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Personalized and Group-aware Digital Menus: Optimizing Decision Making in Multi-user Dining Scenarios

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Abstract. This study investigates whether a menu recommendation system that integrates personalization with group perception can improve decision-making efficiency and user satisfaction in multi-person ordering scenarios. A within-subjects experiment was conducted with two groups of participants, where each participant completed ordering tasks using both a standard menu and a personalized menu generated from their individual taste preferences. Quantitative data, including the task completion time, number of conflicts and number of items browsed, as well as subjective ratings of satisfaction and ease of use, were collected. The results show that the personalized menu significantly reduced the decision time, lowered conflict frequency and improved satisfaction and ease of use. Paired sample T-tests confirmed that the differences in satisfaction and ease of use were statistically significant. These findings suggest that the proposed personalized and group-aware recommendation system holds considerable potential for optimizing group dining experiences.

Keywords: Personalized recommendation, Group decision support, Digital menus, User satisfaction, Decision efficiency

1. Introduction

Dining out with friends from diverse backgrounds often involves long discussions about choosing dishes, particularly when individuals are unfamiliar with the local cuisine. These prolonged negotiations are not just inconvenient but can also reduce the overall quality of the dining experience, as they may delay meal ordering and create frustration within the group. The existing digital restaurant ordering systems primarily focus on menu digitization and visual presentation but they rarely address deeper needs, such as whether all group members feel fairly represented in the final order. In many cases, a few dominant voices may drive the decision, leaving others without their preferred options. This imbalance raises several critical questions: Does everyone ultimately get what they want? Is the process efficient or does it simply take longer without resolving conflicts? Moreover, the current systems seldom incorporate the users' long-term food preferences or provide mechanisms for balancing individual desires with the group consensus. Addressing these gaps is essential for improving fairness, efficiency and satisfaction in multi-person dining contexts.

This research explores a personalized, preference-based menu system that helps both individuals and groups make decisions more efficiently. To test the proposed system, we designed and developed its prototype that integrates the user preference data (e.g., favorite tastes, dietary

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restrictions or allergy information) with the ordering process. When visiting a restaurant, the users can scan a QR code to access the digital menu and the system will automatically place the most relevant recommendations at the top so that they can easily be reordered. The prototype further supports group dining by merging multiple users' preferences into a group-sorted menu, ensuring that the recommended options balance the individual tastes with the group consensus. This design not only enhances ordering efficiency but also demonstrates how personalization and group-awareness can be implemented in a practical, real-world scenario. The proposed system stores a user's flavor preferences (e.g., favorite taste and dietary restrictions) in an app. When visiting a new restaurant, users can scan the menu QR code, and the system automatically reorders the menu to place recommended dishes at the top.

In group dining scenarios, the system can merge multiple users' preferences and generate a ranked menu based on common group preferences, making it faster to select dishes that satisfy most participants. Rather than focusing on privacy, the emphasis of this study is on enhancing decision-making efficiency and user satisfaction during collaborative ordering [1].

This study aims to evaluate whether the proposed approach reduces the time and conflict during group ordering, improves satisfaction and provides a reusable, context-aware group recommendation.

2. Related work

Personalized food recommender systems have been widely explored to support individual dietary goals and taste preferences [2]. However, these systems often lack support for collaborative or real-world group dining contexts. Research on group recommender systems addresses this gap by developing strategies to aggregate multiple users' preferences into joint decisions, reducing negotiation effort and improving group satisfaction [3].

At the same time, studies have shown that the digital menu design plays a critical role in decision efficiency. Visual hierarchy, highlighted recommendations and interactive layouts can reduce cognitive load and accelerate ordering speed [4]. Features, such as shortlists and critique-based interfaces, further support confident and streamlined choices in recommender systems [5].

Together, these strands of research indicate strong potential for improving dining decision-making through personalization, group modeling and interface optimization. However, the existing systems typically isolate individual or group preference mechanisms and rarely implement dynamic menu restructuring in real-world restaurant contexts. This study aims to bridge that gap by introducing a system that persistently stores individual taste profiles and applies them across varied dining environments. This study proposes a scalable, user-centered approach to enhance ordering efficiency, reduce group conflict and support context-aware recommendations during restaurant visits through personalized and group-adaptive digital menus that reorder dishes based on user preferences.

3. Methods

This study employed a controlled experiment involving eight participants divided into Group A and Group B. Each participant completed two ordering tasks: one using a standard digital menu and the other using a personalized recommendation menu based on individual preferences. Group A used the personalized menu first, followed by the standard menu, while Group B vice versa. To minimize potential confounding effects from menu familiarity, the standard and personalized menus were sourced from different restaurants.

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Objective measures adopted in the subsequent analysis included order completion time, number of conflicts and the extent of menu browsing. Subjective data was collected via a 10-item Likert-scale questionnaire that assessed satisfaction and usability. The Likert scale was designed on a five-point range, where 1 indicated “strongly disagree” and 5 “strongly agree.” In addition, open-ended feedback interviews were conducted to capture participants’ qualitative reactions.

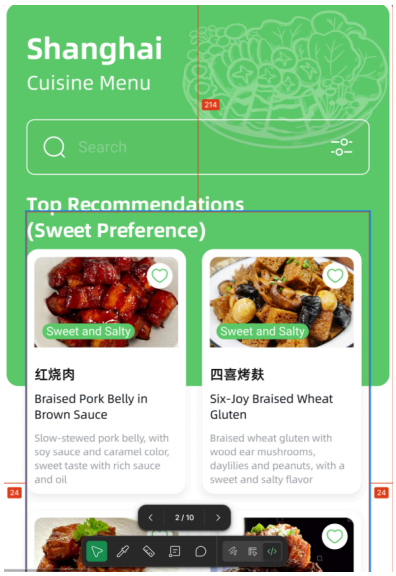


Figure 1. Personalized menu prototype displaying top recommendations based on individual sweet taste preferences

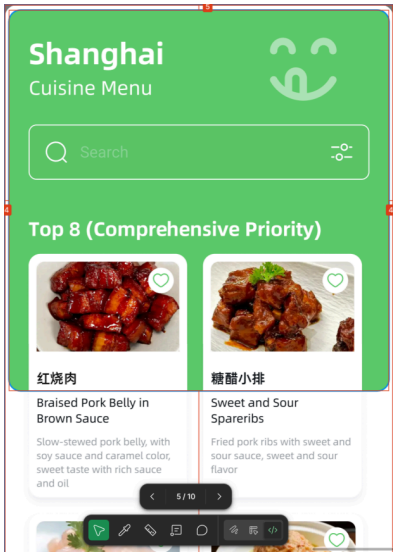


Figure 2. Group-aware menu prototype displaying top recommendations aggregated from all participants’ preferences

To better demonstrate the functionality of the proposed system, prototype interfaces were developed to visualize how personalized and group-aware recommendations would be presented to users.

Figure 1 shows an example of a personalized menu generated for a user with a strong preference for sweet flavors. In this interface, sweet-flavored dishes such as Braised Pork Belly in Brown Sauce

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and Six-Joy Braised Wheat Gluten are automatically placed at the top of the menu. This design highlights the system ability to dynamically reorder items based on individual taste preferences, reducing browsing effort and helping users quickly identify suitable options.

Figure 2 illustrates a group menu generated by aggregating the preferences of all participants in a dining group. In this version, dishes that align with the collective preferences (e.g., Braised Pork Belly in Brown Sauce, Sweet and Sour Spareribs) are prioritized at the top, while the rest of the menu remains in its original order. This approach reflects the group-aware function of the system, aiming to minimize conflicts and accelerate consensus reaching during the decision-making process.

4. Results

A comparison of mean values indicated that the personalized menus consistently outperformed the standard menus. Specifically, participants reported significantly higher satisfaction when using the personalized menu (M = 4.50, SD = 0.58), compared to the standard menu (M = 2.38, SD = 0.54; see Figure 3). Similarly, the usability ratings were higher for the personalized menus (M = 4.25, SD = 0.41) than for the standard menus (M = 2.63, SD = 0.41; see Figure 4). These results, combined with the shortened task completion time and conflict frequency (see Figures 5 and 6), clearly demonstrate the effectiveness of the personalized system in enhancing both decision-making efficiency and user experience. The objective behavioral data aligned with these subjective reports. The average task completion time was shorter under the personalized condition (157.83 seconds) compared to the standard menu (180.07 seconds), indicating that users were able to reach decisions more quickly. In addition, the number of conflicts — defined as disagreements occurring before reaching a final decision — was notably lower with the personalized menus (M = 1.13) than with the standard menu (M = 3.75). These differences highlight the system effectiveness in simplifying group negotiations and facilitating consensus reaching.

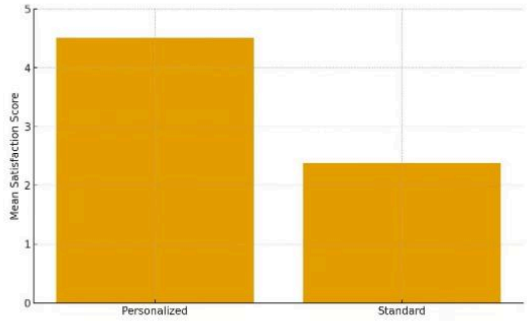


Figure 3. Comparison of satisfaction between personalized and standard menus

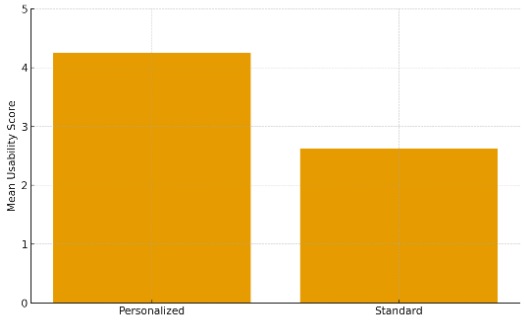


Figure 4. Comparison of usability between personalized and standard menu

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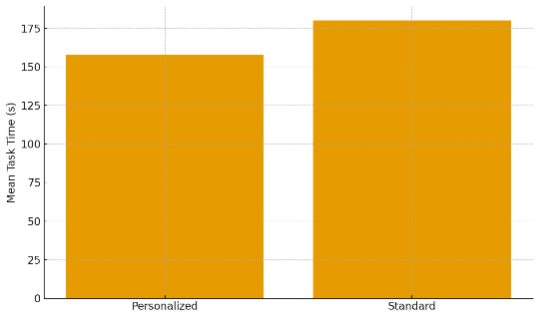


Figure 5. Comparison of task completion time between personalized and standard menus

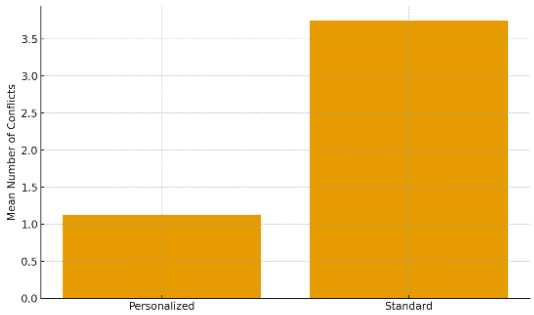


Figure 6. Comparison of conflicts between personalized and standard menus

To statistically validate the reported observations, paired-sample t-tests were conducted. Results revealed that the personalized menus significantly outperformed the standard menus in terms of satisfaction ($t(7) = -3.21$, $p < 0.01$) and usability ($t(7) = -3.02$, $p < 0.05$). Although the differences in completion time and conflict frequency did not reach statistical significance, likely due to the small sample size, the consistent trends still provide strong support for the effectiveness of the system.

The experimental data were processed by calculating the mean values for all dependent variables across the two conditions (personalized vs. standard menu). Subjective measures of satisfaction and usability were collected via a 10-item Likert-scale questionnaire, where responses ranged from 1 (strongly disagree) to 5 (strongly agree). Objective measures — including completion time, conflict frequency and the number of items browsed — were directly recorded during the task. By combining both self-reported and behavioral data, this study achieved a comprehensive evaluation of the system performance.

Overall, the findings clearly demonstrate that incorporating individual preference profiles into a group-aware menu recommendation system can significantly enhance decision-making efficiency and user satisfaction in multi-user restaurant ordering scenarios.

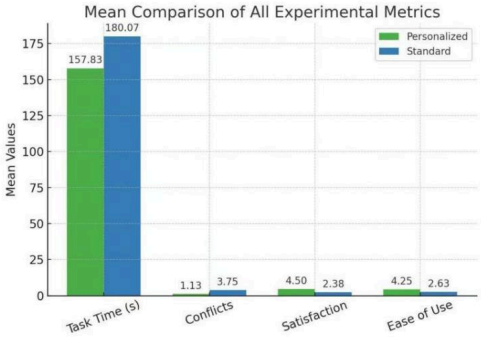


Figure 7. Comparison of mean values of task time, conflicts, satisfaction and ease of use between personalized and standard menus

5. Discussion

The findings of this study provide strong evidence that an AI-driven, personalized, group-aware menu recommendation system can significantly enhance decision efficiency and user satisfaction in multi-user dining contexts. Both subjective and objective data demonstrated the benefits of

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personalization. Participants reported significantly higher satisfaction and usability scores when using the personalized menus, while behavioral measures indicated shorter decision times and fewer conflicts. These outcomes suggest that tailoring menu structures to reflect individual preferences while aggregating them for group decisions effectively reduces the cognitive load of browsing large menus and the social friction often associated with group ordering. As one participant noted, “It saved us a lot of time because I could immediately see dishes I liked” (P3). Another participant emphasized the reduction of conflict: “Usually we argue a lot, but this menu helped us agree faster” (P6). In addition, some participants appreciated the clarity of the layout, with one remarking, “The highlighted dishes made it easy to choose without scrolling endlessly” (P2).

These results align with the prior research on personalization and recommender systems, which has shown that adaptive interfaces can enhance decision-making efficiency and user trust. However, the present study extends the existing work by applying personalization not only to single-user contexts but also to collaborative group scenarios, where negotiation and compromise are essential. The observed conflict reduction is particularly noteworthy as it demonstrates the system ability to facilitate smoother group interactions — a dimension that has been less explored in earlier food recommender studies.

6. Conclusions and recommendations

This study validated the effectiveness of a personalized, group-aware menu recommendation system in enhancing ordering efficiency and group satisfaction in multi-person dining contexts. When applied in real-world restaurant environments, the system has the potential to significantly optimize group dining experiences by reducing conflicts and improving decision-making efficiency.

The study highlights the value of integrating persistent individual preference profiles into group-aware recommendation systems, demonstrating their potential to improve efficiency, reduce conflicts and enhance satisfaction in collaborative decision-making contexts.

7. Future work

Despite the encouraging results, several limitations must be acknowledged. The small sample size (n = 8) limits the statistical power of the analysis and the generalizability of the findings. Additionally, although data trends indicated faster decision-making and fewer conflicts with the personalized menus, these measures did not reach strong statistical significance due to the limited number of participants. Another limitation is that the study was conducted in a controlled experimental setting rather than a live restaurant environment, thus, contextual factors, such as time pressure, background noise and real social dynamics, were unlikely fully replicated.

Future work should address these limitations by conducting studies with larger and more diverse participant demographics, as well as testing the system in real-world restaurant environments to better capture ecological influences. Moreover, the further development of the system may incorporate advanced AI technologies to handle more complex preference data, including allergen filtering, dietary restrictions and culture-related taste preferences. Long-term storage of user preferences should be implemented to improve usability across different contexts.

Additionally, participant feedback suggested specific improvements such as providing visual explanations for recommendation logic, enabling manual adjustment of menu order and enhancing the visibility of dietary restrictions. These adjustments would further optimize the system practicality, user autonomy and overall appeal.

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