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Culture

A Fourth Dimension of Group Support Systems

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A group support system (GSS) is an integrated combination of computer, communication, and decision support technologies designed to support group work [7]. The designs of current GSSs are based on North American concepts of desirable group behavior. Oriental cultures have a different model of desirable group behavior, and a GSS designed in North America may have unintended consequences in an oriental setting.

Exported software frequently requires modification to suit local customs, laws, or conventions. Traditionally, most modifications have focused on altering the technical facilities of the software (for example, modifying the spelling dictionary). However, a GSS is a blend of technical and social facilities. In order to improve group performance, a GSS influences the social behavior of a group. Because GSS design is often based on the customs of the particular culture in which it was developed, both technical and social facilities may need modification for successful adoption in another culture. Therefore, it is important to understand the effect of culture on GSS design and implementation.

Three key factors that should be considered in GSS research are identified by DeSanctis and Gallupe [7]: group size, member proximity, and task type. By classifying group size as large or small, and member proximity as face-to-face or remote, a two-by-two matrix of settings is developed in which to study GSS effects. Because task type can be an important factor in explaining group performance [18] DeSanctis and Gallupe use McGrath's [15] task circumplex to identify the types of tasks GSS researchers should investigate. Their research framework, however, does not include the important dimension of culture. Because GSS technology can have a direct influence on a group's communication patterns, an important cultural variable, we propose that culture is a fourth dimension of GSS research.

Many theories in psychology, sociology and organizational behavior are culturally specific, but theories and research findings that apply in one culture need not necessarily apply in another [2, 12]. Current theories supporting GSS research and driving its design are primarily derived from North American work. In addition, the majority of empirical GSS research has been conducted in North America using local subjects. The usefulness in another culture of these theories, design principles, and research findings has not been determined.

In their development of a foundation for GSS research, DeSanctis and Gallupe [7] argue that provision of an electronic communication channel enhances information exchange within a group and leads to a more balanced involvement of group members, which will in turn lead to better decision outcomes. Implicit in this argument are two assumptions that may be culturally specific. First, an assumption is made that it is important for each group member to have an equal opportunity, regardless of status differentials, to express an opinion in a group discussion. Second, it assumes that group members prefer open and direct communication to resolve conflict or disagreement. In addition, the GSS concept implicitly suggests that group decisions should further organizational objectives and little consideration is given to group harmony. While these assumptions may be valid in North American culture, they may not be acceptable for a distinctly different culture. Existing GSS designs may not be appropriate for settings outside North America.

The study focuses on culture, a fourth dimension of GSS research, and its effect on GSS supported meetings. The study demonstrates the importance of culture by comparing the findings of experimental GSS investigations in two very different cultures: the U.S. and Singapore. This article discusses the study's conceptual foundations, variables, and hypotheses, research method, and findings, concluding with a discussion of the results and their implications.

The Conceptual Foundations of the Research

The conceptual foundations of this investigation stem from research in four domains: GSS research, cross-cultural research, adaptive structuration theory (AST), and small group behavior.

Extensive reviews of GSS research exist [6]. These reviews reveal inconsistent research findings. This is partly because different studies have used a variety of GSSs with different features and design goals, different tasks, different research strategies, groups in different stages of development, and might have had insufficient statistical power to detect an effect. Despite the difficulty in comparing research findings and their inconsistencies, generally, the use of GSS technology improves group performance.

A GSS should lead to more equal participation by group members and reduce domination by a few group members because the system encourages all group members to participate. Greater equality of participation in GSS groups is reported by some studies while other studies (for example [9, 24]) report no statistically significant difference between GSS groups and control groups. Overall, research suggests that the parallel communication feature of a GSS encourages participation because it supports multiple conversations. Good ideas or important thoughts are captured in a GSS setting whereas in a face-to-face meeting they are frequently lost because only one person can talk at a time.

Anonymous communication, which is a feature of most GSSs, supports equality of participation. In face-to-face meetings, group members are often swayed by a speaker's status and more credence is given to the ideas of high ranking individuals. Some group members, through either personality or status, dominate group discussion. Anonymity dampens status influence because the person and the idea are decoupled. As a result, the content of a message, rather than its source, should be the focus of attention.

Several studies suggest that a GSS may increase group consensus [21]. On the other hand, the use of a GSS may reduce group consensus [9], and one study reports no change in consensus [24]. Turoff and Hiltz [23] report that a GSS helps leaderless groups to reach consensus, but has no effect when a leader is present. The impact of a GSS on consensus is unclear.

In summary, research findings are inconsistent concerning the effect of a GSS on equality of participation and consensus. This is not surprising because many of the cited studies differ on a variety of important factors. One factor that has not been explored in prior GSS research is the national culture of the decision-making team.

The Cultural Factor in Decision-making

Culture is the beliefs, value system, norms, mores, myths, and structural elements of a given organization, tribe, or society [16]. Culture exists at national [12], regional [25], and corporate levels [5]. For example, Garreau asserts that there are nine nations in North America, and four generic U.S. corporate cultures have been identified [5].

Hofstede [12] identified four dimensions of national culture by a statistical analysis of 116,000 questionnaires completed by IBM employees in 40 countries: individualism, power distance, uncertainty avoidance, and

masculinity. Individualism and power distance, germane to this study because they are the dimensions on which the U.S. and Singapore differ, are defined as follows:

- ***Individualism*** implies a preference for a loosely knit social framework in which individuals are supposed to take care of only themselves and their immediate families, as opposed to collectivism, which denotes a preference for a tightly knit social framework in which individuals can expect their relatives, clan, or other-in-group to look after them, in exchange for unquestioning loyalty.
- ***Power distance*** is the extent to which society accepts the fact that power in institutions and organizations is distributed unequally. In a high-power distance society, subordinates defer to superiors and do not question their authority.

Singapore and the United States belong to different cultural groups. The culture of the U.S. is characterized by high individualism and low power distance. People in U.S. culture tend to see themselves as 'I' and strive for self-actualization. Status tends to be based on personal merit and individual achievement. Singapore's culture features low individualism and high power distance. People living in this culture will tend to see themselves as part of 'we' and strive for group interest. Both superiors and subordinates expect power differences to be translated into visible differentials and that subordinates should be unquestionably obedient. Status is often based on rank, ancestry, or social position.

Because the Singaporean and U.S. cultures differ with respect to individualism and power distance, research findings in one nation may not generalize to the other. Instances are cited [12] to show the various problems of generalizing a management philosophy of one culture to another. Previous studies (for example, [11]) suggest that management theories based on North American norms and research do not directly transfer to a dissimilar culture.

U.S. culture favors individual rights and Singaporean tradition promotes collective goals [3]. In the individualistic American culture, self-actualization is the supreme need [14]. In the collectivist Singaporean culture, 'belongingness' may come above ego needs such as self-actualization and esteem, and people have a supreme need for actualizing their in-group to maintain group harmony. In individualistic cultures, openness and directness in work relations are often considered virtues. Open conflict resolution is often preferred to consensus building behind closed doors. In collectivist cultures with a tightly knit social framework, there is generally an extensive set of expectations about interpersonal behavior. Violating these expectations threatens the social framework. Maintenance of the proper forms and harmony is usually considered preferable to openness that could lead to discord. Also, the leader in a collectivist culture is normally expected to build consensus to maintain group unity.

These differences between individualistic and collectivist cultures assist in anticipating the effects of GSS technology in the U.S. and Singaporean societies. In Singapore, group members are unfamiliar with open and direct communication in a group meeting. The anonymity feature of a GSS may have both positive and negative consequences for Singaporean groups. For example, it may encourage more equal participation. Conversely, it may encourage high status or dominant members to express anonymously negative opinions about other members, a behavior that in face-to-face meetings is culturally unacceptable. Dominant members could also take advantage of the anonymity feature to gain influence without direct confrontation. In essence, the task-oriented focus of a GSS could conflict with the social-oriented values of Singaporean culture. Because a GSS tends to dampen social-oriented information exchange, it could have unintended consequences for group performance in a culture that places a high value on social-oriented communication.

The concept of consensus may be interpreted differently in dissimilar cultural settings. A parliamentary speech by Goh Chok Tong, the Prime Minister of Singapore, reveals the Singaporean notion of consensus. Goh states: . . . *the Government and indeed the whole nation has been distracted from our main goal of building consensus to achieve a vision of a developed, vibrant and creative society.*

In Singapore, consensus has special significance as a national goal because the Government wants to avoid the racial disharmony that threatened the nation's future in the early years of independence. The planned development of Singapore's economy is based on a stable political and social environment that is attractive to foreign investment. Dissent is to be avoided. Goh concluded his address as follows: *My job is to forge consensus, not to encourage dissent.*

Some insight into the U.S. view of consensus is given by Senator Fulbright's statement to the U.S. senate on October 22, 1965 [22]: *Insofar as it represents a genuine reconciliation of differences, a consensus is a fine thing; insofar as it represents a concealment of differences, it is a miscarriage of democratic procedure.*

Fulbright argues that consensus is fine, but it is more important to openly reveal differences when they exist. In Singapore, however, suppressing differences to further national goals is given higher priority. The role and relationship of consensus to social and economic development are different between the U.S. and Singapore. Thus, instructing a group to reach consensus may be interpreted differently in each society.

Adaptive structuration theory (AST) has been put forward as a theoretical device for understanding a group's use of a GSS [17]. AST makes an important distinction between system and structure. A *system* is a social entity, such as a group, that has an established form of behavior. *Structures* are the norms of behavior that maintain the system. For example, a norm of behavior in most groups is that only one person speaks at a time. If a new person joining the group does not obey this standard, then the system is disrupted. In time, either the new person changes and conforms to the group's rules and the old system is maintained, or a new system

that accepts simultaneous conversations emerges.

A GSS gives a group the opportunity to change its existing behavior because it presents the group with new structures that can be adopted. There are two types of new structures: technological structures in the form of an additional communication channel and a structured approach to group decision-making, and social structures implicit in the design of the GSS. Egalitarianism, non-critical acceptance of ideas, decoupling thoughts and their provider, and leveling of status differentials are examples of social concepts that guide GSS designers.

The inherent social structures of current GSS designs reflect North American beliefs about desirable group behavior and are acceptable within that culture as appropriate norms for group behavior. U.S. groups are more likely to embrace the social structures of a GSS because they are in accord with their culture. In contrast, Singaporean groups are less likely to adopt a GSS because some of the social structures are in conflict with their notions of acceptable group behavior.

Small Group Behavior. McGrath's framework [15] has been suggested as a suitable theoretical basis for exploring the effects of a GSS [7]. According to this framework, the central feature of a group lies in the interaction of its members—the combined behavior of two or more persons. There are four major classes of properties that set the conditions under which group interaction takes place:

- The biological, social, and psychological properties of individuals;
- The physical, socio-cultural, and technological properties of environment(s);
- The existing relationships between group members prior to meeting (the standing group);
- The characteristics of group task.

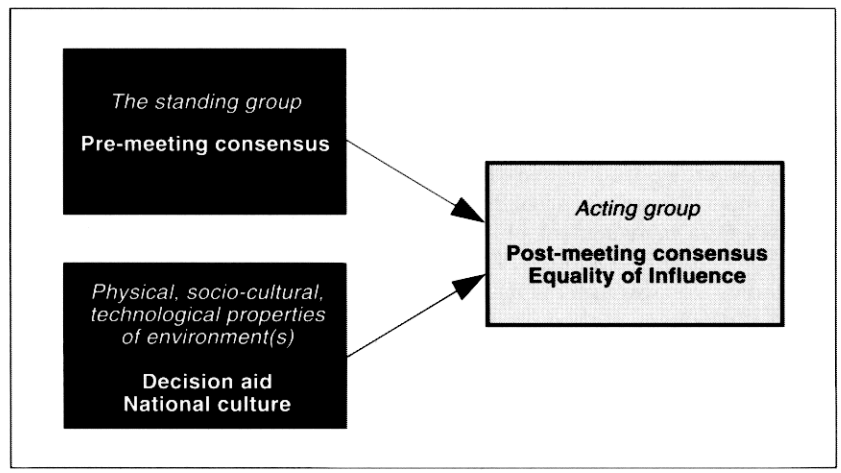
The effects of these four sets of properties shape group interaction. This study's causal model (see Figure 1) is founded on McGrath's framework.

Summary. U.S. and Singaporean cultures are dissimilar with respect to individualism and power distance. Cultural differences and AST suggest that a GSS will have a different effect on Singaporean and U.S. groups. Because consensus apparently has a different meaning and national priority in each society, it is an important variable to study when comparing decision-making in the two nations. Also, the influence distribution in a group is of interest because the two cultures differ markedly on the power distance dimension. Previous research and existing theory indicate that national culture is an important component of GSS research, and culture should be added as a fourth dimension of GSS research.

Research Design and Hypotheses

Three levels of decision support were used. Computer groups received a level-1 GSS, which provided technical features (e.g., public screen, anonymous impact, and voting tools) aimed at removing communication barriers [7]. To isolate the effects of the structure from the effects of the GSS, some groups (henceforth called manual groups) were supplied with flipchart support and a meeting agenda similar to GSS groups. Baseline groups were freely interacting and received no support. All groups met face-to-face. Dependent variables were the change in consensus and equality of influence. Pre-meeting consensus was used as a covariate with the dependent variable equality of influence.

Figure 1. The causal model



The causal model (see Figure 1) asserts that the behavior of an acting group is influenced by the type of decision support, the group's national culture, and pre-meeting consensus. The dependent variables are post-meeting consensus and equality of influence.

The Causal Model

In the remainder of this section, the study's hypotheses are presented (in the form H1, H2, etc.). They are immediately followed by their rationale, which draws on discussion in the prior section.

Singaporean culture stresses collectivism, group harmony, and suppression of discord to present a united front. Unaided decision-making groups in this culture will achieve a greater change in consensus than their U.S. counterparts. There is less cultural pressure on U.S. groups to reach agreement because their society places a high value on individualism and open discussion.

H1 Change in consensus will be greater in Singaporean baseline groups than U.S. baseline groups.

The cultural mores of Singaporean society are such that one group member will not dominate a group's decision, and influence will be more equal in Singaporean groups when compared to U.S. groups.

H2 Influence will be more equal in Singaporean baseline groups than U.S. baseline groups.

GSS technology and its inherent decision-making structure is based on North American notions of effective

group processes and may be incompatible with Singaporean culture. Imposing this technology on a group of Singaporeans may adversely affect group processes. Consequently, Singaporean groups are likely to have a smaller shift in consensus and lowered equality of influence when compared to U.S. groups.

H3 Change in consensus will be less for Singaporean manual and computer-aided groups than corresponding U.S. groups.

H4 Influence will be less equal in Singaporean manual and computer-aided groups than corresponding U.S. groups.

Similarly it may be argued that the imposed structures are likely to have a detrimental effect on group processes in Singaporean manual and computer-aided groups when compared to baseline groups.

H5 Change in consensus will be less for Singaporean manual and computer-aided groups than corresponding baseline groups.

H6 Influence will be less equal in Singaporean manual and computer-aided groups than corresponding baseline groups.

Research Method

The data for this study are a combination of experimental data collected in the U.S. and Singapore. The two experiments were very similar in many respects. Both studies used the same task and the same GSS, for example. The GSS concept has been implemented in a variety of forms with varying features. Consequently, it is difficult to generalize the results of a study based on a particular implementation to other versions of a GSS. However, it may be possible to compare results on the basis of similar design features, when a particular design feature (e.g., a public screen) is considered the dominant factor influencing group behavior. Thus, it is important that researchers clearly state the GSS used, what features it had, and if appropriate, what features were appraised as most influential. The GSS used was SAMM [8]. The main features of SAMM are: public screen, individual terminals for each group member, anonymous parallel communication, and a meeting agenda for structuring the meeting process.

The task involved an allocation of money to six projects based on personal preference structures and called for group members to resolve their conflict in order to arrive at a group solution. This preference allocation task is typical of many decisions made by organizational groups, who frequently must decide how to allocate scarce resources among competing demands. As discussed previously, cultural differences between Singapore and the U.S. indicate that consensus and influence are appropriate measures of group outcomes.

Consensus change was determined by comparing consensus before and after the group meeting using Spillman, Spillman and Bezdek's technique for determining consensus [20]. Equality of influence, which is related to degree of member domination, reveals the influence patterns of group members. Measurement of equality of influence is based on the distance between each person's premeeting decision and the group's decision.

The U.S. study had 287 subjects, who were either graduate or undergraduate students. Groups were comprised of three or four students who had a history of working together. Cell sizes were 27, 26, and 29 for baseline, manual, and GSS treatments respectively. Analysis showed that differences between groups were not due to group size or student status (i.e., graduate or undergraduate). In Singapore, 255 undergraduate students served as subjects for the experiment. They were formed into 48 five-person groups. Cell sizes were 14, 16, and 15 for baseline, manual, and GSS treatments respectively. Most subjects in both studies knew each other beforehand as they were in the same study program, and in many cases had worked together on projects. Subjects in both studies were given course credit for their participation.

All subjects were instructed to work as a group to reach agreement on how funds should be allocated to six projects. Manual groups were given a handout outlining the same agenda as that used by GSS groups. The purpose of the identical agenda was to control for the structuring introduced by the GSS. Manual groups were also supplied with a flipchart on which to record publicly the ideas of group members. GSS groups were given 20 minutes systems training. This appeared to be adequate as subjects had no major problems using the GSS. Manual groups were instructed in the use of the meeting structure. Baseline groups were given no decision aids.

The experiment had three main phases. First, subjects individually recorded how they would allocate a fixed sum of money to the six projects. Second, groups were instructed to reach consensus on the allocation of funds to the same six projects. Finally, subjects were again asked individually to allocate money to the six projects. The two individual allocations were used to calculate pre- and post-meeting consensus. The difference between each person's premeeting allocation and the group allocation was used to compute equality of influence.

The studies differed in two major respects: group size and manipulation of leadership. In the U.S. study, groups of three or four were used, and in the Singapore study, group size was held at five. As the U.S. study found that group size did not explain any variance in group behavior, it is assumed that, across the two experiments, group size did not explain differences in group behavior. Leadership, a manipulated variable in the Singapore study, did not explain variations in group behavior, and it was not considered in the joint data set.

The GSS used in the study (SAMM, see [8]), provided groups with several features that could have changed group behavior. Group members could anonymously exchange information through their personal terminals. Members' thoughts (ideas, opinions, alternatives, etc.) typed into the GSS were displayed on a public screen. Each group member had the same opportunity to participate because no one member could dominate the parallel, electronic communication channel. All thoughts were anonymous, so members who might not actively participate in a tradi-

tional meeting for fear of evaluation should have been more willing to share their thoughts. Thus, ideas and opinions should have been appraised on their own merits and independent of the personal characteristics of their contributor. Anonymous, parallel communication should have increased equality of influence.

SAMM's voting tools and public screen could have increased post-meeting consensus. Voting could be used to ascertain quickly and anonymously group opinion. This facility could have been used by groups to identify areas of disagreement and focus attention on resolving these differences. Also, anonymity should have reduced the influencing power of dominant individuals so that there was more equality in group decision-making. A public screen tends to increase ownership of group output and this can have a positive effect on consensus.

Group members met in the same room at the same time. GSS groups were provided with an agenda that indicated when they should use electronic or verbal communication. However, GSS groups could always ignore the system and rely completely on face-to-face discussion. The anticipated effects discussed previously were dependent on the extent to which the group adopted the GSS and used it as intended.

Results

ANOVA and ANCOVA were used to model relationships between dependent and independent variables, and linear contrasts were used to test hypotheses. Where necessary, variables were transformed to satisfy the assumptions of the statistical method. A significance level of 5% was used for hypothesis testing[1]. The magnitude of statistically significant effects is reported using effect size (ES) categories of small ($0.2 \leq ES < 0.5$), medium ($0.5 \leq ES < 0.8$), and large ($ES \geq 0.8$).

The sequence of presenting the study's hypotheses was to discuss the effects on baseline groups and then the effects on manual and computer-assisted groups. However, in presenting the results, it is sensible to deal with each dependent variable in turn because this minimizes repetition of discussion about characteristics of the data.

Change in Consensus

There are two general methods for measuring the change in a variable measured before and after an experiment. One approach is to take the arithmetic difference, which is a measure of the absolute change. The other method is to calculate the relative change by dividing the post-measurement by the pre-measurement. After some analysis, we determined that the appropriate measure in this case was the natural log of the relative change.[2]

Consensus data, displayed in Table 1, suggests Singaporean groups had higher consensus before meeting than U.S. groups, but there was no difference after meeting. This impression is confirmed by statistical analysis[3] and supports the premise that there are cultural differences between Singaporean and U.S. groups. A large effect size (ES = 0.85) indicates these differences are not trivial.

ANOVA (see Appendix for details) on consensus change indicates main effects for culture ($p = 0.0001$) and decision aid ($p = 0.05$). There was no interaction effect ($p = 0.43$). Further analysis shows that U.S. groups had a larger change in consensus than Singaporean groups ($p < 0.0001$ and ES was medium (0.77)), and manual groups a larger change than GSS groups ($p = 0.02$) and ES was medium (0.52)). The hypotheses relating to consensus were tested using linear contrasts based on the ANOVA model, and the results are summarized in Table 2.

The results indicate that U.S. groups initially had a lower level of agreement. Nonetheless, after a group discussion they had a greater shift in agreement than their Singaporean counterparts. While there is statistical support for H3, it cannot be concluded that the decision aids had an adverse effect on Singaporean groups because across all treatments U.S. groups had a greater shift in consensus. U.S. groups in each treatment reached the same level of consensus as Singaporean groups even though they started with less agreement.

Equality of influence scores are presented in Table 3. Each cell shows the mean score, standard deviation, and number of observations. A low score indicates an equal distribution of influence with zero denoting that all group members had the same influence. There are large variations in equality of influence across cultures and treatments. However, the presence of relatively large standard deviations suggests that within cells variance may mask differences between cultures and treatments.

ANCOVA (see Appendix for details), with pre-meeting consensus as the covariate, was used to analyze equality of influence[4]. The analysis indicates a main effect for culture ($p = 0.01$, ES is small (0.40)), no effect for decision aid ($p = 0.20$) and no interaction effect ($p = 0.10$). Pre-meeting consensus is a statistically significant covariate ($p = 0.016$). Further analysis shows that, after controlling for pre-meeting consensus, influence was more equal in Singaporean groups irrespective of meeting format. This finding is in agreement with previously observed cultural differences between the two societies. The hypotheses relating to influence were tested using linear contrasts based on the ANCOVA model; the results are summarized in Table 4.

While Table 4 data suggest use of a GSS adversely affected the performance of Singaporean groups, it does not take account of the moderating effect of pre-meeting consensus on equality of influence. Given the significance of this covariate in explaining equality of influence, exploratory analysis was undertaken on each cell

[1]Where multiple comparisons were made within a hypothesis, the comparison error rate was adjusted to give a family error rate of 5%.

[2]The transform was necessary to satisfy the homogeneity of variance requirement.

[3]t-tests indicate a difference in pre-meeting consensus ($p < 0.0001$) and no difference in post-meeting consensus between cultures ($p = 0.96$)

[4]To satisfy the requirements of ANCOVA, equality of influence was transformed using a function of the form $1/(x + 1)$. A log transform of pre-meeting consensus was also necessary.

Table 1. Pre- and post-consensus culture by decision aid

		Baseline	Manual	Computer	Combined
Singapore	Pre-Meeting	0.31	0.35	0.35	0.34
	Post-meeting	0.55	0.64	0.48	0.56
	Post/pre	1.78	1.96	1.41	1.72
United States	Pre-meeting	0.27	0.25	0.24	0.26
	Post-meeting	0.55	0.62	0.51	0.56
	Post/pre	2.34	2.63	2.23	2.40

Note: The table shows means for each cell of the experiment. The mean(post/pre) is not necessarily the same as mean(post)/mean(pre).

Table 2. Hypotheses related to change in consensus

Hypothesis	p	Conclusion
H1 Change in consensus will be greater in Singaporean baseline groups than U.S. baseline groups	0.09	Reject
H3 Change in consensus will be less for Singaporean manual and computer-aided groups than corresponding U.S. groups	<0.0001 ES large (1.12)	Accept
H5 Change in consensus will be less for Singaporean manual and computer-aided groups than corresponding baseline groups	0.22	Reject

Table 3. Equality of Influence Mean score (standard deviation and number of observations)

	Baseline	Manual	Computer	Combined
Singapore	.49 (.26 14)	.62 (.69 16)	1.03 (.91 15)	.72 (.70 45)
United States	.93 (.74 27)	.76 (.45 26)	.75 (.51 28)	.81 (.58 81)
Combined	.78 (.65 41)	.71 (.55 42)	.85 (.68 43)	.78 (.63 126)

Table 4. Hypotheses related to equality of influence

Hypothesis	p	Conclusion
H2 Equality of influence will be more equal in Singaporean baseline groups than U.S. baseline groups	0.0034 ES large (0.92)	Accept
H4 Equality of influence will be less equal in Singaporean manual and computer-aided groups than corresponding U.S. groups	0.8	Reject†
H6 Equality of influence will be less equal in Singaporean manual and computer-aided groups than corresponding baseline groups	0.09	Reject‡

†The power of these tests is low, 28% and 25% respectively. Differences might have been masked by large within-cell variances.
‡As this was an exploratory analysis, a Bonferroni correction to the threshold level of significance was made.

of Table 2. A linear regression model with equality of influence as the dependent variable and pre-meeting consensus as the independent variable was used. There was a statistically significant relationship ($p = 0.02$[6] and $R^2 = 36\%$) for Singaporean GSS groups. The regression function implies that groups with high pre-meeting consensus had less equality of influence. Groups that initially had high agreement seemed content to let one person dominate the final solution. A possible interpretation is that, in situations of high pre-meeting agreement, most group members were satisfied that the group view was not sufficiently different from their own opinion and were content to let one person dominate the group decision. Because the influence measure is a relative measure based on the positions of each group member, in a situation with high pre-meeting agreement, the group members' opinions will be relatively close and a slight shift in one direction can lead to a high relative, but low absolute, influence. Therefore, a group acquiesced to the dominant member because its decision was still close to each person's viewpoint. The question is why did this happen in Singaporean GSS groups?

Singaporean culture places a high priority on group harmony and the maintenance of social structure. When there is high pre-meeting agreement within a group, cultural forces promote the acquiescence of group members' opinions to that of the dominant member. In essence, in a high pre-meeting consensus setting, group members are sufficiently satisfied with the group solution to suppress personal opinion in favor of supporting cultural norms. The GSS voting tools enabled a team with an initially high level of consensus to discover rapidly their accord. No effect was observed in baseline groups because the use of informal methods for establishing group opinion did not give a clear picture of the collective opinion. Manual teams were supplied with a method for establishing group opinion that required individuals to state publicly their opinions, and this might have induced a greater commitment to that opinion than a view stated anonymously via computer. This interpretation suggests that a GSS lets a group discover its level of agreement without group members publicly revealing their opinions. As a result, group members are more willing to modify their position because they are less psychologically bonded to their private thoughts as to their public utterances.

Summary

Statistical analysis of the data gives the following findings:

1. Singaporean groups had higher pre-meeting consensus than U.S. groups.
2. All groups in both cultures had the same level of post-meeting consensus.
3. Change in consensus was greater in U.S. than Singaporean groups.
4. After controlling for pre-meeting consensus, influence was more equal in Singaporean than U.S. groups.
5. In Singaporean groups, a GSS led to unequal influence in groups with a high level of agreement before meeting.

Observations

As well as collecting data for formal hypothesis testing, we also observed experimental sessions. On comparing notes, we found some consistencies in GSS group behavior.

The public screen became the focus of attention, and group members would address their comments to the public screen rather than the group. It was not unusual to see the entire group turn their bodies to face the public screen and conduct a discussion in that manner. As a result, the body language and visual expressions of face-to-face conversation were dampened and social distance was increased.

Groups tended to use the GSS mechanically. They had no difficulty in learning how to use the system, but they had difficulty in becoming wise users of the system. There was nothing creative about their use. It was a meeting-by-the-numbers approach. While this finding is not surprising with novice groups, in subsequent research we have observed a similar phenomenon in organizational groups. A group or facilitator learns to use a GSS in a particular way and gets locked into that model. This suggests that groups have problems in realizing the full power of GSS technology.

Groups were very concerned about procedural matters and often neglected to fully explore the problem's issues. Groups seemed to feel that following the correct procedure would lead them to the solution. In U.S. groups, discussion was often very subdued, and there was muted acceptance of voting output. In contrast, Singaporean groups were more argumentative and the atmosphere was tenser. This difference may have cultural origins. The imposed structure and technology was culturally compatible for U.S. groups. Indeed, they had a naive expectation that technology would solve their problem if they used it correctly. Singaporean groups were less accepting of the structure and technology and their stress was manifested in arguments.

Discussion

Compared to U.S. baseline groups, Singaporeans had greater agreement before meeting. These findings support the contention that the collectivism of Singapore's culture creates greater shared understanding of, and commitment to, a broad set of beliefs. In contrast, the individualism of the U.S. results in less agreement prior to meeting. However, U.S. groups demonstrated a higher capacity for accommodating differences and, irrespective of the decision aid, made a larger agreement shift than Singaporean groups. A possible explanation for this phenomenon is that people who live in a diverse society, such as the U.S., encounter many situations where divergent views must be reconciled in order to reach a decision. As a result, they become more adept at accepting divergent opinions and are more willing to change their view. In contrast, Singaporeans may have fewer opportunities to develop a give-and-take attitude because differences of opinion happen less often and are discouraged by the culture. It could be speculated that individuals

in societies with high individuality are more adept at accommodating divergent viewpoints than people in societies with low individuality.

The imposition of manual support or a GSS did not have an adverse impact on Singaporean groups. They did no worse than unsupported groups. Also, U.S. groups with manual or GSS support did no better than unsupported groups. A possible explanation is that culture, particularly in a group setting, is a more powerful influence than technology. The subjects had been embedded in their particular culture for many years, and it is unlikely that a short exposure to a new technology can break well-established, culturally grounded patterns of group behavior. Future research, by examining group processes as well as outcomes, could study how groups incorporate and adapt GSS features into their culture.

Influence was moderated by premeeting consensus. After this effect was considered, influence was more equally distributed in Singaporean than U.S. groups. The negative relationship in Singaporean GSS groups between agreement before meeting and equality of influence may be culturally based. As previously mentioned, Singaporean society places high priority on group harmony and the maintenance of social structures. When there is high agreement within a group, cultural forces may result in a group readily acquiescing to the dominant member. A GSS permits a group to determine that there is high agreement and allows a dominant group member to use the electronic communication channel to exert influence that would be culturally unacceptable if expressed verbally.

We believe several important conclusions are suggested by this study. First, culture will shape the adoption of technology. This conclusion echoes the findings of a detailed analysis of the impact of computing on organizations [1], which suggests that organizational goals override technological effects. Groups, like organizations, use technology to achieve certain objectives, which are strongly influenced by the surrounding culture. A group's norms of behavior, its structures in AST terms, have been fashioned by its national culture, a very powerful force that resists change. After all, the origins of Singaporean culture can be traced back some 2,500 years to the teachings of Confucius [13]. As a result, GSS features that are culturally compatible will be appropriated, and the remaining features may be reshaped to satisfy cultural norms or ignored. Our findings suggest that AST and national culture are overlapping theories for interpreting GSS adoption.

While culture can be most resistant to change, technology can be an overwhelming force in some situations. The story of the Yir Yont tribe [19] is a vivid example of technology devastating an ancient culture. In the case of the Yir Yont tribe, new technology, in the form of a steel ax, completely changed social structure. The introduction of a GSS is a discontinuity in a group's life. It presents new ways of social interaction for which there are no established norms. As was evident in some Singaporean groups, some individuals took advantage of this discontinuity to break a culture code and criticize group members.

Second, GSS designs need to recognize that the common feature of problem-solving groups across all cultures is information exchange. Cultures have evolved a number of different meeting formats, but there is a common goal of information exchange. Thus, a GSS should be a flexible assortment of information exchange tools that can be arranged to operate under a variety of communication configurations. For example, anonymity should be a switchable feature because it might be inappropriate in certain circumstances in some cultures. GSS technology must be highly flexible because restrictiveness implicitly means the imposition of a culturally determined model of a meeting—a model that might be appropriate for only a few cultures.

Third, GSS meeting designers need to be culturally sensitive. Meeting designers match the tools and communication configuration of a GSS to meeting goals and cultural norms. They dovetail GSS technology into culture. This does not mean they use GSS technology to replicate existing meeting structures, rather they use the technology to advance group norms. For example, in U.S. groups egalitarianism is increased by parallel communication and anonymous information exchange. In Singaporean groups, harmony might be enhanced by using a GSS to create a distributed meeting in which group members are physically separated and information exchange is asynchronous. In this case, members can carefully assess others' opinions and weigh their thoughts before making a statement. Precipitous and flippant statements will be less likely and group harmony preserved. This approach should be particularly useful when some group members are using a language other than their native tongue.

This study has several limitations. First, group size was not constant across the two experiments, and group size, instead of national culture, is a potential explanatory variable for the differences. Second, leadership was manipulated, without a significant effect, in Singaporean groups. This manipulation appeared to have no effect, but its potential impact must be recognized. Third, a single meeting may not correctly detect the long-term effects of GSS technology. Fourth, U.S. subjects were from the 'Breadbasket' region of Garreau's [10] nine nations of North America. Because each of the nine 'nations' has a distinct culture, the findings may not be applicable to the other cultural regions. Fifth, the study relies on Hofstede's [12] identification of cultural variables. His data was collected in the 1970s, and in the intervening period there might have been changes in either the Singaporean or U.S. cultures. However, Hofstede argues that culture is very stable over long periods, and it takes a sharp discontinuity (e.g., military conquest) to precipitate norm shifts. Also, Bunke [3] indicates that Hofstede's findings are still valid. Sixth, findings based on student subjects may not generalize to the broad class of decision makers in either country. Seventh, the findings may not generalize to GSS implementations substantially different from SAMM. Finally, the attempts to explain some of the findings are based on exploratory analysis. These con-

jectures are presented to stimulate thinking about the findings and to provide some ideas for future research.

There are many opportunities for research into the effect of GSS technology in different national cultures. If Hofstede's 'four dimensions' model is accepted, future research could compare cultures that vary on a single dimension, instead of two as in this study, so that the impact of a particular cultural factor on computer-assisted decision-making can be isolated. There is a general need to move GSS research in the direction of repeated measures to overcome the possible transitory effects of new technology. Task type can explain much of the variance in group performance [18], and this study could be replicated with a different task to see whether findings generalize across different tasks.

Researchers planning cross-cultural studies should carefully consider settling on a common GSS to permit comparison across studies. SAMM may be suitable because of its low cost and portability. Alternatively, researchers might replicate this study with a different GSS in order to tease out effects that may be specific to a particular GSS.

Cross-cultural studies of GSS technology are highly relevant to a post-industrial society in which managerial teams, often composed of individuals from different cultures, will make extensive use of information technology to support group decision-making. This study has shown that culture is a fourth variable that needs to be considered in GSS design and implementation once it moves beyond the boundaries of North America.

Acknowledgments

The AT&T International Singapore office supplied an AT&T 3B2 500 computer for the experiment. The National University of Singapore GSS research team members, Mr. Lim Lai Huat and Dr. Wei Kwok Kee, participated in the design and conduct of the Singapore experiment. Bob Bostrom and Jerry Lohse's comments were insightful and helpful.

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Appendix: Consensus change/Analysis of Variance

Source of variation	df	Sum of squares	F	Prob > F
Culture	1	2.71	17.06	0.0001
Decision aid	2	0.96	3.03	0.0519
Culture * decision aid	2	0.27	0.85	0.4306
Error	120	19.04		
F = 4.87, Prob > F = 0.0004, R^2 = 17%				

Equality of Influence/Analysis of Variance

Source of variation	df	Sum of squares	F	Prob > F
Culture	1	0.15	6.69	0.0109
Decision aid	2	0.07	1.61	0.20
Log(pre-meeting consensus)	1	0.13	5.94	0.0163
Culture * decision aid	2	0.10	2.33	0.10
Error	119	2.95		
F = 2.69, Prob > F = 0.0176, R^2 = 12%				

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