Text-aided Group Decision-making Process Observation Method (x-GDP): A novel methodology for observing the joint decision-making process of travel choices

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SHORT SUMMARY

Joint travel decisions remain poorly explained in behavioral models due to lack of empirical data. To address this problem, we propose a novel survey methodology to collect data on joint activities, from all members of a given clique. Through this method we are able to observe not only the outcome, but also the decision-making process itself, including the alternatives that compose the choice set, individual and clique characteristics that might affect the choice process, and the discussion behind the choice via texts. This will allow researchers to gain a deeper understanding of the joint decision-making process, including how alternatives are weighted, how members interact with each other, and how joint choices are made. Here we introduce the results of an implementation focusing on joint eating-out activities in Tokyo, focusing on survey components, execution, and insights on the data.

Keywords: Activity-based modeling, group behavior, joint decision-making, leisure travel behavior, social networks, survey methods

1. INTRODUCTION

Many of our behavioral decisions are made in coordination with members of the social networks we are embedded in. However, joint decision-making processes, particularly related to social activities, remain poorly explained in traditional behavioral models. A key reason for this is the lack of empirical data. While some studies have indeed focused on modeling joint activities, these studies rely on agent-based simulations (Arentze & Timmermans, 2008) and still require empirical data for parameter estimation and validation.

In recent years, egocentric network data-collection efforts have been conducted to get a better understanding of ego-centric social networks characteristics and social interactions such as surveys in Canada (Carrasco & Miller, 2006), Switzerland (Kowald & Axhausen, 2012), The Netherlands (van den Berg et al., 2012), Chile (Carrasco & Cid-Aguayo, 2012) and Japan (Parady et al., 2020) and the U.K. (Calastri et al., 2020). A key limitation of these efforts is that since data is collected using an ego-centric approach, the data that can be collected on other group members is limited to what ego can recall. This limitation is particularly critical for modeling travel behavior as spatio-temporal constraints are key constraints defining travel behavior (Hagerstrand, 1970) . Han *et al.* (2023) has shown in the context of group eating-out destination choices that

considering the average travel times of all participating members of a clique increases the predictive ability of the model by up to 49% against a model considering only ego's travel times, a considerable increase in performance.

Against this background, this study proposes x-GDP (Text-aided Group Decision-making Process Observation Method), a novel survey method to collect data on joint activities and their underlying joint decision-making process of any dimensions of travel choice. We implemented the method for joint leisure activities with a focus on destination choice. Through this method we are able to observe not only the outcome but also the decision-making process itself, including the alternatives that compose the choice set, individual and clique characteristics that might affect the choice process, as well as the discussion behind the choice via texts. Observing such a process will allow us to first understand the decision-making process qualitatively, including how alternatives are weighted, how members interact with each other, and finally how the choice is made.

2. METHODOLOGY

The main objective of x-GDP method is to collect data on the joint decision-making process of travel-related activities of a given clique, a group where all members know each other. The general idea of x-GDP is to ask participant cliques to plan (and later actually execute) an actual activity or set of activities in the virtual presence of the researchers, using a chat-group interface. In this study we use as a case study eating-out activities due to its high frequency in joint activities (Stauffacher et al., 2005). Since participants have to actually conduct the activity decided in the group discussion, there are real incentives to guarantee a real discussion that considers the preferences and constraints of clique members. Fig 1 illustrates the flow of an x-GDP survey.

Step 1: Recruitment and pre-registration

x-GDP requires participation of existing cliques and registration of all members for schedule coordination. This study targeted cliques composed of at least one University of Tokyo student to simplify the sampling process. This was also done to limit to some extent the spatial distribution of participants to cliques with similar daily life activity spaces. Provided this condition was met, no constraints were imposed on the eligibility of other members.

Recruitment was done via social media (the Urban Transportation Research Unit Twitter account). In spite of the nonprobability sampling method, it is important to point out that the student population of the University of Tokyo is not that large (27,233 students) and is rather homogeneous in terms of sociodemographics. In total, data on 816 individuals in 217 cliques was collected. Out of the 816 participants 76% were University of Tokyo students, 20% students from other universities and 4% non-students.

Step 2: Virtual meeting schedule coordination

Scheduling coordination was conducted via online forms. As shown in Fig 2, the Schedule Coordinator matched Experiment Moderators (the person in charge of guiding the experiment over Zoom) with cliques. Once matched, all members were informed of the date and time and other details of the experiment such as conditions for payment of participation reward, etc.

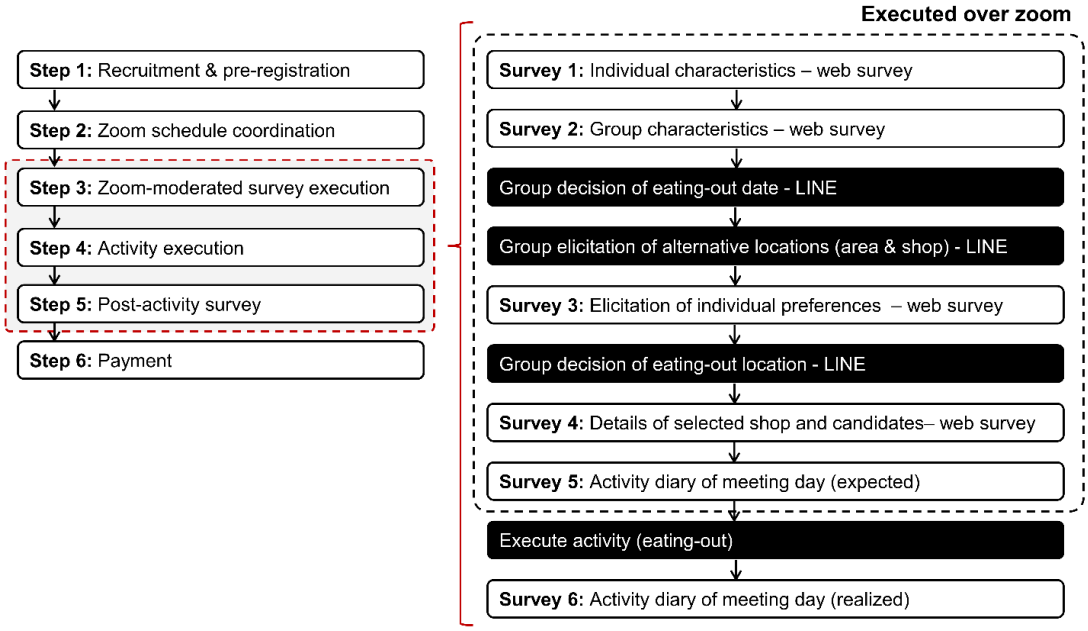

Fig 1. Flow of an x-GDP survey

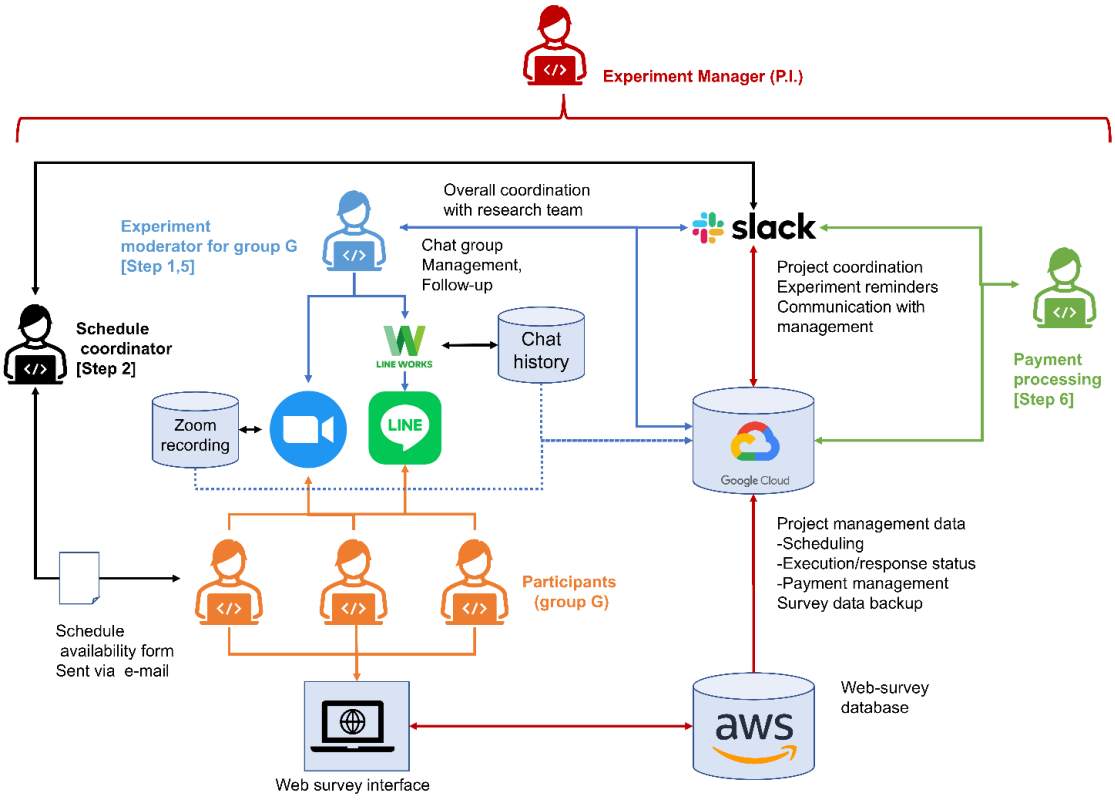

Fig 2. Simplified diagram of the logistics of the x-GDP experiment after recruitment.

Step 3: Zoom-moderated survey execution

This step was the crux of the experiment. Guided by the Experiment Moderator, participants were first asked to respond to Survey 1 and Survey 2 via an online survey platform. Survey 1 collected

data on individual socio-demographic characteristics. Survey 2 collected data on clique characteristics.
After Survey 2 was completed, the Experiment Moderator invited all members to a LINE group chat (LINE is the most popular instant communication app in Japan). The Experiment Moderator joined via a Line Works account (a cloud-based business chat tool that can link to LINE) for privacy, ethical and data management reasons. In the LINE group chat, the Experiment Moderator asked the clique to first decide the date and time of the activity. Two constraints were imposed. First, for management reasons, the date of the activity must be within a maximum of two weeks from the day of the experiment. Second, the activity must be done from 17:00 on to reduce the temporal variability of activities and simplify the modeling process later on. Note that these constraints can be generalized depending on the interests of the researcher.

Date and time defined, participants were asked to elicit potential areas and shops to execute the activity. There was no upper bound on how many candidates could be elicited but participants were asked to propose at least one location per person. Before moving on to the discussion phase to choose the activity location, respondents were asked to respond to Survey 3, which asked them to rank the elicited candidate locations in order of their personal preference. This was done anonymously so that responses were not affected by the opinions of others.

After completing Survey 3, participants were asked to discuss and decide the location of the eating-out activity. No guidance was given regarding how to make this decision, so each clique was free to choose their own method. No time constraint was imposed. The average duration for the LINE discussion section including time decision, preference elicitation and location decision was 35 minutes (S.D. 16.42 mins). The moderator then asked participants to respond to Survey 4 via a web-survey (at the clique level), to collect data on the chosen location as well other candidate locations. To avoid the issue of untraceable locations, participants were asked to use store links from either Tabelog (a restaurant review site in Japan) or Google maps. Out of the 1,188 unique shops elicited in the experiment, we were able to identify 99.5% of the shops via their public links and collect additional data on these shops.

Finally, once Survey 4 was completed, participants were asked to report their expected schedule for the day of the activity in the form of an activity diary (Survey 5) via a visual and interactive interface that greatly reduced the response burden.

Step 4: Activity execution
On the morning of the day of the planned activity, participants were sent a reminder via LINE and were given explanations about proof-of-execution submission such as location pin, a picture in front of the shop with a mobile phone showing date and time, A group picture inside the restaurant and the receipt.

Step 5: Post-activity survey
Using the same interface as Survey 5, data was collected on the actual schedule executed on the day of the activity.

Step 6: Payment
A monetary incentive of JPY 4000 (approx. USD 29.80) was provided for participants who responded to all surveys and provided proof-of-execution. For participants who did not provide proof-of-execution or did not complete Survey 6 after participation, the incentive was JPY 1080 (approx. US$8).

3. RESULTS AND DISCUSSION

For brevity, we will no introduce the details of the individual and clique characteristics and focus explicitly on the scheduled joint activity and its decision-making process. Fig 3 illustrates both the chosen restaurant location as well as other considered candidates. The first thing to point out is the agglomeration of locations around Tokyo sub-centers such as Shibuya, Shinjuku and Tokyo connected via the Yamanote loop line, in addition to areas around the University of Tokyo's Komaba and Hongo Campuses. Historically, the Tokyo sub-centers have exhibited high degrees of agglomeration of commercial and other facilities due to their high levels of access both from the railway-connected suburbs as well as the city center. In addition, smaller agglomerations can be seen around the intersection of railway lines even though they are not central.

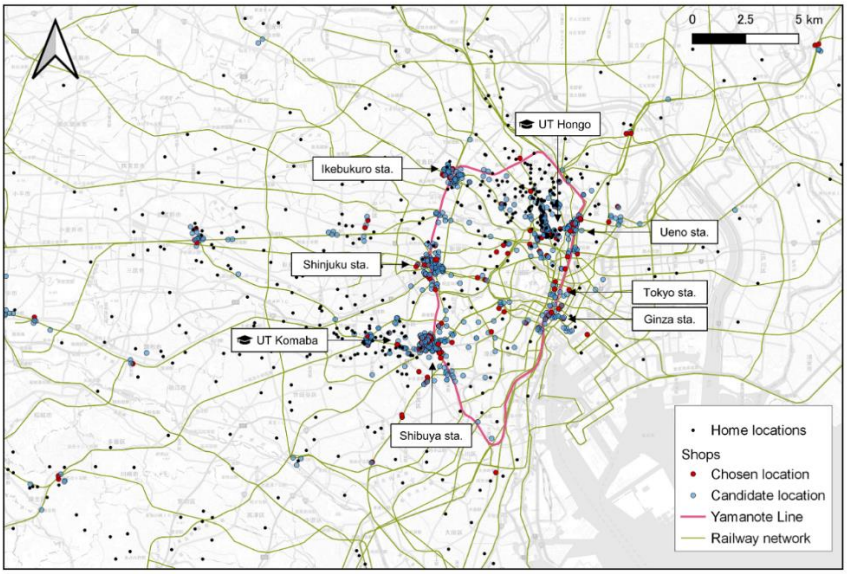

Fig 3. Location of chosen restaurants and alternatives considered during the experiment.

When asked the main reasons for choosing the locations each clique chose, restaurant quality and accessibility were the most frequently mentioned factors (78.8% and 57.1%, respectively). This is also consistent with the attitudinal responses collected in the individual survey (Survey 1) where respondents were asked to rate on a 7-point Likert scale (1 being not important at all, 7 being extremely important), the importance they place on different factors when eating out with a group (Fig 4). Group evaluation of shop and group transit access were rated six or seven by 71.2% and 76.7% of the individuals, respectively. What these answers do not capture is whose accessibility is being prioritized, or whose preferences. As shown in Table 1, in less than 12% of cases, all members' individually top-ranked locations were actually chosen, with this percentage reducing as clique size increases. Furthermore, irrespective of clique size in around 17% to 20% of cases, no one's top-ranked location was chosen by the clique, suggesting a considerable degree of compromise among members. This underscores the importance of observing the actual decision-making process to gain a better understanding of within-group dynamics.

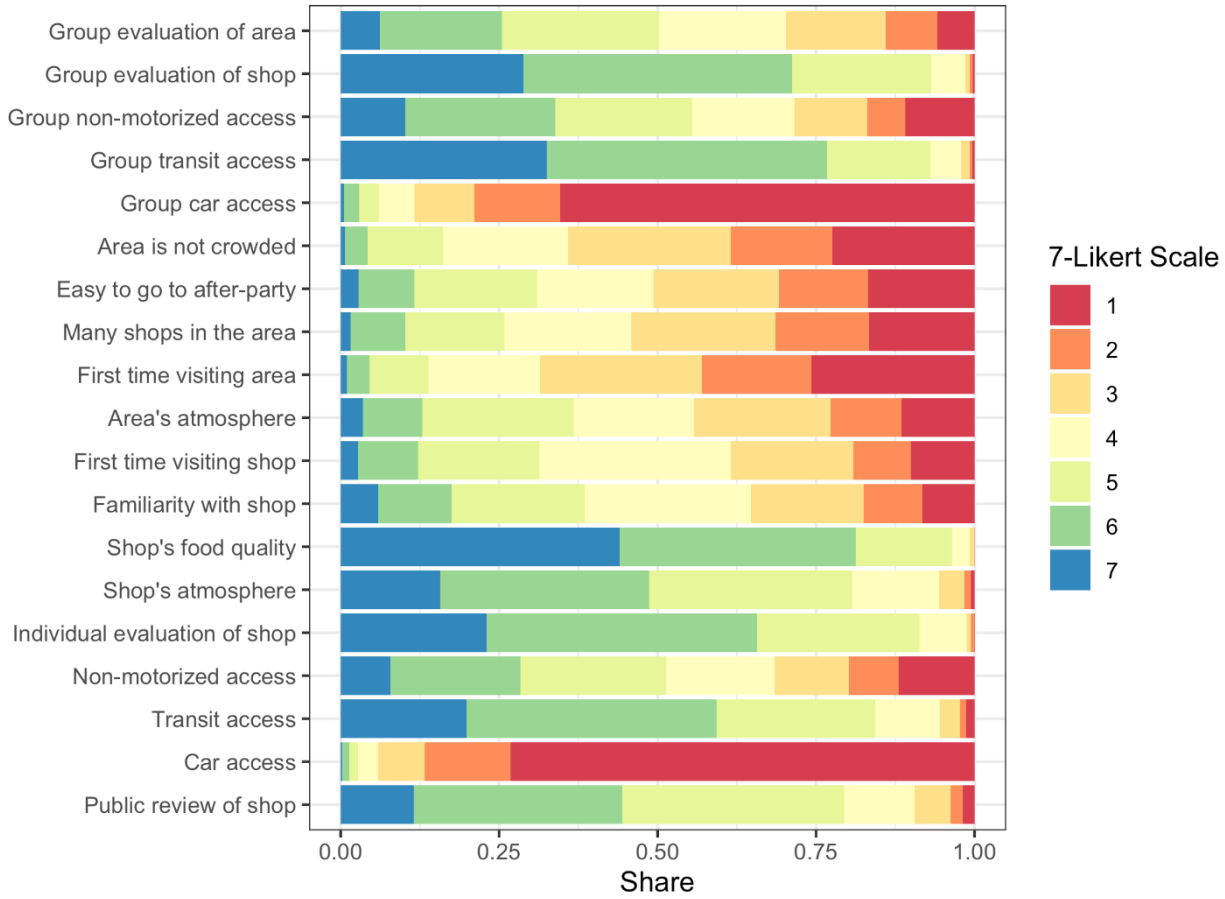

Fig 4. Factors considered important for group-level restaurant choice by individuals (n=816)

Table 1. Degree of matching between individually top-ranked locations and clique choice

		Number of individuals whose top-ranked locations are chosen by the clique					
		0	1	2	3	4	5
Clique size	3	18.6%	37.1%	33.0%	11.3%		
	4	14.7%	29.3%	28.0%	18.7%	9.3%	
	5	20.0%	37.8%	24.4%	11.1%	6.7%	0.0%

Two case studies

To further elucidate the properties of the data collected we will briefly introduce the decision-making process in two particular cases, as summarized in Fig 6 and Fig 7 using information from Surveys 1 to 5 as well as the LINE group discussion text record (a). The plots of members' schedules (b) and activity places (c) were created using data from the individual preference elicitation survey (Survey 3) and the expected activity diary of the meeting day (Survey 5).

The first clique (Fig 6) is composed of five same-year students. Two of the members had previous commitments on the suburbs of Tokyo on the day of the activity (1b and 1c). In this particular case several features of the decision-making process can be highlighted (1a). For instance, Mr. A pushed from early in the discussion for his preference, eating French food at Ginza, an upscale district in central Tokyo. Other members, like Mr. C, had a personal preference but

showed high degree of agreeableness and willingness to compromise for the group stating: "*My preference is for meat, but if everyone is in for French at Ginza, I don't mind.*" While other alternatives were raised during the discussion such as Japanese BBQ or and oyster bar in Shibuya, Mr. A kept insisting on his preference by posting a link to the shop's online site and menu: "*Let me give you an idea of what French at Ginza will be like.*" It should be noted that most members' individually top-ranked locations were close to their expected origin locations on the day of the activity. Another constraint in the process was that some students were under 20 years old, hence could not drink alcohol, which tilted the choices towards restaurants rather than bars or Japanese izakaya. In the end the group agreed on Mr. A's preference. In this particular case, Mr. A's strong opinion clearly influenced the final decision, given the other member's agreeableness and willingness to compromise. In other words, the weight of Mr. A's opinion was larger than other members. At the same time, we can speculate that had other members had similarly strong opinions, the resulting outcome might have been different. Such information cannot be observed from the outcome alone, but we were able to capture it with the proposed x-GDP method.

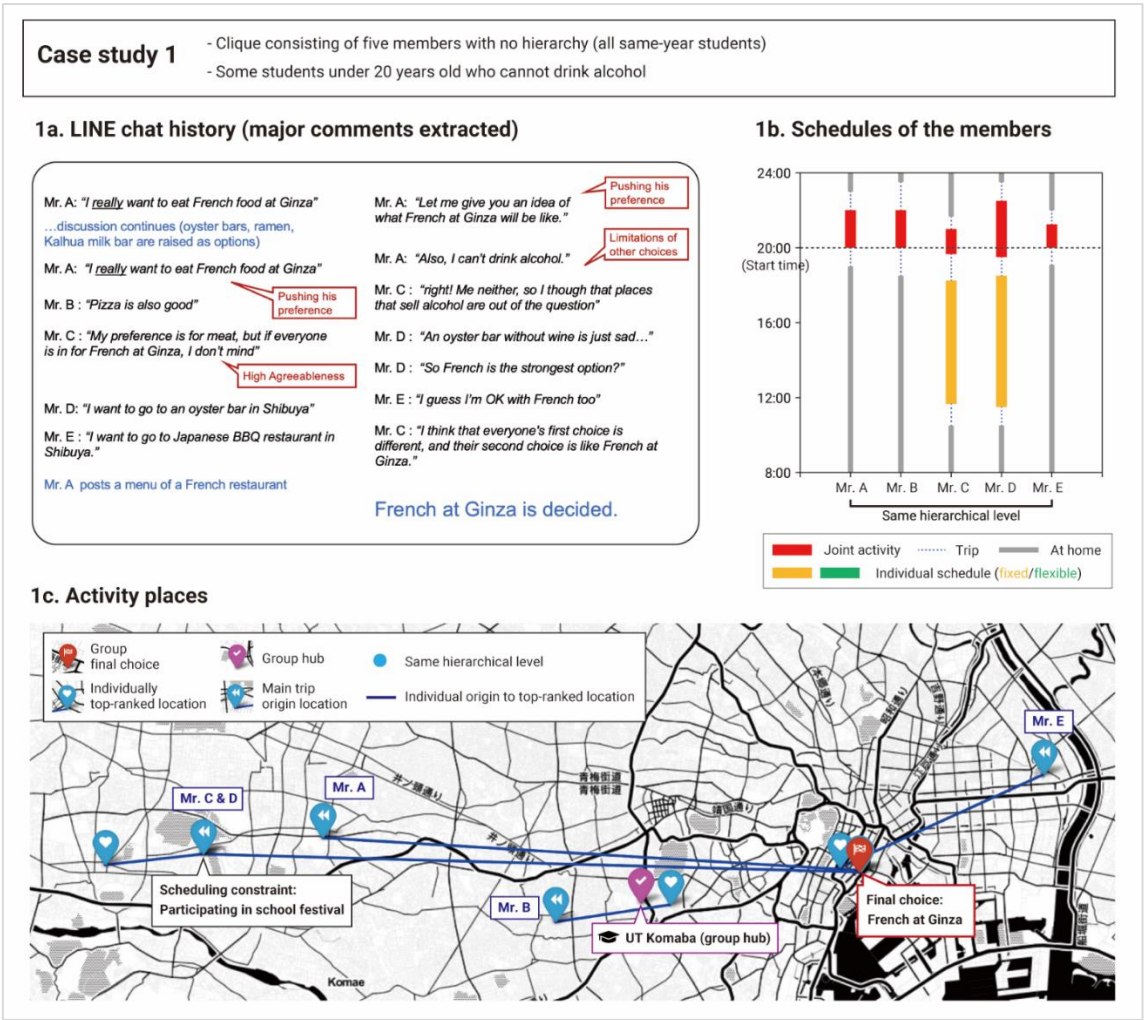

Fig 6. Extract of collected data for a clique 1. 1a. LINE chat excerpt. 1b. Schedule of members on activity day. 1c. OD lines to individually top-ranked location.

The second clique is composed of three futsal club friends, one of them being one year more senior than the other two. First, the joint activity time was set based on two time constraints. First, Mr. A had a part-time job at Shinjuku until 19:00 and second, all members wanted to watch the

FIFA World Cup (Qatar 2022) after dinner. Once the time slot was defined, several candidate locations were proposed, but they were all in Shinjuku. A possible reason for this is that Mr. A had a non-flexible activity schedule during that day. It is also worth noting that Mr. A was the more senior member of the group. The rest of the discussion focused on the restaurant type, such as hotpot, Brazilian BBQ and gibier. In this case, economic constraints were taken into consideration and Brazilian BBQ was selected.

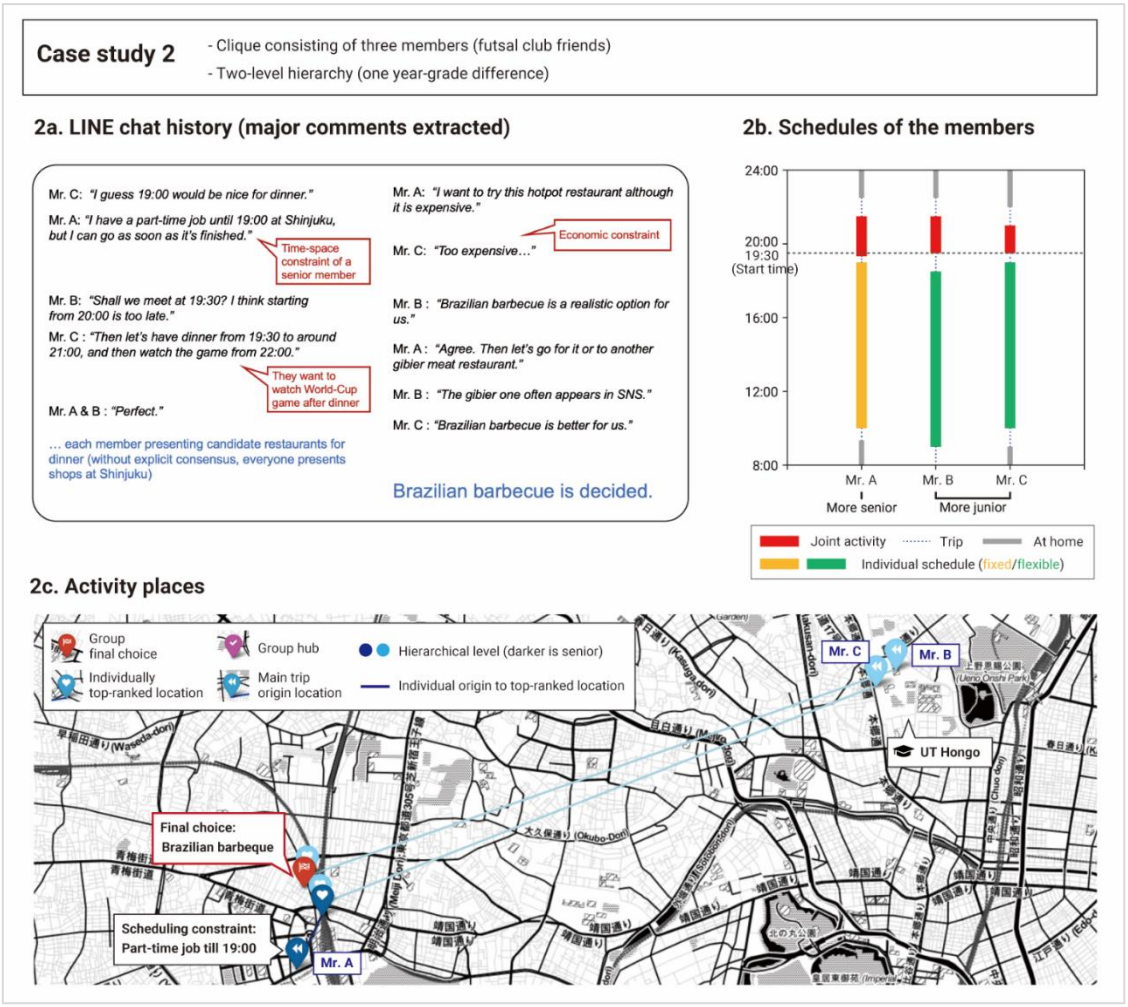

Fig 7. Extract of collected data for clique 2. 2a. LINE chat excerpt. 2b. Schedule of members on activity day. 2c. OD lines to individually top-ranked location.

4. CONCLUSIONS

To conclude we want to point out potential avenues of research that can be pursued with this kind of data. First, we have illustrated with only a few examples, that clique-level decision-making is rather heterogeneous. As such, a first necessary step is a qualitative analysis of the group discussion text records collected to formulate hypothesis regarding decision-making patterns. Such qualitative analysis can be complemented with quantitative methods such as natural language processing and cluster analysis.

Another potential avenue of research is the empirical estimation of joint accessibility and respective parameters. Theoretical joint accessibility methods have been proposed by Neutens *et al.*

(2008) however, empirical data is required to estimate model parameters. Joint accessibility estimates can be used to further investigate agglomeration effects in cities, as well as estimate joint activity destination choice models.

Finally, based on the above, we expect to build a theoretical framework to quantitatively model the joint decision-making process considering clique-level dynamics.

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