysis of those features.

In particular, we calculated the differences in team shot-scores (the average of all teammate's shot-scores) and final score difference (score difference in the end of the match) in some games, and analyzed correlations between team shot-scores and final score difference.

RESULTS: We describe in the results of analysis. As a result, the Pearson correlation coefficient was 0.916 for the correlations between difference in the team's shot-score (DTSS) and difference in the final game score (DFGS). As Figure 1 shows there is a strong positive correlation between DFGS and DTSS. This means that the game tends to be a narrow margin if the difference in the team shot-score is small, and the game tends to be one-sided if DTSS is large. In other words, the team shot-score reflects the scoring ability of the team.

If the team shot-score of the competing team and one's own team is known, the match result can be roughly predicted. Therefore, when planning the game tactics it is effective to refer to this prediction.

For instance, team should maximize expected difference on scores if narrow margin can be expected, the team should focus on keeping point lost to blank if wide margin can be expected. It carried out above were applied in the evaluation of tactical performance ability of the team. We distinguished four subsequent positions (lead, second, third, fourth) and analyzed them as described above. From the analysis result, the Pearson correlation coefficient for the lead was 0.763, 0.698 for the second, 0.789 for the third, and 0.868 for the fourth.

From the analysis result, the lead and fourth have stronger correlation than others because these positions often throw a shot involved in a direct score, and the second and third have correlation lower because they often throw a shot carrying out indirect tactics. The fourth position is always responsible for the final shot in the end. Therefore, the shot-score of the fourth has a strong influence on the score it can be convinced. The lead position is generally thrown front stone and guard which are put in front of house, draw which is put into the house. Therefore, it seems that lead's shot isn't often related directly to the score. The failure of this shot bring the own team in disadvantage by delaying the tactical performances. Therefore, the shot-score of the lead can be understood and can be one of the factors that affect the final score difference. In contrast, in the second and fourth, there was no clear correlation between the lead and the fourth. Depending on situation, these position throws the shots that do not contribute to game scores directly. Because they assumes roles to decrease number of stones in house for reducing the perils own team. In other words,

although it does not contribute directly to the final score, it is interpreted as a large percentage of shots involved in victory or defeat.
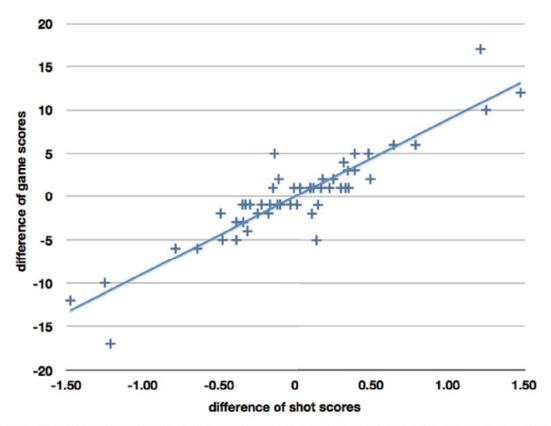

Fig 1: Correlation between the difference of shot-scores and the difference of final game scores

CONCLUSIONS: In this paper, we analyzed the relation between difference in the team's shot-score (DTSS) and difference in the final game score (DFGS) and each position in detail based on curling games recorded by the digital scorebook system iCE.

As a result, we found out that a positive correlation exists between the score difference and shot-score of the whole team. Therefore, the game scores from the shot-score can be predicted to some extent. In particular, we found out that the shot-score of the lead and fourth are strongly related to the game results.

Analysis focused on the shot-score can be said to be effective in finding a characteristics of scores for each position.

Finally, we were able to confirm the relationship between the score and each position of the target team.

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