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An Alternative to Methodological Individualism: A Non-Reductionist Approach to Studying Technology Adoption by Groups[1]

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Abstract

Studies on groups within the MIS discipline have largely been based on the paradigm of methodological individualism. Commentaries on methodological individualism within the reference disciplines suggest that studies embracing this paradigm can lead to potentially misleading or incorrect conclusions. This study illustrates the appropriateness of the alternate non-reductionist approach to investigating group-related phenomenon, specifically in the context of technology adoption. Drawing on theories of group influence, prior research on conflict, technology characteristics, task–technology fit, group communication media, and recent theoretical work surrounding group technology adoption, the paper proposes and empirically tests a new non-reductionist model for conceptualizing technology adoption by groups. Further, the study also empirically compares this non-reductionist model with a (hypothetical) methodological individualist model of technology adoption by groups. Results strongly support most of the assertions of the non-reductionist model and highlight that this model provides a more robust explanation of technology adoption by groups than a methodological individualist view. Further, the study also highlights some conditions wherein the methodological individualist view fails to provide correct explanations. The implications of the study's findings for future research are discussed.

Keywords: Methodological individualism, non-reductionist view, multilevel theory, group technology adoption, valence, task–technology fit, technology characteristics, PLS analysis

Introduction

Methodological individualism is a doctrine that was "introduced as a methodological precept for the social sciences by Max Weber" (Heath 2009). Broadly, the doctrine suggests that any higher level social phenomena (i.e., organizational or group-related) "must be explained by showing how they result from individual actions" (Heath 2009). According to the *Cambridge Dictionary of Philosophy* (CDP) (Little 1995, p.

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616), this doctrine argues that "social entities are reducible to ensembles of individuals—as an insurance company might be reduced to the ensemble of employees, supervisors, managers, and owners." A similar sentiment is echoed by the Cartesian view, which claims that everything about organizations and groups "actually 'boils down' to things about individuals" (Cook and Brown 2002, p. 75).

While this doctrine continues to have a following in academia, including the Information Systems discipline, it has come under serious scrutiny. For example, Hodgson (2007, pp. 218-219) argues that "to get anywhere, we always have to assume relations between individuals, as well as individuals themselves" and that "as long as we are addressing social phenomena, we *never reach an end point where there are isolated individuals, and nothing more*" (emphasis added). Consequently, there have been growing calls to treat organizations and groups in their own right. Several theoretical perspectives, such as the resource-based view at the organizational level (Barney 1991), or the notion of "core competencies" (Prahalad and Hamel 1990) are based on the premise that it is not only the *individual* resources and competencies, but their *combination* that give rise to *organizational* capabilities. Likewise, in the area of groups, researchers rejecting the methodological individualist doctrine, for example, subscribe to the group syntality theory (Cattell and Wispe 1948), which argues that groups have their own personalities, distinct from a summation of individual personalities. Similar trends are also evident in the knowledge management research area, where concepts such as "*communities* of practice" and "*organizational* knowledge" are not seen as arising from a linear aggregation of individual practitioners' knowledge (Cook and Brown 2002).

Nevertheless, members of the MIS research community continue to adopt the methodological individualism lens in much of their work. For instance, Table 1 provides a sample of studies on groups in recent years that have adopted such a stance. While published in well-regarded outlets, these studies appear to adopt methodological individualist assumptions, thereby potentially overlooking the interrelationships among individuals, structures, institutions, etc., all of which may play a role in shaping the behaviors, actions, and outcomes.

It is important to note that two specific issues related to groups accentuate the problems of adopting the methodological individualist perspective: (1) a possible lack of uniformity in individual members' (initial) preferences/attitudes, and (2) the importance of the "we-ness" in a group. These issues are examined next.

A Possible Lack of Uniformity in Individual Members' Initial Preferences/Attitudes

Scenarios are a powerful device to introduce and illustrate a new argument (e.g., Carlson and Zmud 1999), and in that spirit, we introduce the following scenario (inspired by a real-world group event), highlighting the lack of uniformity in the individual group members' *a priori* preferences/attitudes, and the implications of such disagreements.

> Recently, a group of three researchers embarked on a collaborative research project. The project involved a new experimental study using student subjects, and the creation of a research manuscript to be submitted to a journal's special issue. The group of three members was composed of a senior professor, a relatively junior assistant professor, and a senior doctoral student. The group members were distributed across three locations. The junior assistant professor was in a Southeast Asian country, while the two others were in North America (although in different locations). Given the distributed nature of the group, and the enormity of the project (and its coordination) that lay ahead of them, one of the first tasks for the members was to decide upon a technology that they would use for the collaboration. While e-mail was the last resort, the group deliberated upon two other technologies that would enable them to upload files to a shared space and enforce some control over the versions of the study design, and the manuscript when it was being developed. The two technologies being considered were as follows: the first, "ftpcollab," a well-known ftp-based application; and the second, "Collaborative Pointe," a relatively new, but popular, collaborative software. The group needed to adopt, within a short period, the platform that would be used for their collaboration. Thus, serious discussions ensued within the group regarding the suitability of the two technologies, and which one of the two would be adopted. The senior faculty member was strongly in favor of the ftp-based application, the junior faculty was in favor of the second application, while the doctoral student initially chose to not express a preference. Given the disparity in the *a priori* attitudes of the members with respect to the different technology options, clearly, an aggregation of the individual attitudes toward the technologies prior to interaction, while useful, was not *sufficient* in predicting the adoption of the technology by the group.

Table 1. A Sample of Group Studies in IS Apparently Adopting a Methodological Individualist Perspective

Citation	Short Summary	Treatment of group variables	Methodological Individualism?
Dennis and Garfield (2003)	This paper reports on the results of a field study of six medical project teams that worked together in meetings over a seven-week period to develop plans to improve customer service within a hospital. Half the teams used a group support system (GSS), while the other half used traditional processes.	Both qualitative and quantitative analysis was conducted. In the quantitative analysis, perceptions of members were captured on key variables and were used as surrogates of the group perceptions.	The authors argue that results from the individual-level analysis and group-level analysis are similar, although no details of group-level analysis are provided. *Appears to be a case of methodological individualism.*
Dennis and Wixom (2001)	This paper develops the fit– appropriation model, and examines the effect of GSS on performance. The model argues that GSS performance is affected by the fit between the task and the GSS structures selected for use, and the appropriation support the group receives in the form of training, facilitation, software restrictiveness, etc.	Meta-analysis of past studies was used as the methodology. Five key dependent variables were assessed: decision quality, number of ideas, time, outcome satisfaction, and process satisfaction. First three were assessed at the group-level. Satisfaction measures were captured at the individual level and used as a surrogate of group level.	Drawing on Gallivan and Benbunan-Fich (2005), it may be argued that the correct level of analysis was not employed. *Appears to be a case of methodological individualism.*
Dennis, Aronson, Heninger, and Walker II (1999)	This paper reports the results of an experiment that assessed the effect of task structure and time structure on group brainstorming.	Group performance was measured by capturing the assessment of independent raters on the number of ideas generated and the quality of ideas generated. Task structure and time structure were manipulated. Individual perceptions of satisfaction and time provided to complete the task were used as surrogates for group perceptions, through a nested group ANOVA technique.	Drawing on Gallivan and Benbunan-Fich (2005), it may be argued that the correct level of analysis was not employed. *Appears to be a case of methodological individualism.*
Burke and Chidambaram (1999)	This study examines whether groups using different media perceive characteristics of these media differently, and whether media differences result in performance differences. Further, the study also examines whether media perceptions remain static or change over time.	Group performance was captured by the assessment of independent judges of the documents generated per group. Independent variables (i.e., perceptions of the media) were captured at the individual-level. No mention of aggregation.	Drawing on Gallivan and Benbunan-Fich (2005), it may be argued that the correct level of analysis was not employed. *Appears to be a case of methodological individualism.*
Chidambarm and Tung (2005)	This study examined the effect of the different dimensions of social loafing on decision-making, using both collocated and distributed teams of varying sizes.	In the authors' own words, "the degree of cohesiveness in a group" was assessed using "the average score of members' perceptions about the relational ties that exist in the group," and served "as a good indicator of a team's social performance."	Average of individual opinion used without accounting for intra-group agreement. *Appears to be a case of methodological individualism without using appropriate checks.*
Limayem and DeSanctis (2000)	The study introduces a design approach for providing decisional guidance in GDSS and then tests the feasibility of this design in a laboratory experiment.	In authors' own words, "for all variables, except decision time…and consensus,…individual scores were averaged to create a group score."	Average of individual opinion used without accounting for intra-group agreement. *Appears to be a case of methodological individualism without using appropriate checks.*

Table 1. A Sample of Group Studies in IS Apparently Adopting a Methodological Individualist Perspective (Continued)

Citation	Short Summary	Treatment of group variables	Methodological Individualism?
Reinig (2003)	Drawing on goal-setting theory, this article presents and tests a causal model of meeting satisfaction. The results of analysis indicate support for the model in both GSS and face-to-face groups.	Perceptions of process and solution satisfaction were captured at the individual level, and analyzed at the individual level, even though the study focuses on groups.	Drawing on Gallivan and Benbunan-Fich (2005), it may be argued that the correct level of analysis was not employed. *Appears to be a case of methodological individualism.*
Reinig and Shin (2002)	This study empirically examines the relationships between GSS structures, group dynamics, and meeting outcomes over time. Four process constructs (production blocking, free riding, sucker effect, and evaluation apprehension) and three meeting outcome constructs (group cohesion, affective reward, and self-reported learning) were selected for the study.	In the authors' own words, "a seven-point Likert scale post-experiment survey was used to measure individual perceptions of the process constructs and meeting outcomes following each of the eight tasks." Key variables (e.g., group cohesion, perceptions of the collaborative environment), were assessed at the individual level.	It is unclear if the individual-level data were analyzed after aggregation at the group level, or analyzed at the individual level. *If the former, then a case of methodological individualism*, if the latter, then also, drawing on Gallivan and Benbunan-Fich (2005), it is *a possible case of methodological individualism.*
Kahai and Cooper (1999)	This study tests a model of the relationships among computer-mediated communication systems (CMCS), group processes, and group outcomes. The group outcomes examined are agreement and acceptance.	In the authors' own words, "questionnaire data were averaged across group members before they were used in the data analysis. Group level scores of questionnaire items for positive socioemotional communication…were averaged to obtain a second indicator in addition to the coding-based indicator."	Group variables measured using an average of individual opinion without accounting for intra-group agreement. *Appears to be a case of methodological individualism without using appropriate checks.*
Dennis, Hilmer, and Taylor (1998)	This study investigated the effects of GSS use on the exchange and use of information, both when there are (or there is no) majority/minority split of opinion in the group.	Individual perceptions of satisfaction, etc., used as surrogates for groups' satisfaction.	Drawing on Gallivan and Benbunan-Fich (2005), it may be argued that the correct level of analysis was not employed. *Appears to be a case of methodological individualism.*
Ocker et al. (1998)	This study compares the effectiveness of four modes of communication media in groups working on software development. The four modes are face-to-face, synchronous computer conferencing, asynchronous computer conferencing, and combined face-to-face and asynchronous computer conferencing.	In the authors' own words, "solution satisfaction data were obtained via subject self-reports from the post-experiment survey and varied on a scale of one (low) to five (high).… Process satisfaction data were also obtained via subject self-reports from the post-experiment survey using a scale of one (low) to five (high)."	While not explicitly stated, given that the data was collected at the individual level, and was used to hypothesize at the group level, data may have been aggregated per group. *Appears to be a case of methodological individualism without using appropriate checks.*
Mennecke and Valacich (1998)	This study examines the effect of group history (i.e., established versus *ad hoc* groups) and "the level of computer support received by the groups on the information-sharing performance, quality of the decision, and perceptions of satisfaction and cohesion.	Some hypotheses were stated at the group level, while others were stated at the individual-member level (e.g., the effect on members' perceptions of satisfaction). Variables such as information sharing and decision quality were measured at the group level. Satisfaction and cohesion were measured at the individual level. In the authors' own words, "the aggregate group cohesion score for each group was regressed on each of the dependent variables (i.e., information- sharing performance, decision quality, and satisfaction).	Some group variables measured using an average of individual opinion without accounting for intra-group agreement. *Appears to be a case of methodological individualism without using appropriate checks.*

> As the discussion continued, and the suitability (i.e., the fit) of the technologies was debated, there was clearly some level of conflict, especially between the two IS faculty members. At some point, it became clear to the doctoral student that the issue was not going to be resolved easily, and so he/she decided to speak up and convince the senior faculty member that setting up CollaborativePointe for this collaboration would not be cumbersome (in fact, having already figured it out), and was more suited to collaboration across distributed locations. Eventually, after much deliberation, and owing largely to the fit between the nature of the technology with the task at hand, the group as a whole agreed to utilize CollaborativePointe as the collaborative platform for the research project.

The above example highlights a number of issues: first, that *variability* often exists among group members in terms of their *a priori* preferences/attitudes regarding a technology. Second, it indicates that such variability often causes conflict within a group, which in turn prevents us from adopting a methodological individualist perspective, and making predictions regarding the group decision/action by either *summing or aggregating the individual members' pre-interaction adoption preferences*, or *using the views of the individual members as surrogates for the group*. Goodman et al. (1987, p. 163) pose the following question: "Given individual variability... can one aggregate [the individual level preferences] to represent a group-level phenomenon?" Of course, we must acknowledge that in instances where there is no discrepancy in the preferences of group members, an aggregation of the individual preferences could indeed reflect or predict a group phenomenon, at least the overall direction (Festinger 1953; Klein et al. 1994). In fact, James (1982, p. 228) warns that the use of aggregation as an approximation to a group's position on an issue is entirely "predicated on demonstrating" complete agreement among the members on a particular issue, because agreement implies a "shared assignment of psychological meaning." However, since such uniformity often does not exist, it is important to theoretically treat group phenomena as distinct from individual-level phenomena.

Importance of "We-ness"

Fisher and Ellis (1990) argue that for any group-related phenomenon, focus only on the individual members (such as in a methodological individualist perspective) fails (1) to recognize the group as a distinct and unique entity (different from the members who comprise it), and (2) to inform what happens at the group level. Likewise, Shaw (1981, p. 8) views a group as being composed of multiple individuals, where "*each person influences and is influenced by each other person*" (emphasis added). Similarly, McGrath (1984, p. 7) defines groups as "social aggregates that involve *mutual awareness* and potential *mutual interaction*" (emphasis added). Hopkins (1964, p. 56) suggests that the term group should *only* be applied to a collection of individuals "when they develop the high quality of internal relationship which results from resolving their disturbances through cooperative interaction." Gibb (1964, p. 56), drawing on the work of Lewin and colleagues suggests that "interdependence of members" is a key criterion for an entity to be considered as a group. He specifically quotes Krech and Crutchfield (1948, p. 18) as follows:

> A group does not merely mean individuals characterized by some similar property. Thus, for example, a collection of Republicans...is not a group. These collections may be called classes of people. The term group, on the other hand, refers to two or more people who bear an explicit psychological relationship to one another. This means that for each member of the group the other members exist in some more or less immediate psychological way.

In other words, a key feature differentiating groups from collections of individuals is that in groups, the relational and interactional patterns among the members play a key role (Fisher and Ellis 1990; McGrath 1984). On a related note, Hopkins (1964, p. 56) asserts that "the term 'aggregate' is most frequently used to specify that the group is merely the *mathematical sum* of its parts—of the individuals who compose it." However, he cautions that "technically, it is not a group, for a group is based upon we-ness or unity or morale, characteristics which such an aggregate does not possess." Taken together, it is clear that there are conceptual limitations that arise from adopting a methodological individualist perspective in group studies.

The *Cambridge Dictionary of Philosophy* (Little 1995) highlights a number of alternatives to methodological individualism, the most extreme being that of methodological holism. This doctrine argues that "social entities, facts, and laws, are autonomous and irreducible" where "special structures such as the state have dynamic properties independent of the beliefs and purposes of the particular persons who occupy positions within the structure" (Little 1995, p. 617). It must be noted that this doctrine, while accounting for the limitations of methodological individualism, also adopts a relatively extreme viewpoint, failing to recognize that it is individuals who make up the collectives. While such a view may be appropriate for studying organizations, which are institutionalized entities where individuals come and go without significantly affecting the organization, it is arguably less appropriate for studying *ad hoc* groups, where individual beliefs, attitudes, and perceptions do play a role in shaping the group's character.

An intermediary viewpoint between methodological holism and individualism holds that "every social explanation requires microfoundations" (Little 1995, p. 617). Levine et al. (1987, p. 75) view this as the anti-reductionist approach, which "acknowledges the importance of micro-level accounts in explaining social phenomena, while allowing for the irreducibility of macro-level accounts to these micro-level explanations." In other words, this *non-reductionist* view believes that higher level phenomenon can be explained by the patterned relationships among the individuals, and the circumstances that lead them to behave in certain ways. This view is consistent with some group researchers who argue that the structure of a group "can be viewed as a series of ongoings, events, and event cycles between the component parts (e.g., individuals). This structure, in turn, forms the basis for the eventual emergence of collective constructs... [that is] the collective structure that emerges from this interaction" (Morgeson and Hofmann 1999, pp. 252-253). Likewise, Klein et al. (1999) specifically argue, consistent with the philosophy of non-reductionism, that any group activity is influenced by (1) the *a priori* preferences/attitudes of the individual members (i.e., its components), and (2) the interactions and dynamics that ensue during the group phenomenon, which could involve conflict, coalition formation, and various other types of social influence. Thus, it is only by taking into consideration the individual members' *a priori* perspectives, in conjunction with the group's and subgroup's perspectives, are we able to "connect the dots," and "bridge the micro-macro divide," resulting in a "deeper, richer portrait" of group life (Klein et al. 1999, p. 243).

Our objective in this paper is to help establish the value of this viewpoint in studying groups, in contrast with the methodological individualist viewpoint that is often found to guide hypotheses development as well as empirical measurement and analysis. We attempt to illustrate the non-reductionist perspective in the context of technology adoption by groups.

Over the last two decades, technology adoption/acceptance has been extensively studied within the IS discipline (e.g., Agarwal and Prasad 1999; Davis et al. 1989; Goodhue and Thompson 1995; Markus 1990; Taylor and Todd 1995; Venkatesh and Davis, 2000). While this body of research has contributed significantly to our understanding of technology adoption, most known studies have focused exclusively on factors that explain *individual-level* adoption decisions, leaving a void in the understanding of how groups adopt technologies.[2] Even though many organizational tasks are performed by groups (Bettenhausen 1991; Jehn and Mannix 2001), and these groups are often provided with (and expected to adopt/use) various technologies to support their task processes and/or communication (Ramarupa et al. 1999), it is likely that an uncritical adherence to methodological individualism ideals, consciously or subconsciously, has prevented us from separately investigating the important phenomenon of technology adoption by groups. As we have highlighted above, viewing technology adoption by groups through the lens of methodological individualism may lead researchers and practitioners to (1) incorrectly assume that there is complete uniformity in the *a priori* attitudes of the individual members, and (2) ignore the "we-ness related" issues, which are fundamental to the notion of groups. This perspective tends to significantly limit our understanding of how *groups* adopt technologies. As such, we seek to address this important void by *adopting a non-reductionist, multilevel lens, and provide a preliminary empirical assessment of whether this view is superior to a methodological individualist view for this particular context.*

The rest of the paper is organized as follows: Next, we provide a brief overview of the various foundational theories, including a discussion of the study's boundaries. Then, the non-reductionist technology adoption by groups model (m-TAG) is presented, followed by a description of the research methodology. Finally, a discussion of the results, contributions, limitations, and future research opportunities are presented.

Theoretical Foundations

As in the case of any study, it is important to specify its boundaries. First, the study provides an understanding of technology adoption by *ad hoc* groups in which members are expected to have a reasonable amount of influence on each other, at least through the duration of the group's existence (McGrath 1984). Next, in line with Poole et al. (1999, p. 96) who emphasize that a primary assumption in group research is that "regardless of a group's goal or activity...some degree of interdependence is required [among the members] to accomplish the goal or fulfill the activity," we assume that the group's task requires members to cooperate/collaborate for successful task completion. Third, given that group tech-

[2]Only a few preliminary attempts at how groups adopt technologies have been made so far (e.g., DeVreede et al. 1998-99; Sarker et al. 2005).

nology adoption requires members to come to an agreement or consensus on a suitable technology, we view the groups in our study as *consensus-generating systems* (McGrath and Hollingshead 1993). Fourth, we view the adoption of a technology by groups as a specific case of a group decision-making, where the outcome of the decision has significant impact on the group. Thus, our model consists of certain generic variables that could potentially apply to any group decision-making context, and certain specific constructs (e.g., technology-related characteristics) that are particular to a technology adoption context only. Finally, we assume that adoption of the technology by the group in question is voluntary, a common occurrence in organizations (Mustonen-Ollila and Lyytinen 2004).

Sambamurthy and Chin (1994) suggest that a group's perceptions toward a technology are affected by (1) the social influence-related variables and (2) the characteristics of the technology. We sought to focus on both of these characteristics in our model. To develop our model of technology adoption by groups, and our measurement instruments, we build on the work of Sarker et al. (2005), which recognizes the role of both individual members' *a priori* preferences and group-level interactions in shaping a group's adoption of technologies, making it multilevel, non-reductionist, and, consequently, distinct from models developed based on methodological individualism. Additionally, their model draws on the *three levels of valence theories*, which provides a multilevel view to this important group phenomenon by dialectically bridging the individual and group levels of analyses (McPhee et al. 1982). It is useful to mention that not only do we refine Sarker et al.'s model, but we also go beyond it by examining the role of the group's communication media on technology adoption, and also by examining the effect of the adoption on group outcomes.

Our primary theoretical base has been the three levels of valence theories. Valence is defined as the *degree of positive or negative feeling toward a certain option*. Valence has been studied at three different levels (or "source production sites") (Meyers and Brashers 1999), with different theoretical perspectives pertaining to each of the levels. To understand these three different levels of valence, we begin with the social comparison theory (SCT), which suggests that prior to group discussion, individuals adopt a stance on the issue being faced by the group (Meyers and Brashers 1999). During the group discussion, each member is exposed, to some degree, to other members' preferences regarding the issue in question. As a result of this interplay, *individual* members are able to socially compare their own positions with those of other members. This process helps in creating social influences, which may lead members to change their opinions and hence move toward a group level consensus (Sanders and Baron 1977).

At the next level, the distributive valence model (DVM) holds that a group's decision is dependent on the valence of the different coalitions for a particular option (Poole et al. 1982). Additionally, McPhee et al. (1982) recommend the use of different "combinatorial rules" for explaining the influence of the valence of subgroups, most important of which is the *majority rule*. This rule suggests that the choice or position of the largest subgroup is likely to have the strongest influence on the group decision. Empirical tests of this model have shown it to be an important predictor of group choice (McPhee et al. 1982).

Finally, at the group level, the group valence model (GVM) views the valence of the overall group as being the most potent predictor of the groups' adoption decision (Meyers and Brashers 1998). Proponents of this theory argue that the strength of a *group's* orientation toward a particular option influences the likelihood that it will be adopted (Hoffman and Kleinman 1994). The group valence construct specifically captures the we-ness, which has been argued to be an important component of a group.

The SCT provides a view of the entire group dynamics that ensue during a group process. Within this process, the DVM (valence at the subgroup level) and GVM (valence at the overall group level) explain how the group consensus is reached and highlight the major factors that play a role in this decision-making process (e.g., Meyers and Brashers 1998; Sarker et al. 2005). The interplay of these three theories further reflects the non-reductionist view that we have adopted in this study.

Given our focus on groups as consensus-generating systems, we also draw on the conflict literature, which argues that whenever there is *incompatibility* (i.e., disagreement) within a group making a consensus decision, *conflict* can occur (Fisher and Ellis 1990; McGrath 1984). Finally, given that a status hierarchy exists in every group, and this affects the group's consensus-generation (e.g., Fisher and Ellis 1990; Tan et al. 1998b), we also examine the role of high-status individuals on the group's technology adoption.

We also draw on the technology adoption literature to examine the role of the characteristics of the technology being considered by the group on the group adoption. Among the technology characteristics that can have a strong influence during adoption is the *complexity* of the technology (e.g., Kwon and Zmud 1987; Rogers 1995), and the *fit between the task and the technology*, as perceived by the group (Goodhue

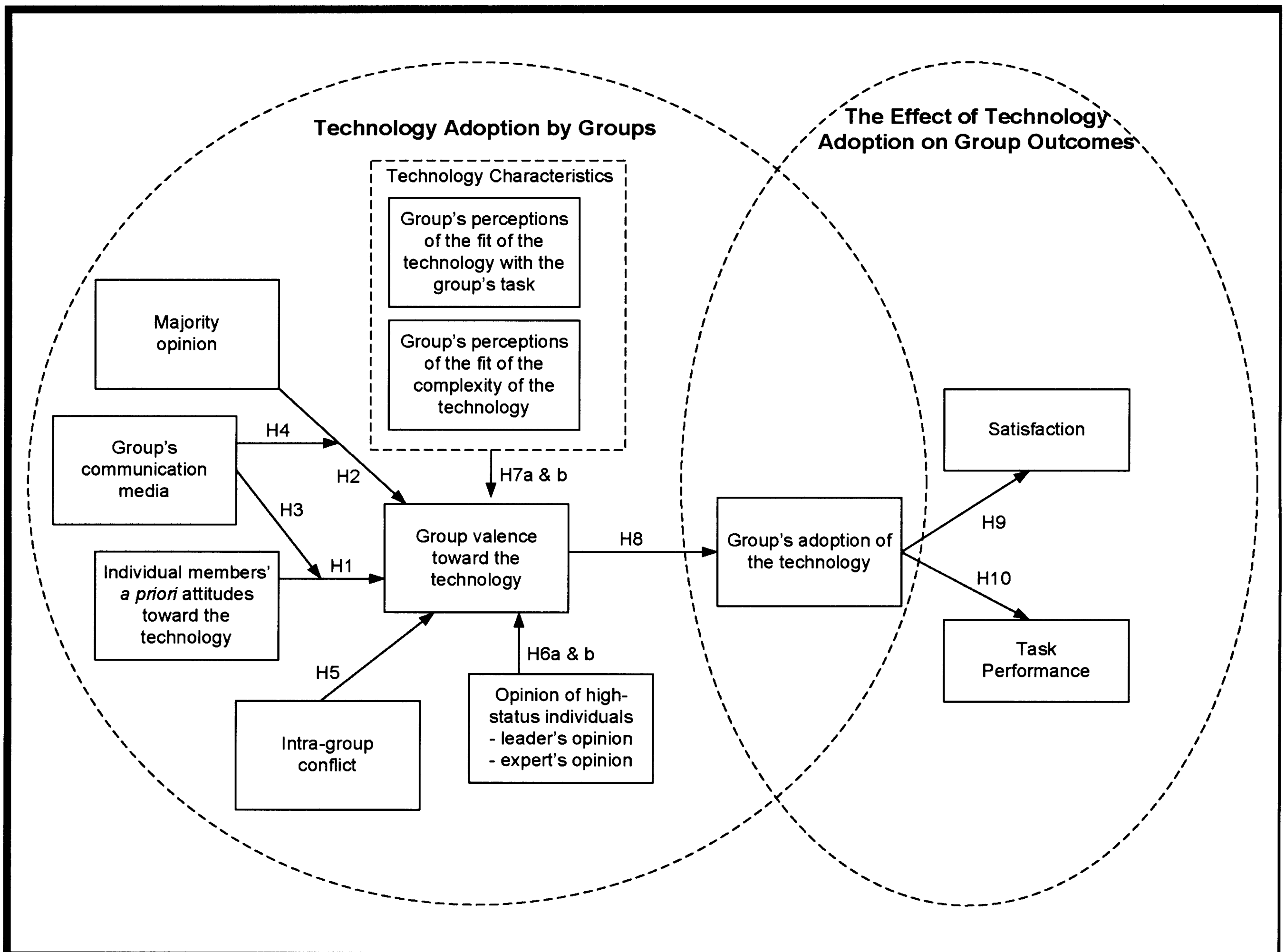

Figure 1. A Non-Reductionist Model of Technology Adoption by Groups (m-TAG)

1995; Zigurs and Buckland 1998). Also, prior research suggests that a group's communication media will also influence the social influences processes (e.g., Zigurs et al. 1988). Based on this, we examine the role played by the *communication media* on the group's technology adoption.

Finally, in line with prior group research and recent work on technology adoption, our model examines the effect of technology adoption on *group outcomes* (e.g., satisfaction, task performance). By examining the effect of technology adoption on outcomes, the study responds to the call by Wixom and Todd (2005, p. 86) to "augment the practical utility of technology acceptance" research. Next, we more thoroughly describe our model (i.e., m-TAG) (see Figure1).

A Detailed Look into m-TAG (Technology Adoption by Groups)

The social comparison theory (SCT) holds that in groups, prior to any group interaction, members have an initial attitude (Meyers and Brashers 1999) toward the issue(s) being faced. *Social comparison* is the process through which a group interaction ensues, and the final group decision/opinion emerges (Meyers and Brashers 1999; Sanders and Baron 1977). This comparison process revolves around the individual members' *a priori* attitudes, which consequently play an important role in shaping the overall group's preference (Gopal et al. 1992-93; Forsyth 2000; Sanders and Baron 1977). In other words, during the social comparison process, group members become exposed to each other's opinions on the issue. As they compare their views explicitly, they are influenced by each other, and this shapes (and partly generates) the entire group's preference toward an issue/ choice option. Thus, we propose

> *H1: Individual group members' a priori attitudes toward a technology will positively affect the group's valence toward that technology.*

While the above hypotheses highlights the role of individual properties on group adoption, our non-reductionist paradigm also calls for the important role of the patterned relationships between the group members and more group macro-level factors (e.g., communication media) on the higher level group phenomena. We discuss these hypotheses in further detail below.

The distributive valence model (DVM) suggests that the opinion of the largest or most powerful subgroup (e.g., majority) tends to have the greatest influence on the overall group (McPhee et al. 1982). Specifically, Tan et al. (1998a, p. 1263) argue that "majority influence is the attempt by a majority of people in a group to impose its common position on a minority of dissenters during decision-making." They contend that during decision making, the minority group members yield to the "conformance pressure" of the majority's opinion relatively quickly (Tan et al. 1998a, p. 1265), and thus the final perspective of the group toward an issue closely resembles the majority's view (e.g., Ohtsubo e al. 2002). Thus, we argue

> *H2: The majority's opinion regarding a technology will positively affect the group's valence toward that technology.*

Further, the nature of influence of the group members' *a priori* attitudes and the majority on the group's valence may also be affected by the communication medium being used by the group (e.g., El-Shinnawy and Vinze 1998; Sassenberg and Boos 2003; Sia et al. 2002; Tan et al. 1998a; Tan et al. 1998b; Zigurs et al. 1988). The literature suggests that communication "media differ in their potential to convey both quantity and type of information within a given timeframe" (Burke and Chidambaram 1999, p. 558). Within organizational groups, two common forms of communication used are face-to-face and synchronous and/or asynchronous computer-mediated (CMC) technologies (Ocker et al. 1998). Several characteristics including (1) the anonymity in CMC environments, (2) the possible parallelism of communication in CMC environments, and (3) the lack of social presence and de-individuation in CMC environments differentiate face-to-face and computer-mediated environments (e.g., Burke and Chidambaram 1999; Nunamaker et al. 1991; Sia et al. 2002). Given that a majority of group-related phenomena within organizations do not necessarily occur in anonymous contexts, a key characteristic of the media argued to affect the social influence process within organizational groups is the degree of *social presence* of the media (Burke and Chidambaram 1999). Social presence "is the extent to which one feels the presence of a person with whom one is interacting" (Burke and Chidambaram 1999, p. 559). Face-to-face communication, with its ability to convey proximal, facial, and other nonverbal cues is considered to be higher in social presence. In contrast, text-based CMC environments are believed to have lower levels of social presence, and restrict "socioemotional communication" (Burke and Chidambaram 1999, p. 559).

The differences in the social presence of the media have been seen to inhibit/accentuate the level of influence exerted within a group (e.g., Dennis et al. 1997-98), although there are contradictory results regarding the nature of the influence (Sassenberg and Boos 2003). One body of literature argues that a lack of social presence or "reduced social cues (RSC)," can lead to more "deregulated" and "less inhibited behavior" as well as increased shifts away from one's *a priori* positions (e.g., Sassenberg and Boos 2003, p. 406; see also El-Shinnaway and Vinze 1998; Sia et al. 2002; Siegel et al. 1986; Short et al. 1976). Further, individuals in lower social-presence communication environments (e.g., CMC versus face-to-face), tend to exhibit lower levels of self-awareness and are more eager to move toward a group-level view. Another body of literature has contradicted these findings, highlighting that members of computer-mediated (CM) groups exhibit *higher* levels of self-awareness, thereby showing lower levels of change in their *a priori* attitudes (e.g., Matheson and Zanna 1988; McGuire et al. 1987; Sassenberg and Boos 2003). Still another body of literature, namely, the proponents of SIDE (Lea and Spears 1992), drawing on social identity theory and self-categorization theory, argue that the role of self-awareness of the members in CM groups depends on the context. In situations where the social identity is salient (that is, members feel more strongly about their group membership, such as in long-standing groups like families or sports teams) (Sassenberg and Boos 2003, p. 407; see also Lea and Spears 1992), there is less self-awareness among the group members of CM groups. However, in *ad hoc* organizational groups, "personal identity is more salient," as a result of which members in CM groups are likely to be more self-aware, and thus more reluctant to move away from their *a priori* attitudes toward a group view.

Others also argue that owing to less normative influence in CM decision-making groups (such as the ones we are focusing on in this study), there might be fewer preference changes in CM groups (e.g., Tan et al. 1998b). Thus, we propose

H3: The effect of the group members' a priori attitudes on the group's valence toward a technology will be higher in CM groups than in face-to-face groups.

Prior research on face-to-face and CM groups has also argued that the effect of the majority opinion toward a certain decision option would be different based on the communication media being used by the group (e.g., Tan et al. 1998a; Weisband et al. 1995). Reduced social presence of the media and associated de-individuation effects have also been argued to moderate the ability of the majority to influence a group. Tan et al. (1998a, p. 1265) report that a majority typically "exert[s] conformance pressure" on the group using "voice and facial expressions." In CM groups, especially those that carry "textual cues" only, in the absence of the verbal and visual cues, "the majority may have fewer means to exercise influence" (Tan et al. 1998a, p. 1266). Further, Tan et al. (1998b) argue that owing to less normative influence, certain subgroups (e.g., majority) are unable to influence the group sufficiently. Thus, we propose

H4: The effect of the majority's opinion on the group's valence toward a technology will be higher in face-to-face groups than CM groups.

Another important (and non-reductionist) component of a group interaction process is intra-group conflict (McGrath 1984). Of the many types, substantive (i.e., issue-based) conflict is often present in groups without a history, and those with a limited temporal scope. Substantive conflict refers to the incompatibility of members' ideas, and issues related to the group's goal (Gouran 2003) and has been seen to play both a positive (e.g., Connolly et al. 1990; Jehn and Chatman 2000; Pelled et al. 1999) and negative role (Gouran 2003; Jehn and Mannix 2001), depending on the group's context. For instance, if the group's goal is to generate *consensus,* conflict will most likely hinder its development (Fisher and Ellis 1990; Knight et al. 1999; McGrath 1984; Priem and Price 1991). Thus, within the context of a group's technology adoption decision (which requires consensus), heightened conflict will negatively influence the group's valence toward a technology. We thereby conclude

H5: The extent of substantive conflict within the group will have a negative effect on the group's valence toward a technology.

Studies have established that a status hierarchy inherently exists in every group (Fisher and Ellis 1990), and that it is an important factor influencing group behavior. Status differences amongst members develop due to the differences in the power among the members. French and Raven (1959) identified five different bases of power: reward, coercive, legitimate, referent, and expert. This initial categorization of power was later revised to two broad types: *structural* or legitimate power (i.e., having the right or authority to exert power), and *personal* or expert power (i.e., having more knowledge regarding a certain area important to the group). Consistent with Sarker et al. (2005), we view the individual possessing structural power within a group as the "leader," and those with expertise with the technology adoption context as the "expert." Prior research argues that both leaders and experts within a group play a key role in the group phenomenon, often by eliciting compliance from the group (Haslett and Ruebush 1999). For example, Pavitt (1999) noted that emergent leaders play an instrumental role in shaping the group's perceptions and attitudes. Similarly, Hoffman and Maier (1967) concluded that leaders had more influence on the group's valence toward a particular choice option than any other members. A similar effect of the expert in the group has also been acknowledged in prior research. For example, Bass (1990, p. 178) states that "groups are likely to be persuaded by the perceived expert, to accept both publicly and privately the expert's opinion." In the context of technology adoption by groups, the opinion/perceptions of individuals with structural and personal power may also be expected to play an important role in shaping the group's valence. We thus propose

H6a: The opinion of the individual possessing structural power within a group in favor of a particular technology will positively affect the group's valence toward that technology.

H6b: The opinion of the individual possessing personal power in favor of a particular technology will positively affect the group's valence toward that technology.

Another key set of antecendents consistent with our non-reductionist perspective to technology adoption by groups is the characteristics of the technology as perceived by the group as a whole (e.g., Delone 1988; Goodhue 1995). The task–technology fit model argues that users form an opinion of suitability of a technology based on perceptions of how the technology fits their task requirements (Goodhue 1995). The fit between the task and the technology is also likely to be examined by the members during a group interaction process (e.g., Zigurs and Buckland 1998), and the group's perceptions regarding the fit of the technology for the group's task at hand will positively influence the group's orientation (or valence) toward the technology. This leads to the following:

H7a: The group's perception regarding the fit of a technology for its task will positively affect the group's valence toward the technology.

In addition to the fit, complexity of a technology in itself can play a key role in technology adoption (e.g. Aiman-Smith and Green 2002; Kwon and Zmud 1987; Leonard-Barton 1988; Rogers 1995; Taylor and Todd 1995; Tornatsky and Fleischer 1990). Complexity of a technology in the context of a group's technology adoption may be viewed as the "*degree of difficulty that group members collectively anticipate in using and adapting to it*" (Sarker et al. 2005, p. 50). For research on technology adoption at the organizational level, Leonard-Barton (1988) argues that perceived complexity shapes the adopters' perceptions toward a technology. Similarly, Aiman-Smith and Green (2002, p. 423) concluded, from their study of Fortune 500 manufacturing firms, that complexity of a technology is a critical determinant of the adoption of new technologies. A similar effect of complexity on the group's technology adoption can be expected. Thus we propose

H7b: The group's perception regarding the complexity of the technology will negatively affect the group's valence toward that technology.

Proponents of the GVM have attempted to predict a group's behavior from the group's valence (Hoffman and Kleinman 1994). When groups are faced with making a choice from multiple available options, the group interaction process usually includes a discussion about the options, and ultimately results in the adoption of the option viewed most positively by the group as a whole (Hoffman and Kleinman 1994; Meyers and Brashers 1999). While a methodological individualist perspective to technology adoption by groups would have ignored this relationship, consistent with our non-reductionist perspective, we believe group valence will play a critical role in the groups' adoption of the technology. In particular, during the group interaction process, the technology that is viewed most positively by the group (i.e., has higher group valence), will be adopted. Thus, we argue

H8: The group's valence toward a technology will positively affect the group's adoption of that technology.

The Effect of Technology Adoption on Group Outcomes

The performance of the group has always been of interest to group researchers (e.g., McGrath and Hollingshead 1994), and no research involving groups seems complete without an investigation of the effects of the group interaction (e.g., technology adoption) on various important outcome variables. We examine the effect of the group's technology adoption on two group outcomes: (1) group satisfaction, and (2) task performance.

Regarding group satisfaction, the *resource utilization* theory argues that technology is a resource, and *more* (use) of it can have significant effects on the satisfaction of the group members (Zigurs et al. 1991). Likewise, Briggs et al. (1998-99) have suggested that technologies can lead to increased synergy within the group, which may add to the satisfaction of the members. Further, Reinig (2003, p. 68) argue that "a new tool…may produce satisfaction in the present," because of the perception "that the tool will allow…[one] to attaining goals in the future." Finally, it has also been argued that the use of a technology (in performing a task) adds a level of structure to the task, leading to a standardized representation of the problem and synergy in thinking among the group members (Sarker and Lee 2006); this in turn is likely to result in greater satisfaction for the members. Thus, we argue

H9: A group's strength of adoption of a technology will positively affect the group's satisfaction.

Technology use has often been associated with improved group performance (Nunamaker et al. 1989). Specifically, Sambamurthy and Chin (1994) argue that groups that use technologies to a greater extent would correspondingly experience a higher decision-making performance. They argue that the use of a structured technology helps groups to better manage and control their task performance. Such an argument has also been made by Poole and DeSanctis (1992) in their adaptive structuration theory. Specifically, they contend that the adoption of a suitable technology by a group can result in an efficient use of the technology's structural features, and thereby help the group generate higher quality outputs. Thus, we propose

H10: A group's strength of adoption of a technology will positively affect the group's task performance.

Comparison of the Non-Reductionist View and the Methodological Individualist View in the Context of Technology Adoption by Groups

In light of our second objective, we sought to compare our non-reductionist model of technology adoption by groups (described above) with a methodological individualist model developed from the aggregation of individual-level theories of technology adoption such as TAM.

TAM proposes that a user's actual adoption/use of a technology will be dependent on his/her intention to adopt that technology. Further, the user's intention to adopt a technology is posited to be dependent on his/her perceptions regarding the ease of use of the technology and the usefulness of the technology. Thus, in a hypothetical methodological individualist group version of TAM (or G-TAM),[3] the average perceived ease of use and perceived usefulness of the members within a group would affect the average intention to adopt a technology within a group. Further, the average intention to adopt a technology would positively affect the group's adoption of the technology. We note that such a perspective would not see the social influence-related variables or the role of higher-level group variables as being relevant to the adoption decision. As argued earlier, prior research (e.g., Goodman et al. 1987; Klein et al. 1994) suggests that a group phenomenon cannot be satisfactorily explained through such an aggregation (methodologically individualist) approach. Based on this, we propose the following:

> *H11: m-TAG will be a better predictor of a group's technology adoption than G-TAM.*

In addition, some researchers argue that in certain group contexts, a non-reductionist model is not only *better*, but it is also the *correct* predictor of a group phenomena. For example, Klein et al. (2001, p. 4) argue that "within-group agreement is a prerequisite for the aggregation of the individual-level data to the group-level," and thus, when there is no "homogeneity among the members of a group," a methodological individualist view, captured through the aggregation of the individual members' preferences and intentions may not accurately reflect the group, and a non-reductionist model is warranted (Klein et al. 1994, pp. 199). Thus, we propose

> *H12: In the absence of homogeneity among the group members' a priori choice of a technology, m-TAG will predict a group's technology adoption better than G-TAM.*

Research Methodology

An experimental methodology was used to test the predicted non-reductionist model of technology adoption by groups, and to compare this model with a methodological individualist model. Similar to prior group research, our methodological choice was dictated by the following two considerations: (1) the availability of an adequate sample size, and (2) the ability to control the effect of extraneous factors (Sambamurthy and Chin 1994). Below, we discuss the sample, procedures, and measures used in the study.

Sample

The sample consisted of students enrolled in the required introductory IS undergraduate course at a major U.S. university. Overall, 321 students originally participated in the experimental sessions. Study participants were randomly assigned to three-person groups (e.g., Dennis et al. 1988), and were provided course credit for participation. There were a total of 107 groups, with a useable sample size of 99 groups (groups with only two members or those that left large parts of the questionnaires unanswered were removed). Out of the 99 groups, 49 groups interacted face-to-face, while 50 groups interacted within a CMC environment.

Task

The purpose of our study was not only to understand the factors affecting technology adoption by groups, but also to examine the effect of technology adoption on outcome variables such as the group members' satisfaction and performance. As a result of the latter, it was important for us to ensure that each group *worked on a specific task* and *delivered a final product,* such that its *objective performance* could be assessed. Our experimental study is similar to the opening scenario described in the manuscript. Specifically, in the study, the groups' task was to generate a flowchart (similar to the research manuscript for a journal special issue in the scenario), but to accomplish the task, they needed to adopt a technology (among two different options) that would then facilitate their task performance. This is also similar to

[3]We would like to emphasize that TAM researchers have *not* put forth any claims regarding TAM's applicability in a group context. However, given the practice of aggregating individual-level constructs to obtain a group assessment, and the absence of specific theories explaining technology adoption by groups, aggregating TAM seems like a logical first step toward understanding this phenomenon.

the scenario where the research team members needed to adopt a specific collaboration software to manage the different versions of the document, and facilitate coordination among them.

To make the study relevant to the IS discipline, the task selected involved the development of a flowchart for an application system (see Appendix A). The flowcharting technique is used by many systems analysts, and has "proven to be invaluable" not only in saving time and money, but also in helping organizations gain in "competitive advantage ...by simplifying work processes and clarifying organizational responsibility" (Janzen 1991). Further, a flowcharting task can be categorized as an intellective task, which usually has a "demonstrable right answer, and the group task is to invent/select/compute that correct answer" (McGrath 1984, p. 63). An intellective task type was important for this study since it enabled the assessment of the quality of the groups' solutions (a key dependent variable in our model). Finally, many different computerized tools are available for drawing flowcharts, thus enabling us (without additional cost) to provide the groups with the opportunity to adopt one out of multiple technologies, thereby creating a "voluntary" technology adoption environment.

The task was developed from different flowcharting examples found in both the practitioner and academic literature (e.g., Galloway 1994). As the narrative of the task was developed, it was reviewed by several peers and practitioners, thereby confirming its face validity (Straub 1989). Finally, the appropriateness of the task was tested in a pilot study prior to the actual experiment (described below).

Adoption Technology

Given that the main objective of this study was to examine a group's voluntary adoption of a technology, groups were given the option to collectively select and use (i.e., adopt) one of the following two technologies for creating the flowcharts: (1) the drawing tool within Microsoft (MS) Word or (2) MS Visio.[4]

[4]We would like to note that an environment where subjects have been provided the "discretion" of using one of two systems has been considered to be a voluntary setting in prior technology adoption research (e.g., Venkatesh and Davis 2000, p. 193).

Communication Environments

Apart from the tools used for examining technology adoption, CM groups also used a computer-based tool for communicating with fellow team members. CM groups "conversed" with their team members using the Chat feature of MS NetMeeting. In addition, to perform the group task, they typically worked on the same diagram and shared the diagram among each other using the "sharing programs" feature of MS NetMeeting. Specifically, the member who housed the diagram also shared the desktop with the two other members in the group, and granted them "control" to the diagram. As a result of this access, other group members could "take control" of the diagram from time to time, and draw different parts of the flowchart when necessary.

Measures

A key issue in the measurement of our model's constructs was to choose an appropriate level of analysis (Gallivan and Benbunan-Fich 2005). A methodological individualist view would call for (1) the collection of individual-level data, and aggregation of this data to construct a group-level measure, or (2) the use of individual-level data (collected from each individual member of the group) and the use of an individual level of analysis as reflective of the group. On the other hand, a methodological holism view would call for using group-level measures only. However, a non-reductionist approach, such as the one in this study, would need to use both individual and group-level measures, depending on the context (e.g., Klein et al. 1994).

In capturing group-level measures, we used the discussion method (see Guzzo et al. 1993). Under such a method, each group was presented with an instrument scale and instructed to *discuss* and provide a single response (as a group) to each of the questions pertaining to the constructs being assessed. Group valence, complexity of the technology, task–technology fit, and groups' adoption of the technology were assessed using this technique (see Appendix B for the items). *Group valence* was measured using four new items, given the logistical difficulty in measuring group valence using an observational system, where a single evaluator observes each group, and scores them on their valence for each option (see Hoffman and Kleinman 1994; Hoffman and Maier 1967), especially when the study involves about 100 groups. *Task–technology fit,* as perceived by the group, was measured by modifying five relevant items from Goodhue's (1995, 1998) questionnaire. *Complexity* of the technology, as perceived by the group, was measured by adapting two items drawn from prior studies (e.g., Karahanna and Straub 1999; Moore and

Benbasat 1991; Rogers 1995). Given that there are no known existing scales for measuring the adoption of a technology by groups, three new items capturing the *group's strength of adoption* were generated for the purpose of this study (see Appendix B), following guidelines from Sambamurthy and Chin (1994).

A priori attitude of the individual members toward the technology was measured using the attitude scale developed by Davis et al. (1989). For obvious reasons, this variable was assessed at the individual level, consistent with the SCT perspective. While there are several existing scales for measuring conflict, owing to the popularity of the scale developed by Miranda and Bostrom (1993-94) within the IS literature, we used the same for measuring *issue-based conflict*.

McPhee et al. (1982) assert that there is "no clearly-justified method of measuring valence" of a majority. Tan et al. (1998a) measured the majority's influence on an individual group member by assessing the amount of time it took the individual member to yield to the pressure of the majority and move toward the "average" of the majority's perspective. Similarly, Zhang et al. (2007) operationalized the influence of a majority on an individual by assessing the number of rounds required to reach consensus. The objective of the current study was not to assess the *extent* of influence of the majority, but to capture *effect of the majority's opinion* on the group's decision (if it exists). Indeed, researchers argue that "majority opinion" reflects the "judgment of a majority of the decision makers who have similar opinions" prior to the group interaction (Pasi and Yager 2006, p. 390). The "concept of majority is usually modeled by means of linguistic quantifiers such as at least 80% and most" (Pasi and Yager 2006, pp. 390). Consistent with this approach, in our study, we captured the *majority support* as a binary variable (1 or 0) based on whether at least two out of three (67 percent) in a group had been in favor (or not) of the tool chosen by the group prior to the group interaction.

Drawing on the literature (Pearce and Robinson 1987; Moehle and Thibaut 1983), we measured the *opinion of high-status members* in favor of a particular technology using the following steps: (1) asking members at the end of the group exercise if there was a high-status individual,[5] and if so, to identify the individual, and (2) capturing the opinion of this high-status individual in the group with respect to the technologies being considered. The opinion was inferred to be in favor of the technology chosen by the group if the high-status member had chosen the same tool prior to the group interaction (coded as 1). Otherwise the variable was coded 0, signifying that the high-status member was not in favor of the technology chosen by the group.

Satisfaction was measured using the scale developed by Green and Taber (1980). Specifically, this scale measures two different subconstructs of satisfaction: solution satisfaction and process satisfaction. To measure *task performance*, quality of the group's solution was assessed following standard guidelines (e.g., Houston et al. 2001). Specifically, two independent raters, both blind to the objective and intent of the research, rated each group's flowchart on three criteria: (1) completeness of the solution, (2) correctness of the solution, and (3) the overall quality. The *inter-rater reliability* of these assessments was adequate, exceeding .90 (Houston et al. 2001). Consequently, the average of the two raters' scores on each of the three solution quality dimensions were used as a measure of the task performance.

The constructs of conflict and satisfaction (both process satisfaction and solution satisfaction) were measured at the individual level (owing to the potential political complexities of measuring such constructs through the group discussion method) and aggregated to the group level after checking for intra-group agreement (e.g., Klein et al. 2001; Klein et al. 1994). The recommended method to assess within-group homogeneity/agreement in such cases where aggregation is unavoidable is to calculate the James rwg (j) coefficient (James et al. 1984). We calculated the rwg for each group on the three constructs (Hardin 2005; James et al. 1984). The rwg scores were .80, .77, and .77, respectively, suggesting good levels of agreement. Finally, to ensure that groups participating in the study perceived the adoption of the technology as voluntary, a question measuring the perceived voluntariness was administered (see Table 2 and Appendix B for details about our measures).

Instrument Validation and Pilot Study

While some of the instruments used in the study have been validated in prior research, others are new (e.g., group valence, group's strength of adoption, complexity). To validate these instruments, the items were first evaluated by peers and (accessible) experts in the area of technology adoption and group research. Based on these reviews, many items were reworded or rephrased, helping achieve face and content validity of the scales (Straub 1989). Further, a pilot study was conducted to validate the instruments and clarify the experimental procedures. Specifically, 59 subjects were assigned to groups of 3 members each, with some groups communicating

[5]We considered two types of high-status individuals in the study: a leader and an expert.

Table 2. Summary of Measures Used in the m-TAG Model

Specific Variable in m-TAG	Measure Used
Members' *a priori* attitudes toward the technology	Four item scale of individual attitudes from Davis et al. (1989), administered to individual group members, and average of scores taken as the input
Medium of communication used by members	Binary measure that captured whether communication media was computer-mediated or face-to-face
Group valence	Four new items measuring the group's positive orientation and feeling toward the technology
Group's strength of adoption of the technology	Three newly developed items measuring *group's* strength of adoption of the technology
Task–technology fit	Four items modified from the task–technology fit scale (Goodhue 1997)
Complexity of the technology	Two items drawing on prior research (e.g., Karahanna and Straub 1999; Rogers 1995)
Majority opinion	Binary measure that captured whether or not the majority's choice of tool was same as that of the group
Intra-group conflict	Issue-based conflict scale from Miranda and Bostrom (1993-94)
Opinion of the leader	Binary measure that captured whether or not the leader had chosen the same tool for the individual part of the exercise as the one chosen by the group after the group interaction (in other words, it assessed the influence of the leader's opinion)
Opinion of the expert	Binary measure that captured whether or not the expert had chosen the same tool for the individual part of the exercise as the one chosen by the group after the group interaction (in other words, it assessed the influence of the expert's opinion)
Task performance	Rating of the solution (on its correctness, completeness, and overall quality) by independent raters
Satisfaction	Modified version of Green and Taber's (1980) scale measuring process and solution satisfaction

face-to-face and others communicating using MS NetMeeting. Prior to the pilot study, subjects were trained on flowcharting concepts, and on creating flowcharts using both the drawing tool of MS Word and Visio. While the sample for the pilot study was small, the computed reliabilities of the scales indicated that they were appropriate for use in a larger study (Brown and Venkatesh 2005).

Training

One week prior to the experimental sessions, subjects attended a 90-minute training session on basic flowcharting concepts and hands-on experience using both the drawing tool of MS Word and MS Visio. In accordance with suggestions provided by industry experts (e.g., Urgo 1995) on the most effective way to provide training on flowcharting, we first exposed participants to the technique itself, including the rules and standards, and then provided them hands-on experience in using the application tools. In addition, subjects were also provided a training manual. At the end of the training session, participants completed a short quiz on flowcharting to confirm their adequate understanding of various concepts. Further, they also completed a questionnaire measuring their perceptions and attitudes toward the two flowcharting technologies. Additionally, participants who were assigned to CM groups were provided approximately 20 minutes of training in using MS NetMeeting. At the end of the training, each participant was asked to complete a short online questionnaire to help assess their level of comfort with the communication environment. Results indicated that the respondents had adequate comfort/familiarity with NetMeeting, rating an average of 3.7 out of a possible 5 on a scale measuring their comfort in using the tool.

Procedure

During the experimental sessions, each participant was given a packet that consisted of a consent form, detailed steps to be followed during the experiment, the experimental task, and the individual questionnaires. First, each participant was asked to read the task narrative and start working on it individually, using either the drawing tool of MS Word or MS Visio for 10 minutes. After 10 minutes, they were asked to stop and complete a short questionnaire that required them to specify the tool they used for performing the flowcharting task and their attitudes toward that tool. In addition, they were also asked to provide their attitudes toward the tool they did not use. Once everyone completed the questionnaire, participants were asked to collaborate with their group members and start working on the same flowcharting task using either the drawing tool of MS Word or Visio (as a group). Each group was given 25 minutes to work on the task. The following excerpts from the participant instruction packets and the experimental script provide an essence of the instructions given to the participants with regard to this issue:

> Excerpts from the experimental script (used by the experiment facilitator for providing instructions during the experiment):
>
> > You will have to decide as a group as to the tool you will use to draw the diagram.
>
> Excerpts from the Participant Instruction packet (provided to all participants):
>
> - Your group will have the option to use either the drawing tool of Microsoft Word or MS Visio to create the flowchart.
> - Decide with your other group members as to which tool your group would like to use for creating the diagram.

Informal observations indicated that face-to-face group members indeed communicated and negotiated the choice of the particular tool for creating their flowchart. For CM groups, we revisited the chat transcripts of the groups, which suggest that groups indeed interacted, communicated, and negotiated the choice of the particular tool for creating the flowcharts. The tool that was ultimately selected was the one upon which the entire group agreed. The process through which this agreement was reached, however, varied: sometimes it depended on the majority view, sometimes on a dominant or emergent leader's view, and sometimes by an open discussion surrounding the technological features of each of the tools. The chat transcripts further emphasize that a methodological individualist view would not have necessarily reflected the group's final choice.

Having chosen the tool, the groups completed the flowcharting task. At this point, each individual member completed another questionnaire measuring their satisfaction and intra-group conflict. Once all members completed this questionnaire, groups were asked to jointly complete a group questionnaire measuring the group's valence, strength of adoption of the technology, perceptions about the task–technology fit, and voluntariness in using the technology chosen.

Finally, participants were thanked and released. The *same* procedure was followed for both the face-to-face and CM groups. All of the experimental sessions were conducted in the same room (in order to reduce the effect of extraneous variables). The CM group members were seated in non-proximate locations from each other, thereby eliminating their possibility of engaging in verbal communication during the group part of the exercise. The face-to-face group members were seated next to each other, but were not informed that they were a part of the same group until it was time for the group exercise to commence. Gift certificates were awarded based on group performance, and also based on a random draw. Participants were informed prior to the experimental sessions that such awards would be presented, in an effort to keep them motivated and engaged with the exercise. See Figure 2 for a timeline of the experiment.

Analysis

To ensure that groups participating in the study perceived the adoption of the technology as voluntary, the mean of the item measuring the voluntariness was calculated. Results indicated that the mean was 5.5 (on a scale of 1, a mandatory setting, to 7, a voluntary setting), reflecting, in general, that groups perceived they were in a voluntary setting.

PLS-Graph Version 3.00 was used for analyzing the data. Our choice of the analysis technique was based on the following two considerations (Bhattacharya and Premkumar 2004; Chin et al. 2003; Hulland 1999): (1) PLS does not require any assumptions of multivariate normality and (2) PLS has been shown to be a superior technique when it comes to analyzing interaction terms and second-order factors. To ensure stability of our estimates using PLS, we conducted the widely used (and highly recommended) "*reactive* Monte Carlo analysis" (Marcoulides and Saunders 2006, p. v), specifically the bootstrapping approach, while analyzing our data. Consistent with prior research using PLS models (see Bhattacharya and Premkumar 2004; Brown and Venkatesh 2005; Chin 1998, 2001; Gefen and Straub 2005; Hulland 1999; Marcoulides and Saunders 2006), we analyzed our model in two stages: The first stage involved "the assessment of the reliability and the validity of the measurement model," and the second stage involved "the assessment of the structural model" (Hulland 1999, p. 198).

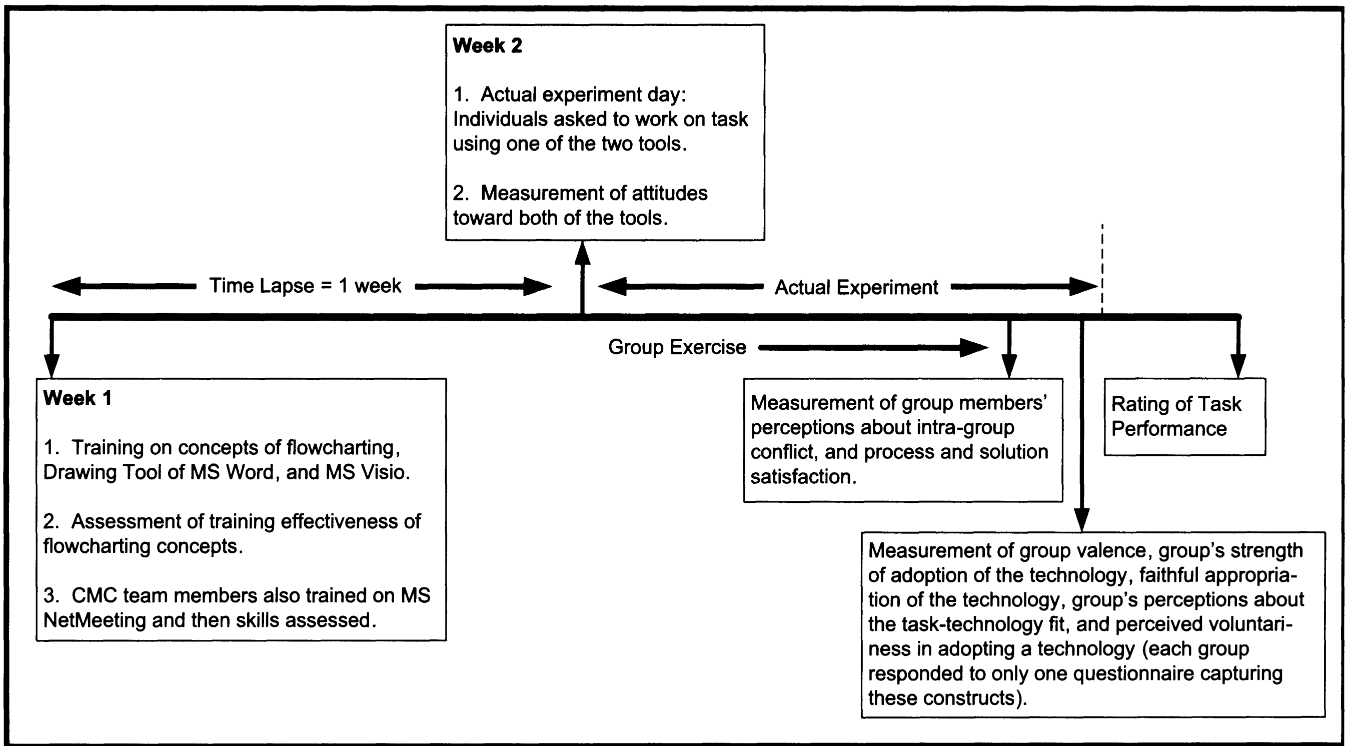

Figure 2. Timeline for Data Collection

Assessment of the Measurement Model

Convergent validity was established by satisfying the following three criteria (e.g, Bhattacharya and Premkumar 2004; Gefen and Straub 2005; Hulland 1999): First, each item loaded significantly on their respective constructs, and none of the items loaded on their construct below the cutoff value of .50.[6] Second, the composite reliabilities of all constructs were over .70. Finally, the AVEs of all constructs were over the threshold value of .50 (see Tables 3 and 4). The means and standard deviation of the constructs are reported in Table 5.

Discriminant validity was established by examining the correlation between the latent variable scores with the measurement items, requiring that the measurement items loaded higher on their "assigned factor" than on any other factor (see Table 6) (Gefen and Straub 2005, p. 93). Discriminant validity was further confirmed by ensuring that for each construct, the square root of its AVE exceeded all correlations between that factor and any other construct (Bhattacharya and Premkumar 2004; Fornell and Larcker 1981; Gefen and Straub 2005) (see Table 4).

Assessment of the Hypothesized Relationships

To test the hypotheses predicting the moderating effects, interaction terms (reflecting the moderating variable) were created following the product-indicator approach suggested by Chin et al. (2003). Prior to creating the product-indicator, the data of the variables involved were standardized or centered as appropriate (Miles and Shevlin 2001).

The second-order factor of satisfaction was modeled using a "molecular approach" (Chin and Gopal 1995, p. 49-50). Thus, as suggested by prior research, a hierarchical component model using repeated manifest variables was created (Chin et al. 2003; Lohmöller 1989). Specifically, the manifest variables for the two dimensions of satisfaction (i.e., process and solution) were included twice: once for each of the two dimensions, and once for the second order factor. All of the path coefficients from satisfaction to its two dimensions were high (.94 and .93 respectively), thereby suggesting that satisfaction was indeed indicated by the two underlying first order factors (Chin et al. 2003).

[6]One item measuring task–technology fit had a loading less than .50, and was thus dropped from the subsequent analysis.

Table 3. Descriptive Statistics and Item Loadings

Scale Item	Construct	Item Mean	Item S.D.	Item Loading†
Att1	*A priori Attitudes*	5.98	0.591	.91
Att2		5.67	0.77	.76
Att3		4.91	1.14	.68
Att4		5.56	0.70	.86
GV1	Group Valence	5.86	1.16	.90
GV2		5.88	1.27	.90
GV3		6.13	1.07	.90
GV4		5.89	1.27	.74
Conf1	Conflict	2.13	0.88	.93
Conf2		2.63	1.33	.78
Conf3		2.31	0.87	.83
Conf4		2.75	0.89	.71
Conf5		3.05	1.33	.76
Conf6		1.99	0.82	.91
TTF1	Task–Technology Fit	5.96	1.29	.75
TTF2		6.12	1.11	.92
TTF3		6.23	0.99	.91
TTF4		6.11	1.15	.63
COMPL1	Complexity of the Technology	2.55	1.66	.93
COMPL2		2.55	1.54	.89
GSA1	Group's Strength of Adoption of Technology	6.31	0.97	.85
GSA2		6.28	0.95	.79
GSA3		4.59	2.04	.58
SAT1	Satisfaction	4.93	0.72	.52
SAT2		5.19	0.83	.68
SAT3		5.54	1.08	.88
SAT4		5.57	0.91	.83
SAT5		5.66	0.99	.89
SAT6		5.14	1.11	.77
SAT7		5.46	0.98	.83
SAT8		5.34	1.04	.82
SAT9		5.55	1.03	.88
SAT10		5.42	1.03	.89
Task_Perf1	Solution Quality	5.17	1.41	.97
Task_Perf2		5.48	0.98	.73
Task_Perf3		5.32	1.23	.99

†All items loaded at $p < .01$.

Table 4. Composite Reliabilities, Correlation between Constructs, and Square Root of AVEs

	Construct	Composite Reliability	1	2	3	4	5	6	7	8	9	10	11
1	*A priori attitudes*	.881	**.808**†										
2	Group valence	.922	.426	**.864**									
3	Conflict	.927	-.094	-.168	**.825**								
4	Task-Technology Fit	.883	.297	.615	2-1	**.811**							
5	Complexity of the technology	.910	-.257	-.509	.228	-.405	**.914**						
6	Group's strength of adoption technology	.793	.303	.630	-.227	.457	-.346	**.753**					
7	Satisfaction	.948	.175	.557	-.471	.488	-.364	.327	**.806**				
8	Solution Quality	.929	.075	.318	-.124	.301	-.320	.190	.459	**.903**			
9	Majority Support	1.00	.394	.211	.118	.126	.084	.300	-.110	-.022	**1.00**		
10	Influence of Leader	1.00	-.091	-.081	.034	.030	.054	-.045	-.184	-.007	-.042	**1.00**	
11	Influence of Expert	1.00	.061	.175	-.114	.081	-.130	.201	.124	.172	.033	.375	**1.00**

†Numbers in the diagonal represent the square root of the AVEs of the constructs.

Table 5. Mean and Standard Deviation of the Multi-Item Constructs

Construct	Mean	Standard Deviation
A priori attitudes	5.53	.642
Group valence	5.94	1.03
Conflict	2.48	.859
Task–Technology Fit	6.11	.909
Complexity of the technology	2.55	1.46
Group's strength of adoption of technology	5.73	.963
Satisfaction	5.38	.788
Solution Quality	5.32	1.11

H1 argued that the individual members' *a priori* attitudes toward the technology that the group adopts would have a positive effect on the group's valence toward that technology. This prediction was not supported ($\beta = .020$, $p > .10$). H2 predicted that the majority members' support of the technology would have a positive effect on the group's valence toward the technology. Results supported this prediction ($\beta = .176$, $p < .01$).

H3, which argued that the effect of the members' attitudes toward the technology on the group's valence would be moderated by the communication media used by group members, with *a priori* attitudes having a stronger effect in the case of CM groups was supported ($\beta = .281$, $p < .01$). Further, as predicted in H4, the effect of the majority's opinion toward a technology on the group's valence was also moderated by the group communication media, with the influence of the majority being greater in face-to-face than in CM groups ($\beta = -.237$, $p < .01$). However, substantive conflict *did not* have a significant effect on the group's valence toward the technology ($\beta = .019$, $p > .10$); this was not consistent with H5. H6a and 6b proposed the effects of the high-status individuals on the group valence. H6a was not supported ($\beta = -.010$, $p > .10$), while H6b was supported ($\beta = .152$, $p < .05$). Both H7a (predicting the positive effect of the group's perceptions about the fit of the technology with the group task), and H7b (predicting a negative effect of the complexity of technology on the group's valence) were supported ($\beta = .368$, $p < .01$; $\beta = -.261$,[7] $p < .01$).

[7]A lower score indicated lower perceived complexity.

Table 6. Correlations between the Items and the Constructs

	A priori Attitudes	Group Valence	Group's Strength of Adoption of Technology	Conflict	Task–Technology Fit	Complexity of the Technology	Solution Quality	Satisfaction
Att1	**0.91**	0.41	0.28	-0.06	0.27	-0.24	0.12	0.21
Att2	**0.76**	0.23	0.21	-0.18	0.27	-0.10	0.03	0.11
Att3	**0.68**	0.24	0.15	-0.14	0.10	-0.22	0.02	0.07
Att4	**0.86**	0.42	0.30	0.00	0.30	-0.24	0.05	0.14
GV1	0.46	**0.90**	0.56	-0.20	0.50	-0.44	0.35	0.57
GV2	0.36	**0.90**	0.62	-0.16	0.55	-0.39	0.39	0.59
GV3	0.23	**0.75**	0.45	-0.03	0.49	-0.44	0.10	0.26
GV4	0.41	**0.90**	0.54	-0.19	0.59	-0.50	0.24	0.48
GSA1	0.26	0.53	**0.85**	-0.22	0.48	-0.33	0.11	0.29
GSA2	0.25	0.44	**0.80**	-0.10	0.33	-0.23	0.07	0.13
GSA3	0.17	0.43	**0.58**	-0.17	0.20	-0.19	0.23	0.29
Conf1	-0.15	-0.19	-0.24	**0.94**	-0.22	0.29	-0.10	-0.46
Conf2	-0.03	-0.11	-0.12	**0.78**	-0.04	0.13	-0.11	-0.34
Conf3	0.01	-0.01	-0.09	**0.83**	-0.10	0.13	-0.17	-0.38
Conf4	0.13	-0.02	-0.10	**0.71**	-0.08	0.14	-0.09	-0.26
Conf5	0.00	-0.02	-0.05	**0.76**	-0.06	0.09	-0.06	-0.25
Conf6	-0.09	-0.17	-0.25	**0.91**	-0.24	0.17	-0.12	-0.45
TTF1	0.32	0.52	0.25	-0.08	**0.75**	-0.22	0.32	0.37
TTF2	0.20	0.57	0.42	-0.29	**0.92**	-0.40	0.25	0.45
TTF3	0.25	0.55	0.50	-0.15	**0.91**	-0.39	0.26	0.47
TTF4	0.19	0.31	0.30	-0.10	**0.63**	-0.30	0.12	0.25
COMPL1	-0.24	-0.51	-0.36	0.17	-0.35	**0.93**	-0.23	-0.28
COMPL2	-0.23	-0.42	-0.26	0.25	-0.40	**0.90**	-0.37	-0.40
Task_Perf1	0.06	0.29	0.22	-0.11	0.28	-0.33	**0.97**	0.41
Task_Perf2	0.12	0.30	0.05	-0.03	0.26	-0.17	**0.73**	0.42
Task_Perf3	0.06	0.32	0.17	-0.15	0.30	-0.31	**0.99**	0.48
SAT1	0.09	0.21	0.09	-0.09	0.18	-0.03	0.19	**0.52**
SAT2	0.01	0.37	0.20	-0.28	0.31	-0.18	0.20	**0.68**
SAT3	0.16	0.51	0.36	-0.43	0.38	-0.38	0.49	**0.88**
SAT4	0.20	0.54	0.30	-0.37	0.44	-0.34	0.38	**0.83**
SAT5	0.17	0.56	0.33	-0.43	0.38	-0.36	0.51	**0.89**
SAT6	0.16	0.49	0.32	-0.44	0.48	-0.37	0.44	**0.77**
SAT7	0.14	0.36	0.21	-0.39	0.37	-0.23	0.32	**0.83**
SAT8	0.04	0.37	0.21	-0.41	0.36	-0.20	0.30	**0.82**
SAT9	0.21	0.47	0.27	-0.44	0.52	-0.37	0.36	**0.88**
SAT10	0.19	0.52	0.29	-0.42	0.46	-0.327	0.43	**0.89**

H8 argued that the group's valence toward a technology would have a significant effect on the group's adoption of the technology. This relationship was supported ($\beta = .630$, $p < .01$). H9 argued that a group's strength of adoption of a technology would have a positive influence on its satisfaction. This too was supported ($\beta = .327$, $p < .01$). Finally, H10, which argued that the adoption of technology by the group would have a positive effect on the group's task performance, was also supported ($\beta = .190$, $p < .05$) (see Figure 3 for the path coefficients and the variance explained in the endogenous variables).

To compare the predictive strength of m-TAG versus G-TAM (H11 and H12), a sample was drawn from the same pool used to empirically test and validate the m-TAG model presented earlier. For testing G-TAM, existing instruments from prior studies involving TAM were used, and administered (using the same procedures as the experimental study) to the participants after the training session (see Figures 4 and 5). In other words, each participant was asked to respond to items measuring *perceived ease of use*, *usefulness*, and *intention to adopt* both the MS Word drawing tool and MS Visio for drawing a flowchart (see Appendix C for the specific items and Appendix D for the psychometric properties of the instruments used). The average of these measures (per group) was then computed.[8] Given that some participants did not complete the questionnaire after the training session, the sample for the *post hoc* analysis consisted of 86 groups (as opposed to the 99 groups used for the empirical test of m-TAG earlier). Due to the reduction in the sample size, we not only tested the G-TAM model, but also tested the m-TAG model again. Again, we used PL-Graph Version 3.00 for this analysis.

The central dependent variable in each model was the group's strength of technology adoption.[9] Overall, results indicated that G-TAM and m-TAG both provide a good explanation of technology adoption by groups, with both the average intentions to use technology and the group valence predicting the group's strength of adoption of the technology. We then compared the relative explanatory power of the two models (see Venkatesh et al. 2003) by contrasting the variance explained by each of the models on the groups' technology adoption (see Table 7). This comparison shows that m-TAG explained a substantially higher degree of variance on the groups' technology adoption than G-TAM (38 percent versus 9.7 percent). Additionally, the path coefficient (or Beta) of the *group valence → group's adoption of the technology* linkage within m-TAG was also higher than the *average of members' intention to use the technology → group's adoption of a technology* linkage within G-TAM. This supports H11.

To specifically test H12, we extracted those groups from our expanded data set, where there was a discrepancy in the opinions of the individual members. In other words, we separated the groups where at least one member had selected a different technology (from their group) to perform the individual part of the task. This partitioning resulted in a subset of 27 groups. We then tested both G-TAM and m-TAG using this refined dataset. Results indicated that in G-TAM, *average intentions to use the technology* **did not** affect the *groups' adoption of that technology* (see Table 8). On the other hand, in m-TAG, *group valence* significantly affected *groups' adoption of that technology*.

[8]For example, when the group adopted MS Visio for its task performance, we computed the average of the members' perceptions/intentions regarding Visio.

[9]We would like to emphasize that our focus was on the average intention → group's adoption of a technology and the group valence → group's adoption of a technology linkages, since our goal was to determine the prediction of a group's technology adoption, and not the interactions among the various constructs leading to that behavior. Such focus on specific relevant linkages of a model is consistent with prior research conducting model comparisons (e.g., Venkatesh et al. 2003).

Discussion

Revisiting the Results

Overall, results indicate a strong support for our non-reductionist model of technology adoption by groups. A key relationship in our model was between the individual members' *a priori* attitudes toward the technology and the group's valence toward that technology. Results indicated that, overall, *a priori* attitudes did not affect the group's valence toward the technology. However, an interactive effect was found between *a priori* attitudes and communication media on the group valence, suggesting that members' *a priori* attitudes play a stronger role in CM groups. This result is consistent with our theoretical arguments. Specifically, owing to the lack of social presence within a CMC environment, and the *ad hoc* nature of the groups leading to stronger personal (as opposed to social) identity among the members (Lea and Spears 1992), members in CM groups experienced greater self-awareness, resisted changing their *a priori* attitudes toward a group-level view (Sassenberg and Boos 2003). This result is consistent with the proponents of SIDE (e.g., Lea and Spears 1992) who argue against the universal applicability of the "reduced social cues" (RSC) effect in group interaction, and emphasize the importance of the group context (e.g., *ad hoc* versus long-standing).

Drawing on the conflict literature, it was predicted that increased issue-based conflict would negatively influence the group valence. Results do not support this prediction. One explanation for this finding is that a negligible level of conflict occurred in all groups (i.e., the average level of conflict was 2.48 on a scale of 1 (never) to 7 (always)). This lack of conflict could have resulted from the *ad hoc* and temporary nature of the group composition, where groups just had 25 minutes to work on the task. In such temporary groups, where the focus is primarily on task completion, there is usually little or no conflict (e.g., Poole, Holmes, and DeSanctis 1991).

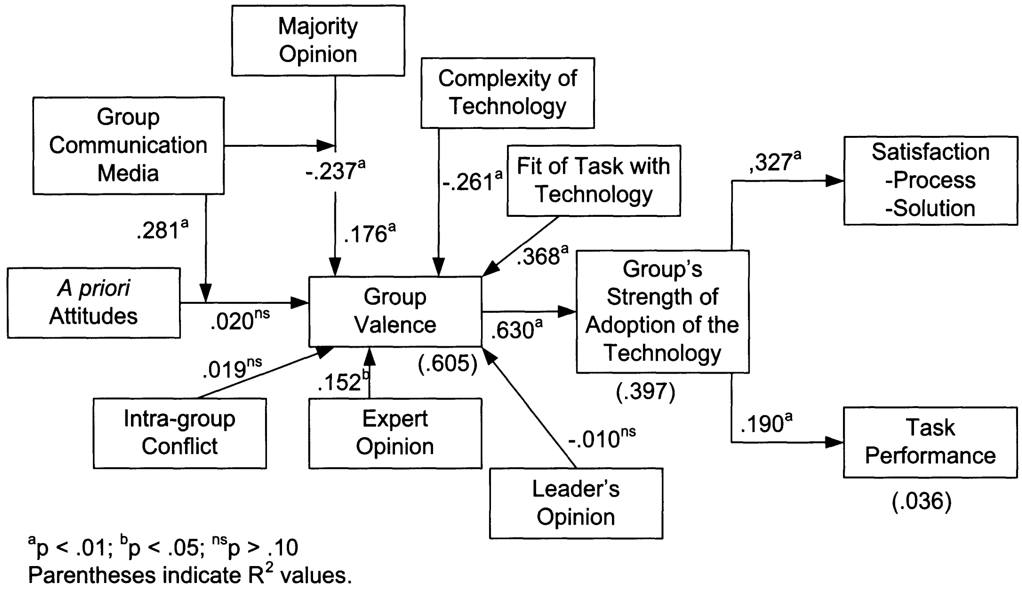

Figure 3. Results of the PLS Analysis of m-TAG

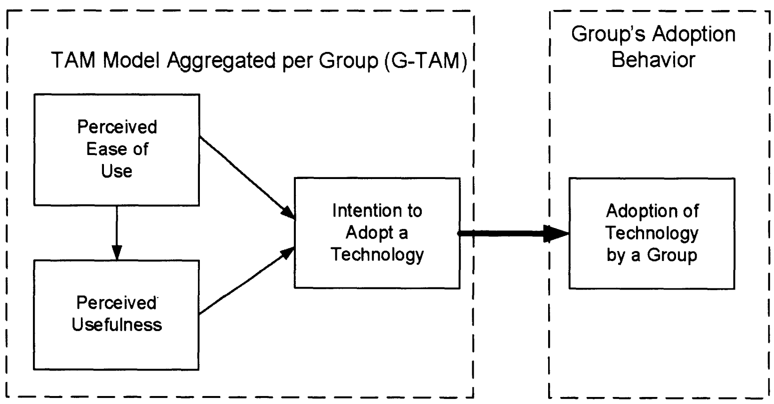

Figure 4. Possible Methodological Individualist Model Explaining Technology Adoption by Groups

Consistent with our hypothesis, results also indicated that the acknowledged group expert's opinion had a significant effect on group valence. However, the individual with the acknowledged structural power in the group (i.e., the emergent leader) did not have a significant impact on the group's valence toward a technology. While this is consistent with our opening scenario, one of the reasons could be the fact that our sample consisted of egalitarian groups composed of student subjects, where there was a lack of formal hierarchy, and therefore very few individuals enjoyed structural power.

Finally, results also indicated a strong effect of the groups' adoption of the technology on members' satisfaction, and the overall task performance. However, the R^2 indicated that only a small percentage of the variance in task performance was explained by the strength of adoption of the technology. This indicates that the adoption of a particular technology in itself may not be sufficient to generate a higher quality flowcharting solution for the group. Future research could examine the moderating effect of other factors such as the level of group competence and/or group efficacy in creating a flowchart,

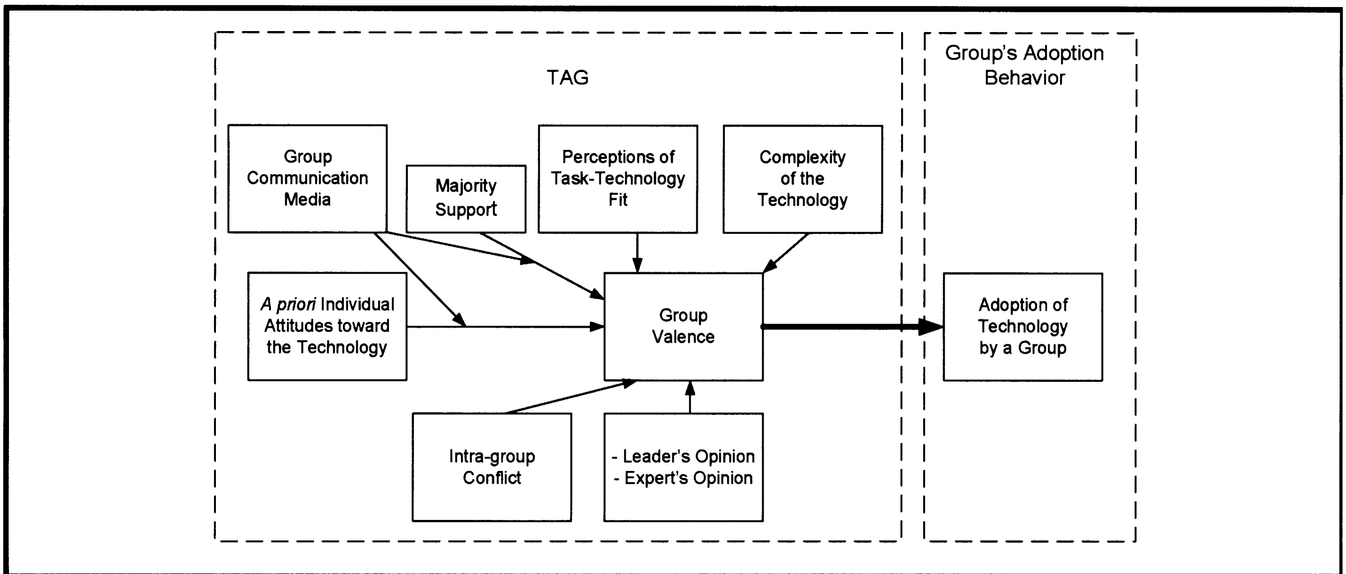

Figure 5. A Non-Reductionist Model Explaining Technology Adoption by Groups Used for Comparing the Explanatory Power of G-TAM Versus m-TAG

Table 7. Comparison of the Two Models of Technology Adoption by Groups

		Technology Adoption by Groups	
Model	**Independent Variables**	**R^2**	**Beta**
G-TAM	Average member's intention to use the technology	.097	.311**
m-TAG	Group Valence	.380	.616**

**p < .01
*p < .05

Table 8. Comparison of the Two Models When There Is Discrepancy Within Groups

		Technology Adoption by Groups	
Model	**Independent Variables**	**R^2**	**Beta**
G-TAM	Average member's intention to use the technology	.064	.254[ns]
m-TAG	Group Valence	.215	.464*

*p < .05
[ns]Not significant

motivation level of the members, and the manner in which the technology is appropriated, as a moderator on the relationship between technology adoption and performance.

A comparison of m-TAG with G-TAM demonstrates that the non-reductionist m-TAG provides a more *robust* explanation of technology adoption by groups than the methodological individualist G-TAM. Finally, our results indicated that in the absence of complete within-group agreement, G-TAM fails to predict a group's technology adoption phenomenon. We believe that this is an important finding, since it highlights a specific context (i.e., the lack of uniformity in the *a priori* preferences of group members) in which a *methodological individualist view will simply fail to provide adequate explanations*.

Theoretical Contributions

This study, we believe, has a number of theoretical and practical implications. First, the study demonstrates the problematic nature of a methodological individualist view underlying group studies, at least in the context of technology adoption by groups. As highlighted in our review of the literature, group studies within the MIS discipline have often adopted methodological individualism, failing to consider the concept of "we-ness" in groups and a possible lack of uniformity among group members prior to a group interaction. Consistent use of such a perspective could have resulted in a limited understanding of group-related phenomenon within the MIS discipline, even though groups are regularly used in all aspects of organizational life. Our study strongly cautions against the use of methodological individualism, and encourages researchers to adopt alternate approaches to studying groups within the MIS discipline. To this effect, our study discusses multiple alternatives, and offers the non-reductionist perspective to studying groups.

Further, our study illustrates some of the problems of adopting methodological individualism without appropriate checks, especially in the context of technology adoption by groups. While technology adoption has been a topic of great interest for information systems researchers, we reiterate that there is little (or no) understanding about technology adoption by *groups*. This study attempts to provide future researchers with a useful foundation for examining various factors related to this critical phenomenon. Drawing on a number of theoretical perspectives, the study developed and empirically validated a non-reductionist model of group technology adoption. It drew on the literature on valence, which has been used extensively in communications research but rarely in the information systems literature. Further, by considering the role of technology-related variables (e.g., group communication media, perceived complexity of the technology, and the perceived fit between the task and technology) along with the social influence processes within a group, the study adopts a sociotechnical approach to technology adoption (Benbasat and Zmud 2003; Lee 1999).

Practical Contributions

The study's primary finding that groups should be treated as a separate entity and not only as an aggregation of individual members points to an important practical implication. While organizations continue to utilize groups in every aspect of business, and practitioner literature aboundsin its discussion about how to improve group performance, our review of this literature suggests that a majority of prescriptions put forth to and practitioners focuses on enhancing group performance by examining how **individual members** "commit to (attitudes about) the work and the group, active participation, degree of added value, handling conflict....giving and seeking feedback" (London 2007, p. 181). Our study will hopefully educate practitioners in terms of the importance of focusing on the *group as an entity in its own right* (**in addition** to the individual members), where the group-level characteristics arguably play a more critical role in the final group outcomes.

Specifically, for the context of technology adoption by groups, the empirical test of the model highlights that the expert's opinion plays a key role in shaping the valence of the group toward a particular technology. While this is an encouraging result, highlighting that the group values the opinion of experts, the intention of the expert should also be monitored. It is important for the manager of such groups to ensure that the expert's opinion is not a result of political pressures or conflicts of interests that he/she may be facing (Benveniste 1984), but an opinion based on his/her perceptions of the appropriateness of the technology.

Further, the results of the study highlight that the perceived complexity of the technology has a negative effect on a group's valence. Prior research and articles from the popular press often argue that top management typically bring in several technology options to the organizational members, although the final selection may depend on the individuals or the groups adopting it (Liang et al. 2007). Owing to their high environmental scanning, top management is also known to bring in novel and innovative technologies, which may be sophisticated, but too complex for the group to use it productively (Liang et al. 2007). The results of this study caution that tools with high levels of complexity (irrespective of sophistication) can push groups toward rejecting them, which can be counterproductive. In such cases, strong training mechanisms initiated to reduce the group's perceived complexity of the technology may help elevate the valence toward the technology.

The results of the study also indicate a strong effect of the groups' perceptions of the fit between a technology and its task. It should be the role of the group facilitators to provide assistance to the group in understanding the level of fit between the task and the technology, if a group is unable to do so on its own. Such content facilitation (in the form of an intervention that relate directly to the problem being discussed, such as an insight or opinion) will ensure that the group adopts a technology that best serves its purpose and enables members to be most productive (Miranda and Bostrom 1999, p. 100). The role of the facilitator in keeping the group focused on the perceived fit of the technology with the task or on the complexity of the technology will be paramount in other situations as well. Our results highlight that both the majority opinion and the opinion of the expert have an effect in shaping the groups' valence toward a technology. However, as our opening scenario highlighted, the view of the expert may not always be in line with that of the rest of the group. In such cases, facilitators should intervene, and encourage the group to focus on relevant technological characteristics and using these perceptions to make an informed decision.

Finally, we believe that the model presented in this paper can be applied to many organizational arenas, including that of information systems development (ISD), which is typically performed by groups. In many cases, ISD groups may need to adopt a certain technology (such as a flowcharting tool or a CASE tool) to perform their tasks. Often, such adoption of a technology by a group is reasonably voluntary, and is not mandated by top management or dictated by technological infrastructure compatibility constraints (Bajwa and Lewis 2003; Mustonen-Ollila and Lyytinen 2004). The results of this study provide guidance to better understand such situations.

Limitations

While we believe that our study makes a number of interesting contributions, like all other research studies, it too has some limitations. For instance, given the experimental methodology, we utilized student subjects who often lack in motivation and have other idiosyncracies, thereby leading to a limited generalizability of the study (Gordon et al. 1986). However, other researchers (e.g., Dipboye and Flanagan 1979) have argued that student subjects represent a variety of backgrounds and goals, and usually reflect a typical working professional. Similarly, Locke (1986) contends that student participants are appropriate in situations where clear-cut theory testing and issues of measurement precision and control are paramount. This is more the case when examining group-oriented phenomena requiring a large number of participants to be studied in specific conditions (Sambamurthy and Chin 1994). Further, we believe that the design of the study (substantial course credit given to all participants for attending the training and experimental sessions, refreshments provided during the sessions, and attractive gift certificates awarded for high quality flowcharts) helped in addressing some of the motivation-related concerns. However, future research should still focus on validating the model tested here using organizational groups. Such an examination may also shed more light on the role of the leader and conflict during technology adoption by groups (results that have not been supported in this study).

Another limitation of this study stems from the use of the type of the communication medium (i.e., synchronous text-based CMC environment). Given that much of organizational work is conducted using both synchronous and asynchronous media, and where group members may be collocated or distributed (e.g., Nunamaker et al. 1991), questions may also be raised about the generalizability of this study. However, we would like to note that a large body of research has concluded from empirical studies that distributed CM groups do not necessarily differ from collocated CM groups in many tasks (e.g., Jessup and Tansik 1991; Ocker et al. 1998). Nonetheless, the results from this study should be used with caution, and future research should examine technology adoption in groups that are globally distributed and/or use an asynchronous communication medium or electronic media with different degrees of social presence than the ones used here (e.g., videoconferencing).

In this study, we examined a group technology adoption phenomenon using a specific type of technology (i.e., flowcharting tools) only. Such technologies are not group technologies *per se*, and are typically those that may be used by individuals working by themselves or collaboratively within a group. Organizational groups often need to adopt (or make an adoption decision surrounding) other types of technologies such as a group support system (GSS) or a group communication system. In such cases, additional variables such as the extent to which the technology supports the group's process (e.g., social relationship development, collaboration) may play an important role, and needs to be investigated in future research.

Finally, while our study examines the nature of the influence of different types of subgroups and high-status individuals on the group's opinion/preference, it does not inform researchers about what happens when the majority's view conflicts with that of high-status individuals, and how such conflicts may get resolved. While we have not specifically examined such contexts, an examination of the ranks of the beta weights (see Appendix E) suggests that in the case of a conflict between an expert and the majority, the majority's view (which has a higher beta weight) would hold more strongly. In any case, future research needs to examine this through a more processual understanding of technology adoption by groups, perhaps by engaging in in-depth case studies.

Conclusion

Group-based work has become a routine part of organizational life; yet, in a large proportion of group-related investigations within the MIS discipline, the dominating paradigm has been that of methodological individualism, which, we contend, may have provided incorrect or questionable conceptualization and empirical results in many cases. Our study not only highlights the problems associated with adopting methodological individualism in group studies within the MIS discipline, but also provides an in-depth understanding of the technology adoption by groups phenomenon. This issue has not been investigated, even though technology adoption (by individuals) has remained one of the most widely explored topics within the IS research community. We believe that there is much to know about technology adoption by groups and on suitable approaches for conducting such research, and we are hopeful that this study provides a useful approach for future investigation.

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