Research Article

Impact of Cold-Calling on Student Voluntary Participation

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Abstract

Classroom discussion is perhaps the most frequently used "active learning" strategy. However, instructors are often concerned about students who are less inclined to participate voluntarily. They worry that students not involved in the discussion might have lower quality learning experiences. Although instructors might consider whether to call on a student whose hand is not raised ("cold-call"), some instructors resist cold-calling fearing that the student will feel uncomfortable. This study examines the impact of cold-calling on students' voluntary participation in class discussions and their comfort participating in discussions. The results demonstrate that significantly more *students* answer questions voluntarily in classes with high cold-calling, and that the number of students voluntarily answering questions in high cold-calling classes increases over time. Furthermore, students in classes with high cold-calling answer more voluntary *questions* than those in classes with low cold-calling; this also increases over time. Finally, in classes with high cold-calling, students' comfort participating in class discussions increases while in classes with low cold-calling, students' comfort participating does not change. Research findings show that cold-calling can be done fairly extensively without making students uncomfortable. Thus, the research reported here provides support for using this instructional strategy to engage more students to participate in discussions.

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For more than 20 years, educational philosophers and practitioners have encouraged instructors to use strategies designed to actively engage students in the teaching–learning process (Bonwell & Eisen, 1991; Nyquist & Wulff, 1990). Classroom discussion is perhaps the most frequently used and more often embraced "active learning" strategy. However, when leading classroom discussions, instructors are often concerned about students who are less inclined to participate voluntarily. They worry that if discussion engages students in their own learning—and, as suggested by some, improves student performance and satisfaction (Bonwell & Eisen, 1991; Dallimore, Hertenstein, & Platt, 2010)—then students not actively involved in the classroom discussion might have a lower quality learning experience.

One approach to increase the number of students engaged in classroom discussion is to cold-call students; we use the term *cold-call* to refer to any instance in which a teacher calls on a student whose hand is not raised. Nevertheless, despite the fact that cold-calling might engage more students in the discussion, some instructors resist the idea of cold-calling as they fear that a student who is cold-called will feel uncomfortable, or worse, humiliated (Dallimore, Hertenstein, & Platt, 2005). Student responses, however, suggest that this may not necessarily be the case (Dallimore, Hertenstein, & Platt, 2006; Rosmarin, 1987; Souza, Dallimore, Aoki, & Pilling, 2010).

This study examines the impact of cold-calling on students' voluntary participation in class discussions and their comfort participating in discussions in a required business course. The primary results indicate that cold-calling is effective at increasing the number of students who answer questions voluntarily; furthermore, in classes with high cold-calling, voluntary participation increases over time. Finally, comfort participating in class discussion increases in classes with high cold-calling; it does not change in classes with low cold-calling.

Our results make important contributions to the literature on discussion teaching in general and cold-calling in particular. First, we demonstrate that significantly more *students* answer questions voluntarily in classes with high cold-calling in contrast to those with low cold-calling, and the number of students voluntarily answering questions increases over time. Furthermore, students in classes with high cold-calling answer more voluntary *questions* than those in classes with low cold-calling, and this also increases over time. These findings suggest greater student engagement in classes with high cold-calling as more and more students participate voluntarily and more frequently. Finally, in classes with high cold-calling, students become more

comfortable participating in discussions, whereas in classes with low cold-calling students' comfort participating in discussions does not change. These findings are consistent with the development of communication skills more generally; that is, the more a student practices participating in class discussions (even if via cold-calling), the more skilled the student becomes, and the more comfortable he or she becomes when using this skill. Thus, the findings should encourage instructors to consider using cold-calling techniques to develop discussion skills that will enable students to become comfortable participating voluntarily in class discussions.

We begin by reviewing the literature on class discussion as a means for engaging students in their own learning, and the literature on cold-calling as a means to engage students in class discussion. Next, we present our research hypotheses, methodology, and results followed by our discussion and implications. After we acknowledge the limitations of this study, and make suggestions about future research, we provide our concluding remarks.

Literature Review

Active learning—which encourages student collaboration in the teaching–learning process—has long been encouraged as an educational strategy (Bonwell & Eisen, 1991; Nyquist & Wulff, 1990). Discussion teaching is one of the most widely used forms of active learning. Discussion provides the opportunity for students to practice and develop essential skills such as organizing concepts, formulating arguments, evaluating evidence, and responding thoughtfully and critically (Davis, 2009) and elicits higher level reflective thinking (Ewens, 2000). Through participation in discussion, students are better able to retain information (Ewens, 2000) and to learn more (Weaver & Qi, 2005). Several explanations have been proposed for why students who participate in discussion learn more. Arbaugh and Benbunan-Fich (2006) suggest that more learning results because it is easier to internalize explanations from knowledgeable peers and because disagreements/misunderstandings can be resolved during group discussions. This explanation is consistent with Hertenstein's (1991) earlier assertion that discussions provide students the opportunity to learn "both through their own active participation and through the contributions of others" (p. 175).

In the field of business, references in the literature to class discussion often focus on case discussion as the case method is one of the most common and important pedagogical techniques used to teach business (Greenhalgh, 2007; Rollag, 2010). Indeed, it has been said that cases have become "ubiquitous" in management education (Schmidt-Wilk, 2010, p. 492); case discussions provide varied benefits. Gilmore and Schall (1996) find that case

discussions are preferred to lectures when training future business leaders because they serve to enhance students' problem-solving skills. Liang and Wang (2004) indicate that cases "bring 'a chunk of reality' into the classroom so that students can learn how to solve complex problems in the real world" (p. 409). C. R. Christensen and Hansen (1987) further suggest that this pedagogy benefits students by enabling them to develop their own framework for dealing with business problems and by creating an environment where intellectual inquiry, risk taking, and new learning occur. C. M. Christensen and Carlile (2009) indicate that by drawing lessons from experiences with case discussions, students will be prepared to be discerning consumers of theory; this will help them to instinctively know whether they can trust the recommendations of a consultant or subordinate in a given circumstance.

More specifically, in accounting, case discussions are considered to be effective in part because they demonstrate how accounting contributes to the development and communication of information in organizations (Bruns, 2006). Case discussions are especially suitable for management accounting, which focuses on decisions managers must make to achieve their organizational objectives and the information required to support these management decisions. Case discussions provide students the opportunity to analyze varied alternatives for selecting, preparing, and communicating information and to choose those most appropriate for the company's unique situation and its strategic goals.

As any classroom teacher knows, not all students are equally likely to participate voluntarily. Although some reticence may be because of learning styles,[1] Dallimore et al. (2010) suggest a broad-based relationship between participation and learning. That study shows that the frequency of a student's participation is positively associated with learning and that the participation of other students increases learning. Thus, if students do not participate in class discussions, they may not learn as much, and other students in the class may not learn as much.

Many different approaches have been suggested to increase the number of students who participate, especially voluntarily. It has been noted that it is important for instructors to set clear expectations about participation (Scollon & Bau, 1981), to provide participation feedback and evaluation rubrics (Arter & McTighe, 2001; Stevens & Levi, 2005), and to encourage all students to participate (Davis, 2009). Others have noted specific techniques such as study questions and response logs (Fishman, 1997) or assigning roles in discussions (Smith & Smith, 1994). More recently, there have been references to using technology to increase student participation in discussion—including clickers, online discussions, or even online course delivery (Arbaugh, 2000; Brower, 2003; Bump, 1990; Carnaghan & Webb, 2007; Cunningham, 2008; Ellis,

Goodyear, Prosser, & O'Hara, 2006).[2] Although any of these approaches may help involve some students who are reluctant participators, they do not resolve this problem entirely.

A student's ability to participate in class discussions is an acquired skill, which, like other communication skills such as making formal presentations, develops over time. Both academic and practical sources suggest that with such skills, the more students practice, the better they get, and the more comfortable they become ("10 Tips for Public Speaking," n.d.; Dallimore, Hertenstein, & Platt, 2008; "The Habit of Courage," n.d.; Sprague & Stuart, 2003). Students explain that they are more comfortable participating when they participate more and when other students participate more (Souza et al., 2010). One reason students' comfort is enhanced when engaged in discussion with other students is because they relate to one another as peers. C. R. Christensen (1991) explains,

> Students also tend to share the language system of their generation, a common idiom of "go" and "no go" words and relevant metaphors. . . . This, plus their knowledge of fellow students brings them swiftly to the core of effective communication, speaking *to* not *at* one another. Equally important, it is simpler and less threatening for participants to check and recheck each other's meaning than for the instructor to do so. (p. 109)

Although some students may have developed sufficient class discussion skills, others may not. Those who have not may be knowledgeable and well prepared for the class, yet they may be unwilling or unable to volunteer because they lack well-developed discussion skills. Since comfort participating in class discussions has been shown to be associated with increased frequency of participation (Dallimore et al., 2010), instructors may need to bring these less willing students into the discussion—even if not voluntarily—so that they can develop the skills to participate and can become comfortable volunteering.

Cold-Calling: A Technique to Increase Class Participation

There is an emerging literature on cold-calling which examines the relationship between cold-calling by instructors and students' participation. First, when students were asked to respond to questions about what instructors do or say that (a) increases the quality of student participation and (b) increases the effectiveness of the discussion, a key theme in their responses to both questions was cold-calling (Dallimore, Hertenstein, & Platt, 2004).

Although it may not be obvious why calling on a student whose hand is not raised might increase student participation quality and discussion effectiveness, a study by Dallimore et al. (2006) provides some insight. The study examines one graduate class taught by an instructor who cold-called frequently and graded participation. The primary findings were that not only did students' self-reported participation frequency increase, but their self-reported preparation increased as well. If cold-calling is associated with increased preparation, then preparation may enhance participation quality and discussion effectiveness. This link between cold-calling and preparation is noted in an earlier edited book about case teaching (Rosmarin, 1987).

Despite the apparent potential for cold-calling to enhance participation quality, discussion effectiveness, frequency of participation, and preparation, some instructors are hesitant to call on a student whose hand is not raised. These instructors worry that cold-calling might make students feel "humiliated" or that they were "victims" (Dallimore et al., 2005, p. 24). Experienced instructors further suggest that because cold-calling would make students uncomfortable, they would be less likely to volunteer (Dallimore et al., 2006).

However, in the limited research available where data are gathered from students rather than instructors, the evidence suggests that cold-calling might not have a negative impact on student comfort participating. Dallimore et al. (2006) report that average student comfort participating in class did not decrease between pre- and postcourse surveys in one graduate course taught by an instructor who cold-called frequently. They further note that increased preparation and increased participation frequency are associated with increased comfort participating. Souza et al. (2010) report results from a study where teachers in some courses cold-called, whereas teachers in other courses did not cold-call. Using pre- and postcourse surveys, they report that comfort participating increased significantly in courses with and without cold-calling.[3] Thus, student perceptions about the effects of cold-calling on student comfort participating seem to contradict the views of instructors.[4]

However, the earlier studies have methodological limitations, which also raise concerns about some of their findings. For example, student participation frequency was measured based solely on student self-reported frequency. It is possible that at the end of the course, students had a positive perception of their participation and perceived that they participated more than they actually did. In addition, the earlier studies do not distinguish voluntary participation from participation resulting from cold-calls. Thus, the perception of increased frequency may result solely from cold-calling, and students' voluntary participation may not change.

Furthermore, earlier studies have no measure of the number of students who actually participated (as contrasted with the frequency of a student's participation), either voluntarily or via cold-call. The earlier studies also rest on the instructors' assertions that they did or did not cold-call. That is, these earlier studies do not objectively measure cold-calling, and there is no evidence on how frequently it occurs or how much it varies between instructors. Although it may have been reasonable for these exploratory, preliminary studies to use student perceptions of participation frequency and instructor assertions about the use of cold-calling, there is a need for more comprehensive studies with more objective measures of participation and cold-calling.

Finally, the earlier studies gathered data by survey at two points in time: precourse and postcourse. If a student's class discussion skill develops over time, data gathered at additional points in time may enable us to more fully understand the discussion skill development process.

This study is designed to extend our understanding of the effects of cold-calling by addressing these limitations. It extends earlier studies by using observational data from independent observers to measure students' class participation. The observational data provide an objective means to determine not only the total number of students participating in the discussion but also the total number of students who volunteered or were cold-called. Furthermore, instead of relying on student perceptions of their class participation frequency, this study uses actual counts of student participation in the discussion and measures not only the frequency of their participation as in previous studies but also identifies whether that participation was voluntary or resulted from a cold-call. This latter measure—the total number of cold-call questions asked—provides an objective measure of the degree to which instructors use cold-calling instead of relying on instructor assertions that they did indeed cold-call their students. Finally, the observational data provide additional data points, which, when combined with precourse and postcourse surveys, can more clearly reveal the class discussion-skill development process.

Given the recent study linking student participation frequency and student learning (Dallimore et al., 2010), it is especially important to examine the relationship between cold-calling, student participation frequency, and student comfort more systematically and in greater depth. In particular, we need to examine whether cold-calling is related to changes in voluntary participation frequency and comfort over time since we have suggested that discussion skills develop over time. If instructors better understand how cold-calling affects the frequency of participation—especially volunteering—in their classroom, and if they have better evidence on the relationship between

cold-calling and student comfort in class participation, they will be better able to decide how much cold-calling to use.

Research Hypotheses

One factor that characterizes student participation in class discussions is the number of students who participate in the class. For example, in a 40-student class, participation would be considered to be greater if 30 students participate than if only 10 students participate. In heavy cold-calling environments, some students may be brought into the discussion for the first time. Given this first opportunity to exercise and develop their class discussion skills, these individuals may find themselves more willing to volunteer to participate in subsequent class discussions. Through cold-calling, participation opportunities may be offered to more students throughout the course, so we expect the percentage of students who voluntarily answer questions to increase. Thus, Hypotheses 1a and 1b are as follows:

Hypothesis 1a: Cold-calling positively affects the percentage of students who voluntarily answer questions.

Hypothesis 1b: The percentage of students who answer questions voluntarily increases over time in sections with high cold-calling, but does not change in sections with low cold-calling.

Another characteristic of student participation in class discussions is how often a student participates in a class session. For example, participation would be considered to be greater if students participate three times versus if they participate once. Analysis of data from graduate students in a heavy cold-calling environment suggests that students' self-reported frequency of participation increases despite instructor concerns that cold-calling might make students uncomfortable and hence less willing to participate (Dallimore et al., 2006). In a heavy cold-calling environment, some students may be given more opportunities to participate than they typically have. If these additional opportunities to participate in the discussion contribute to the development of students' class discussion skills, then students may become increasingly willing to volunteer to answer questions in the class discussion.[5] As a result, we expect the frequency of students' voluntary participation to be greater when cold-calling is used extensively, and we expect it to increase over time. Thus, Hypotheses 2a and 2b are as follows:

Hypothesis 2a: Cold-calling positively affects how frequently students participate voluntarily.

Hypothesis 2b: The frequency that students participate voluntarily increases over time in sections with high cold-calling but does not change in sections with low cold-calling.

A student's overall frequency of participation includes the number of times each participates voluntarily and the number of times each is cold-called. If cold-calling positively affects how frequently students participate voluntarily as hypothesized above, then cold-calling will positively affect the overall frequency of their participation. That is, when cold-calling is frequent, students will be cold-called more and they will volunteer more. Thus, Hypothesis 2c is as follows:

Hypothesis 2c: Cold-calling positively affects the overall (voluntary plus cold-called) frequency of students' participation.

Despite instructor concerns that cold-calling will make students uncomfortable, there is some evidence that this may not be the case. Dallimore et al. (2006) found that student comfort with class discussion in a high cold-call environment did not change over the course of the term. More recently, Souza et al. (2010) found that student comfort with class discussion increased in both control (no cold-calling) and treatment (some cold-calling) groups; however, these researchers did not directly compare the increased ratings for the two groups. Because of design or methodological issues, these previous studies have not provided definitive evidence on the effect of cold-calling on the change in student comfort with class discussion over the course of the term. Looking at factors related to student comfort with class discussion, Dallimore et al. (2010) found that increased participation in class discussion led to increased comfort. Because Hypotheses 1 and 2 posit a positive relationship between cold-calling and voluntary participation over time, we expect that student comfort with class discussion should increase over time in high cold-calling sections whereas student comfort in low cold-calling sections should not change. Thus, Hypothesis 3 is as follows:

Hypothesis 3: Student comfort participating in class discussion increases in sections with high cold-calling but does not change in sections with low cold-calling.

Method

Research Design

The research design involved gathering data at various times in 16 sections of a single course in which 632 students were enrolled. Data were gathered using two surveys administered to students and observations of two class discussions for each section.

Course

This research was conducted in the undergraduate management accounting course required for the BS in Business Administration degree at a large, private university. This course is taught on-ground, not online. The course was selected because it has multiple sections taught by multiple instructors each year, and a common syllabus and final exam are used across sections. Although the sections are not identical because of individual differences in instructional style between instructors, all sections share common pedagogical elements such as syllabus, textbook, slides for lectures, cases, final exam, and so on. The pedagogy includes case discussions, written case analyses, small-group problem solving, lecture, team projects, and student presentations.[6]

Data were gathered from 16 sections of this course taught in two consecutive fall semesters. The course met twice a week in 100-minute sessions for a total of about 25 sessions. There were approximately 40 students in each section and attendance was required.

Data

Two surveys were used to gather data on student opinions and perceptions about class discussions; in addition, each section was observed twice during the course. Thus, data were gathered at four times during the course as shown in Figure 1.

Surveys. The purpose of the precourse survey was to establish a baseline prior to the course of students' attitudes and behaviors related to class participation. To avoid biasing students, it did not mention cold-calling or calling on students whose hands were not raised. The survey stated, "We are conducting a study on class discussion and student learning to help faculty understand approaches that lead to student learning so they may become more effective teachers."

The postcourse survey focused on participation frequency and comfort participating in this course. Although the postcourse survey did not mention

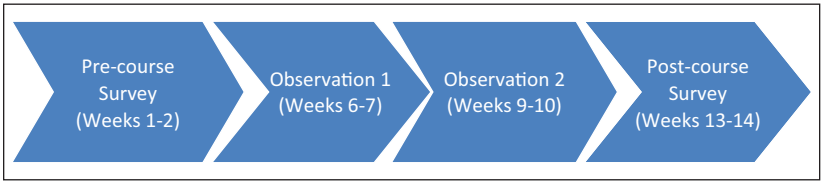


Figure 1. Time line for survey and observation data (week in course for data collection in parentheses).

cold-calling per se, it asked whether the professor had called on students whose hands were not raised in this course, and, if so, the effect on the overall discussion and the respondent's preparation.

The appendix lists precourse and postcourse questions analyzed in this study. Students responded to these questions using a 7-point Likert-type scale. They also provided their gender.

Observations. Days when case discussions were held were selected for observation to maximize the periods of discussion observed. The observers were graduate students employed as research assistants. There was one observer for each case discussion class.

Training sessions were held to teach observers to categorize questions and record data. The initial training session was followed by multiple practice sessions. Each practice was followed by debriefing and discussion to clarify the coding process. Practice sessions were repeated until consistency in coding was achieved across observers. Following the training session, observers recorded data in actual classes not in the study and discussed their results with researchers before conducting research observations.

Observers were told that they were assisting in research about discussion teaching. Observers did not have detailed information about the research project; specifically, researchers did not discuss the hypotheses with the observers.

At the beginning of each case discussion observed, the observer recorded the gender of each student and her location (seat) in the classroom on a seating chart diagram. For each question the instructor asked during the discussion, the observer recorded which student responded and whether the student volunteered or was cold-called.

The students observed in this study were enrolled in one of the first courses where they encounter case discussions; thus, instructors need to actively facilitate the discussion to engage students and help the discussion to progress. Questions related to all levels of Bloom's taxonomy (Anderson

& Krathwohl, 2001; Bloom, 1956) were used by instructors in this study to facilitate the discussion.[7]

Students

Students enrolled in this course are typically sophomores. Class rosters issued 1 week prior to the start of the course indicated that 632 students were enrolled in the 16 sections of the course; rosters at the end of the course indicated that 598 students were enrolled. To ensure confidentiality, students were not asked for their names on the surveys; however, they were asked for the last four digits of their nine-digit student identification number to enable precourse surveys and postcourse surveys to be matched for analysis purposes. Precourse surveys were completed by 581 students and postcourse surveys by 541. A total of 359 students provided accurate identification information on both the precourse and postcourse surveys allowing surveys to be matched, consisting of 46% (166) women, and 54% (192) men.[8] During the first observation, 578 students were present, for the second, 559. The proportions of men and women in the two observations were approximately the same as for the surveys.

Instructors

The 16 sections of this course were taught by seven full-time instructors. Two were tenured faculty, four were tenure track but nontenured faculty, and one was full-time but not tenure track; two were women and five were men. The Informed Consent form signed by each instructor indicated that they were participating "in a research study on class discussion and student learning . . . designed to identify factors that affect student learning during class discussions." Instructors were not informed about the hypotheses.

All instructors in this research project were considered effective teachers. The teaching-effectiveness ratings for all sections in this study averaged 4.51 out of a maximum possible score of 5.0.[9] Furthermore, the ratings for "treats students with respect" for all sections in this study averaged 4.64 out of 5.0[10]; thus, all instructors in this study were considered to provide a supportive learning environment.

No constraints were imposed on these instructors; each of them used their natural instructional style, including whether, or how much, they cold-called students. Variations between instructors were because of individual differences in instructional styles.[11]

Data Analysis

Dependent Variables: Observation Data

Percentage student participation in class discussion. During each observation period, the behavior of individual students (based on seat location during the class, not name or student identification number) was observed and recorded, as described above. Based on these recorded observations, a student who answered at least one volunteer question was given a value of 1 on the "answered a voluntary question" variable; otherwise, the student was given a 0. Likewise, a student who answered at least one cold-called question was coded as a 1 on the "answered a cold-called question" variable; otherwise the student was coded as a 0. The percent of students present who answered either volunteer or cold-called questions was calculated for each section. Together, these variables measured the extent to which there was broad student participation in the class discussion in a particular class section.

Participation frequency per student. Because student behavior was recorded with respect to type and number of questions answered, a measure of frequency of class participation was obtained by counting the number of volunteer questions answered by each student present and the number of cold-called questions answered by each student. These metrics focus on participation frequency at the individual student level of analysis.

Dependent Variables: Survey Data. As discussed above, two surveys were administered to assess student opinions and perceptions of class discussion. The survey variables used as dependent variables in this analysis included measures of participation frequency in class discussion and measures of comfort participating in class discussion.

Independent Variables

Cold-call environment. The primary focus of this study is to compare student behavior and perceptions in differing cold-call environments. Instructors used their own pedagogical style, including whether or how much they cold-called students; we did not actively manipulate this variable. In one section no cold-calling was used; in all other sections instructors used some combination of cold-calling and voluntary questions. Because instructors used their own pedagogical style, we used the observation data to classify sections into high cold-call (Hi CC) versus low cold-call (Lo CC) environments. Based on observation of the first case discussion for each section, the

mean percentage of students cold-called was calculated for each section; it ranged from .00 to .84 with an overall mean for all sections of .26. The overall mean percentage of students cold-called was used to separate sections into Hi CC versus Lo CC groups. The mean percentage of students cold-called in Hi CC sections was .61, ranging from .33 to .84 versus a mean of .10 of students cold-called in Lo CC sections, ranging from .00 to .24. This grouping rule resulted in 5 sections with 196 students rated as Hi CC and 11 sections, with 486 students, as Lo CC. To exclude alternative explanations for differences between Hi CC and Lo CC sections, we compared mean teaching effectiveness ratings, "treats students with respect" ratings, and years of teaching experience for the instructors between the two groups. We found no significant difference between Hi CC and Lo CC sections for any of these variables ($p = .68$ for teaching effectiveness, $p = .24$ for "treats students with respect," $p = .42$ for years of experience).

Analysis of percentage of students cold-called in *both* observation periods validates this grouping methodology. From the observation data, the percentage of students present who answered cold-called questions was analyzed using a full factorial analysis of variance (ANOVA) with cold-call environment and observation period as the two fixed independent variables. The results reveal a significant main effect due to cold-call environment, $F(1, 1134) = 267.81$, $p = .000$, with the Hi CC sections having a significantly higher proportion of students who were cold-called (.45) than the Lo CC sections (.02) across both observation periods. Neither the main effect of observation period nor the two-way interaction effect was statistically significant. Furthermore, student survey results also validate this grouping methodology. In the second year of the study, the postcourse survey asked students, "How often did your professor call on students whose hands were not raised?" based on a Likert-type scale from 1 = *very little* (not more than once in a class) to 7 = *a lot* (seven or more times per class).[12] A t test comparing the means between Hi CC and Lo CC sections revealed a statistically significant difference between cold-call environments, $t(189) = -6.36$, $p = .000$; the mean of the Hi CC sections (4.93) was significantly higher than the Lo CC sections (3.45). Thus, students perceived a significant difference in their instructor's classroom behavior with respect to cold-calling consistent with the difference observed in the percentage of students cold-called during the first observation period.

Time of observation. In each section, two case discussions were observed and behavior recorded. The two observation points were treated as between-subject measures because we could not certify that the same students sat in the same seats for both discussions.

Statistical Analysis. Univariate and multivariate analyses were conducted to test for differences in student perceptions (based on survey data) and behavior (based on observation data) between the two cold-call environments.

Results

Cold-Call Environment and Prior Student Attitudes and Perceptions of Class Discussion

Based on the precourse survey data, there were no significant differences between students in Lo CC and Hi CC sections at that time, as shown in Table 1. Although students self-select into particular course sections based on the course time and sequence, there does not appear to be a difference in student characteristics a priori with respect to important features of class discussion. Most notably, students in both environments had similar perceptions of their own participation in class discussion in terms of frequency, satisfaction, liking, and comfort participating. Furthermore, there were no differences between the two types of cold-call environments with respect to expectations about participation in this course.

Effect of Cold-Calling on Percentage of Students Voluntarily Responding to Questions

The primary evidence examining the effect of cold-calling on voluntary responses to questions comes from the analysis of observation data collected during two case discussions. The percentage of students present who answered questions voluntarily was analyzed using a full factorial repeated-measures ANOVA with two independent factors—cold-call environment (Hi CC vs. Lo CC) and time of observation (Observation 1 vs. Observation 2). The group means by cold-call environment and time of observation are shown in Figure 2 along with the *F*-test results of the ANOVA. The analysis of the percentage of students present who voluntarily answered questions revealed three significant effects, as shown in Figure 2: a main effect due to cold-call environment (Hi CC vs. Lo CC), a main effect due to time of observation (Observation 1 vs. Observation 2), and an interaction between cold-call environment and observation. The main effect due to cold-call environment shows that across both observation periods the mean percentage of students who voluntarily answered questions was significantly higher in the Hi CC sections (77%) than in the Lo CC sections (55%). Also, the percentage of students averaged across both cold-call environments who voluntarily

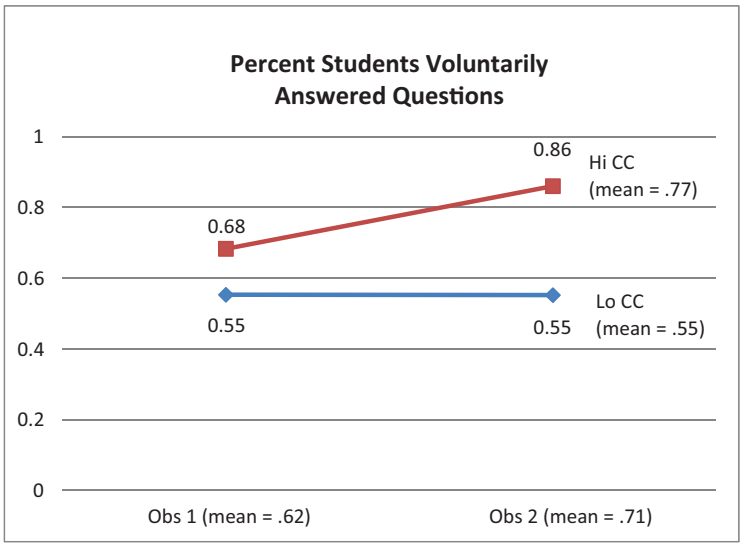
Table 1. Precourse Survey Mean Comparisons Between Hi CC and Lo CC Sections for Key Measures of Participation Frequency and Comfort With Class Discussion.

	Mean: Lo CC Sections (n = 241)	Mean: Hi CC Sections (n = 118)	Difference: p Value
Liking of class discussion	5.20	5.14	*ns*
Familiarity with class discussion	5.78	5.87	*ns*
Typical participation frequency	4.74	4.81	*ns*
Expected participation frequency	5.07	5.11	*ns*
Typical comfort participating	4.83	4.78	*ns*
General evaluation of class participation	4.96	5.00	*ns*
Satisfaction with class participation	4.78	4.87	*ns*

Note: Hi CC = high cold-call; Lo CC = low cold-call.

answered questions rose from the first class discussion (62%) to the second class session (71%). Finally, there was a significant interaction between cold-call environment and observation such that there was a divergence between the cold-call environments. Whereas the percentage of students who voluntarily answered questions increased significantly in the Hi CC sections, $t(350) = -4.026$, $p = .000$, the percentage of students who voluntarily answered questions remained the same in the Lo CC sections from Observation 1 to Observation 2, $t(784) = 0.034$, $p = .973$.

Furthermore, an indirect measure of the percentage of students participating in class discussion is obtained from the postcourse survey question which asks students about their perception of *other* students' participation. Students in Hi CC sections rated the number of other students participating in this course as compared with other courses significantly higher than students in the Lo CC sections (Table 2). This confirms that students perceive the differences in percentage of students participating in class discussion that were revealed by the observation data.



	F	p-value
Observation main effect	8.395	0.004
CC main effect	52.399	0.000
Observation x CC interaction	8.629	0.003

Figure 2. Percentage of students who voluntarily answered questions.

Hypothesis 1a focuses on the relationship between cold-call environment and the percentage of students volunteering during class discussion. The results provide clear support that cold-calling positively affects student volunteer behavior as the mean percentage of students who voluntarily answered questions in Hi CC sections is higher than in the Lo CC sections. Furthermore, Hypothesis 1b addresses the impact of cold-calling on student volunteering behavior over time. The results described above provide strong evidence for Hypothesis 1b. Most notable, the mean percentage of students volunteering in the Hi CC sections increases significantly from Observation 1 (68%) to Observation 2 (86%). In contrast, the percentage of students volunteering in the Lo CC sections remains stable at 55%. Thus, the analysis of the percentage of students volunteering during class discussion supports both Hypotheses 1a and 1b.

Table 2. Postcourse Survey Mean Comparisons Between Hi CC and Lo CC Sections for Key Measures of Participation Frequency and Comfort With Class Discussion.

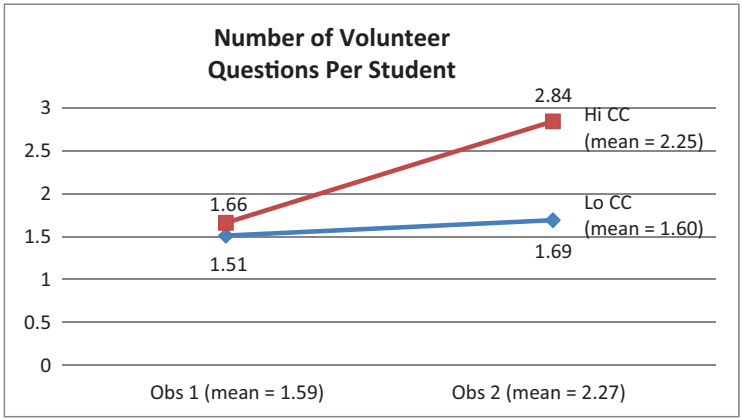
	Mean: Lo CC Sections (n = 241)	Mean: Hi CC Sections (n = 118)	Difference: p Value
My actual participation frequency	4.54	5.06	.003
Number of other students participating compared with other courses	4.37	5.04	.000
Comfort participating in this course	4.93	5.06	*ns*

Note: Hi CC = high cold-call; Lo CC = low cold-call.

Effect of Cold-Calling on Frequency of Student Class Participation

Whereas previously the analysis has focused on the percentage of students participating in class discussions, this section focuses on the number of questions being answered. Frequency of class participation was measured in two ways. First, using the observation data, the number of questions answered per student was calculated. Second, using the survey data, student self-reported actual frequency of class participation was recorded.

Observations of class room behavior. Counts of the number of questions answered per student were analyzed using a full factorial univariate ANOVA with two independent factors—cold-call environment and observation. The analysis of number of volunteer questions answered per student is shown in Figure 3. The results reveal two significant main effects due to cold-call environment and to observation and a significant interaction effect. The main effect due to cold-call environment shows that the number of volunteer questions answered per student is significantly higher in Hi CC sections (2.25) than in Lo CC sections (1.60). Furthermore, the main effect due to observation period shows that students answer significantly more volunteer questions in the second observation period (2.27) than in the first (1.59). Finally, the interaction indicates that in the Hi CC sections there is a significant increase in the number of volunteer questions answered per student over time, $t(350) = -5.317$, $p = .000$, whereas the number of volunteer questions answered per student in the Lo CC sections does not significantly change, $t(784) = -1.185$, $p = .237$.

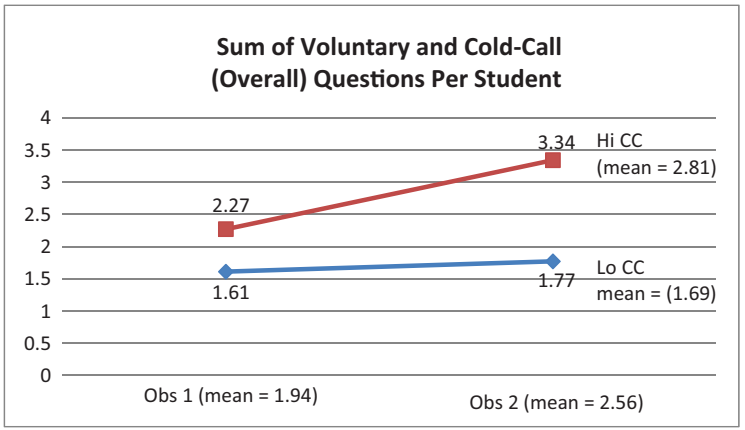


	F	p-value
Observation main effect	25.461	0.000
CC main effect	23.292	0.000
Observation x CC interaction	13.868	0.000

Figure 3. Number of volunteer questions per student.

The results from the analysis of the number of volunteer questions per student strongly support both Hypotheses 2a and 2b. Hypothesis 2a relates cold-calling to voluntary student class participation. The mean number of voluntary questions answered per student was significantly higher for students in Hi CC sections (2.25) compared with Lo CC sections (1.60). Hypothesis 2b contends that the frequency of voluntary class participation per student increases over time in Hi CC sections but does not change in Lo CC sections. This is precisely the pattern of the significant interaction found between cold-call environment and observation period: The number of volunteer questions answered per student rose significantly from 1.66 to 2.84 in Hi CC sections, but the change for Lo CC sections was not significant, increasing slightly from 1.51 to 1.69.

To understand students' overall frequency of participation, we need to know not only how many times they participate voluntarily but also how often they were cold-called. Thus, the two variables, number of voluntary questions answered per student and the number of cold-called questions



	F	p-value
Observation main effect	20.713	0.000
CC main effect	66.735	0.000
Observation x CC interaction	11.158	0.001

Figure 4. Sum of voluntary and cold-call (overall) questions per student.

answered per student, together provide a comprehensive description of the frequency of a student's class participation. Analysis of the sum of these two variables revealed two significant main effects, due to cold-call environment and to observation period, as well as a significant interaction effect, as shown in Figure 4. The main effect due to cold-call environment shows that there were significantly more questions answered per student, on average, in Hi CC sections (2.81) than in Lo CC sections (1.69). Furthermore, the mean overall number of questions answered per student was significantly higher during the second observation period (2.56) than the first (1.94). Finally, the cold-call environment interacted with the time of observation. In the Hi CC sections, there was a significant increase from the first to the second observation (2.27 vs. 3.34) whereas in the Lo CC sections, the two observations remained stable (1.61 vs. 1.77).

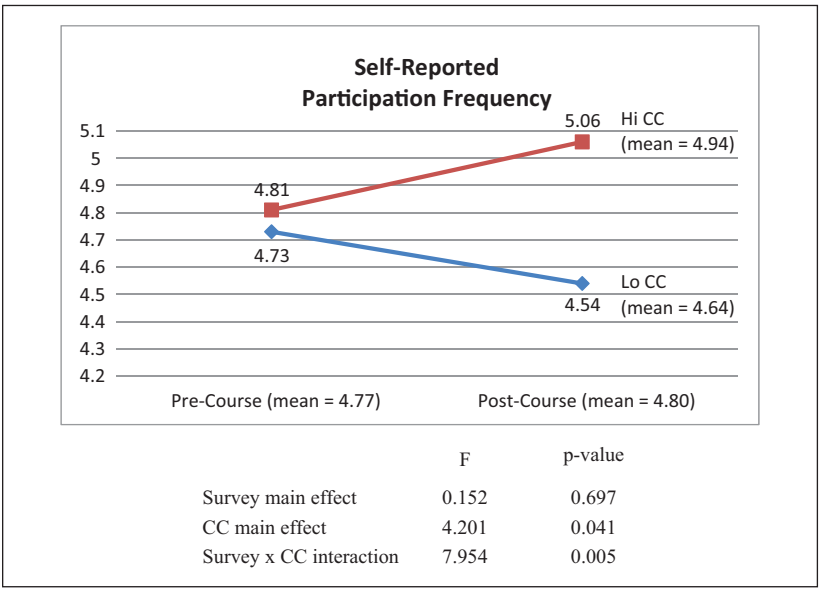
This combined variable of overall participation frequency exhibits the same pattern as was found for the number of voluntary questions answered per student. This is the case because instructors ask many more voluntary

questions than cold-called questions in both environments. Thus, even though a significantly higher mean number of cold-calls per student were observed in Hi CC sections than in Lo CC sections (0.56 vs. 0.09), these numbers are small relative to the respective number of volunteer questions per student (2.25 vs. 1.60). Given these results, we would expect that student perception of their class participation would reflect the pattern found for the combined voluntary and cold-called questions answered during class discussion.

Student self-reported participation frequency. Turning to evidence from the survey data, no differences were found between Hi CC and Lo CC sections with respect to self-report of one's own typical participation frequency from the precourse survey (Table 1). However, students' self-reported ratings of their perception of their actual participation frequency in the course from the postcourse survey revealed a statistically significant difference between the Hi CC and Lo CC sections (Table 2).

A repeated-measures ANOVA was conducted for students' self-reported perception of their participation frequency, with the precourse and postcourse self-reported survey variables as the repeated measure and the cold-call environment as the between-subject variable. Figure 5 contains the analysis for participation frequency, comparing the students' perceived typical participation frequency from the precourse survey with their self-reported actual participation frequency in this course from the postcourse survey. The results indicate a significant cold-call environment main effect and a significant interaction between cold-call environment and survey period. Self-reported participation frequency was significantly higher in Hi CC sections (4.94) than in Lo CC sections (4.64). As shown in Figure 5, there was a divergence of self-reported participation frequency at the end of the course such that students in the Hi CC sections marginally increased their assessment of their participation frequency from 4.81 to 5.06, $t(117) = -1.823$, $p = .071$, whereas students in the Lo CC sections significantly decreased their participation frequency ratings relative to their assessment at the beginning of the course from 4.73 to 4.54, $t(238) = 2.201$, $p = .029$.[13]

Hypothesis 2c relates cold-calling environment to overall frequency of student participation. The results provide clear support that cold-calling positively affects overall student participation frequency. First, students in the Hi CC sections significantly increased the number of overall questions answered from the first observation to the second, whereas the number of overall questions answered by students in the Lo CC sections remained stable across time. Second, the magnitude of the difference in participation frequency was sufficient for students to perceive the difference. Student self-reported



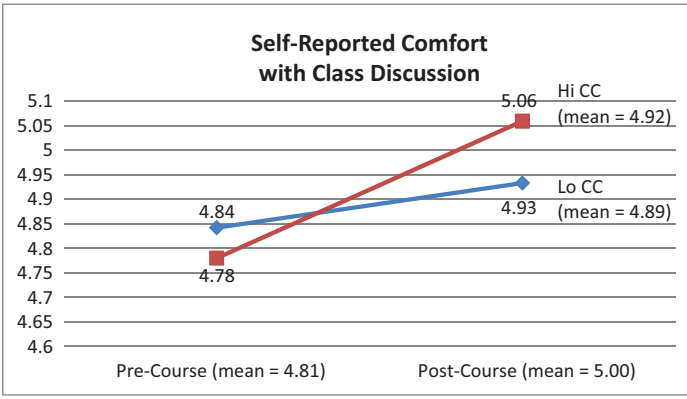
	F	p-value
Survey main effect	0.152	0.697
CC main effect	4.201	0.041
Survey x CC interaction	7.954	0.005

Figure 5. Self-reported participation frequency.

participation frequency diverged between the two cold-call environments such that students in the Hi CC sections reported marginally higher participation frequency at the end of the course compared with the beginning of the course, whereas those in Lo CC sections reported significantly less participation frequency at the end of the course compared with the beginning of the course. Thus, the evidence strongly supports the contention that cold-calling is positively related to increases in overall participation frequency in class discussion. Furthermore, data in this study clearly indicate that the high cold-call environment is positively and significantly related to overall frequency of student participation in class discussion and that the frequency of class participation increases in Hi CC sections over the course of the term.

Effect of Cold-Call Environment on Comfort With Class Discussion

Given that cold-calling affects observed student participation behavior, including the percentage of students participating and frequency of student participation, the question of how cold-calling affects student comfort is of



	F	p-value
Survey main effect	4.613	0.032
CC main effect	0.059	0.809
Survey x CC interaction	1.182	0.278

Figure 6. Self-reported comfort with class discussion.

interest. As discussed above, there were no differences found between Hi CC and Lo CC sections when assessing self-reported comfort with class discussion from the precourse survey. Given that differences observed due to cold-call environment with respect to question asking and answering behavior are notable enough that students perceive and report the differences, students may also experience different levels of comfort due to cold-call environment.

To assess differences, we systematically analyzed the independent effects of cold-call environment and survey time period on self-reported measures of comfort with class discussion. A repeated-measures ANOVA was conducted for comfort, with the precourse and postcourse self-reported survey variables as the repeated measure and the cold-call environment as the between-subject variable; the results are shown in Figure 6. Only the main effect due to survey period was statistically significant. Students overall reported an increase in comfort with class discussion. Although Figure 6 shows that comfort ratings rose more for students in Hi CC sections than for those in Lo CC sections, the interaction was not statistically significant.

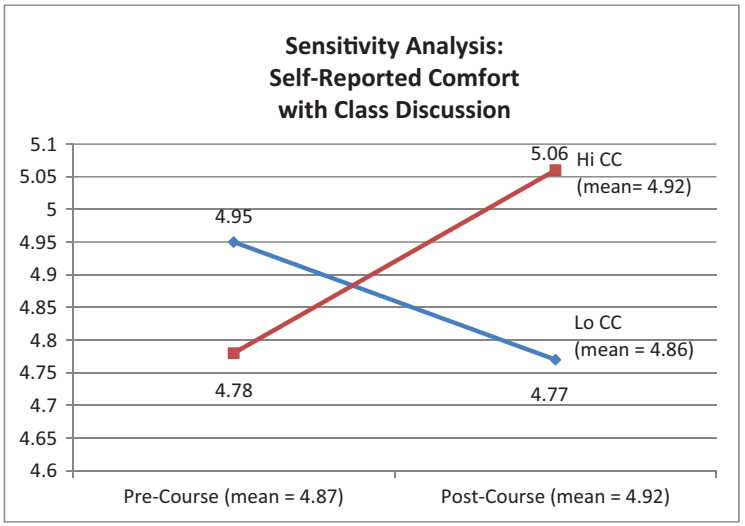
Hypothesis 3 deals with the effect of cold-calling on student comfort with class discussion. The results provide no evidence that students' self-reported comfort with class discussion is significantly affected by the cold-call environment.[14]

Sensitivity Analysis

The results examining the effect of cold-calling on student class participation behavior and their perceptions of class discussion are based on one approach to categorizing sections into Hi CC and Lo CC groups. We wondered how sensitive the results reported above are to this grouping decision rule. To maximize the difference between Hi CC and Lo CC sections, we split the sample into thirds with respect to the mean percentage of students cold-called during the first observation. We designated the top third of the sections as Hi CC sections and the bottom third, as Lo CC sections. The middle third of the sections were omitted from this analysis. This grouping rule resulted in five sections with 196 students rated as Hi CC sections and five sections with 210 students, as Lo CC sections. The mean percentage of students cold-called in the Hi CC sections was .61 with a range from .33 to .84 and in the Lo CC sections, .01 with a range from .00 to .02.

The analyses based on this maximally differentiated sample (with respect to cold-call behavior) revealed very similar results for the percentage of students answering voluntary questions and the number of voluntary questions answered per student (see Figures 2 and 3), observed frequency of class participation (see Figure 4), and student self-reported participation frequency (see Figure 5). There were, however, different results with respect to student comfort.

As shown in Figure 7, the repeated-measures ANOVA showed that neither the survey period main effect nor the cold-call environment main effect was statistically significant. However, the two-way interaction was statistically significant, showing a divergence between the two cold-call environments over time with respect to self-reported comfort with class discussion. Further analysis of the interaction found that students in Hi CC sections increased their comfort ratings marginally from the precourse to the postcourse survey, $t(117) = -1.885$, $p = .062$, whereas student ratings of comfort with class discussion in the Lo CC sections did not change, $t(113) = 1.243$, $p = .216$. Additionally, although the traditional t test shown in Table 2 measuring mean comparisons between Hi CC and Lo CC sections for the postcourse survey responses did not yield a significant difference between cold-call environments, the significant interaction discussed



	F	p-value
Survey main effect	0.26	0.612
CC main effect	0.15	0.698
Survey x CC interaction	4.93	0.027

Figure 7. Sensitivity analysis: Self-reported comfort with class discussion.

above enables a post hoc comparison between cold-call environments in the postcourse survey to be conducted. A 95% Scheffé confidence interval revealed a significant difference in the mean comfort rating between Hi CC sections and Lo CC sections ($.003 < \mu_1 - \mu_2 < .571$; Dixon & Massey, 1969).

The different results between the full sample and the differentiated sample that maximizes differences between Hi CC and Lo CC sections seems to rest on the relationship between precourse and postcourse student self-reported comfort ratings for the Lo CC sections. In the full sample, the two-way interaction was not significant, but in the differentiated sample, it was. In both cases, student comfort ratings increased marginally for Hi CC sections. Ad hoc analysis of the Lo CC sections in the full sample revealed that there was

no significant increase in comfort ratings for the Lo CC sections alone, $t(239) = -.947$, $p = .345$, which is similar to results reported above for Lo CC sections in the differentiated sample. Thus, in both samples, student comfort with class discussion ratings were stable from the precourse survey to the postcourse survey for the Lo CC sections but increased marginally for the Hi CC sections.

This sensitivity analysis confirms earlier results concerning Hypotheses 1a, 1b, 2a, 2b, and 2c. Furthermore, it provides evidence that the cold-call environment affects students' self-reported comfort with class discussion (Hypothesis 3). The significant interaction between observation period and cold-call environment for the differentiated sample indicates that in the Hi CC sections, student ratings of comfort increase, whereas in the Lo CC sections, they do not change.

Discussion and Implications

Cold-calling has a significant effect on the number of students who voluntarily answer questions. As we know from the precourse survey, students in both high and low cold-calling sections enter the course with the same typical participation frequency in prior courses, and they expect to participate the same amount in this course. By the time the first observation is conducted in Weeks 6 to 7, the instructor's questioning pattern is likely well established. At that point, more students in the high cold-calling sections are already voluntarily answering questions, and by the second observation (Weeks 9-10) the percentage of students who voluntarily answer questions in the high cold-calling sections continues to increase and diverge from that in the low cold-calling sections. Furthermore, students in the high cold-calling sections are simply answering more questions, overall, than students in the low cold-calling sections. Also, the percentage of students who participate in class discussions increases quite dramatically from just more than half in low cold-calling sections to just more than 90% in high cold-calling sections.

These findings suggest greater engagement of students in the high cold-calling sections. These differences are not only visible to trained observers but are also perceived by students themselves. Students in the high cold-calling sections reported an increased participation rate for themselves and they reported that more than the typical number of other students participated in the course.

Finally, cold-calling does not have the dire impact on student comfort that the instructors cited earlier had feared. In fact, what we find is that

students in high cold-calling sections are more comfortable participating in this course than they were participating in previous courses, whereas the comfort of students in the low cold-calling sections does not change.

Increased comfort participating in class discussions in high cold-calling environments may seem counterintuitive, as it seems unlikely that cold-calling per se makes students more comfortable. This study shows that high cold-calling is associated with increased frequency of participation, especially voluntary participation. Both participation frequency and preparation have previously been shown to be associated with increased comfort participating (Dallimore et al., 2010). Thus, a more plausible explanation is that cold-calling encourages students to prepare more and to participate more frequently; the more they prepare, and the more frequently they participate, the more comfortable they become when participating.[15]

Implications for Teaching

The clear implication for teaching is that cold-calling is a way to engage more students more actively in class discussions and that this can be done without necessarily making them less comfortable participating. These findings are especially important in light of the learning model presented in Dallimore et al. (2010). That model shows positive relationships between preparation, participation frequency, comfort participating in class discussions, and student learning. In this study, we find that cold-calling increases students' participation frequency and comfort participating, and some evidence that it also increases preparation for class. Thus, cold-calling increases those factors which have previously been shown to be associated directly with increased learning.

We do not suggest, however, that any and all cold-calling by instructors would produce the same results as those shown in this study. As with any other instructional technique, instructors must be thoughtful about how they use cold-calling. Dallimore et al. (2005) reports instructional strategies used by experienced instructors to "warm up" cold-calling so that it is effective and nonpunitive. These strategies include establishing the expectation of participation (e.g., stating expectations in the syllabus, telling students you will cold-call, cold-calling in first class), providing opportunities to reflect and respond (e.g., give them time to think and prepare, let small groups of students discuss the answer first), and creating a supportive learning environment (e.g., encourage with body language, reinforce any reasonable attempt).

Furthermore, given that class discussion skills develop over time, students must first simply learn to speak before they can develop the ability to contribute in a more significant and thoughtful way. Thus, instructors might use a hierarchy such as Bloom's taxonomy (Anderson & Krathwohl, 2001; Bloom, 1956) to guide the development of student class discussion skills and enhance their confidence participating. They might cold-call early in the course using straightforward knowledge or recall questions to make sure each student's voice is heard and that each student has a successful participation experience. Building on this the questions can become more challenging—eventually progressing to analysis and evaluation—while creating a series of successes through which a student can develop the skills to participate more substantively and the confidence to participate voluntarily. As more students are engaged more actively in class discussion, the discussion benefits from more voices being heard and from the greater diversity of thought and of experience that they represent.

Clearly, this study has implications for discussion facilitation more generally (e.g., encouraging instructors not simply to rely on volunteers and to understand the available range of nonvoluntary participation strategies). Additionally, there are clear implications for faculty development and teacher training. For example, findings provide support not only for the development and use of classroom discussion pedagogies that engage more reluctant participants in discussion activities but also support the value of helping faculty learn how to effectively use these strategies. Furthermore, relative to student-skill development and program design, we suggest that a systematic use of cold-calling could be an informal but systematic way to help communication-apprehensive students feel more comfortable speaking in front of their instructors and peers.

Limitations and Future Research

The results of this study should be interpreted in light of its limitations. First, student data were gathered only for one course with multiple sections and instructors. Thus, our ability to generalize to other courses is limited. Second, we do not know the exact nature of the questions asked by instructors in the high cold-calling sections that enabled them to increase the voluntary response rate and overall participation rate without reducing student comfort. Although Dallimore et al. (2005) contains some guidance along this line, more research is needed. One area for future inquiry would

be an exploration of the relationship among specific questioning-and-answering patterns. For example, does cold-calling use at the higher levels of Bloom's taxonomy increase voluntary participation while use at its lower levels—where there are arguably a more narrow range of acceptable responses (i.e., right or wrong answers)—inhibit voluntary participation? Another example would be to explore the relationship between cold-calling at various levels of Bloom's taxonomy and answering patterns that might be characterized as chains of student-to-student contributions.

In addition, since we did not differentiate among students in this study, we do not know whether our findings hold in the same way for male as well as female students or for students from different cultures. Again, additional research could illuminate these issues by testing for gender effects on cold-calling versus voluntary-participation patterns. One such area for future inquiry would be to assess cold-calling versus voluntary participation based on the gender of both the instructor and the students, especially since differences in participation patterns for gender have already been documented in in-class and online environments (Caspi et al., 2006; Howard et al., 2006). Such questions might include the following: Are instructors more likely to cold-call on male students? If so, do instructors also tend to direct more difficult questions toward the male students? What about soliciting voluntary participation across Bloom's taxonomy based on gender? If differences exist, does the gender of the instructor influence these outcomes?

Furthermore, although our data do not explain why the percentage of students voluntarily answering questions is so much higher in the high cold-calling sections, our informal discussions with students suggest three possibilities, which can be characterized as "priming the pump," "comfort in numbers," and "defensive volunteering." First, once a student has participated a few times, it becomes easier to participate, including volunteering; this explanation is akin to priming a pump. Second, if only a few students volunteer, additional students might feel uncomfortable joining this visible minority. However, when the percentage of students voluntarily answering questions approaches 90%, then volunteering is the norm, and students may find that there is comfort in numbers. Finally, when instructors cold-call, students who prefer not to be cold-called may volunteer more frequently. They use a defensive strategy for participation reasoning that if they volunteer often, their instructor is less likely to cold-call them. We suspect that each of these three explanations is true to some degree for at least some students. Further research is needed to determine the strength and validity of these possible explanations.

Furthermore, our study showed the longitudinal development of greater participation across the course. This raises interesting questions about the effects beyond the boundary of a single course, that is, the impacts on program design. If this pedagogy were used in the introductory courses of (or better yet consistently throughout) an academic course of study, students could develop confidence in their ability to express themselves orally in a more low-stakes and ongoing way before being required to complete a more formalized speaking assignment or even more explicitly communication-focused course (e.g., public speaking, business communication).

Finally, with an increasing emphasis on the development and delivery of online courses, future research might examine the form cold-calling might take in an online learning environment. For example, such research might examine strategies for engaging less willing participants (e.g., posing a question to a particular student in a chat session rather than to the entire class) as well as an examination of how cold-calling use, through both synchronous and asynchronous discussion pedagogies, might affect variables such as student preparation, participation behavior, and learning.

Summary

This study examined the effect of cold-calling on students' participation in class discussions, especially voluntary participation, and on their comfort participating. Pre- and postcourse surveys concerning student perceptions about and behaviors during class discussion in a required business course were gathered from sophomore students at a large, private research university. In addition, trained observers gathered data on instructor question-asking behavior during two case discussions.

The primary results indicate that in high cold-calling environments, more students participate voluntarily, the number of students participating voluntarily increases over time, and more questions are asked and answered. Furthermore, more students participate overall in class discussions in high cold-calling environments. Finally, comfort participating increases in high cold-calling environments; it does not change in low cold-calling environments.

That cold-calling has such a significant, positive effect on participation is an important and valuable extension of literature related to discussion teaching in general and cold-calling in particular. Furthermore, the fact that cold-calling can be done fairly extensively without making students uncomfortable provides support for using this instructional strategy to engage more students to participate more actively in class discussions.

Appendix

Survey Variables	Survey Questions
Precourse survey	
Liking of class discussion	How much do you like class discussion? 1 = *not at all* and 7 = *very much*
Familiarity with class discussion	How familiar are you with class discussion? 1 = *not familiar* and 7 = *very familiar*
Typical participation frequency	In most courses, I participate: 1 = *not at all* and 7 = *very frequently*
Expected participation frequency	In this course, I expect to participate: 1 = *not at all* and 7 = *very frequently*
Typical comfort participating	In general, when I participate in class discussions, I feel: 1 = *uncomfortable* and 7 = *comfortable*
General evaluation of class participation	In general, the evaluation of my class participation has been: 1 = *low* and 7 = *high*
Satisfaction with class participation	In general, my satisfaction with my class participation is: 1 = *not satisfied* and 7 = *very satisfied*
Postcourse survey	
My actual participation frequency	In this course, I actually participated: 1 = *not at all* and 7 = *very frequently*
Number of other students participating compared with other courses	Compared with other courses, the number of students who participated in class discussion was: 1 = *much lower* and 7 = *much higher*
Comfort participating in this course	In this course, when I participated in class discussions I felt: 1 = *less comfortable* and 7 = *more comfortable*

Observation Variables	Variable Definition
Percentage students participated in class discussion	Total number of students answering volunteer or cold-called questions/total students present
Percentage students cold-called	Total number of students answering cold-called questions/total students present
Percentage students voluntarily answering questions	Total number of students answering volunteer questions/total students present
Total number of questions per student	Total number of questions asked/total students present
Number of volunteer questions per student	Total number of volunteer questions asked/total students present
Number of cold-called questions per student	Total number of cold-called questions asked/total students present

Declaration of Conflicting Interests

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Notes

1. There is extensive literature on learning styles and how these learning styles affect discussions and conversations. See, for example, Claxton and Murrell (1987), Rayner and Cools (2011), Sadler-Smith and Evans (2006), and Sims and Sims (1995).
2. We have seen rapid movement toward technology in teaching and as a tool for student learning. It has been used to engage students in discussion for varied reasons (e.g., it allows for more participation without the constraints of class time and allows students more control over both the content and context of their participation). The impact of technology on class interaction is investigated in the field of management by Arbaugh (2000) who examines participation in an asynchronous Internet-based MBA course and finds no significant differences in learning or interaction quality from the conventional classroom. However, he finds significantly more participation overall, a finding consistent with Bump's earlier conclusions.
3. The four teachers in the study are all authors on the Souza et al. (2010) article; they collaborated and agreed to follow consistent instructional practices with the exception of the use of cold-calling. The authors note that "the fact that each of the four instructors work diligently to create and maintain a supportive communication climate and have been recognized for effective teaching likely impacted the results" (Souza et al., 2010, p. 245). Furthermore, there were significant differences in the precourse variables between the students in courses with cold-calling and the students in courses without cold-calling. This suggests that these groups of students were quite different before the experiment, which may also affect the results.
4. This discrepancy may stem from instructors' extrapolating their past experience with a particular student at a point in time, rather than understanding the impact of cold-calling on students' comfort in general, and comprehending the effect of this pedagogy on student comfort over time.
5. This is consistent with Bandura's (1997) theory of self-efficacy.
6. Although we attempted to control for as many variables as possible to eliminate alternative explanations of our findings, this research was conducted in actual

classes and was not a controlled experiment. Thus, other contextual factors (e.g., setup of the classroom, time of day of class) could possibly influence the results.

7. Prior to conducting this research study, two of the authors observed many discussion sections in this course to develop instruments and coding schemes for the study. They observed instructors asking questions related to all levels of Bloom's taxonomy. For example, knowledge/recall (How do fixed costs behave when production increases?); comprehension (Why do fixed costs per unit decrease when production increases?); application (If you double production, what happens to variable costs?); analysis/synthesis (What is really going on here? What might be the reason for an unfavorable price variance and a favorable usage variance? What can you conclude from these data? How did you come to that conclusion?); and evaluation (What would be the arguments for using the [. . .] method? Do you agree with Susan? Why? Did you see any problems with this approach? Do you think this is realistic? What are the pros and cons? How would you summarize what we have said so far?).
8. The remaining students may have been present for one survey and not the other, or they may have forgotten, incorrectly remembered, or chosen not to reveal the last four digits of their student identification number. In these instances, data from the precourse and the postcourse surveys could not be matched, and they were eliminated from the analysis sample. For the variables examined in this study (Table 1) we conducted mean comparison tests between matched and unmatched samples. No significant differences between the two groups were found.
9. Teaching effectiveness ratings are independent of this project. They were gathered from the university's teaching evaluation program.
10. "Treats student with respect" ratings are independent of this project. They were gathered from the university's teaching evaluation program.
11. Dates that surveys would be administered and observations conducted (as shown in Figure 1) were discussed with the instructors to minimize disruption. Since observations were planned when instructors had scheduled case discussions, virtually no changes occurred in the observation dates; however, survey dates were sometimes adjusted by one class session to ensure sufficient time was available to administer a survey.
12. This particular postcourse survey question was only asked in the second year of the 2-year study period.
13. It may be that the analyses reported for participation frequency could be affected by the majority of students who really like class discussion. Out of concern that we might be overlooking the effect of cold-calling on students who do not like class discussion, we conducted the analyses on participation frequency for just those students who reported that they did NOT like class discussion on the precourse survey. Although this substantially reduced the sample size, it produced similar results. As with the larger sample, students in

the Hi CC sections rated their participation frequency significantly higher than students in the Lo CC sections. Although the interaction between CC section and survey period was not significant, the pattern of results was similar, in that students in the Hi CC sections increased their self-reported participation frequency ratings over time, whereas students in the Lo CC sections reported stable ratings of participation frequency.

14. Students who are most uncomfortable with class discussion may simply choose to not attend those sessions. *Z* tests comparing percentage of students attending class by cold-call environment revealed no difference in percentage of students attending class by cold-call environment for the first class discussion ($Z = .15$, $p = .881$) or the second class discussion ($Z = .12$, $p = .904$). Thus, class attendance is not related to cold-call environment, that is, cold-calling does not dissuade students from attending class.
15. We had limited data on student self-reported preparation for class on which we could conduct ad hoc auxiliary analysis because this particular postcourse survey question was only asked in the second year of the 2-year study period. The results showed that students in Hi CC sections rated the impact of cold-calling on their preparation for class (4.71) marginally higher than students in Lo CC sections (4.29), $t(108) = -.77$, $p = .080$.

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