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**EQUALITY OF RETICENCE IN GROUPS AND IDEA GENERATION:
AN EMPIRICAL STUDY**

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ABSTRACT

Contingency models proposed for group support systems suggest that task, technology, group and individual characteristics may explain observed effects. Task, technology and group characteristics have been studied to some extent. Characteristics of individual participants have received less attention. In this article, the results of an experimental study on the equality of reticence in groups on idea generation are reported. Groups comprising equally-reticent or unequally reticent subjects generated ideas in one of two brainstorming modes: oral brainstorming and electronic brainstorming. No effect was observed for equality of reticence, but electronic brainstorming (computer-supported condition) did produce a larger number of ideas than oral brainstorming.

INTRODUCTION

Several authors (e.g., DeSanctis and Gallupe, 1987; Nunamaker, Dennis, Valacich, Vogel, and George, 1990; Rao and Jarvenpaa, 1991) have proposed explanations based on contingency factors to explain effects observed in studies of group support systems (GSS). Many studies have examined the effects of task, technology and group characteristics (for summaries, see McLeod, 1992; Benbasat and Lim, 1993), but few have examined the effects of individual differences. Among those examining individual factors, Wheeler and Mennecke (1992) have examined the effect of preference for procedural-order, Rao and Monk (1999) have examined the effect of inner-motivation and other-motivation on commitment under conditions of

anonymity, and, Massetti (1996) has reported results on the effect of individual idea fluency on idea generation. The effects of individual reticence have not been examined.

The importance of reticence or shyness in GSS studies has been acknowledged by several authors (e.g., Huber, 1982; Nunamaker, Applegate and Konsynski, 1987; Connolly, Jessup and Valacich, 1990). They have suggested that GSS will lead to greater or fuller participation of reticent members. For instance, Huber (1982) in arguing for the use of GSS says 'Group members with dominant personalities ... tend to participate in the group discussion more... This domination by a few ...suppresses the contribution of other members [i.e., reticent members]' (p. 97). Connolly et al (1990) suggest that '...anonymity should encourage

full participation of junior or shy members' (p. 691-692). But no empirical study has been published on the effect of individual reticence on variables of interest in group support systems. In this paper, we examine the effect of individual reticence on idea generation in groups.

The rest of the article is arranged as follows. In section 2, concepts pertinent to this study are reviewed. The theoretical model and hypotheses are in section 3 and the methodology is described in section 4. In section 5, the statistical results are presented. In section 6, the results are discussed. Suggestions for future work are provided in section 7. Section 8 offers concluding remarks.

LITERATURE REVIEW AND CONCEPTUAL DEVELOPMENT

In this section, pertinent literature is reviewed. Three issues are addressed. First, we review two relevant sub-areas of GSS studies: individual differences in GSS and idea generation. Second, we examine reticence-related constructs. Third, we look at studies in the non-GSS literature that examine the effects of reticence (also referred to as shyness) on dependent variables of possible interest in GSS research.

Group Support Systems

The current study focuses on individual differences and idea generation. So, the review or literature on Group Support Systems is limited to the literature on individual differences in GSS and idea generation.

Individual Differences in GSS

Process and outcome variables in GSS research can be affected by personality traits (Gray, 1987). The individual differences that have been examined as contingent factors in the context of GSS are individual preference for procedural order (Wheeler and Mennecke, 1992), inner-motivation and other-motivation of individuals (Rao and Monk, 1999), and, idea fluency of individuals in idea generation (Massetti, 1996). Wheeler and Mennecke found that decision quality was not different for the high procedural order (HPO) groups compared to the decision quality for the low procedural order (LPO) groups, but that HPO groups reported higher levels of overall satisfaction, satisfaction with the solution and higher participation. Rao and Monk (1999) studied the effect of anonymity, and inner-motivation and other-motivation of an individual on commitment. They found that anonymity did not affect commitment, but the individual differences in inner- and other-motivation

provided explanatory power for differences in commitment. The primary focus of the study by Massetti (1996) was the effect of generative and explorative support systems for idea generation. She did not find any effect for the technology variable, but did find that idea fluency of individuals explained a large portion of the variation in performance. These studies provide empirical evidence that dependent variables of interest to GSS researchers can be affected by individual differences.

Idea Generation

A significant portion of research in the area of GSS appears to be focused on brainstorming. This is not surprising since most claims for the benefits of GSS are related to brainstorming or idea generation. The research on idea generation can be divided into two categories: the nature of the stimuli used in triggering new ideas and the attempts to determine the source of productivity gains in electronic brainstorming.

Some examples of studies which examine different stimuli are Malaga (2000), Sosik (1997), Satzinger, Garfield and Nagasundaram (1999) and Massetti (1996). Malaga reported that pictorial stimuli led to the generation of more creative ideas than verbal stimuli. Sosik reported that high transformational leadership (confederates typing in comments concerning the importance of the task, confidence in group etc.) led to more original solutions than low transformational leadership (confederates typing in remarks about serving clients, economic payoffs etc.). Satzinger et al examined the effects of using stimuli stored in GSS group memory. Massetti (1996) examined the effects of generative and exploratory support systems on creativity of ideas. She found no difference between the types of support provided, but did report a significant difference between having support and not having any support at all. She also reported a high effect for idea fluency of individuals, as mentioned in the previous subsection.

The second major stream of research in brainstorming focuses on understanding the differences between electronic brainstorming and non-computer supported brainstorming. In the domain of non-computer supported brainstorming, there are some reports that group brainstorming leads to fewer ideas than an equal number of individuals brainstorming alone (e.g., Diehl and Strobe, 1987; Paulus and Dzindolet, 1993). In sharp contrast, in electronic brainstorming, the preponderance of evidence is that groups generate more ideas than individuals. Several studies have focused on identifying

the reason for this difference. Dennis and Valacich (1993), Gallupe, Bastianutti and Cooper (1991), and Gallupe, Cooper and Grise (1994) have shown that the absence of production blocking and the reduction in evaluation apprehension are major reasons why electronic brainstorming sessions are more productive.

In summary, the literature review confirms the original premise that individual differences are not being

studied adequately in GSS research. In particular, while several explanations have been put forward to explain variances in productivity of electronic brainstorming, reticence has not been examined.

The Reticence Constructs

Many closely related constructs tap into the shyness or reticence trait. In this sub-section the commonality between reticence constructs is pointed out. Workplace reticence is then defined, emphasizing the distinctions between workplace reticence and other reticence constructs. The empirical effects of reticence are then discussed. The commonality among reticence-related constructs allows us to argue that some of the effects observed for other reticent constructs can be generalized for workplace reticence also.

The Commonality of Reticence Constructs

Reticence, shyness and communication apprehension, social anxiety, audience anxiety, unwillingness to communicate and other terms are closely related constructs (Daly and Stafford, 1984). Each term has evolved in a separate context. For instance, shyness and reticence are the more commonly used terms in the psychology literature, and communication apprehension in communication literature. There are over thirty self-report scales (Daly and Stafford, 1984), to measure reticence and related variables, each focusing on a slightly different aspect. However, there is general acceptance that, while the conceptual distinctions between the different constructs are important, all the terms tap into the same underlying trait. Daly and Stafford (1984), focusing on communication apprehension, state '... there is considerable evidence suggesting that, by and large, the many different constructs within this area tap into a single, broad disposition' (p. 126). These sentiments are

echoed by researchers in psychology, such as Cheek and Briggs (1990), who state '...in spite of the continuing debates among the test constructors about potentially important conceptual distinctions, these measures generally intercorrelate to an extent that permits us to consider them in our literature review as alternative operational definitions of the same global construct' (p. 323).

Workplace Reticence

The difficulty of defining workplace reticence, becomes apparent when one reads seemingly circular definitions of related constructs, such as 'It [shyness] includes attitudes and feelings such as reticence' (Jones and Russell, 1982, p. 629). Table 1 provides definitions of some reticence-related terms, such as shyness, social reticence, and communication apprehension. It is interesting to note that there has been an acceptance of these definitions and there has been no serious attempt to expand on them. It should also be noted that there has been no prior attempt to articulate the concept of workplace reticence. An argument for distinguishing between social and workplace reticence can be inferred from Maroldo (1998), who reported that privately shy leaders do not appear to be shy when carrying out their duties, i.e., shyness in a social environment does not always equate to shyness in the working environment.

Characteristics associated with social reticence such as lack of confidence and disruptive anxiety (Jones and Russell, 1982) will affect behavior in the workplace also. Rao, Desroches and Trapnell (1993) argue social reticence is not adequate to completely characterize workplace behavior. For example, social situations are ambiguous, with somewhat ill-defined rules for interaction. Work situations, on the other hand, can be more structured with roles of individuals and the rules for interaction more clearly defined. So, a person who may lack the confidence to speak in a social situation may be quite comfortable speaking up in a work situation. Alternately, a person who is not reticent in social situations, may exhibit reticence in the presence of his/her superiors or colleagues in the workplace as a result of evaluation apprehension or fear of reprisal for expressing contradictory opinions. The term, workplace reticence, is defined as the inability or unwillingness to communicate in the workplace as a result of generalized anxiety or evaluation apprehension or fear of reprisal or some related reason.

REFERENCE	VARIABLE	DEFINITION
Jones and Russell (1982)	Shyness (social reticence)	a lack of confidence in new or unfamiliar social settings, inadequate social skills and disruptive anxiety in social situations, among other characteristics (p. 629)
Buss(1984)	shyness	discomfort, inhibition, and awkwardness in social situations, especially with people who are not familiar (p. 39)
Phillips (1984)	reticence	when people avoid communication because they believe they will lose by talking than by, remaining silent
McCroskey (1984)	communication apprehension	an individual's level of fear or anxiety associated with real or anticipated communication with another person or persons (p. 13)
current paper	workplace reticence	the inability or unwillingness to communicate in the workplace as a result of generalized anxiety or evaluation apprehension or fear of reprisal or some related reason.

Table 1. Definitions of Some Reticence-related Variables

The Effects of Reticence

Behaviors attributable to reticence manifest both in terms of social actions and communication patterns. Social actions refer to taking charge, positioning oneself in-a group, and so on. Communication patterns refer to the characteristics of communication, such as, amount of talking and ability to initiate a conversation.

In terms of social actions, Crowell, Katcher, and Miyamota (1955) have shown that shyness is inversely related to likelihood of assuming leadership positions. Mantei (1988) has observed that group leaders assume ‘power’ positions when taking seats in group decision rooms. This observation is consistent with other observations where shy persons select seats in small group settings that involve fewer communication demands (McCroskey, 1976; McCroskey and Sheahan, 1976). Santee and Maslach (1977) have reported that shyness is significantly related to conforming with others. Jablin, Seibold and Sorenson (1977), and Jablin and Sussman (1978) have also observed comparable tendencies of reticent individuals to conform with the majority in brainstorming sessions. Bradshaw and Stasson (1998) report that shy persons rate their own contributions to groups as less important than the contributions of other group members. They also report that shy persons were more likely to withhold ideas and comments from the

group. Further, shy persons also identified less with the group’s decision.

In terms of communication behavior, reticence has been shown to be inversely related to frequency and duration of talking done by the person, and inversely related to the individual's ability to interrupt successfully (Natale, Entine and Joffe, 1979; Pilkonis, 1977). Burgoon et al (1988) found that reticent individuals speak less often and for shorter durations. Manning and Ray (1993) report that shy individuals used extensive talk, and employed pretopical sequences which did not initiate the topic. Reticent persons also have difficulties in initiating and controlling a conversation (Arnston, Mortenson, Lustig, 1980; Pilkonis and Zimbardo, 1979). Nonverbal communication by reticent individuals tends to reflect anxiety (Burgoon et al, 1988) and is characterized by gaze avoidance (Carrell and Wilmington, 1998; Van der Molen 1990). Burgoon (1976) reports that reticent persons engage in less information seeking and giving. Reticent individuals generate far fewer ideas in a social brainstorming setting [non-computer-supported] than in individual brainstorming (Jablin, *et al*, 1977; Jablin and Sussman, 1978). Jablin *et al* surmise that the reticent subjects are coping with the anxiety related to oral communication demands in a group than with the problem of generating ideas.

Assumption of leadership roles, conforming with others, frequency and duration of talking, number of ideas generated and so on are variables of significant interest to the researchers in the field of GSS. Prior research in the area of shyness and reticence indicates that these variables are affected by individual reticence. What this implies is, that some of the differences in effects between GSS and non-supported meetings can be expected to be stronger when there is a larger variance in reticence across members of a group. The role of individual reticence should be examined carefully when studying the effect of GSS, and in particular when studying variables, such as conformity, information seeking, number of ideas generated and so on.

In this section, we have established that (a) individual differences have not been studied much in GSS research, (b) reticence affects variables of interest to GSS researchers. The overlapping conceptualizations of reticence and closely related variables have been discussed, building up to a definition of workplace reticence. Some of the known effects of reticence have been discussed highlighting that reticence explains social and communication behavior of interest to the GSS community.

THEORETICAL MODEL AND HYPOTHESES

The Theoretical Model

The literature in psychology and communication includes reports that reticent persons speak less and for a shorter time in group interaction (Natale, Entine, Joffe, 1979; Pilkonis, 1977) and have difficulties initiating or controlling a conversation (Arnston, Mortenson, Lustig, 1980; Pilkonis and Zimbardo, 1979) in non-supported meetings. Based on the research on the behavior of shy persons, several reasons can be put forth to argue that shy persons are less likely to contribute in a meeting environment. First, shyness is associated with fear of evaluation. Second, shy persons rate their own contributions to groups as less important than contributions of other group members (Bradshaw and Stasson, 1998). Bradshaw and Stasson also report that shy

persons identify less with the group. Third, Van der Molen (1990) reports that shy people often lack initiative and prefer to wait till they are asked. Each of these reasons increases the likelihood that shy people will contribute less to a group meeting than non-shy persons.

In groups comprising individuals of nearly equal reticence (equal-reticence groups), each individual is equally likely to contribute at a given opportunity, i.e., each and every group member contributes ideas to the fullest extent of their ability. The total number of ideas generated will be maximized as a result. In groups comprising individuals of unequal reticence (unequal-reticence groups), high-reticence individuals are likely to withhold contributions because of fear of evaluation, lack of identification with group, and poor perception of own ideas. The loss of the ideas that could have been contributed by the high-reticence individuals will lead to the total number of ideas generated by a unequal-reticence group being less than the maximum possible. Thus the equality of reticence of the group members can affect the number of ideas generated by the group.

The relationship between the equality of reticence in groups and the number of ideas generated is argued to be moderated by the brainstorming mode. This argument is best illustrated by considering two modes of brainstorming: oral brainstorming and electronic brainstorming. In oral brainstorming, group members engage in an open and spontaneous discussion. This presents two possible problems, particularly for high-reticence subjects. First, the high-reticence individuals may be hesitant to contribute because they may be less confident about their ideas and have a fear of evaluation. Second, the dynamics of the interaction requires that group members actively seek their share of air time. There is the likelihood that high-reticence individuals in unequal-reticence groups may not succeed in garnering their share of air time and thus contribute less. On the other hand, in equal-reticence groups, all individuals are equally likely to contribute. Each group member is equally likely to garner air time and have an opportunity to contribute. Thus there will be a difference between the total number of ideas generated by equal-reticence groups and unequal-reticence groups.

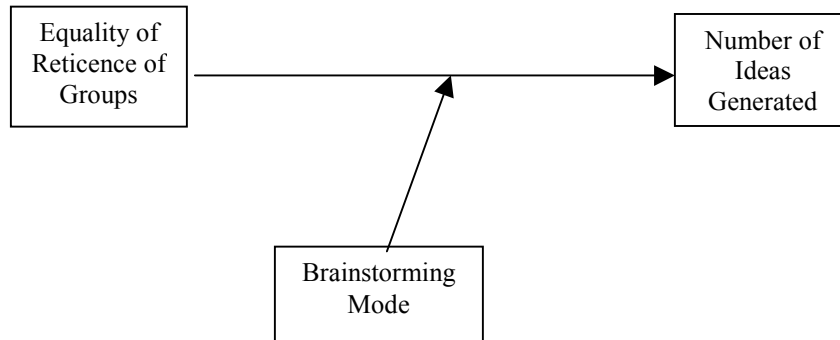


Figure 1. The Theoretical Model

In electronic brainstorming, group members have the support of a computer-based system, which affords them anonymity for contributing ideas and also allows group members to contribute ideas simultaneously. In unequal-reticence groups, the high-reticence members will be less inhibited because the anonymity of their contributions reduces the fear of evaluation. Further, since each member can contribute at the same time, there is no conflict for air time. Thus their contributions to the idea generation process will improve, and consequently the overall number of ideas generated by the unequal-reticence groups will be close to maximum. In equal-reticence groups, productivity was already at near-maximum in the non-computer environment, computer support will not significantly improve overall idea generation. In the electronic brainstorming mode, both equal-reticence and unequal-reticence groups will be producing ideas at near maximum levels, thus there will be no difference in the number of ideas generated by the two types of groups.

Since there is a predicted difference between the number of ideas generated by the equal-reticence groups and unequal-reticence groups in oral brainstorming and no predicted difference between the two types of groups in electronic brainstorming, it is argued that the brainstorming mode moderates the relationship between equality of reticence of group members and total ideas generated. The theoretical model is shown in Figure 1.

Hypotheses

Overall Effect of Equality of Reticence

H1a: Overall, the number of ideas generated by equal-reticence groups will be significantly higher than the number of ideas generated by unequal-reticence groups.

Overall Effect of Brainstorming Mode

H1b: Overall, the number of ideas generated in the electronic brainstorming mode will be significantly higher than in the oral brainstorming mode.

Effect of Equality of Reticence in Oral Brainstorming

H2a: In oral brainstorming, unequal-reticence groups will generate fewer ideas than equal-reticence groups.

Effect of Equality of Reticence in Electronic Brainstorming

H2b: In electronic brainstorming, the number of ideas generated by unequal-reticence groups will not be significantly different from the number of ideas generated by equal-reticence groups.

Effect of Brainstorming Mode in Unequal-reticence Groups

H3a: In groups of unequal-reticence, the number of ideas generated in the oral brainstorming mode will be significantly less than the number of ideas generated in the electronic brainstorming mode.

Effect of Brainstorming Mode in Equal-reticence Groups

H3b: In groups of equal-reticence, the number of ideas generated in the oral brainstorming mode will not be significantly different from the number of ideas generated in the electronic brainstorming mode.

EXPERIMENTAL METHODOLOGY

The study used a 2 x 2 experimental design: equality of reticence in groups (equal-reticence groups and unequal-reticence groups) and brainstorming mode (oral and electronic).

Subjects and Formation of Groups

About 150 students were recruited from an introductory MIS class for the study. The demographics of the subjects are shown in Table 2.

Each subject completed a questionnaire to provide a self-report measure of workplace reticence. Students scoring in the top quartile of the reticence scale

were assigned to a category Y, i.e., high-reticence category; (reticence score of 1.38 to 2.13); students in the bottom quartile were assigned to the X category, i.e., low-reticence category (reticence score of 2.75 to 4.13). Students in the middle two quartiles were assigned to the Z category, i.e., mid-reticence category (reticence score of 2.13 to 2.75). Subjects were informed which category (X, Y or Z) they fell into, but were not told what "X", "Y" or "Z" meant.

Each group was to consist of six members. Equal-reticence groups were to be formed by having all six subjects from the Z category (mid-reticence). Unequal-reticence groups were to be formed by having three from the X category (low-reticence individuals) and three from the Y category (high-reticence individuals). In reality, most groups had either five or six members, with one group having only three members. Smaller size groups were the result of subjects not showing up at the assigned time. Also, one session had 4 subjects in the X category and 2 in the Y category. This was unintended. The data point is included in the analysis to keep from reducing the sample size.

	All Groups	Equal-Reticence Groups	Unequal-reticence Groups
Age			
Range	18 – 49	18-49	19 – 49
Average	27.2	28	26.2
Standard Deviation	7.36	8.0	6.33
Gender Ratio			
Overall Male: Female	1.11	1.08	1.13
Reticence Scores			
Range	1.5 – 4.13	2.13 ¹ -2.75	1.5-4.13
Average	2.45	2.37	2.55
Standard Deviation	0.55	0.22	0.79

Table 2. Subject Demographics

Assignment of individuals to specific groups was achieved as follows. Sessions of only Z members or three X and three Y members were scheduled. Then individual subjects were allowed to sign up for a session if their categorization based on the reticence scale was acceptable for that session.

Incentives

Students were given 50 points course credit, which was approximately 7% of the credit for the course. Participation was on a voluntary basis. Those not wishing to participate were given an alternative assign-

ment for equal credit. Approximately 60% of the recruited students participated in the study. To motivate active participation in a session, the group with the largest number of ideas was to be awarded a \$ 100 gift certificate.

The Task

The task assigned to the subjects was to generate ideas to solve the parking problem at the University. Students were polled prior to the study on the problems facing them. About 70% of the students ranked parking as the most important problem facing them at that time. The usual problems associated with parking in universities were aggravated at the time of the study by ongoing construction.

Technology

In the oral brainstorming sessions, the subjects were seated around a rectangular table, usually three across from three. The session was audiotaped and videotaped. The subjects were provided with a pad of paper and a pencil or pen. They were instructed to produce a list of ideas as the end-product of their session. The electronic brainstorming session was conducted using GroupSystem. The system allows ideas to be generated anonymously. It also has the facilities for subjects to generate ideas simultaneously, i.e., without having to wait for air time. The electronic brainstorming sessions were videotaped.

Training

All subjects were trained on the electronic brainstorming tool for about fifteen minutes. The training consisted of familiarizing the subjects with the mechanical aspects of using the software, i.e., the subjects were walked through the brainstorming module to help them get familiar with how to enter ideas and submit them. Other details of the software were not covered. The training was provided over a two to three week period, much prior to and independent of the experimental sessions.

All choices of which subjects to train and on what technologies can be challenged for equivalence of pre-experimental treatments. The decision to train all subjects in electronic brainstorming is a compromise decision. All subjects were trained on the technology for two reasons. First, since the subjects were recruited from an introductory information systems class, exposure to

group support technology was considered educational. Second, it was considered appropriate to separate the training session from the experimental session. By training all the subjects, the necessary leeway to assign subjects to different treatments was gained.

Experimental Procedure

In all sessions, the subjects were given a few minutes to introduce themselves to each other at the beginning of the session. They were provided instructions on the task, i.e., that they were generating ideas to solve the parking problem at the university.

In the oral session, the subjects were told that they would have an oral brainstorming session, but they would have to submit a written list of ideas as the end-product from the session. There was no instruction requiring that they agree on the idea before including it in the list. In all oral sessions, one subject took on the responsibility of recording ideas as the discussion progressed. The discussions followed a free format. The list of ideas submitted by oral groups was not used for coding. Instead the audiotapes of the sessions were transcribed and coded.

The electronic brainstorming session was initiated by the technology facilitator. Subjects generated ideas on the topic of discussion. The researcher took care of logging them out of the session, copying the files with the ideas and so on.

In all sessions, there was no time limit. Subjects continued to generate ideas until no participant had any additional idea to offer. This decision may be criticized, but the alternate option of providing equal time for all groups is not without problems either. In oral brainstorming sessions, ideas are generated sequentially. In electronic brainstorming sessions, ideas are generated in parallel. If all sessions are allowed the same amount of time, it could be argued that a larger number of ideas in electronic brainstorming than in oral brainstorming would not be a surprise at all. The decision to allow the subjects to continue brainstorming till no participant has any additional idea to offer, in our opinion, has greater external validity, since in real life situations, brainstorming is unlikely to be terminated at some arbitrary time limit if participants are continuing to generate relevant ideas.

The number of data points in each treatment category is shown in Table 3.

	Unequal-reticence Groups	Equal-reticence Groups
Oral Brainstorming Groups	5	7
Electronic Brainstorming Groups	5	6

Table 3. Number of Data Points in Each Cell

Measures

Individual workplace reticence was measured using a scale developed by Rao, Desroches and Trapnell (1993). Summary results of scale validity and reliability from the original development of the scale are shown in Table 4.

A summary measure on a 1 to 5 scale was calculated for each subject. Equality of reticence in a group was a dichotomous variable. Unequal-reticence groups were formed by having subjects from the two extreme quartiles, while the equal-reticence groups were formed with subjects from the two middle quartiles. Reticence score parameters are shown in Table 2.

The number of ideas generated was determined by coder(s) from transcripts of sessions. The oral sessions were transcribed from audiotapes. The electronic sessions were compiled from logs of ideas generated. Both sets of transcripts were presented to the coder(s) in the same font. Logs from the electronic sessions were edited to remove headers that identified them as ideas generated in electronic sessions. The first few sessions were coded by two coders until they achieved a satisfactory level of inter-coder reliability. Subsequently, only one coder was used.

Test	Score
Internal Reliability: Cronbach's Alpha [n=273]	0.90
Structural Validity: a) Factor Analysis b) Correlation with social reticence scale	a) loaded onto separate factors from 16-item social shyness scale. b) R = 0.67 (p <0.001)
Test-Retest (after 14 weeks) [n=17] a) test-retest correlation b) pairwise t-test of difference of first and second scores of each subject	a) R = 0.70 (p <0.001) b) T= 0.59, p >0.50 (not different)
Veridicality of Self-reported measures: correlation of self-report scores with ratings of external observers [n=36]	R=0.63 (p < 0.001)

Table 4. Summary of Reliability and Validity Tests for Workplace Reticence.

RESULTS

The results are organized in three segments. The first segment reports results on the possible effect of group size. The second segment reports results on the main effects, and the third segment reports the results on the possible differences between individual cells.

It should be mentioned at the outset that the number of data points available for analysis is limited. Hence only hypotheses H1a and H1b were tested formally using the general linear equations model. T-tests were conducted to examine hypotheses 2a, 2b, 3a and 3b in an exploratory spirit.

It should also be mentioned that the results of non-parametric tests are consistent with the results reported in all cases.

Possible Effect of Group Size

A constant group size of six was aimed at. However, group size was not constant across sessions. There were thirteen (13) groups of six subjects, nine (9) groups of five subjects and one (1) group of three subjects. The possibility that group size may have affected the number of ideas generated was considered and tested for. The correlation coefficient between the number of ideas and group size was -0.05 ($p < 0.80$). A second test was conducted to examine with group size varied systematically with either of the independent variables, i.e., the equality of reticence of groups or the brainstorming mode. Group size did not vary systematically with either of the independent variables.

Hence, the variation in group size was ignored in further analyses.

The effect of Equality of Reticence in Groups and Brainstorming Mode on Idea Generation

The means and standard deviations of the number of ideas generated are shown in Table 5. The results of the statistical analysis are shown in Table 6. The results indicate that equality of reticence in groups has no effect on the total number of ideas generated ($F_{1, 23} = 0.54$, $p > 0.47$). Hypothesis 1a is not supported. The brainstorming mode did have a significant effect on the number of ideas generated ($F_{1, 23} = 6.9$, $p < 0.02$). Hypothesis 1b is supported. There was no interaction effect, i.e., the interaction of equality of reticence in groups and brainstorming mode did not affect the number of ideas generated ($F_{1, 23} = 0.14$, $p > 0.71$).

	Unequal-Reticence	Equal-Reticence	Total
Oral Brainstorming	61.6(16.6)	56(24.7)	58.54(20.6)
Electronic Brainstorming	90.6(21.3)	79.1 (29.6)	83.91(28.0)
Total	76.1(26.2)	68.46(28.9)	71.78(27.4)

Table 5. Number of Ideas Generated [Means (Std. Dev.)]

Dependent Variable: Number of Ideas Generated.

Source	Deg. of Freedom	Sum of Sq.	Mean Square	F-value	Pr>F
Model	3	4508	1501	2.4	0.01
Error	20	12537	626		
Corrected Total	23	17042			
Equality of Ret.	1	338	338	0.54	0.47
Mode	1	4324	4324	6.9	0.02
Eq-of-Ret X Mode	1	89	89	0.14	0.71

Table 6. Effect of Equality of Reticence and Brainstorming Mode on Number of Ideas Generated

Exploratory Tests

The rest of the hypotheses are examined in an exploratory spirit. The number of data points available is limited; consequently, the power of any formal test will be weak. T-tests (see Tables 7a thru 7d) have been conducted to examine if the trend in differences follows

expectations. The hypotheses are stated again to facilitate clarity in presentation.

H2a: In oral brainstorming, unequal-reticence groups will generate fewer ideas than equal reticence groups.

	Means (SD) Unequal-Ret	Means (SD) Equal-Ret	t	Deg. of freedom	Sig (2-tailed)
Oral Brainstorming	61.6(16.6)	56(24.8)	0.43	9	0.68

Table 7a. Effect of Equality of Reticence in Oral Brainstorming on Number of Ideas Generated

Hypothesis H2a is not supported. The data do not indicate any significant difference between the number of ideas generated by the unequal-reticence groups and the number of ideas generated by the equal-reticence groups in oral brainstorming.

H2b: In electronic brainstorming, the number of ideas generated by unequal-reticence groups will not be significantly different from the number of ideas generated by equal-reticence groups.

	Means (SD) Unequal-Ret	Means (SD) Equal-Ret	t	Deg. of freedom	Sig (2-tailed)
Elec. Brainstorming	90.6(27.3)	79.1(29.6)	0.68	10	0.51

Table 7b. Effect of Equality of Reticence in Electronic Brainstorming on Number of Ideas Generated

Hypothesis H2b is supported. There is no statistically significant difference between the number of ideas generated by the equal-reticence and unequal-reticence groups in electronic brainstorming.

H3a: In groups of unequal reticence, the number of ideas generated in the oral brainstorming mode will be significantly less than the number of ideas generated in the electronic brainstorming mode.

	Means (SD) Oral	Means (SD) Electronic	t	Deg. of freedom	Sig (2-tailed)
Unequal Reticence	61.6(16.6)	90.6(27.3)	2.03	8	0.08

Table 7c. Effect of Brainstorming Mode for Unequal-reticence Groups on Number of Ideas Generated

There is weak support for Hypothesis H3a ($p < 0.10$), i.e., groups of unequal reticence produce more ideas in the electronic brainstorming mode than in the oral-brainstorming mode. This would suggest that the results would be much stronger if more data points were available.

H3b: In groups of equal reticence, the number of ideas generated in the oral brainstorming mode will not be significantly different from the number of ideas generated in the electronic brainstorming mode.

	Means (SD) Oral	Means (SD) Electronic	t	Deg. of freedom	Sig (2-tailed)
Equal Reticence	56(24.8)	79.1(29.6)	1.51	11	0.15

Table 7d. Effect of Brainstorming Mode for Equal-reticence Groups on Number of Ideas Generated

Hypothesis H3b is supported. The data do not indicate a significant difference between the ideas generated by equal-reticence groups in the electronic brainstorming mode and the oral brainstorming mode. It should be observed that the numerical difference is fairly large and one cannot eliminate the possibility that a significant difference may surface if sufficient data are gathered.

of ideas generated were being examined in the study. It has already been stated that the number of data points may be adequate to detect strong effects, but not weak effects at a statistically significant level. So, in the discussion, we have interpreted the data as they are. We have also discussed the possibility of significant differences on some tests if the sample size were larger.

The results of the hypotheses testing are summarized in Table 8.

DISCUSSION

The effects of two variables, equality of reticence in groups and brainstorming modes, on number

Hypothesis	Supported?
Overall H1a: Equal-reticence Groups > Unequal-reticence Groups	NO
Overall H1b: Electronic Brainstorming > Oral Brainstorming Groups	YES
Exploratory Tests	
Oral Brainstorming H2a: Unequal-reticence Groups < Equal-reticence Groups	NO
Electronic Brainstorming H2b: Equal-reticence Groups = Unequal-reticence Groups	YES
Unequal-reticence Groups H3a: Oral Brainstorming < Electronic brainstorming	WEAK
Equal-reticence Groups H3b: Electronic brainstorming = Oral Brainstorming	YES

Table 8. Summary of Results

The Effect of Equality of Reticence in Groups

There were three expectations with respect to equality of reticence in groups. First, in the oral brainstorming mode, equal-reticence groups would produce significantly more ideas than unequal-reticence groups (hypothesis H2a). Second, in the electronic brainstorming mode, there would be no significant difference in the number of ideas generated by the equal-reticence and unequal-reticence groups (hypothesis H2b). Third, overall, the number of ideas generated by equal-reticence groups would be significantly higher than the number of ideas generated by the unequal-reticence groups (hypothesis H1a).

The first expectation that equal-reticence groups would produce more ideas than unequal-reticence groups in oral brainstorming was not supported by the statistical analysis. Raw scores are not encouraging either (a mean of 61.6 for unequal reticence and 56 for equal reticence scores). The expectation was based on several assumptions. One, that all individuals, irrespective of their reticence score, have the same capacity for producing ideas on average; differences in the number of ideas produced are a result of the failure to overtly articulate the ideas during the brainstorming session. Two, there is nothing in the dynamics of interaction which causes the low-reticence subjects to compensate for lack of production by the high-reticence subjects. Both assumptions are subject to empirical verification.

The second expectation was that, in electronic brainstorming, there would be no significant difference between the number of ideas generated by unequal-reticence groups and equal-reticence groups. This expectation was supported, i.e., no statistical significance was observed. The difference in raw scores (91 for unequal-reticence groups vs. 79 for equal-reticence groups) is non-trivial and suggests that a difference may surface if a sufficiently large sample size is used. If the difference does surface, it would be somewhat puzzling. There is no simple argument to support the expectation that unequal-reticence groups will produce more ideas than equal-reticence groups in electronic brainstorming. Once again, the assumptions underlying the hypotheses will have to be examined further.

The third expectation was that, overall, the number of ideas generated by the equal-reticence groups would be significantly higher than the number of ideas generated by the unequal-reticence groups. This was based mostly on the expectation that the differences in the oral brainstorming mode would be large, even though there would be no difference between the two types of groups in the electronic brainstorming mode. There was no significant difference either in the oral brainstorming

mode or in the electronic mode. Hence it is not surprising that there is no overall difference. While there is no support for the hypothesis, the results do challenge a widely-held belief among GSS researchers, i.e., reticence has a significant effect on idea generation. Further examination of the belief is necessary.

The Effect of Brainstorming Mode

Once again, there were three expectations. First, for groups of unequal-reticence, the number of ideas generated in the electronic brainstorming mode would be significantly higher than the number of ideas generated in the oral brainstorming mode (hypothesis H3a). Second, for groups of equal reticence, the number of ideas generated would not be significantly different in the two brainstorming modes (hypothesis H3b). Third, overall, more ideas would be generated in the electronic brainstorming mode than in the oral brainstorming mode (hypothesis H1b).

In groups of unequal reticence, the number of ideas generated in the electronic mode is higher than the number of ideas generated in the oral mode (91 in the electronic mode vs. 61 in the oral mode). The statistical significance of the difference is weak ($p < 0.10$). The difference in raw scores is fairly high, allowing the speculation that this effect will be demonstrable strongly if more data points are gathered.

In groups of equal-reticence, the number of ideas generated in the electronic mode is not significantly higher than the number of ideas generated in the oral mode (79 in the electronic mode vs. 56 in the oral mode). The difference in the raw scores is non-trivial and can be expected to be statistically significant if adequate data points are gathered. This difference, if it pans out, would be attributable to elimination of 'production blocking', i.e., since electronic brainstorming allows ideas to be generated simultaneously by all subjects, subjects do not have to wait for a turn to contribute and are less likely to forget the ideas that they have.

Overall, the number of ideas generated in the electronic mode is significantly higher than in the oral mode. This is consistent with earlier studies (Valacich, Dennis and Connolly, 1994; Reinig, Briggs, Shepherd, Yen and Nunamaker, 1996). It should be observed that even though there is no significant difference in the ideas generated in the two brainstorming modes when equal-reticence groups and unequal-reticence groups are considered separately, the difference is significant when the two groups are considered together. Evidently, the increase in sample size helps surface the difference at a significant level. Taken in isolation, it is difficult to argue whether the difference in the number of ideas generated is

attributable to increased idea generation by high-reticence individuals or to the removal of production blocking. This could be determined if the number of ideas generated by each individual member could be identified. In the current study, the videotapes are not adequate to identify who said what during the session.

Contributions of the Study

The study has two primary results. First, groups produce more ideas in the electronic brainstorming mode than in the oral brainstorming mode. Second, no significant difference was found in the number of ideas generated by unequal-reticence groups and equal-reticence groups. The result that electronic brainstorming generates more ideas than oral brainstorming is not new, but is consistent with previous results (e.g., Valacich, Dennis and Connolly, 1994; Reinig, Briggs, Shepherd, Yen and Nunamaker, 1996). This consistency attests to the overall quality of the current study, i.e., that the experiments have been conducted with reasonable care, and therefore the other results can be considered trustworthy.

The result that the equality of reticence of group members does not affect group productivity of ideas is not conclusive, but it can be argued that if an effect exists for the equality of reticence, it is not strong. Does the absence of a hypothesized effect constitute a contribution to knowledge? In some cases it does. When there is a generally-held belief among researchers in an area, and empirical evidence from a study does not support that belief, then the study contributes by modifying the belief or at least the strength of that belief. The belief in the importance of reticence, in general, to GSS is pervasive (Huber, 1982; Nunamaker, Applegate and Konsynski, 1987; Connolly, Jessup and Valacich, 1990). The result that there is no strong effect for the equality of reticence on group productivity of ideas challenges that belief. This can be argued to be a contribution. While the finding does not explain all aspects of the relationship between individual reticence and idea generation in groups, it contributes to the overall process of accumulating knowledge to understand the nature of the effect of reticence on idea generation in groups.

SUGGESTIONS FOR FUTURE RESEARCH

In this section, avenues for future inquiries are examined. The current study confirmed that electronic brainstorming generates more ideas than oral brainstorming, but failed to show any effect for workplace reticence. The failure to demonstrate an effect for reticence may be due to one of many reasons. Further

studies should focus on empirically determining if any of the reasons are indeed responsible for obscuring the anticipated effects. The suggested studies are divided into three broad categories: verification of assumptions, modification of experimental parameters, and inclusion of contingency factors.

Verification of Assumptions

The current study makes two implicit assumptions. First, the number of ideas conceived by each group member is independent of his/her workplace reticence. Second, the failure to articulate ideas conceived during oral discussion is a result of evaluation of apprehension or the inability to get air time. There is a corollary to the second assumption, i.e., that reticent individuals will freely express all ideas in electronic brainstorming because the idea articulation is anonymous and there is no conflict for air time.

There is evidence in prior research that reticent individuals contribute fewer ideas than non-reticent individuals in a group interaction (e.g. Jablin et al, 1977). Jablin et al assume that the lower level of contribution is due to the anxiety in communicating ideas. They do not raise the possibility that shy persons may only be capable of conceiving fewer ideas. If this assumption that the number of ideas conceived is independent of reticence is not true, i.e., shy individuals do conceive fewer ideas, then their performance will not improve in the electronic brainstorming mode in spite of the cover of anonymity or the availability of air time. Thus there would be no difference in idea generation between oral brainstorming and electronic brainstorming in the unequal-reticence condition. The relationship between the ability to conceive ideas and reticence should be tested. It would be best tested in individual brainstorming sessions, with proper incentives for subjects to express all ideas, good or bad.

Once ideas are conceived, they have to be expressed before the individual gets credit for having generated ideas. In the current study, it was assumed that the ideas may not be expressed by reticent individuals in groups because of evaluation apprehension or lack of air time. Bradshaw and Stasson (1998) report that shy individuals rated their own contribution as less important and were more likely to report that they withheld ideas. Such withholding may or may not be associated with apprehension of evaluation by other group members or air time. It could be attributed to a tendency to self-censor because shy individuals do not consider their contribution to be important. Such self-censoring can be present regardless of the mode of the brainstorming sessions. In such cases, there would be no statistical difference in the

number of ideas generated in the oral and electronic brainstorming modes. This issue can be tested by examining the number of ideas comparing the number of ideas generated by shy and non-shy individuals in the unequal-reticence groups. As stated in the previous section, in the current study, such a comparison could not be made because in the videotapes of the oral sessions, it was not possible to identify who was making an utterance at a given time.

Experimental Parameters

There are three experimental parameters that may provide explanations for the lack of results: sample size, time allowed for brainstorming, and the difference in reticence scores of group members. The number of data points is limited and it is possible that gathering more data points will surface the anticipated effects for reticence.

In the current study, groups were allowed unlimited time to generate ideas. This was done because rate of idea generation is likely to be different in the oral and electronic modes and the ratio of the rates has not been established to be a constant. However, allowing unlimited time to generate ideas may produce conditions under which reticent individuals may find an opportunity to contribute ideas. If the reticent individuals are withholding ideas because they are self-censoring or because they are apprehensive of evaluation, then the additional time will not make a difference. However, if the reticent individuals are not able to contribute in oral sessions because of lack of air time, then towards the end of the session, when the less reticent individuals have contributed all their ideas, the reticent individuals will be able to contribute their ideas. This can be verified by examining the time course of ideas. However, this needs the ability to identify who contributed which idea in all the sessions. As stated earlier, in the current study, the videotapes of the oral sessions were not adequate to identify the author of each idea.

The last experimental parameter that may be of relevance is the range of reticence scores in the equal-reticence and unequal-reticence groups. In the equal reticence scores, the range of reticence is between 2.13 and 2.75. It was assumed that these scores were close enough where less reticent individuals would not dominate the more reticent individuals. In the unequal-reticence groups, the low reticent individuals had reticent scores between 2.75 and 4.5, and the high reticent individuals had scores between 1.38 and 2.13. In this case it was assumed that the difference in reticence scores between the high reticent and low reticent individuals were sufficiently large to cause the low reticent individuals to dominate the high reticent individuals.

Either of these assumptions is subject to empirical verification. A reduction in the range of reticence scores in the equal-reticence groups or an increase in the difference between the reticence scores of the high reticent and low reticent individuals may provide empirical support for the hypotheses.

Contingency Factors

The current study focused on the workplace reticence variable and used one kind of task, i.e., an idea generation task. There are additional contingency factors, i.e., covariates, which could affect the idea generation behavior of individuals, e.g., idea fluency of individuals and leadership in groups. Further, the effects of reticence may be more accentuated in consensus tasks than in idea generation tasks.

Masseti (1996) has shown that individual idea fluency explains more than 40% of the variance in idea generation. Thus measuring individual idea fluency and including it as a variable may help isolate the effect of reticence in idea generation.

Next, in the current study, no individual was assigned the role of a leader. However, different groups evolve differently. In some groups, leaders emerge. Some leaders may be dominant, while others are facilitative. Facilitative leaders are likely to control the flow of the interaction and solicit contributions from all individuals. Van der Molen (1990) states that shy people often lack initiative and prefer to wait till they are asked. Thus in oral sessions, in which facilitative leaders emerge, reticent individuals may be able to contribute effectively. Thus, it would be appropriate to include leadership style as a covariate in the analyses.

Lastly, the task used in this study is a brainstorming problem. The subjects were required to generate ideas, but were not required to arrive at a consensus. More controversial subjects for brainstorming may increase the pressure. Further any need to arrive at a consensus will require overt discussion. This will also increase the pressure on the reticent individuals. Thus, reticence may be an important variable when groups are involved in controversial discussions and have to arrive at a consensus.

Summary: The current study is among the first studies, if not the first study, to examine the role of reticence in explaining differences between oral and electronic brainstorming. The results indicate that the role of reticence is not simple, nor does reticence have a strong direct effect. Future studies need to focus on the complex nature of the relationship between reticence and the process of brainstorming. In this section, several ideas

have been proposed for further research, along with arguments to support the ideas.

CONCLUSION

The study is the first step in trying to understand the role of reticence in group support systems. The effect of equality of reticence in groups on the total number of ideas generated by each group in brainstorming sessions was examined. The data do not indicate a statistically significant difference between the number of ideas generated by equal-reticence groups and unequal-reticence groups. This result should not be considered conclusive. Further studies have been proposed, which may explain why no difference was observed. An effect was observed for the brainstorming modes, i.e., more ideas were generated in the electronic brainstorming mode than in the oral brainstorming mode. This is consistent with previous research. A clearer understanding of the effect of reticence on idea generation in different brainstorming modes will emerge when the number of ideas generated by individual group members is measured and analyzed.

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