

# A Model of Decision Support Based on Estimation of Group Status by Using Conversation Analysis

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**Abstract.** We propose a model for a decision support of a group based on estimations of group status through utterance analysis. Based on methods used in prior studies of group dynamics and utterance analysis, we measured the utterance characteristics of group members to estimate group status; moreover, we aim to enhance the overall condition of the group by providing appropriate reference information in a timely manner through a conversational agent system.

The goal of this model is a more satisfying decision-making process. Future work will focus on manufacturing a prototype system to verify both the operations involved in the test case and the ability to estimate group classification and status according to group dynamics.

**Keywords:** Conversation estimation · Group status estimation · Utterance feature · Conversational agent · Intention extraction

## 1 Introduction

In group decision making, it is not necessarily the case that the opinions of all members will match; some members may even become frustrated with some final group decisions. In this research, therefore, we focus on estimating the group status and aim to support members in the weak position rather than those in the strong position in group. Particularly, we are motivated for this research to solve this problem by using speech recognition and the extraction of intentions.

Our objective is to clarify the effectiveness of estimating the classification and status of a group by measuring the utterance characteristics of the group members. We also aim to lead overall group to good condition by providing appropriate reference information and suggestions in a timely manner by using status estimations based on a group dynamics approach.

## 2 Background

### 2.1 Group Dynamics

Group dynamics refers to a system of behaviors and psychologically influential interpersonal processes [4]. Here we focus on the former aspect of group dynamics, and in particular we apply intragroup dynamics approaches to the estimation of the decision-making behavior of small groups through conversation. Previous group dynamics research has found groups to have many measurable characteristics, including relationships, homogeneity durability, permeability, common goals, common outcomes, and size [9].

In groups, the relationships between members are various and can change dynamically based on their particular classifications and current status [13]. For example, groups are affected variously based on the classifications and tasks of their individual members [8].

We define *group* as an aggregate of individuals who have frequent interaction, mutual influence, common feelings of camaraderie, and who work together to achieve a common goals. We define *member* as an individual who joins a group.

### 2.2 Group Decision-Making

Decision-making in group conversation is affected by the classification and status of the group. For example, it is easy to feel sympathy in groups in which there is a high degree of aggregation. Conversely, it is not only easy to feel sympathy but also contradiction in groups in which the members are able to speak straightforwardly to each other [3].

The members of a group can be easily satisfied with forming a consensus if members can argue for their opinions and some of them are adopted in the course of making a group decision through conversation [2, 5, 7].

### 2.3 Utterance Analysis

In prior studies of utterance analysis, it was shown that the utterance feature values in dialogue (e.g., tone, speed, overlapping) can be utilized for identifying various types of group status (e.g., tuning trend, familiarity, upsurge) [10–12]. Examples of utterance feature values are shown in the Table 1.

We define *utterance* as the smallest unit of speech of spoken language, that is a continuous piece of speech beginning and ending with a pause, *speech* as the vocal form of human communication, *conversation* as a form of interactive, spontaneous communication between two or more people, typically occurring in spoken communication, and *conversational agent* as a computer system intended to converse with humans.

The utterance feature values like spectrum of utterance power levels have been also used for estimation of member tension in previous research [1]. *Tension* is defined as mental appearances of physiological responses in this paper. Methods of intention extraction in spoken dialogue utterances have been established by prior research [6].

**Table 1.** Examples of utterance feature value for group status estimation.

Parameter	Unit	Calculation method
Length	msec	Length (time duration) of each utterance
Times	times/min	Times of occurred utterances per minute
Power level	dB	Power level (loudness) of each utterance
Tone (F0)	Hz	Fundamental frequency
Mora	mora	Unit numbers in phonology that determines syllable weight
Speed	mora/sec	Number of moras per second
Overlap	times/min	Times of overlapped utterances per minute

We define *intention in spoken dialogue* as a plan or an expectation in a speaker's mind to do something that has been mentioned in their speech, and it can be estimated by comparing the text data between speech recognition results and spontaneous dialogue corpora.

### 3 Models

#### 3.1 Group Model

Based on previous group dynamics research, we defined our group model as one that discusses and decides some undecided or changeable matters through conversation; in particular, we focused on aspects of group status.

Group dynamics prior research shows that groups are classified by using the intimacy, the task and the social relationships such as *intimacy group*, *task group* and *social group* [4]. In this classification, the relationship between members and the structure of group are not uniformly for each classification, and it is difficult to identify the intimacy and the structure of group by this classification, particularly in the case of social group.

We aim to estimate the group status based on the group classification. Therefore, we proposed the original classification of groups in our group model. We assume that groups can be classified based on their intimacy, structure, and relationship between members, which can be estimated by using analysis of captured data of conversation. Particularly, we prepared following 3 types of classification which are supposed to be detectable.

1. groups that have high intimacy and flat relationships (e.g., friends)
2. groups that have high intimacy and hierarchy (e.g., families)
3. groups that have low intimacy and hierarchy (e.g., bosses and subordinates at work).

In group decision making, reference information is not dealt in discussion, if it is not provided appropriately [7]. Then we aim to provide the reference information by the method based on the group classification in our model of decision support shown below.

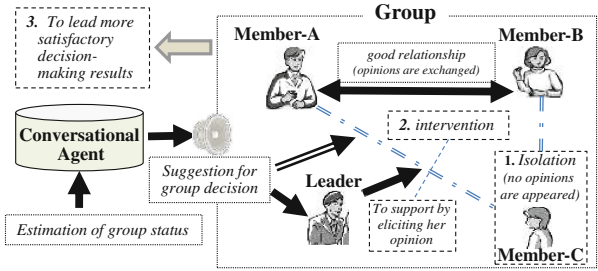


Fig. 1. Intervention to group in our proposed model

### 3.2 Model of Decision Support Based on Group Status

We propose a model of decision support based on group status estimation by using group dynamics approach and conversation analysis. We assumed that the conversational agent system provides reference information and suggestions that take into account the wishes of each group member, using the synthetic voice at an appropriate time based on the estimated group status, resulting in more satisfactory decision-making.

In this model, first, we investigate relationships between group members by using the result of extraction of intention and estimation of tension in each utterance during conversations occurring among the group members, which shows what and how members communicate with whom, and it also apply to estimation of intimacy and structure of whole group. Thus, we can classify the group according to the group classification above by such relationships between group members, intimacy and structure of whole of group.

Our proposed intervention examples for typical detectable classification group are as follows. The agent provides information through leader, if leader exists, or the agent provides to target member, if not so.

1. High intimacy and flat connection group  
 The members of this group classification are assumed to share their opinions frankly. For example, by asking for each member’s opinion, one by one through the conversational agent, and it can be determined whether the members have any specific ideas or requests. Then the agent can provide detailed information based on the situation of each member.
2. High intimacy and hierarchy group  
 This group classification assumes that the older member knows the views of each member. For example, the dialogue may start by the conversational agent asking the older member which kind of information is preferred by all the members. Then the conversational agent can provide the detailed information to the members, and thus it will be easy for them to discuss or make a selection from the available options.
3. Low intimacy and hierarchy group

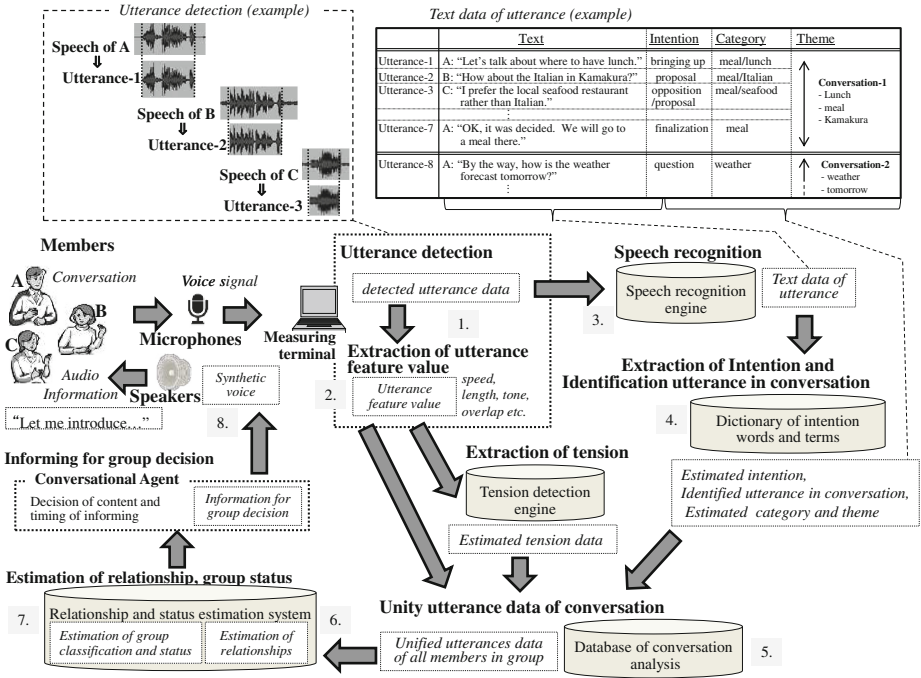


Fig. 2. Processes of group status estimation and provision of group decision-making.

This group classification assumes that an older member leads the group and that junior members may be hesitant to express their feeling directly. Then, it is started to found members in the weak position like isolation from other members, and it aims to support such members by eliciting their opinions from them with appropriate reference information or suggestions. (Fig. 1)

### 4 Methodology

The processes to estimate the group status by measuring utterance characteristics of group members are shown as follows, as well as in Fig. 2.

1. Voice signal monitoring and utterance detection
2. Utterance feature value extraction
3. Speech recognition and text conversion
4. Extraction of intention and identification of utterance in a single conversation
5. Unification of utterance data in a single conversation
6. Estimation of relationships among group members
7. Estimation of classification and status of the group
8. Intervention to Group in Decision-Making

## 5 Conclusion

In this paper, we proposed a model to estimate the group status by measuring utterance characteristics of group members, and to enhance the overall group condition through a conversational agent system based on their estimations. The proposed model can obtain all utterance feature values and combine them with the extracted intention of utterances. We can mention that the estimating of group status by measuring the utterance characteristics of users is basically possible through our basic function test. In future work, we will confirm availability of our proposed model to intervene to the group by the prototype system.

## References

1. Ariga, M., Yano, Y., Doki, S., Okuma, S.: Mental tension detection in the speech based on physiological monitoring. In: 2007 IEEE International Conference on Systems, Man and Cybernetics, ISIC, pp. 2022–2027. IEEE (2007)
2. Desanctis, G., Gallupe, R.B.: A foundation for the study of group decision support systems. *Manage. sci.* **33**(5), 589–609 (1987)
3. Deutsch, M., Gerard, H.B.: A study of normative and informational social influences upon individual judgment. *J. Abnorm. Soc. Psychol.* **51**(3), 629 (1955)
4. Forsyth, D.: *Group Dynamics*. Cengage Learning, Belmont (2009)
5. Herrera-Viedma, E., Martinez, L., Mata, F., Chiclana, F.: A consensus support system model for group decision-making problems with multigranular linguistic preference relations. *IEEE Trans. Fuzzy Syst.* **13**(5), 644–658 (2005)
6. Hodjat, B., Amamiya, M.: Applying the adaptive agent oriented software architecture to the parsing of context sensitive grammars. *IEICE Trans. Inf. Syst.* **83**(5), 1142–1152 (2000)
7. Hogg, M.A., Tindale, S.: *Blackwell Handbook of Social Psychology: Group Processes*. Wiley, New York (2008)
8. Kelley, H., Thibaut, J.: *Interpersonal relations: a theory of interdependence*. Wiley, New York (1978)
9. Lickel, B., Hamilton, D.L., Wierzchowska, G., Lewis, A., Sherman, S.J., Uhles, A.N.: Varieties of groups and the perception of group entitativity. *J. Pers. Soc. Psychol.* **78**(2), 223 (2000)
10. McCoy, W., Pelz, J.B., Alm, C.O., Shi, P., Calvelli, C., Haake, A.: Linking uncertainty in physicians' narratives to diagnostic correctness. In: *Proceedings of the Workshop on Extra-Propositional Aspects of Meaning in Computational Linguistics*, pp. 19–27. Association for Computational Linguistics (2012)
11. Oviatt, S., Darves, C., Coulston, R.: Toward adaptive conversational interfaces: Modeling speech convergence with animated personas. *ACM Trans. Comput.-Hum. Interact. (TOCHI)* **11**(3), 300–328 (2004)
12. Pon-Barry, H., Shieber, S.: The importance of sub-utterance prosody in predicting level of certainty. In: *Proceedings of Human Language Technologies: 2009 Annual Conference of the North American Chapter of the Association for Computational Linguistics*, pp. 105–108. Association for Computational Linguistics (2009)
13. Walster, E.: The effect of self-esteem on romantic liking. *J. Exp. Soc. Psychol.* **1**(2), 184–197 (1965)