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# Analyzing Intuitive Skills of a Waitperson in a Restaurant Dining Room Using a Serious Game

Fumihide Nishimura<sup>1</sup>, Emi Kinoshita<sup>1</sup>, Tomomi Nonaka<sup>2</sup> and Hajime Mizuyama<sup>1</sup>

<sup>1</sup> Aoyama Gakuin University, Sagami-hara Kanagawa 252-5258, Japan

<sup>2</sup> Ritsumeikan University, Kusatsu Shiga 525-8577, Japan  
mizuyama@ise.aoyama.ac.jp

**Abstract.** It is important to shorten customers' waiting times in a restaurant, and their waiting times at the table are largely affected by how waitpersons perform their tasks in the dining room. However, the quality of their work still depends heavily on their experiences and intuitive skills. Thus, this paper proposes a serious game emulating the tasks of a waitperson in the dining room of a restaurant, and analyzes the intuitive skills for the tasks by using the game. It defines two distinctive tactics called *collection of multiple tasks* and *movement on a prediction basis*, and introduces several measures on these tactics. As a result, by analyzing the game score, waiting times and these measures obtained from game experiments, several characteristics of the skills have been successfully revealed.

**Keywords:** Serious Games, Intuitive Skills, Service Science, Service management.

## 1 INTRODUCTION

In recent years, as the popularized terms *product service systems (PSSs)*, *servitization*, *service production*, etc. indicate, service providing systems have become an important field of production and operations management research. In the restaurant industry, for instance, it is important to improve customer satisfaction to increase sales. It has been pointed out that the customer satisfaction is affected by various waiting times [1, 2]. The shorter the waiting times, the higher the customer satisfaction in general, and the more customers will visit the restaurant. This also highlights the importance and difficulty of shortening waiting times. Vries et al. [3] empirically shows that the waiting times do have a significant impact on the revenue of a restaurant.

Hwang and Lambert [4, 5] investigated the relationship between the resource levels and the waiting times through numerical simulation. Simamura et al. [6] also utilized numerical simulation to reduce staff motion and thereby customers' waiting times by redesigning kitchen layout. Further, several authors studied how to shorten the waiting times of customers in the waiting room until they are assigned to a table in the dining room [7-10]. Then, in the dining room, waitpersons are required to take care of the customers so as not to have them wait too long at the table. Roy et al. [11] and Tanizaki and Shimmura [12] modeled the waitpersons' operations in the dining room using a

queuing network and two-dimensional cellular automata respectively, and studied appropriate resource levels.

However, the quality of the operations also depends largely on the experiences and intuitive skills of the waitpersons performing the operations. Since it is not realistic to fully automate the interactions with customers in all the restaurants, it is important to deepen the understanding on the skills and devise how to properly train and/or support them. In order to address this challenge, this paper proposes a serious game emulating the operations of a waitperson in the dining room of a restaurant, and analyzes the intuitive skills for the tasks by using the game. Serious games provide a cost and time efficient tools for collecting (virtual) operational data for skills analysis and it is usually easier to conduct if-then analysis on the games than in actual fields. Games can also be used for training the skills uncovered through the analysis. A similar approach has been successfully applied to table assignment operations in a restaurant in an authors' earlier work [10].

## 2 TASKS OF A WAITPERSON

The main tasks of a waitperson include seat guidance, receiving orders, serving dishes, clearing dishes and accounting. Among them, this paper focuses on receiving orders, serving dishes and clearing dishes, which are thought to have a big influence on the customers' waiting times at a table. It further defines two distinctive tactics of the waitperson, which are taken while performing the tasks; *collection of multiple tasks* and *movement on a prediction basis*. When a waitperson carries out two or more tasks of receiving orders, serving dishes, or clearing dishes in a single tour departing from the *tray point* until returning to the same point again, it is said that *collection of multiple tasks* is taken. This tactic can be quantified by calculating how many tasks are collected in a tour, how many tasks are performed at a same point without moving, etc. When a waitperson moves closer to a customer in anticipation that she/he will be called by the customer or the customer will finish the meal soon, it is said that *movement on a prediction basis* is taken. In order to capture this tactic, the position of a waitperson before and after a task occurs is compared, and the distance that the waitperson approaches to the task point is calculated. The larger this *approaching distance*, the more it is likely that the waitperson took a *movement on a prediction basis*. This paper analyzes the intuitive skills of a waitperson by focusing on these two tactics.

## 3 PROPOSED SERIOUS GAME

The proposed game was created using a programming language called Processing [13]. As shown in Fig.1, the locale of the proposed game is a restaurant dining room having six tables. The customer at each table may require tasks of receiving orders, serving dishes and clearing dishes, and the player is expected to carry them out by controlling a waitperson agent in the dining room.

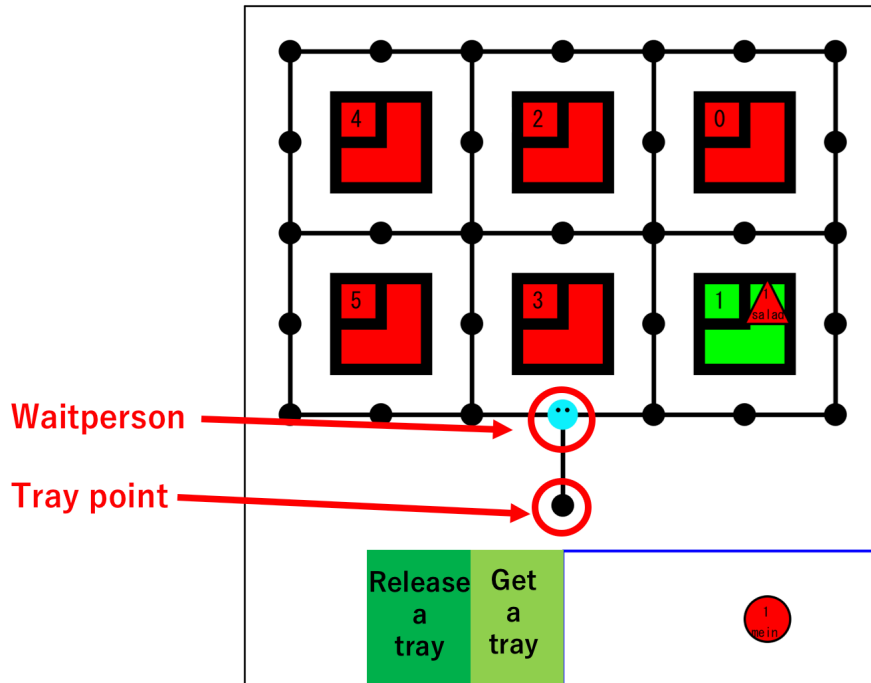


Fig. 1. Restaurant dining room in the game

The player can move the waitperson agent from the current point to an adjacent one on the grid at a time. In order for the agent to carry out a task, it must be at the upper, lower, left-hand or right-hand side point of the table to work on. When the agent performs serving dishes and/or clearing dishes, it has to hold a tray. The number of dishes that can be placed on a tray is limited to five, and the agent can hold at most one tray. Further, dishes to deliver and those to be cleared cannot be kept on a same tray at a same time. There should not be any dishes on the tray, when the agent receives orders from a customer. Accordingly, possible task configurations in a single tour of the waitperson agent can be summarized as shown in Fig.2.

Customers arrive at the restaurant randomly one by one. Then, they are assigned to a table on first-come first-served basis. When there are two or more tables are available, a table is chosen randomly. After a while, they place an order for up to three dishes only once at a table. Each customer leaves automatically, when the meal is over.

When a task to be done by the waitperson agent occurs, the color of the corresponding element changes from white to yellow, orange and red as time elapses without being handled. When the color of an element is white, it means that the corresponding task has not yet occurred. For example, when a white dish is on a table, the customer is still eating it and the task of clearing it has not yet called for. When the task is carried out by the agent, a certain score is given or deducted according to the color of the corresponding element. That is, if the color is yellow, 10 points are added, and if the color is red, 10 points are subtracted. Further, 10 points are added each time a dish is sold.

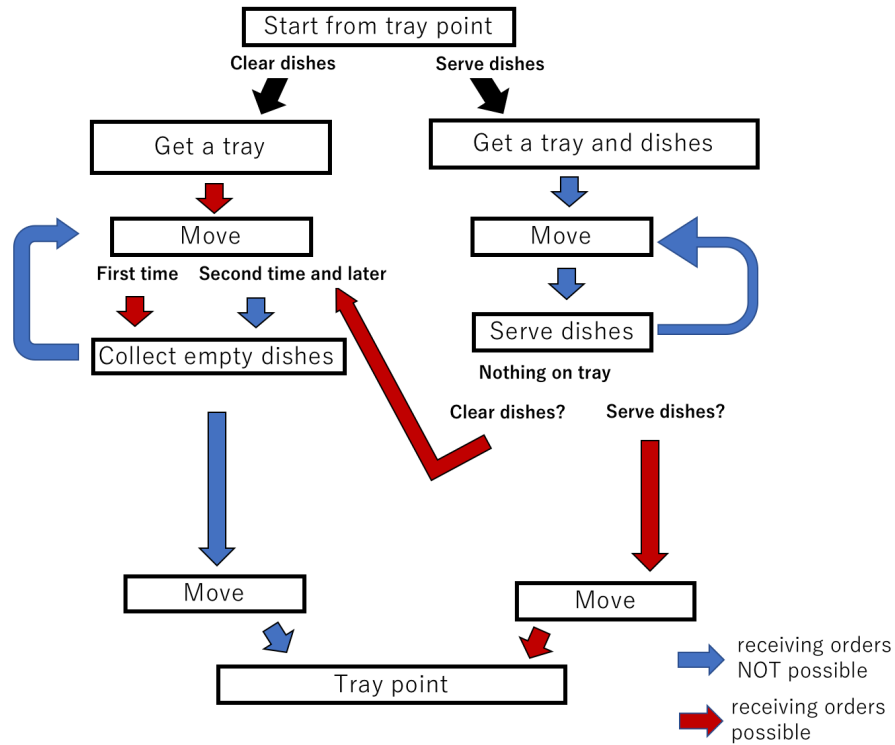


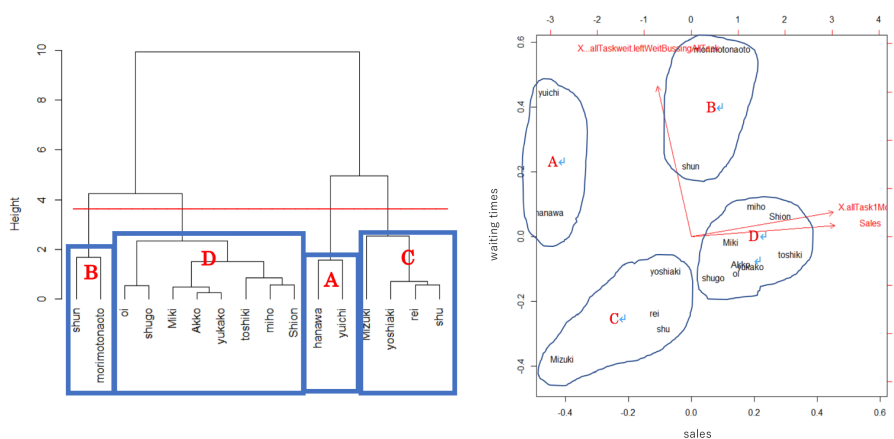
Fig. 2. Possible task configurations in a single tour

## 4 GAME EXPERIMENTS AND THEIR RESULTS

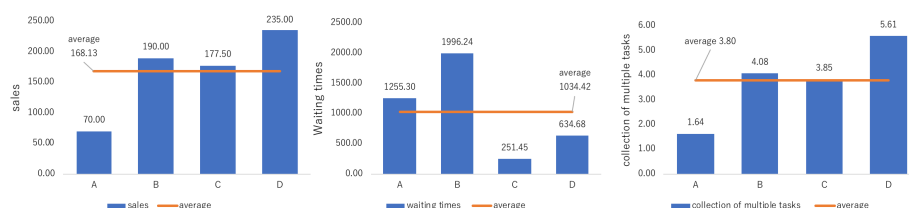
Game experiments are conducted with 16 university students, and various measures related to the game scores, waiting times and each tactic are calculated from the log data of every game session. Some of the participants have worked in a restaurant as a waitperson, and the others have not. Further, the length of the experience differs among those who have worked in a restaurant. Accordingly, the skill levels of the participants are expected to be significantly varied among them.

### 4.1 Collection of Multiple Tasks

In order to analyze the intuitive skills concerning *collection of multiple tasks* tactic utilized in the game sessions, cluster analysis and principal component analysis are applied to the data on the total sales, average waiting time of each task, and average number of collected tasks in a single tour (see Fig.3).



**Fig. 3.** The results of the analyses on *collection of multiple tasks*



**Fig. 4.** Averages of *sales*, *waiting times*, and *collection of multiple tasks* in each group

As shown in Fig.3, players are categorized into four groups, A, B, C and D. How players handle the tasks in each group can be characterized by looking into their game play data more in detail. As shown in Fig.4, the players in group A did not collect many tasks in a tour and this results in a higher number of inefficient movements. These features further lead to low turnover rates and long waiting times. To sum it up, this is a group of low skill players.

The players in the other groups collected more tasks in every tour. However, the waiting times in group B are significantly larger than the other groups. This shows that the players in group B collected tasks by only considering task efficiency but not waiting times. On the other hand, the waiting times in groups C and D were shorter than average. In these groups, tasks were performed in relatively large batches at an earlier timing, and, as a result, the turnover rate and the sales were increased and the waiting times were shortened. Accordingly, the players in groups C and D seem to possess higher skills.

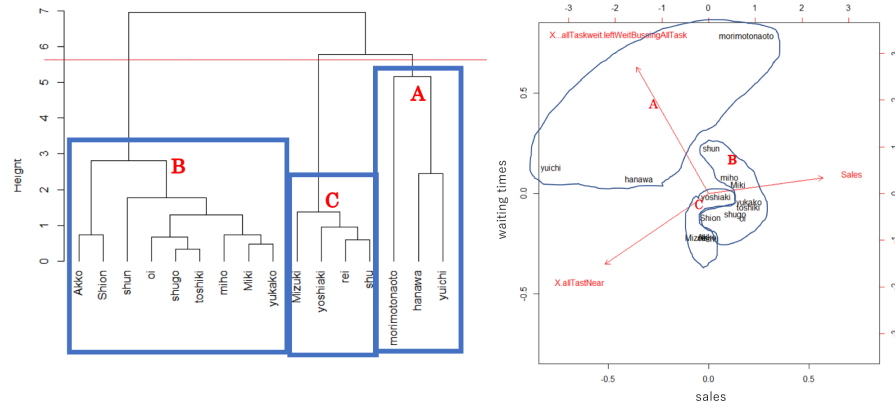
Comparing these two groups, it seems that the players in group C put a higher weight on shortening the waiting times. Whereas the players in group D seem to pursue two

objectives of shortening the waiting times and increasing the task efficiency in a more balanced manner, and, as a result, achieved the highest sales.

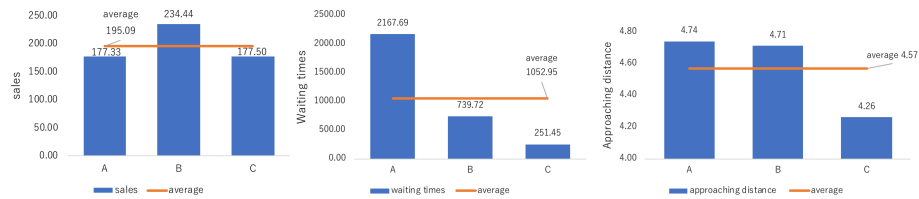
How the players in group D perform the tasks can be characterized with two features. The first feature is that they tended to clear dishes after receiving orders. The second feature is that they tended to receive orders after serving dishes. From these two features, it is implied to be important to handle other tasks before clearing dishes.

## 4.2 Movement on a Prediction Basis

Similarly, the intuitive skills concerning *movement on a prediction basis* tactic utilized in the game sessions are analyzed using the data on the total sales, average waiting time of each task, and average approaching distance (see Fig.5).



**Fig. 5.** The results of the analyses on *movement on a prediction basis*



**Fig. 6.** Averages of *sales*, *waiting times*, and *approaching distance* in each group

As shown in the Fig.5, players are categorized into three groups, A, B and C, this time. How players handle the tasks in each group is characterized similarly by looking into their game play data.

As shown in the Fig.6, the average *approaching distance* of the players in group C is significantly shorter than that of the other groups. This shows that the players in this group did not or cannot move the waitperson agent on a prediction basis. As a result,

their sales values are lower than the average. To sum up, group C can be deemed as a group of low skill players.

The average approaching distances of groups A and B are equally high, so the players in these groups seem to have taken the tactic well. However, the average waiting times and the resultant sales values are different between the groups. That is, the average waiting times is longer and the sales value is smaller in group A. The reason for this seems to be that the players in this group left some tasks for a long time, and, as a result, the turnover rate became low. Thus, it can be concluded that it is group B that contains the players with high skills.

How the players in group B perform the tasks can be characterized as follows. That is, they tended to shorten the waiting times by properly predicting the completion time of cooking dishes and when customers finish their meal. Therefore, it is implied to be important to predict the completion time of cooking dishes and eating them and to start acting earlier based on the prediction.

## 5 CONCLUSIONS

This paper analyzed a waitperson's intuitive skills for shortening the customers' waiting times at a dining table using a serious game newly developed for this purpose. It defined two distinctive tactics called *collection of multiple tasks* and *movement on a prediction basis*, and introduced several measures on them. By analyzing the game scores, waiting times and these measures obtained from game experiments, several characteristics of the skills have been successfully revealed. That is, it is clarified that two tactics defined are actually utilized by the players, different players apply the tactics differently, and when and how the tactics are applied affects the overall performance of the operations.

However, it is still not clear what makes it possible for skillful players to properly determine when and how each tactic should be applied. To understand this aspect of the skills, it will be helpful to study what input information they utilize when determining when and how they apply the tactics. In order to make this study possible, the game should be extended so that it can control what information and when the players are provided with.

Further, various waiting times at a dining table depend not only on how the waitperson performs the tasks, but also which tables customers are assigned to. That is, if two customers are assigned to tables which are close to each other, it will be easier for the waitperson to work on them efficiently. In this paper, since table assignment is determined automatically in a random manner, the potential interactions between the skills of table assignment and the tasks taken up in this paper are difficult to capture. Thus, an important future research direction is combining the proposed game with the table assignment game developed earlier by the authors, so that the interactions can be studied. It is also interesting to extend the proposed single-player game to a multi-player one and analyze collaborative skills among multiple waitpersons.



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