Experimental Research about Matching Relationship between Group Size and Communication Mode in Group Decision-Making

Ying DUAN[1], Lei CHEN[1]

[1]College of Mechanical Engineering, Chong Qing University, Chong Qing, China
(e-mail: cl2005fly@163.com)

Abstract - **The matching relationship between group size and communication modes is investigated in this paper. Three teams of students whose average age is 21 years old, and each team is divided into several groups with 3 to 17 persons respectively to take the experiment for an intellectual task, by means of two communication modes of FTF and CM. Quality of schemes created by different groups have been compared, the result shows that group in FTF mode can create better scheme than in CM mode when the group size is smaller (n≤7),and turns reversal when the group size is larger (n≥11).**

Keywords - **communication mode, group decision, group size**

I. INTRODUCTION

Group size and communication mode are both important factors that affect the performances of group decision-making. A large number of scholars dedicated into relevant studies. Early as Weick[1] announced group size made an impact on group performance in 1969.The study of Nunamaker et al.[2,3] showed there is an optimal group size under certain group environments to form best performance, but the specific value can be different. Xi You min[4] studied 3-men and 6-men groups under GDSS experimental environment with the conclusion of group performance increase with the increase of group size. Liu Shulin et al.[5] made experimental study about different group sizes within the oral face-to-face environment, and the results showed that the number of created schemes by a group varied with the increasing group size, of which the trend presented an "n"-shaped curve with a high middle and two low ends, while the per capita number of created schemes decreased with the group size increasing. Taylor Sando summarized their results in terms of Steiner's model for explaining the effects of group size and task characteristics on group performance [6].Researches focus on the similarities and differences between face–to-face (FTF) and computer mediated (CM) communication modes for group decision-making. Siegel et al. study showed that, CM mode use shorter time than FTF mode for decision, and with more fair participation and non-inhibited behavior[7].Kiesler et al indicated that CM group members propose less arguments of depth and breadth than the FTF group, but the FTF groups cannot make better decisions with the drawback of status and expertise conflicts[8].Lam et al pointed out that CM mode has an advantage of parallel communication, group members are more equal participation and non-binding during decision-making[9]. Zheng Quanquan compared the generated view made by FTF and CM with 3-men and 6-men groups experiments, and in all experimental conditions, CM group generated more effective view than the FTF groups, otherwise he studied decision-making information utilization under different communication mode[10] .

The researches above showed normally about the impact of group size to group performance base on certain task situation, or different communication mode to information exchange and the decision quality, but few took into account combined effects. Certain group size with different communication mode may lead different decision-making performance. This study is to examine the joint factors' impact on decision-making performance, to explain their matching relationship, so as to choose better communication mode apply to different group size.

II. EXPERIMENTAL HYPOTHESIS

Intellectual decision-making tasks require frequently information exchange among members. A proper communication mode matches a certain group size for best group performance. The affect of group size and communication mode to group performance for decision-making were studied by many domestic and foreign scholars. According to their conclusions, demanded resources increase with the group size increases, as well as communication coordination gets more complicated and process loss increases, particularly in Face-to-Face (FTF) communication mode. In view of the advantages of unrestrained and parallel communication, the Computer-Mediated(CM) communication mode can overcome the process loss problem better, but less realistic than FTF during information exchange. Therefore, here give two hypotheses. Hypothesis 1: The group in FTF mode can **create** better scheme than in CM mode when the group size is smaller (n≤ 7); Hypothesis 2: The group in CM mode can **create** better scheme than in FTF mode when the group size is larger (n≥11).

The decision-making group's size and communication mode was chosen as experiment independent variables while keeping other factors, such as tasks contents, processes, as well as the cultural

backgrounds, ages, knowledge structures of experiment takers, all runs alike. The quality scores of group decision-making schemes are chosen as experiment dependent variables while the rules, environment and periods are under strict control during experiments. Series of quality scores of the schemes on a certain group size is compared to determine the matching communication mode. The experimental research model is shown in Figure 1.
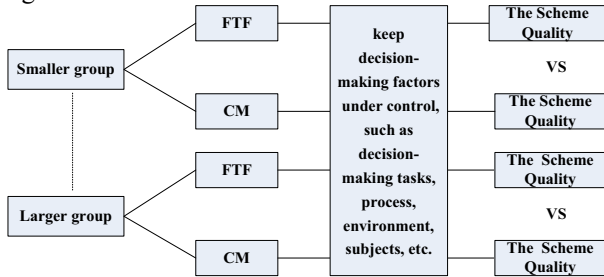

Fig.1. The Experimental Research Model

III EXPERIMENT DESIGN

A Experiment Task

Here we give a decision-making topic: An annual bonus totaling up to 10 million Yuan is going to be assigned to staffs of a scientific research institute by their leader. Yet each staff deserves his own price, how their leader make an assignment decision after considering various individual information that includes wages, positions, wage level, job seniority, performance and personal situation (given on a list to experiment takers)? The reasons of choosing this task topic to run the experiment are：(1) This topic is a intellectual task that requires frequently information exchanges among crews during the decision-making process, and is convenient to see how that different modes affect decision-making performance；(2) The available scheme is not only, and can be evaluated by given standards to get available results; (3) This topic does interests the participators because of its reality and easy understanding.

B Experiment Subject

There are three teams with 160 students of each, whose members have the same educational background and an average age of 21. Those members are chosen inexperienced about such experiment and share a similar age and knowledge structure that show few pre-difference by questionnaire. Each team is divided randomly and go fifty-fifty to FTF and CM communication sub-teams. The typing speed is required no less than 30 words per minute under CM mode.

C Independent Variable

Group size: Each team is randomly divided into different groups with a size of 3, 5, 7, 9, 11, 13, 15, 17 etc. separately. Communication mode: FTF and CM.

D Dependent Variable

In this experiment, the dependent variable is the quality score of final scheme reported by each group within the same communication period. The scheme quality is evaluated objectively under the same evaluation standards with following indexes: whether the report contains：(1) the characteristics of performance assessment for the research institution staff (30 points); (2) the bonus effect to teamwork (20 points); (3) how to ensure fairness among individuals (20 points); (4) the bonus effect to work enthusiasm (20 points); (5)how to deal with individual conditions (10 points).

E Experiment Procedure

The experiment procedure is as follows: 1) The task purpose, content, requirements are introduced by a host before grouping and every participator is given one copy of the printed task details material. 2) Grouping as the "Experiment Subjects" section described by lots and each group is required to give an only scheme report. 3) Each FTF group discusses separately to reduce interference. each members of CM group are equipped with one computer to ensure independence.5) Each group member give alternative schemes during the same period, then the group finish the final scheme using Borda method within the stipulated time and submit it to the host in writing or electronic documentation form.

F Experiment Measures

In order to improve the reliability and validity of the experiment, measures are taken as follows: 1) Each group cannot have sub-groups that the alternative schemes are created by the whole.2) The participators are unaware of the experiment case or the hypothesis, just be told to finish class work. 3）The host or others can't appear during the experiment unless necessary to leave participators in a natural mood. 4) Give adaptation time to the CM members to debug computers or chat for a while. 5）The participators are told that the report quality will affect their group assessment before experiment in order to strengthen consciousness of teamwork.

IV Experiment Results Analysis

Under the CM and FTF communication mode, the quality of the final scheme report created by each group with different group sizes is shown in Table I.

TABLE I

TABLE I
QUALITY OF THE FINAL SCHEME OF EACH GROUP WITH DIFFERENT
SIZES AND FTF/CM MODE

group size		3	5	7	9	11	13	15	17
difference	group1	3	2	-1	-2	-2	-6	-8	-9
Of FTF	group2	4	3	2	-2	-4	-8	-10	-11
and CM	group3	5	4	4	2	1	0	-3	-6

A Regression Analysis and Discussion

The quality of differences between each group with different size under FTF/CM mode are shown in Table II.

TABLE II
THE QUALITY DIFFERENCE BETWEEN FTF AND CM

group size		3	5	7	9	11	13	15	17
difference	group1	3	2	-1	-2	-2	-6	-8	-9
Of FTF	group2	4	3	2	-2	-4	-8	-10	-11
and CM	group3	5	4	4	2	1	0	-3	-6

Along with Table II, it can be seen from Figure 2 that, the difference of scheme quality between FTF communication mode and CM communication mode varies along a similar trend in each team, which is: Scheme quality under FTF communication mode gradually getting worse than those under CM communication with group size increasing. However, the critical point of group size when CM communication mode turns better than FTF communication mode remains inexact. The Correlation Coefficient values of the three teams by Linear Regression analysis are -0.983, -0.987, -0.96, respectively.
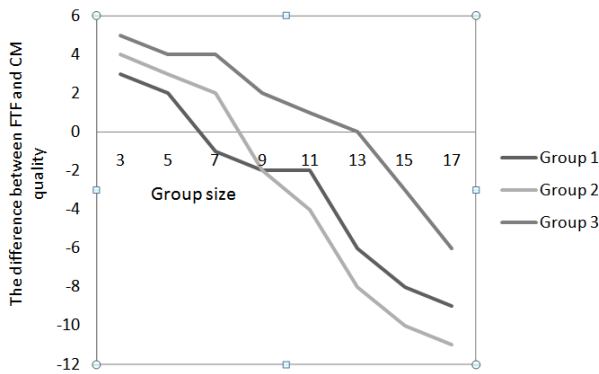

Fig.2. The quality difference between FTF and CM of corresponding group size

B Significance Analysis of Hypothesis

Figure 3 and Figure 4 are drawn by classification of Table 2.It can be seen from Figure 3 that most of the groups in FTF mode can **create** better scheme than in CM mode when the group size is smaller ($n \leqslant 7$), t-test ($t = 3.3$, df = 8, $p = 0.011 < 0.05$) results show there are significant differences. It can be seen from Figure 4 that most of groups in CM mode can **create** better scheme than in FTF mode when the group size is larger ($n \geqslant 11$) , t-test

($t = -4.601$, df = 11, $p = 0.001 < 0.05$) results show that there are significant differences. So the hypotheses in section 2 are proved right: The group in FTF mode can **create** better scheme than in CM mode when the group size is smaller ($n \leqslant 7$), and vice versa.
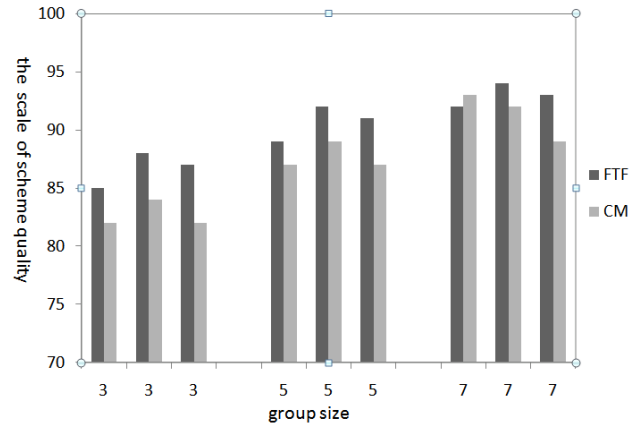

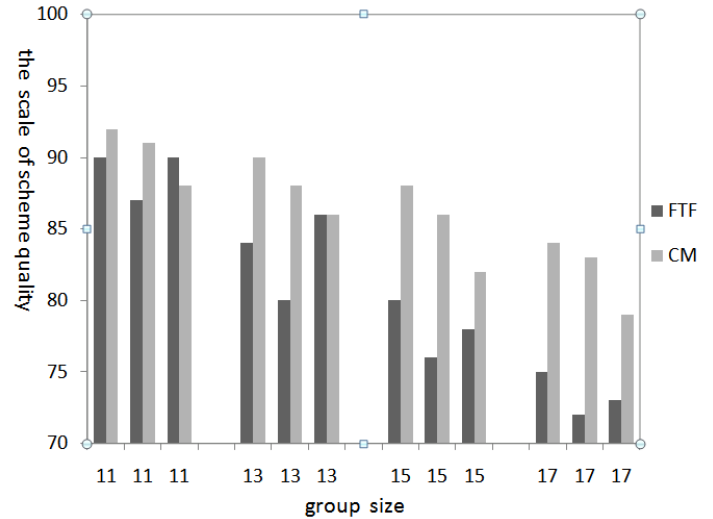Fig.3. The quality of scheme under FTF and CM mode when the group size is smaller

Fig.4. The quality of scheme under FTF and CM mode when the group size is larger

V CONCLUSION

The matching relationship between group size and communication modes is examined by experiments under the Chinese culture environment for an intellectual task by free discussion to make decisions. Hypotheses are given and be proved from the angle of the comprehensive influence of group size and communication mode on the quality of group-created schemes. The result of this study shows that group in FTF mode can create better scheme than in CM mode when the group size is smaller ($n \leq 7$), and turns reversal when the group size is larger ($n \geq 11$). When group size is much too large, ($n \geq 15$)，neither FTF nor CM can obtain schemes with good quality, maybe it needs sub-group discussions to improve decision-making performance.

There are improvements, if any, can be considered in this study, such as sex difference; familiarity to each other; complementary knowledge; adaptability to the CM mode; dual array grouping; larger groups or larger experiment.

Continuing work can be done from the following three aspects: 1) Adding more communication modes (for example, computer interface print media) to refine experiment study to exam appropriate communication mode for groups of different sizes. 2) Alternating new decision-making tasks with different types to investigate matching relationship among task type, group size and communication mode .3)Reducing process loss in group discussion by sub-grouping when group size is very large, and study how to conduct discussion inside or between groups.

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