Observing Group Decision Making Processes

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ABSTRACT

Most research on group recommender systems relies on the assumption that individuals have conflicting preferences; in order to generate group recommendations the system should identify a fair way of aggregating these preferences. Both empirical studies and theoretical frameworks have tried to identify the most effective preference aggregation techniques without coming to definite conclusions. In this paper, we propose to approach group recommendation from the group dynamics perspective and analyze the group decision making process for a particular task (in the travel domain). We observe several individual and group properties and correlate them to choice satisfaction. Supported by these initial results we therefore advocate for the development of new group recommendation techniques that consider group dynamics and support the full group decision making process.

CCS Concepts

•Information systems → Recommender systems; •Human-centered computing → User studies;

Keywords

Group recommender systems; User study; Preference aggregation; Group decision processes

1. INTRODUCTION

Most research on group recommender systems originated from the assumption that individuals, when facing a choice problem, like finding a travel or a movie to experience together, do have conflicting preferences. Hence, the role of the recommender is to mediate the preferences of the group members and suggest options that can simultaneously satisfy group members [10].

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However, it is not easy to define the right mediation procedure; it is impossible to identify mediation techniques that satisfy even simple requirements (Arrow's impossibility theorem). Hence, several preference aggregation techniques have been proposed in the literature, experimental studies have compared them, and confirmed that there is no clear winner [10]. In parallel, observation studies have tried to identify which preference aggregation techniques are actually used in groups and they, however, could not identify a uniquely preferred approach [10].

It is also worth noting that other empirical studies have shown that in many group recommendation no conflicting preferences are observed [3]. In fact, group recommendations may benefit from the usage of a larger amount of preference data, i.e. the union of the group members.

Hence, a fundamental research question is whether preference aggregation is the core problem for group recommendation or if we have to tackle other facets of group decision making. In fact, scholars of group dynamics, while studying decision making in groups, have identified the importance of the full decision process adopted by the group and de-emphasized the preference aggregation step, as only one component of such a process [6].

In this work we follow this indication and argue that group recommendation research benefits from a wider analysis of how people make decisions in groups. Hence, in this paper we describe an observational study, in which several user groups were monitored while facing a travel decision task. We recorded: the individual preferences for a small set of alternative destinations (before group interactions); the interactions between group members during the decision making process; and the individual evaluations of the task and the choices of the group.[1] The contributions of this paper are:

- The definition of a replicable observational study procedure and measurement tools that can shed light on the actual group decision making process.
- The implementation of the observational study in the concrete case of tourism decision making.
- Experimental evidence that conflicting preferences, even if initially present, do not substantially affect participants' satisfaction with the final group choice.

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- Experimental evidence that other factors, related to user and group characteristics, are more important in understanding the decision making outcome, such as choice satisfaction or task difficulty.

These results are of primary importance for the development of novel types of group recommender systems and can stimulate complementary studies aimed at understanding group decision making processes and the role of recommendation in groups.

2. STATE OF THE ART

Several researches in group recommender systems focused on core preference aggregations algorithms. Two overarching strategies are commonly used: aggregating individual profiles into a joint group profile (*aggregated profiles*) and aggregating individual recommendations into a single group recommendation list (*aggregated recommendations*) [3]. Several aggregation strategies have been proposed [10]. For example, *Average* strategy returns the average of individual ratings, *Least misery* and *Most pleasure* strategy maximize the preference of the least and the most happy members respectively.

The research in travel recommender systems for groups has made several contributions. In particular, *Intrigue* [1] is a tool helping tour guides in designing tours for heterogeneous groups of tourists that include relatively homogeneous subgroups (e.g. children). The group model is a weighted average of the subgroup models, which are weighted according to the importance of the subgroups. *Travel Decision Forum* [9] allows group members to define their preferences and uses animated characters to help them arrive at an accepted choice in the organization of a vacation. *Trip@dvice*, a case-based reasoning recommender system, applies a cooperative negotiation methodology to tackle the group recommendation problem [4]. *Collaborative Advisory Travel System* (CATS) proposes to use critiquing in order to support the negotiation of recommendations [11], i.e., each member can send a *critique* to the other members, thereby sharing his or her thoughts about a particular option.

Recommender systems can also support mediation, such that system proposed items could become acceptable by all group members. *Choicla* is an environment that supports the flexible definition of decision functionality in a domain independent fashion [14]. It includes recommendation and explanation modules that can improve trust in recommendations and in the decision support quality.

Up to now group recommender systems research has only devoted minor attention to explore how group members make choices and how the process of making choices can be supported [5]. A considerable amount of the observational literature on group decision making comes from social science and psychology. In [15], the authors have emphasized and demonstrated that "*social sharedness*", the degree to which preferences, information etc. are shared within groups, is a key element to understand group decision making. Moreover, researchers who study the functional theory of group decision making suggest that groups engaged in the four stages: *Orientation Discussion Decision Implementation* (ODDI model) are more likely to make better decisions than those who mishandle information along the way [6].

3. STUDY PROCEDURE

Pre-studies took place at TU Delft and the universities in Klagenfurt and Leiden, while an extended study was carried out at TU Wien. Each study implementation consisted of three phases: pre-survey, groups meeting and post-survey phase. At each university, participants were arranged into groups of two, three or four members. Additionally, at TU Wien each group selected two students (observers) to observe and record their group activities, while others took part in the decision making process (decision makers).

In the pre-survey phase, the decision makers filled in an online questionnaire capturing the participants' individual profiles, preferences and dislikes: basic demographic data, 17 tourist roles [7], Big Five Factors [8] and important criteria for ranking destinations. Furthermore, students rated the attractiveness of ten predefined destinations, i.e., Amsterdam (for Austrian participants), Berlin, Copenhagen, Helsinki, Lisbon, London, Paris, Rome, Stockholm and Vienna (for Dutch participants) using a five point scale. In the second phase, the group meetings took place. The task for decision makers was to jointly choose one of the ten previously rated destinations that they, as a group, would like to visit. Additionally, students were asked for their second choice in case the first would no longer be available. In Vienna, each group had two observers who audio recorded and reported the group discussion and decision process. Observer's report was constructed based on Bales's Interaction Process Analysis (IPA) [2] and covered: decision scheme, discussion and decision time and twelve categories of group members' behavior, i.e., Friendliness, Tension Release, Give/Ask for Opinion, Suggestion or Information, Tension and Unfriendliness. In the post-survey phase, the participants responded to an online questionnaire their first and second group choice, their perception of the attractiveness of the ten destinations, their satisfaction with the group choice, their perceived difficulty of the group decision process, how they identified themselves with the group and their assessment of the task. In total the collected data sample comprised 78 entries with 24 groups of two, three and four group members.

4. RESULTS

The main objective of this study was to analyze group decisions and their associated decision processes in the travel domain from a group dynamics perspective. To shed more light on this, we analyzed individual preferences of group members, the actual group choices after the discussion and the quality of the group choice, i.e., the individual satisfaction with the group choice.

Table 1: Frequency of ratings aggregated for the 10 cities

Rating	1	2	3	4	5
# of ratings	61	90	212	216	147
Percentage	8.4%	12.3%	29.2%	29.7%	20.2%

5 - Very Attractive to 1 - Not Attractive.

The individual ratings from the pre-survey of the predefined destinations were relatively high (see Table 1). The distribution was slightly right-skewed and is rather similar to other rating distributions (e.g., MovieLens). This was confirmed by the post-survey, where 87.3% of partic-

ipants agreed to the statement *"Many destinations were appealing"*. Furthermore, the individual satisfaction with the group choice was overly high (see Table 2).

Table 2: Group choice satisfaction

	5	4	3	2	1
ChoiceSat1	44.9%	48.7%	5.1%	0.0%	1.3%
ChoiceSat2	39.7%	39.7%	15.4%	5.1%	0.0%
ChoiceSat3	35.9%	46.2%	9.0%	7.7%	1.3%

ChoiceSat1 - *"I like the destination that we have chosen"*; ChoiceSat2 - *"I am excited about the chosen destination"*; ChoiceSat3 - *"The chosen destination fits my preference"*; Ratings: 5 - Strongly Agree to 1 - Strongly Disagree.

Remarkably, for the majority of participants (i.e., 40 individuals) the outcome of the group decision process did not correspond to their most preferred destinations, while for the remaining 38 individuals the group choice was in line with their individual preference. As expected, the satisfaction with the group outcome was particularly high for those who had their initial top choice selected as the group choice, i.e., 35 individuals out of 38 (92.1%) indicated that they were excited about the chosen destination. However, when the group choice did not correspondent to the participants' initial preference, they were nevertheless remarkably satisfied. Here, more than two-third (i.e., 27 out of 40) were excited about the group choice, even though the chosen destination was not their preferred one.

Next, we compared the actual group choices with recommendations that would be produced by the most common aggregation strategies in group recommender systems. There was a big gap between the actual choices and these strategies. Based on the individual ratings of the group members we computed the top two recommendations for each group according to the most common aggregation strategies. The actual group decisions on their top 2 destinations were our ground truth and we calculated precision for the top one and top two group choices (see Table 3). Overall, the analyzed aggregation strategies, confirming our assumption, only partially predict the choices made by groups after a face-to-face discussion. Thus, an aggregation strategy applied in a mechanical way may not produce a recommendation that the group would choose. Hence, we believe that a useful group recommender can be built without adhering to any of these strategies. Nevertheless, the obtained results confirm the results from [10] - multiplicative strategy outperforms other aggregation strategies.

Table 3: Aggregation strategy performance

Strategy	Precision Top 1	Precision Top 2
Additive	0.333	0.233
Multiplicative	0.343	0.25
Median	0.277	0.214
Least Misery	0.200	0.157
Most Pleasure	0.140	0.122

Finally we tentatively explored which individual or group features such as personality traits and travel behavioral patterns [12] and their composition in a group setting influence outcome measures such as group choice satisfaction or the perceived difficulty of the decision process. Results of an exploratory correlation analysis showed some statistically significant associations (see Table 4). In the first part of Table 4 the size of the used data sample was 77, in the second 27 (data collected solely in Vienna) and in the third 24 (correlation at the group level). We analyzed relations between the diversity within a group and satisfaction and difficulty at the group level. The diversity within a group was calculated as the variance of the respective individual features of all group members. Choice satisfaction and difficulty of the group decision process at the group level were calculated as mean values.

Table 4: Correlations

Individual features	**Satisfaction**	**Corr.**
Openness	ChoiceSat2	0.36
Behavior	**Sat./Diff.**	**Corr.**
Give opinion	ChoiceSat1	-0.44
Ask for suggestion	ChoiceSat2	-0.39
Give opinion	Difficulty1	0.53
Ask for opinion	Difficulty4	0.63
Group diversity in	**Sat./Diff.**	**Corr.**
Independence & History	ChoiceSat2	-0.51
Sun & Chill-Out	Difficulty6	-0.51

Difficulty1 - *"Eventually I was in doubt between some destinations"*; Difficulty4 - *"The task of making this decision was overwhelming"*; Difficulty6 - *"The decision process was frustrating"*; *Independence & History* and *Sun & Chill-Out*: travel behavioral patterns [12].

Next, we studied choice satisfaction at the group level in more detail. We aimed at identifying differences between highly satisfied and not so satisfied groups. However, the 24 groups in our data sample had different sizes: 12 have four members, six have three members and six have two members; the smaller the group the higher the chance that all its members were satisfied: this was the case for 83.3% of the groups of size two, for 66.7% of the groups of size three, but only for 33.3% of the groups of size four.

To capture group satisfaction, we considered the average choice satisfaction of its members, i.e., how much they agreed on average to the statement *"I am excited about the chosen destination"* (based on a five-point Likert scale). We took the average of all group satisfactions (i.e., 4.1), and next assigned the groups to two categories: 1) group satisfaction higher than the average and 2) group satisfaction equal or below the average. Each category comprised nine groups. Based on Student's t-tests, we found various significant differences between the two categories (see Table 5). Some of the results show the consistency of the participants' answers, e.g., members of high satisfied groups found the alternatives to choose from on average more appealing than members of low satisfied groups (p-value<0.001). However, there were also differences related to the personality of the group members. Members of high satisfied groups have on average displayed higher openness and neuroticism scores (p-value<0.05 and <0.01 respectively). Furthermore, the travel behavioral patterns, e.g., *Sun & Chill-Out* were more distinct in high satisfied groups (p-value<0.01). To conduct a robustness test, we repeated the analysis for the groups of size four only; this did not change the presented results. For the groups in Vienna, moreover, where information on the behavior during the group decision process was available, we found that in low satisfied groups typically all members

showed disagreement behavior during the discussion; i.e., significantly more than in high satisfied groups where on average about half of the members displayed this behavior (p-value<0.05). However, overall, the small sample size is clearly a limitation here and in order to confirm these presumed relationships follow-up studies will be needed.

Table 5: Significant differences in variable means between low satisfied groups and high satisfied groups

	Low	High	p-value
Alternatives were appealing (avg)	3.19	3.98	0.00
Openness (avg)	3.81	4.11	0.03
Neuroticism (avg)	3.08	3.61	0.00
Sun & Chill-Out (avg)	2.73	3.25	0.01
Show disagreement (percentage)	100%	54%	0.03

All variables w.r.t. to a five-level Likert scale.

5. CONCLUSIONS

The results of this study clearly indicate that research in group recommender systems needs to put more emphasis on the decision making process taking place in groups. We know that user preferences are not stable and they therefore must not be considered as independent input variables for the recommendation mechanism. This is true for individuals, but even more so for groups: group preferences are constructed during the process, and this study indicates people readily accept this outcome. Consequently, we may not address group recommendation problems with the classical machinery of RSs, i.e., predicting group preferences from individual preferences of group members. Even though we should be cautious to infer far-reaching conclusions based on a single study using a student sample, this study nevertheless clearly demonstrates that well-known aggregation mechanisms cannot fully describe the outcome of a group decision problem and a recommender may deviate from this normative rule. In addition, as a first step we tried to identify the properties of group members and the group as a whole that may influence the group outcome.

Now, as a next step, we are developing a group recommender system whose interaction design incorporates the lessons learned by this study [13]. It is based on the concepts of discussion groups and bots, where the recommender rather takes the role of a facilitator for the group decision making process rather than being a rigid mediator of users' preferences.

6. ADDITIONAL AUTHORS

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