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Abstract

This study examined minority influence within virtual groups and how members' geographic dispersion and argument consistency affect group decisions. Competing predictions were derived from several theories that were applicable but untested in the domain of online interaction: a double minority effect, the black sheep effect, congruity theory applied to groups, and the minority leniency contract framework. Online groups were created that had 4 collocated members or 4 geographically distributed members, or 2 collocated and 2 isolated members. Group members were provided biased distributions of information resembling a hidden profile to facilitate majority and minority positions resulting in 24 groups with a minority opinion holder geographically isolated or in proximity with one or more other members. The patterns of minority members' influence on majority members' decisions lent greatest support to the black sheep effect, congruity, and minority leniency approaches, depending on the respective location of the minority opinion holders and the consistency with which they argued their positions.

Keywords

minority influence, virtual groups, hidden profile, computer-mediated communication.

Virtual groups are employed, among other reasons, to take advantage of individuals' disparate perspectives and information that may arise from differences in members' local contexts. It is, therefore, important for virtual groups to synthesize the information contributed by all members. There is growing evidence, however, that virtual groups fail to capitalize

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on members' disparate views and arguments (Campbell & Stasser, 2006; Dennis, 1996; Hollingshead, 1996a-b; Straus, 1996).

Geotemporal distributions of members combined with aspects of computer-mediated communication (CMC) may stimulate perceptions of similarity or dissimilarity among subgroups, and these factors may complicate identification and social influence among the members of virtual groups. Most virtual groups use some form of asynchronous CMC (Baltes, Dickson, Sherman, Bauer, & LaGanke, 2002) and many involve geographic distribution of some members (Burke, Aytes, Chidambaram, & Johnson, 1999). Geographic dispersion introduces not only mechanical and coordination requirements but also various social identification processes, with collocated group members experiencing similarity to one another and differences felt from remote colleagues (Fiol & O'Connor, 2005). Research has begun to examine how divisions among the members of such groups may affect their conduct (e.g., Bazarova & Walther, 2009; Cramton & Hinds, 2005; Jarvenpaa & Leidner, 1998; Mortensen & Hinds, 2001; Polzer, Crisp, Jarvenpaa, & Kim, 2006; Walther & Bazarova, 2007; Walther & Bunz, 2005). The present research is particularly concerned with how virtual groups deal with minority opinions among their members and whether the relative isolation or collocation of minority opinion members affects their influence on others. A further element of focus is the consistency with which minority arguments are maintained in discussion. Argument consistency reflects a position holder's certainty (Nemeth, Swedlund, & Kanki, 1974) and may influence perceptions of a minority member's deviance from the majority. In turn, the consistency of a minority opinion holder's arguments may yield different effects on social influence within groups.

Although between-media comparisons are useful in many investigations of distributed work teams, a complete cross of member distribution and media is not possible because geographically distributed groups always use some form of CMC. To control the effects of variations in communication media versus face-to-face interaction, the current study examined only pure virtual teams—defined by Fiol and O'Connor (2005) as never meeting face to face—whereas it varied geographic distribution of people and distribution of information. This study used three different configurations of virtual groups who communicated strictly via text-based CMC, including (1) *collocated* groups in which all members resided at the same university, (2) *distributed* groups in which all members resided at different respective universities, and (3) *mixed* groups in which two members resided at the same university and two other members resided in other individual locations.

To activate differences in opinion without artificially assigning members to positions, a decision-making task using a *hidden-profile* information allocation (Stasser & Titus, 1985) with a minority information set (McLeod, Baron, Marti, & Yoon, 1997) was used to stimulate a distribution of majority and minority opinions among group members, with the potential for members to exchange arguments that were consistent with their own or others' initial positions during discussion. By ascertaining members' preinteraction rankings among three decision alternatives, analyzing the consistency with which they argued this position, and assessing the opinion change among majority opinion holders, analyses were able to discern support for hypotheses among sets of predictions derived from competing theories of minority influence in groups.

Virtual Groups: Media and Distribution Effects

Virtual groups may involve factors that alter the patterns of social influence that groups otherwise typically experience. The combined effects of the communication medium and different geotemporal distributions are only partially understood. Little is known about the interaction of medium-by-geographical distribution effects with the distribution of information, though the distribution of both members and members' information are the hallmark of virtual groups. Although evidence shows that longer-term CMC groups can compensate for the lack of cues and face-to-face (FtF) contact over time and multiple tasks (Walther, 1997), or be induced to work and relate as effectively as FtF groups (Walther & Bunz, 2005), short-term virtual groups often fail to develop effective interpersonal relations. As a consequence, misattributions between collocated and distant partners can arise (Walther & Bazarova, 2007).

Recent thinking suggests that CMC may accentuate alternative forms of identification among partners (see for review, Walther & Parks, 2002). Some propose that social identification follows geographic dispersion. Fiol and O'Connor (2005) conjecture that members in the same location are perceived as part of the in-group and those in remote locations as out-group members. A number of studies of mixed-location virtual groups can be seen to reflect this framework. In a study of geographically dispersed teams, Polzer et al. (2006) found that members' geographic locations became the faultlines dividing people into subgroups: Participants in their study identified more strongly, reported more trust, and experienced less conflict with proximal than distant team members. Armstrong and Cole's (2002) study of software development teams found that location was the basis for identification among team members: Members at the same site referred to each other as "us" while referring to team members at other sites as "them." Using a simulation of distributed software development, Shami et al. (2004) found that workers enlisted help from collocated colleagues at a much higher rate than from remote colleagues.

As appealing as a broad social identification approach may appear to be for geographically dispersed groups, research that assumes that in-group–out-group differences follow geographical lines alone does not consider the potential identification impacts of opinion heterogeneity *within* as well as *between* locations. Social identity theorists agree that for individuals with a sense of shared identity, such as that imbued by geographical similarity, a group identity is reinforced by convergent and homogeneous communication among group members (Postmes, Baray, Haslam, Morton, & Swaab, 2006). In contrast, it is possible for a remote partner to have different information or a different opinion than proximal group members because virtual groups are formed to capitalize on disparate information and opinions that arise due to different sets of local knowledge and experience (Phillips, 2003). A broad social identity approach, however, would predict that due to the dynamics of in-group favoritism versus out-group derogation a remote partner may be systematically ignored precisely because of his or her remoteness. Although this framework bodes poorly for the utility of virtual groups, other identification-related theories suggest alternative outcomes depending on other specifiable contingencies.

Four theoretical approaches offer promising yet divergent predictions about the effects of geographic distribution crossed by opinion divergence: double minority, black sheep effect, congruence, and minority lenience contract approaches. Each of these frameworks pertains to the dynamics of opinion deviance in groups and maps onto distributed groups in potentially useful ways. In the following, we discuss the social cognitive dynamics that arise when opinion divergence becomes apparent within and across location-based groups and then examine the predictions derived from each of these four frameworks.

Group Disagreement and Minority Influence

When group members encounter opinion divergence, they may either reexamine the issue at hand by considering the minority's opinion, or, alternatively, they may try to minimize the potential for minority influence, for example, by looking for reasons to discount the deviant opinion. In what follows, we consider both possibilities in general terms, which are then explicated by the four theories of minority influence as applied to geographically distributed virtual groups specifically.

According to minority influence research, minority opinions, if argued consistently, can cause majority members to reexamine the entire situation, increase effort, and stimulate divergent thinking in the group (Nemeth et al., 1974). This, in turn, increases the potential to discover novel solutions: "Minorities stimulate a greater consideration of other alternatives, ones that were not proposed but would not have been considered without the influence of the minority" (Nemeth, 1986, p. 25). The influence of a minority opinion holder, however, depends on the degree to which an individual's arguments are consistent or inconsistent with respect to the minority position he or she advocates. Consistency is an individual's adherence to a well-defined position sufficient to create perceptions of his or her certainty and confidence (Nemeth et al., 1974). Meyers and colleagues reconceptualized consistency in terms of conversational argument patterns, and argument consistency has been found to predict social influence both in FtF (Gebhardt & Meyers, 1995; Meyers, Brashers, & Hanner, 2000) and CMC interactions (Lemus, Seibold, Flanagan, & Metzger, 2004).

The changes in majority positions in response to a consistent minority position can happen privately or publicly. Whereas both private and public opinions of majority members can change as a result of minority influence (Nemeth, 1986), in some situations majority members may privately agree with the minority's opinion, without acknowledging the deviant position in public (Moscovici, 1980). Because public agreement with a minority position is contrary to the group norm and, therefore, more costly, minority influence produces more private than public changes in majority members' opinions and behaviors (e.g., Sinaceur, Thomas-Hunt, Neale, O'Neill, & Haag, 2010).

Whereas minority opinion can lead to changes in private and public opinions of majority members, in some situations majorities may seek to minimize the potential for minority influence, such as by looking for reasons to discount the deviant opinion. Opinion divergence in a group increases uncertainty, especially if it arises from members who are perceived to be similar in other respects (Turner, 1999). As individuals seek the cause of the

disagreement, questioning the view of external reality can destabilize the rectitude that a consensual view confers on a group, and therefore, in response, individuals may question the social identifications of a minority opinion holder, which can affect the majority's openness to minority information. According to Turner (1999),

The uncertainty is created by individuals' implicit awareness that people who are similar and who are judging a similar (shared, publicly invariant) stimulus situation ought to agree (i.e., react in the same way). Furthermore, where they do so agree, the agreement provides evidence that in-group members' responses reflect an external, objective reality, rather than personal biases or idiosyncrasies. . . . By the same token, disagreement within the group raises basic questions to do with the perceived cause of one's response, which amount to the experience of uncertainty: do we differ in some relevant way after all? Are we confronting the same reality, approaching from the same perspective? Am I or are they wrong? (p. 16)

When majority members concentrate on social categorizations rather than reexamine external reality as a potential cause of disagreements, they may choose to reclassify a deviant's social category. Different theoretical models depict different circumstances or thresholds that prompt such reclassifications and, therefore, imply different levels of minority influence by those who may be reclassified.

Double Minority

A double minority perspective illustrates how a group member whose opinion differs from others may be disregarded if that member is seen as different than other members in some additional important respect. An individual is identified as a double minority when there is a cognitively salient factor that can explain the minority's deviant position, and the majority uses it to discount a minority's arguments as being due to something other than an unaccountable difference in assessments of reality by right-thinking people. One such cognitively salient factor with which to dismiss a minority opinion holder is an ascribed social category membership different than the majority's (Maass, Clark, & Haberkorn, 1982). When this occurs, a double minority's influence on others' opinions is reduced compared to the greater influence by a "single minority" member. In reference to virtual groups, we propose that geographical lines affect out-group categorizations in virtual groups and can turn an isolated and relatively distant minority opinion holder into a double minority member of the group.

Thus, despite the potential of an argument-consistent minority opinion holder to influence the private opinions of majority group members, if not their public positions, the presence of other plausible causes for the minority's disagreement may render minority advocacy moot. Maass and Clark explained this effect by reference to Kelley's (1971) discounting principle, according to which a potential cause (honest disagreement) loses its explanatory power when an alternative plausible cause (fundamental categorical difference) becomes available or salient (see, for review, Maass & Clark, 1984). The differential

impact between single and double minorities, the latter who deviate from the majority both in terms of their opinions and their social category membership, can be understood within a more general framework of social categorization: Double minorities are discriminated against as members of an out-group, whereas single (opinion) minorities are treated as members of the same social group (see also Maass et al., 1982).

By applying the double minority concept to virtual groups, members' differences in geographic locations may place a geographically isolated minority opinion holder into a position of a double minority, who is different from the majority both in terms of opinions and their social category membership triggered by geographical difference. Geographical dissimilarity, in the eyes of the majority, could account for differences of opinions, supplanting attributions to minority's certainty and causing the majority to disregard minority's arguments. Deriving from the double minority perspective, we, therefore, predict that a consistent position of a geographically isolated minority will be less influential than a consistent position of a geographically collocated minority.

Hypothesis 1: A consistent position by a geographically isolated minority opinion holder is less influential than a consistent position by a geographically collocated minority.

Congruence

One approach to the effects of intermember differences on group decision making has been developed in work by Phillips and colleagues (Phillips, 2003; Phillips, Mannix, Neale, & Gruenfeld, 2004; see also Gruenfeld, Mannix, Williams, & Neale, 1996). Based on Newcomb's (1961) congruence theory, Phillips argued that group members expect others who are categorically similar to themselves to have similar opinions and information and expect those who are different from themselves to hold different information and ideas. During the process of information sharing, differences among group members that are congruent with these expectations facilitate social influence compared to the presentation of information that is incongruent with expectations. Thus, according to Phillips et al., group members should be influenced more by *divergent* opinions and information from *dissimilar* others but less attentive to divergent information when it is presented by people who are *similar* to themselves.

To test these propositions Phillips et al. (2004) created three-person experimental groups that varied in composition with respect to familiar and unfamiliar members. A hidden-profile information set was used such that members had several pieces of information relevant to the groups' decisions that were held in common by all group members, and in addition, each member held a smaller number of unique pieces of information that other members did not share. Furthermore, information sets were planted so that a minority opinion and information set was either held by one of the two familiar members, or in another experimental condition, by the member of the group who was not familiar to the other two members. Results showed, as expected, that when the minority opinion/information was held by the unfamiliar member, groups solved the decision-making task more

effectively than did groups in which the minority information was held by one of the familiar members. In other words, when unique information was offered by the unique member, congruent with balance-theoretic expectations, it was more influential and the groups were more effective.

Like the familiarity factor in Phillips et al.'s (2004) study, Fiol and O'Connor (2005) suggest that geographic proximity or distance may trigger alternate social identifications in virtual groups. Thus, a congruity theoretic approach predicts that a minority opinion that is presented by an isolated group member is more influential on majority members' decisions than is a minority opinion presented by a collocated group member.

Hypothesis 2: A consistent position by a geographically isolated minority opinion holder is more influential than a consistent position by a geographically collocated minority.

Black Sheep Effect

Another approach to opinion heterogeneity among in-group members—the “black sheep” effect—illustrates how an established social category may be rethought after a group has encountered a deviant opinion within the group and how it in turn affects minority influence in a group. Whereas many applications of social identification dynamics to small groups treat intragroup social perceptions as “homogenized and consensualized” (Postmes & Baym, 2005), others argue that all groups are internally differentiated, based on socio-demographic category memberships or “other nested and cross-cutting categories” (Hogg & Tindale, 2005, p. 150). There are disparities within the social identification literature regarding how groups deal with information or opinion deviants who reside *within* an in-group.

One school of thought holds that, within an in-group, an individual whose position differs from others will be worse than uninfluential. The “perception of someone as being a deviant discredits and devalues them, and reduces their persuasive potential,” according to Marques, Abrams, Paez, and Hogg (2001, p. 401). Indeed, the “black sheep effect” (Marques, Abrams, & Serôdio, 2001) predicts that in-group members “react so strongly against fellow group members who are deviant—often derogating and rejecting (deviant) in-group members significantly more strongly than outgroup members” (Marques, Abrams, Paez et al., 2001, p. 400). Whereas congruence dictates that collocated minority positions are unnoticed, the black sheep effect suggests they are actively rejected. The black sheep effect suggests that a collocated minority may be *negatively* influential; that is, a (consistent) minority opinion presented by a collocated member has a negative influence on group decisions; majority members are more likely to change their decisions in the opposite direction than that which the minority advocates, relative to a minority opinion expressed by a (consistent) isolated member. This “boomerang effect” should take place in groups with collocated minority holders, but not groups with an isolated minority.

Hypothesis 3: A consistent position by a geographically *collocated* minority opinion holder has a negative influence on the majority's individual and group decisions.

Minority Leniency Contract

Crano (2001) developed an alternative perspective with respect to minority opinion and social identification called the "minority leniency contract model." This model may also pertain to groups with a collocated minority opinion member, but it offers different propositions than those above. Crano acknowledged that in-group members ignore out-group members who hold minority opinions (consistent with the double minority effect) and that if an in-group member strongly deviates from the majority's opinion, he or she will be reclassified as an out-group member, derogated as such, and be uninfluential (as in the black sheep effect). However, Crano argued, if an in-group member differs somewhat from the majority this divergence challenges the group. Rather than trigger derogation or reclassification of the minority opinion holder as a traitor or outsider, moderate deviation prompts the majority to search for an explanation for the insider's behavior. In cognitive dissonance terms, the inconsistency produced by divergent positions within a group causes discomfort and a reexamination of one's own and others' positions (Matz & Wood, 2005). Ultimately, the group is liable to be influenced by the minority opinion because in-group conflict leads members to elaborate on the cause of the apparent dissensus (Martin & Hewstone, 2001), increasing consideration of the rationale for the minority position.

Applied to virtual groups, the minority leniency model contrasts the congruence approach, by predicting that the presentation of a minority opinion by a collocated group member will prompt greater rather than lesser influence than if the minority opinion was isolated. Unlike the black sheep hypothesis, this process should render the collocated minority member influential and likely improve the group's decision quality, provided that his or her opinions and arguments are not too disparate from those of the other collocated members. The criterion of being moderately disparate—that is, marginally different than the in-group but not so much as to trigger the black sheep effect—is critical. Drawing on the consistency of arguments principle related earlier, an opinion minority who is collocated and argument consistent may be too deviant, whereas a collocated minority who is argument inconsistent may be just different enough to trigger consideration by majority members and will be more influential than either a collocated consistent minority or a distant minority. In this respect, the minority leniency model differs from the double minority perspective, which predicts that a minority influence will be most effective in groups with a consistent collocated minority.

Hypothesis 4: An inconsistent position by a geographically *collocated* minority opinion holder is more influential than (a) a collocated argument-consistent minority, or (b) a distant minority.

Thus, four different variants of identification involving minority status, relative location, and argument consistency offer different predictions for minority influence within

Table 1. List of Hypotheses With the Theoretical Positions and Mechanisms That Prompt Them

Theory	Mechanism	Effects
Double minority	Social recategorization of a distant minority member reduces influence	A consistent position held by a geographically isolated minority opinion holder is less influential than a consistent position held by a geographically collocated minority.
Congruence	Expectations based on the established social categories moderate influence	A consistent position held by a geographically isolated minority opinion holder is more influential than a consistent position held by a geographically collocated minority.
Black sheep effect	Social recategorization of a collocated minority member reduces influence	A consistent position held by a geographically collocated minority opinion holder has a negative influence on the majority's individual and group decisions.
Minority leniency contract model	Reexamination of external reality as a cause underlying moderately different opinion of a collocated member	An inconsistent position held by a geographically collocated minority opinion holder is more influential than that of (a) a collocated, argument-consistent minority, or (b) a distant minority.

virtual groups. A summary of predictions drawn from each theoretical approach is listed in Table 1.

Method

Participants

Participants were 180 students recruited from 6 different colleges or universities in the United States and Canada (see Bazarova & Walther, 2009). They were recruited through courses in different academic departments in return for partial course credit and entry in a drawing to win one of four iPods®, contingent on the groups' decision quality. Fifty-eight percent of the participants were women. Participants ranged in age from 18 to 49, with a mean of 21 and mode of 19.

Manipulation of Geographical Distribution

In the *collocated* condition, all four members were from the same school. In the *fully distributed* condition, all four group members were isolated and each belonged to a different

school. In the *mixed* conditions, two members were from the same school, and the other two isolated members were each from two different schools. To make participants aware of the locations of each group member, their names and respective school logos appeared on the entry page of the electronic discussion board that they used to communicate. Access to the discussion was only possible by clicking through this page.

Experimental Procedure

Blocking on the participants' schools/locations, participants from each location were randomly assigned to geographic distribution and information set conditions. Researchers mailed paper copies of instructions for the communication system and the experimental stimuli containing one of the four different information sets to participants. Instructions required participants to indicate an individual solution to the task by e-mail to the researchers. Participants retained access to their information sets throughout the study. All participants communicated via the Internet using an asynchronous discussion board created for each group in the Blackboard online courseware system. A discussion board was available to each group 24 hour a day for 2 weeks.

Task. To instigate the presence of a minority position in each group, and to provide the minority opinion holder with arguments that could be used to support that position (as well as to contradict it), a group decision-making task was devised to induce disparate pre-discussion preferences among group members. This task involved an original version of a hidden-profile task (Stasser & Stewart, 1992). It presented information about a fictitious city faced with the choice of three urban development projects, with information sets containing pros and cons related to these three alternative projects. The task requested a group consensus on the optimal rank order of all three alternatives. Within the group as a whole there were 16 pieces of information about Alternatives A and C each, and 18 pieces about Alternative B.¹ Each participant received 10 pieces of information about each of the 3 alternatives. The pros and cons were distributed in a biased manner across the four members, in accordance with the hidden-profile research strategy, giving some pieces of information to all members (common information) and other pieces to only one member (unique information). By manipulating the balance of positive and negative items about each alternative that were given to all or to just one member, each individual member's information set was designed to lead to a preference for an incorrect rank order. Only by pooling and considering all members' pieces of unique information should the optimal solution become clear. Three of the four members' information sets, if interpreted correctly (i.e., if pros and cons were counted properly), favored Alternative B over the other alternatives. Whereas most hidden profiles provide information favoring a single wrong answer to all group members, the fourth set of information in this study was designed to favor Alternative C rather than B (see, for example, McLeod et al., 1997). That is, the minority information set pointed to a different, also incorrect, solution than did the other three sets. The correct answer, which all information summed should favor, was Alternative A. Once participants had an opportunity to read the information set provided to them, but before they were

allowed to join the group discussion, they individually indicated their preferred rank-order solution to the researchers via a web form.

Coding Procedures

Determining majority-minority opinion holders. Although the intended design of the hidden profile was that three members would prefer the same, but incorrect solution, and the fourth member would prefer a different, but also incorrect solution, it is common for preinteraction preferences not to match the solutions suggested by the original information sets in hidden-profile studies.² In such a case there may be no minority opinion formed. To mitigate this potential problem, researchers identified the actual majority/minority opinion holders in each group on the basis of the participants' preinteraction preferences rather than by relying on the hidden-profile information distribution. Groups were identified and excluded from further analysis if the combined preinteraction preferences exhibited (a) a two-two split, (b) a consensus (all members favoring the same ranking), or (c) a dissensus (two group members favoring the same ranking and two others favoring different rankings each). The final number of usable groups with a single minority opinion holder was 24.³

Coding for information sharing. As is the case in other hidden-profile studies, coding involved identifying the pieces of information that participants actually wrote in their group discussions by matching it to the inventory of information items they had been provided.⁴ Following previous approaches (Stasser & Stewart, 1992; Stasser, Taylor, & Hanna, 1989), three coders were trained in the identification of information items. Each coder worked independently and without knowledge of the distribution conditions in which groups operated. They counted partial information statements as if they were whole, as long as the utterances conveyed a factual statement about one of the alternatives. Totals were assessed using Cronbach's alpha, both when 10% of the data were coded, and again when the entire corpus was completed, with overall Cronbach's alpha at .97. Disagreements were settled through discussion. Because these information items matched the hidden-profile inventory, their values as positive or negative statements (in connection to the respective alternative to which they referred) was inferred a priori based on the pros and cons nature of the pieces of information.

Unlike typical hidden-profile studies, the same coders made a second pass through the transcripts to analyze statements that some group members made reflecting arguments that expressed their personal opinions or reflected advocacies that had no actual basis in the information in the task materials that were provided to them. These statements, such as "I think that the arts and education one is the best plan" or "They tried a convention center in my home town, too, and it was a disaster," were unitized and then coded for positive or negative valence in relation to a specific alternative. Intercoder reliability was once again assessed by comparing the frequency counts within and across each of these new categories (Alternative A = positive, Alternative A = negative, and Alternative C = negative), Cronbach's alpha = .91.

Determining consistency. Conversational argument consistency reflects the degree to which one argues his or her position consistently in the discussion. In accord with earlier research (Gebhardt & Meyers, 1995; Meyers et al., 2000), consistency calculations involved all arguments articulated by each minority member favoring or opposing his or her top preinteraction preference. Arguments included information items from the hidden-profile materials, original advocacies, and personal opinions. Consistency was calculated as a difference between a minority member's arguments favoring his or her top preference and favoring the other two alternatives, such as $((+C) + (-A) + (-B)) - ((-C) + (+A) + (+B))$, where +A are arguments in favor of Alternative A, +B are arguments in favor of Alternative B, +C are arguments in favor of Alternative C; but -A are arguments against the Alternative A, -B are arguments against the Alternative B, and -C are arguments against the Alternative C, based on the preinteraction minority information preinteraction rank order of $C > A > B$.

The calculated value was divided by the total of that group member's arguments to yield the range of possible scores from -1 to 1. Therefore, a minority opinion holder with a score closer to +1 was more consistent than a minority opinion holder with a score closer to -1.

Outcomes

Several measures were developed with which to assess a minority opinion holder's influence on majority holders' decision making. The principles of the hidden-profile information distribution scheme allowed some unique and revealing approaches to the assessment of influence. In a hidden profile, attention to group members' unique information improves members' decisions. As such, one measure of influence with both theoretical and pragmatic implications consisted of the correctness of each majority member's private, individual, postdiscussion rank-order decision, relative to the a priori correct ordering of the alternatives (*majority correctness*). Minority influence was also assessed by a change in the correctness of each majority member's rank order from prediscussion to postdiscussion private rankings (*majority change*). Another measure of minority influence was the closeness of majority postdiscussion private decisions to the minority *prediscussion* rankings (*majority conversion*). Finally, we assessed the correctness of the groups' actual final decision, rather than the individual members' private decision (*group correctness*).

To calculate majority correctness and group correctness, each of 6 possible rank orders can be compared to the correct ordering of the 3 alternatives, resulting in a 4-step interval-level scale with decreasing point values representing decrements due to the distance of each alternative's position from its optimal place in the order (see McLeod et al., 1997). The correct rank order of ABC, where Alternative A > Alternative B > Alternative C, was assigned a value of 4; the rank orders of ACB and BAC were assigned values of 3; the rank orders of BCA and CAB were assigned values of 2; finally, CBA was assigned the value 1. Majority conversion was calculated by comparing each majority member's postdiscussion rank order to the minority member's prediscussion rank order. Finally, majority change was calculated by subtracting the value of each majority member's prediscussion correctness from his or her postdiscussion correctness score.

Table 2. Descriptive Statistics and Correlations Between Variables

Variable	<i>M</i>	<i>SD</i>	1	2	3	4
1. Majority correctness	0.82	0.67	1.000	0.575*	-0.325*	0.764*
2. Majority change	0.06	0.60	0.575*	1.000	0.011	0.452*
3. Majority conversion	2.51	0.83	-0.325*	0.011	1.000	-0.367*
4. Group correctness	0.75	0.61	0.764*	0.452*	-0.367*	1.000

Note: Correlations computed at the individual member level ($N = 68$).

* $p < .01$ (two tailed).

Results

To address the hierarchical structure of the data and the potential nonindependence of scores for individuals nested within groups, the data were analyzed using multilevel modeling within an SPSS MIXED procedure. Multilevel modeling accounts for variability at each level of data, including estimation of random-effects residuals for the effects of participants nested within groups (Kenny, Kashy, & Bolger, 1998).

Table 2 provides the descriptive statistics for and correlations between the primary variables of interest. It shows that group correctness, majority correctness, and majority change are positively correlated, whereas majority conversion is negatively correlated with majority correctness and group correctness. Because the minority information set also pointed to an incorrect solution, closeness to the minority's prediscussion preference did not imply a more correct solution.

The first analysis tested the effect of minority argument consistency and minority location on majority correctness. The interaction of a minority member's location and minority argument consistency revealed a significant effect on majority correctness, $F(1, 20) = 8.73$, $p = .01$, $\eta^2 = .02$. Neither minority location, $F(1, 28) = 1.18$, $p = .29$, nor minority argument consistency, $F(1, 19) = 1.31$, $p = .27$, were significant. To probe the interaction effect, a categorical variable of minority argument consistency was derived from the continuous measure of minority argument consistency using a median split ($MD = 0$), rendering minority opinion holder's arguments as consistent or inconsistent. When a minority opinion holder argued inconsistently, the mean for majority correctness was 1.15 ($SE = 0.24$) when the minority opinion holder was collocated, but when the inconsistent minority opinion holder was isolated, the mean for majority correctness was only 0.63 ($SE = 0.18$). In contrast, when a minority opinion holder argued consistently, and when the minority opinion holder was collocated, the mean for majority correctness was 0.47 ($SE = 0.24$), but when a consistently arguing minority opinion holder was isolated, majority correctness had a mean of 1.15 ($SE = 0.22$); see Table 3. That is, the influence of a minority opinion holder on majority members' correctness depended not only on where that minority member was physically located with respect to majority members but also on whether his or her arguments were more or less consistent with others' positions, and argument consistency had different effects depending on being close or remote. When a minority opinion member was collocated with others, argument consistency was negatively associated with influence;

Table 3. Means and Standard Errors for Majority Decision Correctness, Majority Opinion Change, and Group Decision Correctness by Relative Location and Argument Consistency of Minority Opinion Holder

Minority argument	Inconsistent		Consistent	
	Collocated	Isolated	Collocated	Isolated
Majority correctness	1.15 ^{a,b} (0.24)	0.63 ^{a,b} (0.18)	0.47 ^a (0.24)	1.15 ^b (0.22)
Majority change	0.32 ^a (0.21)	-0.13 ^a (0.16)	-0.13 ^a (0.20)	0.33 ^a (0.19)
Group correctness	1.00 ^{a,b} (0.28)	0.63 ^{a,b} (0.20)	0.40 ^a (0.25)	1.17 ^b (0.23)

Note: Means with different superscripts within a row indicate significant difference ($p < .05$).

a collocated “extremist’s” arguments backfired. In contrast, a collocated but argument-inconsistent minority opinion holder was more influential on majority opinion holders. For remote minority opinion holders, the pattern was reversed: They were more influential with respect to majority members’ private decisions when they were argument consistent than when they were inconsistent.

The next dependent variable was majority members’ opinion change (majority change), which was assessed by analyzing a change in the correctness of the majority members’ post- and pre-discussion rank orders. The difference due to the interaction of minority member location by minority member argument consistency was once again significant, $F(1, 19) = 5.83$, $p = .03$, $\eta^2 = .09$. Neither minority location, $F(1, 23) = 1.12$, $p = .30$, nor minority argument consistency, $F(1, 18) = 0.001$, $p = .98$, were significant. To probe the interaction effect, the analysis was rerun with the categorical (median split) variable for minority argument consistency. The results concur with the patterns from the previous analysis: Argument-consistent, geographically isolated minority members facilitated greater change in the majority postinteraction ratings than an argument-consistent, collocated minority member, as predicted by congruence theory. When a minority opinion holder was argument consistent and collocated, majority members’ decision change was negative, $M_{\text{collocated}} = -0.13$, $SE = 0.20$, whereas an isolated, argument-consistent minority member prompted a positive change in majority opinion holders’ decisions, $M_{\text{isolated}} = 0.33$, $SE = 0.19$. In contrast, as seen in Table 3, when a minority opinion holder was argument inconsistent, the mean score of majority members’ opinion change reflected a positive effect when the minority member was collocated, $M_{\text{collocated}} = 0.32$, $SE = 0.21$, whereas there was a negative change when the minority member was isolated, $M_{\text{isolated}} = -0.13$, $SE = 0.16$, with a positive change reflecting an improvement in decision correctness and negative numbers indicating a decline in the majority opinion holders’ prediscussion to postdiscussion change in decision quality. As in the first analysis, the arguments of a consistent collocated minority led to a decline in the majority rankings’ quality, the implications of which will be addressed in the conclusion of this article.

The next analysis tested majority conversion due to the minority member’s argument consistency and geographical collocation. The results showed that a minority’s argument consistency was a significant predictor for the majority’s conversion to a minority

prediscussion position, $F(1, 18) = 7.04, p = .02$. Minority location did not affect the majority's conversion, $F(1, 27) = 0.06, p = .81$. The interaction of minority location and minority consistency was not significant either, $F(1, 20) = 0.02, p = .89, \eta^2 < .001$, suggesting that regardless of the location minority members with consistent argumentation caused majority members to consider and accept their positions more than minority members with inconsistent argumentation.

Finally, group correctness was evaluated as a function of the interaction of minority argument consistency and minority location. The difference was significant, $F(1, 19) = 9.33, p = .01, \eta^2 = .33$. Neither minority location, $F(1, 19) = 0.15, p = .71$, nor minority argument consistency, $F(1, 19) = 0.96, p = .34$, significantly affected group correctness. To probe the interaction effect, we reran the analysis with the categorical variable for minority argument consistency using the median split. The pattern of means resembled those in the previous analyses: When minority arguments were inconsistent, groups' final rankings were better in groups with collocated minority opinions rather than in groups with distributed minorities (supporting the minority leniency model); when a minority opinion holder was more consistent in his or her arguments, groups with isolated minority opinion holders finished with better rankings than did groups with collocated minority opinion holders (supporting the congruence theory). As seen in Table 3, for an argument-inconsistent minority scores were greater for groups with a collocated minority member, $M_{\text{collocated}} = 1.00, SE = 0.28$, than when the argument-inconsistent minority was isolated, $M_{\text{isolated}} = 0.63, SE = 0.20$. When a minority opinion holder was argument consistent, scores were smaller for groups with a collocated minority, $M_{\text{collocated}} = 0.40, SE = 0.25$, than when an argument-consistent minority opinion holder was isolated, $M_{\text{isolated}} = 1.17, SE = 0.23$. The negative influence of an argument-consistent collocated minority on the final group ranking is consistent with the black-sheep-effect predictions.

Discussion

This research examined the patterns of influence of a minority opinion holder within virtual groups. Virtual groups are useful to the extent that members can attend to and consider the inputs of members who may know different things and see things in different ways. When they do so, however, biased processing may take place, systematically excluding some information contributions and privileging others. Whereas previous research has suggested that the geographic separation of virtual group members is liable to instantiate in-group-out-group attributions among them, no research to date has examined group identification dynamics that result from opinion divergence within virtual groups. The potential for group disagreement to trigger different responses is complicated by whether opinion divergence comes from "within or without," that is, from among collocated partners or from their remote or isolated colleagues. Several theoretical perspectives predict various patterns of influence based on the consistency and social identification of minority opinion holders, which map on to distant/close-group members, providing reasonable hypotheses for minority influence in virtual groups. The present results indicate that whereas minority argument consistency was an overall predictor for majority conversion to the

minority's opinion, majority correctness, group correctness, and majority change were influenced by both the position (close or remote) and argument consistency of a minority member. Overall, remote and argument-consistent minority opinion holders caused more majority change and improvement in majority and group correctness compared to collocated argument-consistent minority. What follows is a discussion of these results in reference to the four theories of minority influence, which this research extended to virtual groups.

The double minority hypothesis predicted that when a minority opinion holder is remote and argument consistent, that person will be classified as an outsider and be uninfluential because of groups' tendencies to derogate the opinions of outsiders. Results did not support this prediction. A remote minority opinion holder who offered consistent arguments was more influential than when an argument-consistent minority was collocated. These combinations affected the majority members' postdiscussion decisions as well as the group members' change in position from pre- to post-discussion.

These patterns are more consistent with the application of congruence theory to groups derived by Phillips (Phillips et al., 2004). This model predicts greater minority influence by a consistent, isolated minority compared to a consistent, collocated minority. Indeed, remote minorities were more influential in general than close ones, provided their arguments were sufficiently consistent. The negative influence of an argument-consistent collocated minority on the majority decisions suggests, however, that this relationship is best described by the black sheep effect, which predicts an inverse relationship between a minority's argument-consistent advocacy and the majority's private opinions. This illustrates a case when the uncertainty borne out of in-group members' disagreements is resolved through majority members' reassigning an opinion deviant to a different social category, which is held responsible for his or her opinion divergence (rather than an external situation, which may have prompted different perspectives).

The most complex prediction was also supported. The minority leniency contract model (Crano, 2001) explains how a collocated minority member may gain influence in a group, as long as his or her argument consistency is low enough to allow others to regard the person as an in-group member who diverges moderately. Consistent with Crano's predictions, a moderately divergent in-group member (i.e., an inconsistent minority) evokes more reflection and consideration of alternatives among a group than does an extremist whose consistent deviance from the group's majority overturns his continued belongingness to the in-group. Once reclassified due to extreme divergence, this individual's opinion can be ignored. When it is moderately divergent, however, it is potent, accounting for the positive effect on the majority's postinteraction preferences for an argument-inconsistent collocated minority.

Altogether the results support several hypotheses, some of which are incompatible but several of which form a contingency scheme predicting who will be influential—close or distant colleague—and when, that is, under what condition of argument consistency. Although the minority member's argument consistency had a main effect on the convergence of the majority opinion holders' final decision to the position held by the minority, the correctness of the majority's and the group's postdiscussion rankings was determined by a combination of the minority member's consistency and location.⁵ The results suggest

that the right configuration of the minority location and consistency influenced the majority. This may be the outcome of prompting majority members to think about things, rather than their mimicking or accepting the minority position *carte blanche*, a process suggested by Nemeth (1986).

The results about a positive influence of a distant minority are consistent with the recent findings by O'Leary and Mortensen (2010) who found that teams with geographic isolates had unexpectedly positive outcomes for both the isolates and their teammates. Whereas virtual groups with geographically distributed subgroups experienced negative outcomes, similar to this research, groups with geographical isolates produced outcomes that in some cases exceeded those of their collocated counterparts. The positive effects of geographical isolates on group dynamics suggest, according to O'Leary and Mortensen, "that such isolates may serve unique, beneficial roles for their team, potentially acting as devil's advocates or, as evidenced in participants' comments, prompting small (but valuable) increases in mindful coordinating activities among all team members" (p. 127). The role of distant minorities as devil's advocate stimulating divergent thinking and cognitive effort is compatible with the findings in the present study about improved decision quality in groups with distant minorities.

On a larger scale, the results of the present study draw attention to the importance of geographical configurations within virtual teams, a topic of recent theoretical and empirical inquiries by O'Leary and colleagues (O'Leary & Cummings, 2007; O'Leary & Mortensen, 2010). According to O'Leary, a group's geographical configuration—the number of sites and the relative number of members at different sites—is a key predictor of virtual group dynamics, which can account for discrepant effects of geographically distant members on virtual group dynamics. Whereas groups with geographic subgroups suffer negative outcomes, including conflict and partner denigration along the geographical fault lines (e.g., Cramton, 2001; Hinds & Mortensen, 2005), groups with geographical isolates seem to avoid these problems and can experience surprisingly positive dynamics, as the present research and the previously mentioned O'Leary and Mortensen's (2010) study suggest. Given previous research on the influence of subgroups (e.g., Gebhardt & Meyers, 1995), a fruitful direction for future research would be to examine the effects of different geographical configurations, such as near and distant subgroups, on minority influence in virtual groups.

An additional avenue for future research is to investigate information-sharing patterns in distributed groups that have biased samples of information. Although this study used a hidden-profile decision-making task, the focus was not on information sharing but on minority influence in virtual groups, in which differences in members' geographical location were crossed with their opinion differences. Furthermore, this study was about the importance of argument consistency, which went beyond the initial opinion differences between majority and minority members. Future research needs to examine how various factors that have been shown to affect information sharing or information withholding (e.g., conformity pressure, social comparison effects, etc.) may operate differently when social pressures change due to media and distribution of group members.

The current study focused specifically on minority opinion holders, but another interesting topic for future research would be the role of argument consistency among majorities.

The classic dual-process models of majority versus minority influence predict that message characteristics (e.g., consistency or argument quality) matter more for minorities than for majorities (Gardikiotis, Martin, & Hewstone, 2005; Mackie, 1987; Moscovici, 1980). Given that the dual-process model was developed in a context based on face-to-face communication, it may be important to examine how technology mediation and geographic dispersion may affect characteristics of majority member arguments, such as consistency.

A number of additional factors associated with the experimental nature of this study should be considered in interpreting the results. The participants were students placed in zero-history groups with no anticipation of future interaction. The willingness to persist on a particular position may differ under circumstances in which group members are concerned about maintaining good working relationships or their reputation in the group. Furthermore, with the hypothetical task used in the current experiment, minority opinion holders may not have felt as invested in maintaining consistency of their arguments, than if the discussion outcome had had an effect on their lives beyond the research incentive. Despite these limitations, the strength of experimental design was that it permitted testing focused hypotheses and added new theoretical insight into minority influence in virtual teams with collocated and distributed members.

Authors' Notes

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Notes

1. The two extra pieces of information about Alternative B were necessary to allow equivalent sets of information across three group members and a different set for the minority information recipient. The information about Alternative A, which ranked highest according to the task design, had 10 positively valenced and 6 negatively valenced pieces of information. Alternative B had 8 positively valenced and 10 negatively valenced items. Finally, there were 6 positively valenced and 10 negatively valenced items about Alternative C, which was the lowest ranking alternative per task design.

2. This kind of distribution is not uncommon in hidden-profile research. For example, Hollingshead (1996a) found 46% of experimental groups included flawed preinteraction preferences, and in control groups where all members were given the complete information sets, 89% of groups contained at least one person with an incorrect preinteraction preference. Phillips (personal conversation, July 2005; Phillips et al., 2004) indicated that 44% of participants chose the correct answer prior to group discussion, though 0% should have done so based on the information they received.
3. Because the experimental task required ranking of three alternatives, two types of minorities emerged: strong and weak. Based on the preinteraction preferences, the strong minority differed from the three other members on the top two alternatives, whereas the majority members ranked the top-two choices unanimously. In groups with the weak minority, three members were unanimous on their top alternative but only partially agreed on the ranking of the lower two alternatives. The patterns of social influence were found to be similar in groups with a strong and weak minority, and this distinction, therefore, was dropped from further consideration.
4. An analysis to see whether participation varied systematically due to the geographic distribution of the groups showed no differences in the participation levels (number of message postings) between collocated ($M = 4.89$, $SE = 9.70$) and distributed group members ($M = 4.33$, $SE = 0.67$), $p = .57$.
5. If there had been different degrees to which minority members were correct in their prediscussion rankings either in association with location or with argument consistency, this factor would provide an alternative explanation for their different impact on the correctness of the majority members' and the group's final decisions. However, the analyses revealed no difference in the correctness of the minority opinion holders' prediscussion rankings, either due to location, $r(24) = .14$, $p = .50$, or to their argument consistency, $r(24) = -.07$, $p = .76$.

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