Theory-Driven Collocated CMC: A Study of Collocated Mediated Interaction as a Public Sphere

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ABSTRACT
Computer-mediated communication (CMC) tools are used to increase social interaction in collocated settings. Recent research has been primarily constructive (oriented to building of systems) or phenomenon-driven (serving attempts to understand interactions in collocated CMC). The paper contributes a theory-driven approach and examines collocated CMC as a Habermasean "public sphere": a space that supports inclusive, civil, and rational discussion. An in-the-wild experimental study comparing CMC with face-to-face (F2F) communication enabled ascertaining that CMC is more inclusive than F2F communication. Respectfulness levels did not differ but were established differently: via collective construction of a common narrative in F2F and through quick reactions in CMC. Similarly, while rationality figures were on a par, F2F communication allowed participants to justify their claims better. The article discusses how a theory-based approach can strengthen phenomenon-driven research with new conceptual frames and measurement tools, and steer constructive research with a normative framework.

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Collocated computer-mediated communication; Public sphere; Deliberative democracy

INTRODUCTION
For years, HCI and CSCW research have paid particular attention to the design and uses of collocated groupware systems, or *collocated computer-mediated communication* (CMC) technologies: systems that facilitate coordination and collaboration among people interacting at the same time and in the same place [25]. This research has been mostly constructive [36, 37] (oriented towards system-building) and phenomenon-driven [24, 80] (aimed at understanding interactions in collocated CMC). Academics and practitioners alike have been especially interested in applying collocated CMC across a broad range of academic settings, among them university environments, with the aim of promoting student participation [24, 36, 80] and interaction between the students and educators [37, 42]. This work has shown that collocated CMC systems can increase group cohesion [24], improve learning [42], enhance decision-making [59, 60], activate the audience [24, 37], and get participants engaged in peer learning [80].

Whereas the importance of the various technologies in supporting such participation is not in question, research in this space remains incohesive, as do the ways in which these technologies are designed. Several studies have examined participation via mediated environments in collocated settings, but they have lacked a theory for framing the participation (e.g., [24, 37, 42, 59, 60, 80]). That is, there does not currently exist a unifying framework – a theory – underpinning efforts to support participation adequately via design and evaluation of collocated CMC systems. To address this gap, we attempted to apply a single normative framework for participation.

We turned to a discipline that has focused directly on participation, political science [76], within which several normative frameworks have been developed to improve participation [16, 38]. Our work drew on one of these frameworks, known as *deliberative democracy*, as deployed by political and communication scholars as a means for investigating the potential that new technology affords for participatory democracy (e.g., [31, 40, 70, 74, 77]).

According to Habermas, deliberative democracy takes place in a *public sphere*, an ideal communication space that is characterized by the following values: (a) it is inclusive, with equality among all participants; (b) it is an environment where discussion takes place in a civil and respectful manner; and (c) it is one where the discourse is rational and affords the sharing and communication of diverse perspectives [15, 21, 34, 38].

In presenting design goals in the form of these values, this framework is normative and can be used as a basis for design,

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in line with the increasing attention to values in HCI (such as [9, 26, 58, 66, 79]). We have used this framework to examine the opportunities and challenges of collocated CMC relative to traditional face-to-face (F2F) communication. We conducted an "in-the-wild" experimental study comparing use of collocated CMC with traditional F2F communication in the participatory context of a typical classroom environment. Through theory-driven research, we will demonstrate the possibility of (a) developing rich empirical observations by attending to these values and (b) identifying design opportunities that can be exploited in other participatory contexts, beyond the classroom environment. In the concluding section, we discuss opportunities for applying the concept of public sphere beyond political and civic contexts, in the evaluation and design of collocated interaction technologies. We also explore how it can offer normative guidance for collocated computing.

THE PUBLIC SPHERE

Increasingly since the 1990s, political and communication scientists have studied deliberative democracy, a process whereby citizens freely participate in the discussion of public issues [34]. As characterized by Habermas [34], deliberative democracy takes place in an *ideal communication space* known as the *public sphere* (or "Öffentlichkeit"). The public sphere is a domain of our social life comprising three core, normative values that facilitate political deliberation: inclusiveness, civility, and rationality.

The first of these dimensions, *inclusiveness*, consists of the ability for everyone to participate equally in decision-making and deliberation. Habermas states that "everyone has to be able to participate" if a discussion is to be considered in a public sphere [34]. The importance of inclusiveness and equality is linked to the need to consider a topic from various perspectives and, thus, truly discuss it rationally. Potential challenges include over-participation and under-participation [32, 41], along with under-representation (e.g., caused by lack of competences or means for participation) [7].

The second dimension – *civility* – involves participants' respect for the others and their contributions [72]. Research has focused on the civility and relevance of messages [31, 64, 77]. However, there have been several distinct approaches to operationalizing this (e.g., [72, 73]). In 1998, 53% of Usenet messages incorporated contributions from others and 16% were direct replies, thereby demonstrating respect towards original authors' contributions [77]. With regard to civility, it has been found that Facebook communications are more civil than the comment sections of news sites [64], indicating that sociotechnical systems can afford different levels of civility. In addition, research has sought ways to improve such discussion environments – that is, make them closer to a public sphere – in order to support respectful and civil participation. Among the desired characteristics are neutrality and encouragement of respect via such means as motivational side banners [50]. Since the discussants' previous contributions determine the norms of participation [27, 75, 78], researchers have also suggested that, for helping to produce positive discourse from the outset, model postings can be used.

The third aspect is the *rationality* element of the discussion. The discussion is deemed of high quality if it is supported by rational argumentation ("Räsonnement" [34]). This entails each contribution having explicit claims supported with evidence [30, 72, 78] or by personal experiences and value-based argumentation [71]. This dimension's operationalizations include counting the number of supporting arguments [72] and evaluating the claims' contributions to larger discussions (e.g., via counterclaims and affirmative claims) [30]. Empirical data show that more than half of the messages in online spaces demonstrate rationality, meaning that they make a claim and provide support through at least one argument [31, 77].

Research on deliberation and the public sphere has focused on three separate perspectives: the empirical, practical, and theoretical [10]. The *empirical perspective* takes the public sphere as an evaluative metric for participation. Work in this vein has identified how various communication environments, such as Usenet groups [77, 63], Web-based discussion forums [31, 70], and other discussion groups [40], and social media [74, 68], can be considered deliberative. The main finding has been that deliberation indeed can take place in such venues.

Scholars taking the *practical perspective* ask how to develop participation opportunities that closely resemble a public sphere. The aim is to improve decision-making processes by increasing the opportunities for participation in political decision-making. For example, Finland's off-road traffic law was reformed after citizens were invited to participate and discuss the challenges related to the existing law [1].

The *theoretical perspective* entails seeking to understand how political systems could be characterized as public spheres. The most recent example of this type of work is related to so-called deliberative systems – the creation of several mutually complementary deliberative spaces, for different audiences, and cross-linkages between these to improve the overall outcomes of deliberation (e.g., [39, 47]).

While research on deliberation and the public sphere has been lively and encompasses empirical work, the concept of the public sphere has not been adopted and adapted by the CSCW and HCI communities; it has remained primarily the domain of political science and communication scholars. Those HCI/CSCW researchers who have employed the concept have found it useful (a) in the design of interactive systems for political and civic contexts (e.g., [20, 45, 46, 48, 67]), (b) as motivation related to their empirical research challenge (e.g., [3, 68]), or (c) in arguing that it could be used for evaluation of group work (e.g., [57]). This leads to the question of how the conceptual framework of the public sphere can be adapted to think about creating spaces for deliberation in other participatory contexts?

In returning to Habermas, for example Dewey [17] and Mouffe [52] have critiqued his conception of the public sphere as it is believed to be highly utopian. In particular, Dewey [17], in *The Public and its Problems*, describes how the Habermasean public sphere ignores the stark realities of civic life related to when, how and who can participate in deliberative democracy. That is, Dewey drew attention to inequalities in access and

participation in civic life. It is important to consider such realities when designing interactive systems for small groups.

We use the framework to understand an emerging form of mediated interaction: people's use of technology to mediate or augment their interactions when they are collocated. Therefore, we extend application of the public-sphere approach beyond the political and civic contexts, to traditional group-work situations. The first benefit of this approach lies in enhancing research on collocated mediated interaction, currently lacking research frameworks. It also advances the public sphere approach within HCI/CSCW work and demonstrates possible applications of normative social science frameworks, therefore potentially extending the scope for the public sphere beyond currently explored (civic and political) contexts.

Technology and Values

Our motivation for using a normative framework stems from the increasing interest in values seen in the HCI community [8, 35] and science and technology studies [28, 79]. We find it evident that every design has values encoded in it [58, 79] and that designers should take these values into account when designing systems [58] and evaluating them [**?**]. For example, value-sensitive and value-based design methodologies offer approaches to designing systems such that they correspond to the stakeholders' values [9, 26, 66].

As we have noted above, the public sphere is a strongly value-laden concept: it specifies which characteristics designers and actors should strive towards. From studies of non-augmented participation, we know that nurturing inclusiveness, civility, and rational argumentation represent multiple perspectives related to social issues; this work promotes their mutual recognition (e.g., [14, 33]). Further positive effects encompass the inclusion of minority opinions and more accountability in decision-making (there are various reviews [14, 53]).

Previous work on collocated CMC is imbued with values, even when the writings do not explicitly articulate them. Implicitly or explicitly, existing researcher-developed systems are designed to transform (passive) participants into more active ones [24, 37], decrease the effect of groupthink and social pressure linked to talking [54, 59], and increase the level of participation [36]. Next, we delve into this literature more fully to understand how well these systems already manifest the three goals for the public sphere.

COLLOCATED COMPUTER-MEDIATED COMMUNICATION

Situations wherein users are face-to-face but use computer-mediated communication systems have been widely studied (in work on, for example, live-participation systems [55], audience-response systems [42], and group-support systems [59]). Often the motivation behind the adoption of CMC is to *scale up* the interaction possibilities. In event contexts, performers can use these systems to allow numerous spectators to participate in the performance [55]. Examples include question-management systems [5, 37] and audience-response systems ("clickers") [13, 42].

However, collocated computer-supported interaction systems are used not only to scale up interaction but also to *transform the social interaction*. Prime positive examples of such effects include the experience of freedom from social norms [54, 59] and more equal turn-taking in group discussions [19, 44]. As for the tools, group-support systems [59] and various social dashboards [5, 19, 44], which record participation and visualize it for participants, are among the systems designed for small-group interaction. Also, computer-mediated discussion environments, such as Tin Can [36] and ThoughtSwap [18], have been directed toward changing social practices. Below, we assess prior research on collocated-mediated communication through the lens of the three dimensions of the public sphere: again, (a) inclusiveness, (b) civility, and (c) rational argumentation.

Inclusive Participation

Mediated communication increases the diversity of participation in at least higher-education [36] and elementary-school [54] group discussions, because it decreases the impact of low conversation confidence and thereby boosts participation by those who are not otherwise active. Similarly, graphically representing participation activity for discussants evens out participation in classroom environments [5, 19]. Therefore, we believe that mediated communication can be useful in supporting equal and inclusive participation.

Civil Discussion

Results pertaining to civility of discussion are relatively sparse in existing research. While in one study, primary-school pupils using a backchannel to augment their classroom activities were not bullied [54], researchers in another project found that some discussions were demeaning [23]. This clearly demonstrates the potential for uncivil behavior on such platforms.

Research on respectfulness, in contrast, has been more active. A requirement – though not sufficient – for respectful discussion is that the participants focus on the assigned tasks in the mediated-communication environment. The term "on-task activities" refers to using the system as intended by those who set it up, for example, to discuss a problem defined by the teacher in a classroom [54]. However, participants can create non-relevant content in the system, and levels of 25% have been observed [4, 24, 37, 54]. Therefore, participants clearly engage in extraneous activities, such as amusing other participants (e.g., [37]).

This metric is not a sufficient indicator of respectfulness, though. Far more important is to examine how participants relate to each other in social situations, how they treat other participants, and how they acknowledge contributions from other group members [72]. The documented cases have shown that 40–60% of messages are comments and reactions, which can be interpreted as ways of showing respect to others in mediated settings [23, 56]. We conclude that the existing research shows collocated CMC to hold potential for respectful and civil discussions.

Rational Argumentation

Of all the aspects of the public sphere, research in the domain of collocated interaction has examined rational argumentation the least. Although studies exist of message contents in collocated mediated-communication systems (e.g., [22, 23, 51])

and the social functions of the messages (e.g., [56]), none of them allows us to describe what type of argumentation took place in the respective systems. This lack of findings creates an interesting space for new research, though we believe that collocated CMC can facilitate rational argumentation.

THE METHODS AND SETUP

One of the significant benefits of the public-sphere concept is that it has already been conceptualized and operationalized by social scientists. Operationalizations include examination of the content and tone of participants' speech acts, the equality and distribution of participation, participants' experiences, and the outcomes of the participation process [6]. There are commonly used – and validated – tools to measure how well the communication situation adheres to the ideals of the public sphere (e.g., [6, 72]).

To explore collocated interaction, we chose to conduct an in-the-wild study [12] to ensure the necessary level of ecological validity. However, to guarantee comparability, some level of control was needed too [61]. We wanted to strike a balance between the experimental methods (e.g., lab-based studies) often applied in social-science work on the public sphere (e.g., [11, 43]) and a desire that the group discussions be meaningful and relevant for the participants.

A university course setting provided the necessary contextual elements for the study. The first author (MN) taught a course on computational research methods for social science students, with discussions about pre-selected relevant academic papers. This paper-discussion task had the benefit of being exciting and capitalizing on the students' interest in the papers' topics. It also resembled a research setting commonly used in collocated CMC studies: assessing how university students express themselves when using an anonymous collocated mediated channel [22, 24, 36]. We acknowledge that the academic-education setting was chosen for examining of collocated interaction and might not be suitable for a critical examination of the public sphere. Usually, experimental designs for studying the public sphere as a framing device have been focused on discussions that are conflict-prone [11, 43]. Similar conflicts are not to be expected in classroom discussions. That said, the goals for the public sphere, such as mutual understanding of divergent viewpoints, are relevant also in academic contexts.

To discuss the "public-sphereness" of collocated CMC, we developed a baseline condition against which we could evaluate the utility of our collocated CMC. The F2F condition served as a suitable baseline since mainstream political-science research (and the conceptual background) on the public sphere has revolved around this type of interaction [34]. In further pursuit of reliable and valid comparison, our study followed a within-subjects design wherein the students met weekly to engage in discussions and the condition (CMC or F2F) changed every week, in an alternating manner, with the F2F condition being the initial state. The alternation minimized the impact of various contextual and confounding factors on the findings.

We triangulated methodologically by using observations, video recordings, and logs from the CMC system. We transcribed the video recordings from the F2F condition for further analysis.

(a) The face-to-face setup (b) The computer-mediated setup

Figure 1. The research setup.

At the end of the course, the participants completed a survey that explored their experiences across the three dimensions of the public sphere. This end-of-course survey included a 20-item questionnaire (with three scales) adapted from political science [6] and a field for open-ended textual feedback ("Kindly also write about your experiences of face-to-face/computer-mediated communication. How did the setup make you feel? Did you observe any particular behavior patterns in yourself or others?").

Also, we collected background variables via a survey. These included how many years the student had been at the university, field of study, and 10 items addressing the Big-Five personality traits [29]. We have used these background variables to uncover factors involved in the experience of participation.

Arrangement of the Group Discussions

The course consisted of six weekly meetings and had 15 participants. It was held at a Nordic research university. Each week, participants gathered in a small group (see Figure 1(a)) for a predefined discussion task. In the computer-mediated communication case, the discussion took place via laptops (see Figure 1(b)). This resulted in 3 + 3 F2F and CMC meetings.

Each week, the students discussed a research paper assigned by the lecturer and worked on programming exercises. He provided 2–3 framing questions for each paper as a means of initiating discussion. The students had access to the discussion questions before each of the classes. Here, we aimed to scaffold participation by focusing on the most critical aspects of each paper, to help students be better prepared for a discussion.

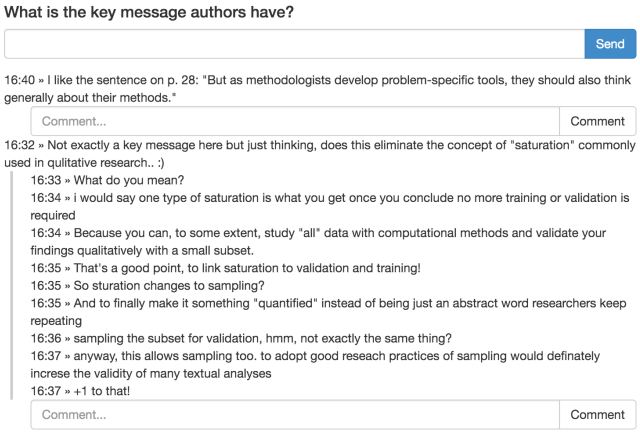


Figure 2. Presemo UI with threads. The framing question is presented above and followed by participants' discussion.

The course being aimed at master's and doctoral-level students ensured a certain familiarity with academic writing and reading. We made sure to gain the necessary ethics approval for the study and data-collection. Participation in the research study (i.e., the surveys) was voluntary for all participants. In total, 14 students (93%) agreed to take part in this study. All students who participated received remuneration in the form of two additional points for completing the survey, and all students were offered alternative ways of receiving that boost to their grade: performing two further programming exercises within the course context. Furthermore, no evaluation of students was based on the content or quality of the discussions, presence was mandatory, and evaluation for the course was based on the programming work.

In the F2F condition, discussion was initiated by the teacher identifying the paper to be discussed and reiterating the questions for that particular paper. The instructor also intervened to move the discussion toward other framing questions. Otherwise, the discussions and how they subsequently evolved were decided upon by the students without instructor intervention.

In the CMC condition, participants used a modified version of Presemo[1] [55], which is a platform that allows participants to engage in mediated interaction, such as a collocated chat, via any Web-enabled device. Presemo had been in use at the university in conjunction with regular teaching activities for several years, and many students who participated were familiar with it; this eliminated bias with respect to technical efficacy. In our modified version, Presemo supported threaded discussions, allowing participants to respond directly to a comment, right below that message (see Figure 2). As in the F2F condition, the instructor provided the initial framing questions to initiate discussion. Students could compose an answer to the question and reply to other participants' comments.

We set the parameters of Presemo such that participants contributed anonymously: their identities were not visible to students or the teacher. They were, however, stored in log files for use in later analysis of within-subject patterns. Anonymization is common in collocated groupware systems (e.g., [18, 36]). We acknowledge that anonymous participation may have implications for social dynamics, such as the degree of participation; this is especially relevant since the face-to-face communication did not afford anonymity. However, since our aim was to examine collocated computing, in which anonymity is commonplace, this setting, while unbalanced, was justified. Choosing to use communication that is tied to one's identity would have been artificial for collocated-interaction research and prevented us from extending from existing literature.

Measuring Inclusive Participation

The first criterion for the public sphere is related to inclusive participation. Researchers have not been explicit about how to consider inclusiveness; many map this to the socio-economic background of participants (e.g., [2]). Others have examined inclusiveness from the perspective of whether everyone is listened to (has a voice) during any given participatory session (e.g., [32]). We align ourselves with the latter. Hence, we calculated the frequency with which participants contributed to discussion, either verbally (F2F) or by sending messages (CMC). This yielded statistical representations of the number of speech acts each participant had engaged in per session.

We used this information to explore how participation was distributed within the group, applying the Gini coefficient [49] for measuring this. The resulting value is between 0 and 100, with 0 denoting equal distribution, 33 a uniform distribution, and 100 total dominance by one participant. We computed a Gini coefficient for each of the six sessions and compared these (further statistical analysis of the coefficients was not possible, on account of their nature). This gave us an overview of equality of participation, especially any emergence of dominance. The measurement thereby captures the original concept of equally distributed participation as elaborated upon by Habermas.

Additionally, we used the 10-item Big-Five personality traits questionnaire [29] to compare between those who contributed to discussions and those who did not participate in them. By statistical means, we sought to uncover differences between these two samples, using the Mann–Whitney–Wilcoxon (MWW) test, which is a non-parametric version of Student's t-test. As our data is of small sample size, we may not assume a normal distribution and thus used non-parametric test.

Measuring Civil and Respectful Discussion

The second criterion is linked to respectful participation. In broad terms, there are two approaches to measuring this: observation of interaction and participant surveys. Specific measurement tools have been developed for use of each of these methods in the field. Interaction observations, for example, might focus on references made to other participants wherein respect is demonstrated [72]. Also, survey items can be used to measure respectfulness and civility [6].

We compared communication approaches on the basis of students' experiences with respectfulness. A 10-item five-point Likert scale questionnaire, adapted from political-science research [6], was used, with two subscales for experiences of participation. Our version of the scale was adapted to collocated CMC. The first subscale (with five items) evaluated how well participants felt they *listened* to each other (e.g., "I paid careful attention to participants when they explained their point of view"). The second (also with five items) was for judging how much participants felt they *respected* other participants by taking them into account in the discussions (e.g., "After a participant made a comment, some other discussion participant almost always had a constructive response"). In the analyses, we compared the experiences of listening and respect between the F2F and CMC conditions, using the MWW test. We confirmed that reliability was good for both subscales (listening scale: $\alpha = .85$; respect scale: $\alpha = .83$).

Also, we analyzed the discussions qualitatively *post hoc*, to assess *how* participants maintained respectful discussions. We read through both transcripts and the logged data and made qualitative observations about how messages were formed. We explored the relationship between each message in the discussion and the previous messages. Furthermore, we examined

[1] Presemo is an Open Source live-participation environment available via http://www.github.com/presemo/.

counter-arguments and references to other participants or their contributions (e.g., "that's interesting what *you* brought up [emphasis added]" acknowledges a contribution by another participant), identifying expressions of respect (see [72]).

Measuring Rational Argumentation

The final criterion for the public sphere is related to rational argumentation. This operationalization has two directions: observations of interaction (e.g., what kind of claims participants make [72]) and participants' experience [6]. We applied several methods in this operationalization: a 10-item survey scale, content analysis examining the reasonableness of claims, and analysis of open-ended responses. The survey was used for comparison between the face-to-face and computer-mediated argumentation, by means of MWW testing. This measurement tool met the necessary statistical-reliability criteria ($\alpha = .87$).

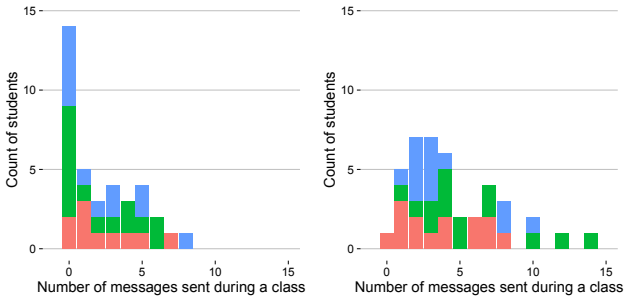
In our content analysis, we classified the messages into the following categories: speech acts with a reasoned claim, speech acts presenting a non-reasoned claim, and speech acts not offering a claim, following similar studies on deliberation in online spaces [30, 31, 72, 78]. Our starting point was to examine whether there was a claim, an expression of an opinion [30], or merely a statement of fact in the comment (such as repeating content from the paper). For those arguments with a claim, we examined support given for that claim, elaboration on why the opinion stated should be adopted. We recognized various forms of support, from rational argumentation to personal experiences. A more detailed presentation of this classification, including examples, can be found in Table 1. Proceeding from the classification of the content, we conducted a χ^2 test to explore whether differences existed between the F2F and CMC conditions.

In analysis similar to that for civility, described above, we made *post-hoc* qualitative observations about the comments to understand *why* certain levels of argumentation can be achieved. We sought to examine reasoned claims in detail and explore how arguments were constructed. Also, we compared the reasoned claims to other claims made by participants, to understand how they differed from other contributions made via the relevant communication channel.

Finally, we searched the free-form responses for comments on discussion quality. These provided additional insight for our analysis, allowing us to confirm or disconfirming our observations. These also provided some detailed explanations that aided in understanding why such observations were made.

FINDINGS

Before assessment of the differences between the F2F and the CMC condition as a public sphere, it is important to highlight participants' stated preferences for one or the other communication medium. The results emerged from our analysis of the open-ended statements, wherein many participants specified which condition they had liked more. Four participants cited a preference for the CMC environment, and five preferred the F2F environment. Four were ambivalent. Below, we will examine how the participation level, respectfulness of the discussion, and quality of the argumentation differed between the two conditions.



(a) F2F (b) CMC

Figure 3. Participants' activity levels in classes, with different classes indicated with colors. Active students are in the right extreme and passive ones in the left. For example, in the F2F condition, all the three classes had several students who did not speak at all, while in CMC condition only one student sent no messages.

Inclusive Participation

We observed that CMC-based participation gave better support for equal participation. This assertion is based on the Gini coefficients, the values of which varied between .50 and .60 for F2F participation and .34 to .41 for CMC.

The primary reason for the greater equality was that in the CMC condition everyone participated in the discussion. In all three F2F sessions, some students did not contribute, while this pattern was less evident in any of the CMC-based sessions. Figure 3 reflects this: for the CMC condition, the message counts reveal a smaller number of participants with zero messages, and a slight skew towards the right can be observed in the distribution. Also, we found that no participants were hyperactive in the CMC condition, while in the F2F one this phenomenon was evident.

We further examined the characteristics of contributing vs. non-contributing class members in the F2F condition, to shed light on reasons for non-participation (see Table 2). To our surprise, neither extroversion nor agreeableness was a significant predictor of non-participation in the F2F condition (extroversion: $W = 26$, $p = .224$; agreeableness: $W = 18.5$, $p = 1$). This implies that F2F participation was not determined by shyness levels, contrary to the assumptions behind previous collocated CMC system designs [36]. Instead we observed a significant effect of the conscientious personality type ($W = 28$, $p = .02$).

Taken together, the earlier suggestions of mediated communications' suitability for deliberative discussions seem tenable.

Civil and Respectful Discussion

Our analyses showed that the communication conditions did not differ significantly with respect to our two operationalizations, experience of listening and of respect (see Table 3). Even though scores were .4 points higher for the F2F condition in both cases, the differences were not statistically significant ($W = 43$, $p = .16$ for listening and $W = 38.5$, $p = .09$ for respect). Our *post-hoc* qualitative analysis showed that the method of showing respect differed, with more narrative-like structure in the F2F condition and an emergent practice of quick reactions in the CMC condition. The F2F speech turns referred back to previous speech turns and commented on

Class	Definition (adapted from other work [30, 31, 72])	Examples from our data
No claim	Messages that request or provide information or that express participants' feelings or attitudes. Also, messages that *only* affirm, assent to, or concede points in previous messages were considered not to make a claim.	"But that's interesting what you brought up, do social scientists actually need to understand the equations behind there, or like many people using SPSS like they click around and get the result and they read the instructions and you know what you need to have in the certain box there, and if it's right then you go on and if not, then you start all over again, like, but I'm not sure what is the answer [to] this."
Non-reasoned claim	Messages that state an original view or opinion without providing justification / indicating why it is true.	"Aye I would guess first some fields will want to prove previously untestable theories empirically"
		"Yeah, there's always some error in the models, what if you happen to be the two percent in the margin and didn't get treated unfairly because of the model, and I think that, something like that is probably a good case for kind of when something like that occurs in [a] serious way and then they start making some changes in the visibility how the algorithms are chosen."
Reasoned claim	Messages that state an original view or opinion and provide at least one justification / argument as to why such a view should be adopted.	"I do not see 'invasion' here, as they will invent their own field – and they are already trying to market CSS [computational social science] as a new field of research"
		"Yah, I think it is just easy [to] say that you should know all of the math behind the things or whatever, the basic behind the things, but there aren't enough resources for us to be able to learn math and we don't have time to learn all the development."

Table 1. Content classification for purposes of analyzing rationality of discussion.

them, while replies with brief expressions of agreement were used more often in the CMC channel, to show others that one had read the message.

Since our observations during the sessions did not identify any obvious cases of non-civil behavior, such as spamming or antisocial behavior, we did not examine the content of the messages with regard to civility. The high level of civility that we observed may be particular to classrooms. In other use contexts, civil behavior might be less likely.

We examined this dimension further by using the videotapes and logs to explore how civil and respectful discussions were created and maintained. Of the two operationalizations (showing respect and listening), we were able to carry out these analyses only for respectfulness, since listening could not be analyzed via message logs or from videos. Such analyses could be conducted for respectfulness, however, because it was possible to assess the nature of the participants' subsequent replies to each other's speech acts. In particular, we sought to identify the "best practices" by which, in both conditions, the participants could express respect to others in a positive manner. We identified two such practices, related to participants' attempts to maintain a narrative and to display quick reactions to other people's contributions. We present them in the following subsections.

Expressing Respect by Maintaining a Narrative

We observed that participants formulated their contributions differently between the two conditions. In the F2F condition, the contributions usually formed a single clear narrative, and, therefore, the experience of being respected (i.e., of other participants reacting to the contributions made) was clearly observable. Participants also engaged in "meta-discussion" to establish a clear narrative: they referred to previous contributions when presenting new ones. In one example of meta-discussion, participants often made specific reference to others and rephrased their statements:

> But that's interesting what *you brought up*, do social scientists actually need to understand the equations behind [emphasis added]

Another example could be seen when participants made contributions that had not been discussed in previous messages; they often framed these in a way that took the latest messages into account, thereby attempting to preserve the coherence of the discussion and, hence, its narrative:

	Active	Passive	Signif.
Personality: Extroversion	9.2	6.2	n.s.
Personality: Agreeableness	9.7	9.5	n.s.
Personality: Conscientiousness	11.2	8.8.	*
Personality: Emotional stability	8.8.	9.2.	n.s.
Personality: Openness to experiences	11.5	11.0	n.s.

n.s': Difference not significant at $p < 0.05$ in MWW testing.
*: Difference significant at $p < 0.05$ when MWW was used.

Table 2. Differences of contributing and non-contributing class members in face-to-face condition.

	F2F	CMC	Signif.
Listening	4.17	3.73	n.s.
	(.36)	(.67)	
Respect	3.83	3.36	n.s.
	(.29)	(.32)	
Quality of the discussion	3.62	3.47	n.s.
(rational argumentation)	(.25)	(.38)	

n.s.: Difference not significant at $p < 0.05$ in MWW testing.

Table 3. Experiences of being listened to and respected, by condition, with variance reported in parentheses.

	Reasoned claim	Non-reasoned claim	No claim
F2F			
(%)	20.24	14.29	65.47
(*n*)	17	12	55
CMC			
(%)	9.05	23.12	67.83
(*n*)	18	46	135

Table 4. The types of claims made in the discussions.

> But there's *also another interesting aspect* to this, the separation of labor *you talked about* [emphasis added]

In the CMC condition, there was no evidence of explicit meta-discussions that would have maintained a shared narrative. Instead, several conversations occurred simultaneously, and not all of them attracted further replies. Of all the initial posts, 51% to 70% elicited one or more responses (on average, 2.9 responses; median: 1 response).

We believe the main reason for the difference is that Presemo's threaded conversation structure limited the need for this type of meta-discussion. Because the previous posts were visible, no individual contribution had to rephrase the previous narrative or claims. For example, the following message is clearly a response but does not present the context itself:

> That's a good point, to link saturation to validation and training!

The aforementioned observations suggest that the F2F condition provides better means for showing respect, yet participants felt that they had been respected to almost the same extent in the CMC condition as in the F2F one. Together with the Gini-coefficient results above, these findings further attest to the viability of CMC settings for forming public spheres for participants.

Expressing Respect with Quick Reactions

In both conditions, we observed that participants reacted to the ongoing discussion with short remarks. In our view, such reactions are not signs of respect in the sense specified in our survey, because they are not full contributions that can provide constructive feedback. This said, if we apply a more relaxed definition, wherein respect means taking other contributions into account [72], reactions of this type emerge as an important aspect of the experience of being respected by others. Brief acknowledgments are recurrently observed in conversation analysis [65], and participants in our study too made successful use of them, throughout the course.

In the F2F condition, participants engaged in minimal responses, such as "mmmm," or laughed together to indicate that they were attending to other participants. Also, the speech acts, which were based on turn-taking, were sometimes interrupted with short remarks by other students (such as "Yes"), either to provide feedback or to engage in turn-taking practices. In the CMC condition, participants demonstrated similar practice by sending brief messages such as `:D` and `+1`. In total, 6% of all messages in the CMC condition were of this nature.

Rational Argumentation

We found no significant difference between the two conditions with regard to the participants' perceptions of comprehensiveness and rationality (see Table 3); $W = 53$, $p = .44$. Accordingly, participants' experiences of these elements' presence in the discussions were rather positive in both conditions.

More in-depth examination revealed a difference in argumentation style between the conditions, however. We obtained this result by looking at "reasoned claims" (see Table 1 for examples). When analyzing the rationality dimension of the individual discussion contributions and comparing across conditions in line with the coding system described above, we found that the F2F condition featured more reasoned claims and the CMC one had more non-reasoned claims (see Table 4). The conditions were similar in the number of messages with no claims (F2F: 65.5%; CMC: 67.8%). The overall distribution of reasoned-, non-reasoned-, and no-claim items was not equal between the two conditions ($\chi^2 = 8.27$, *d.f.* = 2, $p = .016$).

The absolute quantity of reasoned claims did not differ; i.e., the conditions showed the same number of reasoned claims. The difference between condtions was caused instead by there having been more messages in the CMC condition. Participants' open-ended comments support this finding. They felt that the CMC condition lacked reasoned claims and instead, in their words, was "superficial" and "lacked depth." To understand why that condition lacked depth, we analyzed which features of the contributions made them reasoned claims in particular.

The first finding in this respect is related to content length. The F2F contributions were longer than contributions of the same rationality class in the CMC data. We even observed that contributions with reasoned claims were longer than other contributions ($W = 238$, $p < 0.01$) in the F2F condition. In the CMC condition, in contrast, the length of contributions (as measured by word count) did not differ between reasoned and non-reasoned claims ($W = 4299.5$, $p = 0.75$).

Another feature of the F2F conversation was that reasoned claims emerged gradually over the course of a speech turn. Participants, for example, reformulated their statements, elaborated on their responses, and used adjunct clauses to amend their ideas. We did not observe such behavior in the CMC setting. Instead, people contributed statements that were rather solidly formulated at the outset. Therefore, if a claim lacked justification when first made, the participant usually did not amend it later.

In summary, it is possible that typing being slower than speaking may have been the main factor in the lower number of reasoned claims in the CMC condition; the low speed is a hindrance. Such factors can explain both the contribution lengths and the gradual building of justified arguments. Moreover, the CMC condition gave people more time to think about their response and build their argument. However, since the discussion took place in a synchronous manner, the effect of this might be less evident, because the participants needed to catch up with what others were saying.

DISCUSSION

In this work, we have demonstrated how Habermas's concept of a public sphere can be applied as conceptual grounding in the realm of group work via collocated CMC. Its three dimensions – inclusive participation, civil discussion, and rational discourse – mediate important values in interpersonal communication. In the literature review, we demonstrated how research on collocated CMC can be fruitfully considered through the lens of a public sphere. We found that, although HCI/CSCW studies have examined online media, such as Facebook, as public spheres, such works are few [45, 46, 67] and have not stretched beyond a political and civic context. To demonstrate the value of the public-sphere idea also as a theoretical lens for understanding CMC, we operationalized its three dimensions and conducted an empirical study comparing between F2F and CMC conditions. We will now reflect on the values that Habermas's framework associates with participation, after which we discuss how it could contribute to the phenomenon-based and constructive streams of collocated CMC research, which until now have been lacking explicit value-oriented frameworks.

Normative Frameworks in HCI

In the introduction, we briefly acknowledged the existence of several normative frameworks for participation [16, 38]. We took the concept of public sphere as the guiding framework for our research because it ostensibly entails creating mutual respect and shared understanding of the issues under discussion [14, 53]. However, the public sphere is only one of many angles from which to study collocated CMC. If we had approached the design from a liberal–individual value-system standpoint [16], we could have focused on ensuring that each participant could take part and that the shared understanding was an aggregate of the group members' individual views. In that case, our experimental design could have been aimed at examining majority-based decision-making enabled via, for instance, up- and down-voting. Participants could have voted, for example, on what they considered to be each paper's most important contribution. Alternatively, by adopting the counter-public approach [16], we could have explored both whether HCI systems can support formation of a counter-group and its functioning and demonstration of solidarity. A study with this focus would have been the most suitable in contexts of non-mainstream social movements or minority groups as users.

One motivation in HCI research's shift towards values [8, 35] has been a deeper awareness that technical systems manifest these values [79]. Accordingly, in the system used in our study, replies were enabled and voting was disabled. This decision was based on values that in Habermas's framework prioritize conversation. From a value-sensitivity perspective [9, 26, 66] from which the values are distilled via study of stakeholders, our approach, embedding in the system values that we deem important, may strike the reader as disruptive. In particular, the values we imposed might not coincide with those of end users or other stakeholders. Therefore, our approach could be better called value-centered or value-driven; we have explicitly stated that we use the public-sphere idea to guide our research. Consistently with our conviction that more conceptual frameworks are needed for understanding collocated CMC, we maintain that research that makes explicit the values proposed/imposed by the technical system should be further encouraged. This feature is particularly lacking in the literature on collocated CMC, as we found in the literature review. Laying bare the values may provide stronger theoretical apparatus, which can be applied throughout the research (see the following subsections).

Reflective attention to values may give room to address the social settings more explicitly, sensitizing us to new questions. For instance, how ethically acceptable is it for researchers to impose their values on a research design if they conflict with those of participants? Are some values more acceptable to impose while imposing others is less acceptable? Finally, how should those developing the systems address potential conflicts in values between stakeholders, and whose values should be given priority? When HCI adapts normative frameworks to its theory or design, questions of this sort become relevant, not only in terms of collocated CMC but also more widely.

The Public Sphere in Phenomenon-Driven Research

In the long run, developing theoretically grounded concepts for understanding empirical phenomena (such as collocated CMC) will be of great benefit to any research field [62]. Applying a theory to a heretofore "foreign" domain can direct attention to previously understudied topics or inform operationalization for study of the phenomena. Furthermore, having a clear framework helps to advance the research: others can more clearly build on previous work.

Of the three values of deliberation, we wish to discuss how the focus on the rationality of discussion aided in foregrounding a previously unrecognized question related to reasoned claims. Specifically, we found that reasoned claims were less frequent in the CMC condition than in the F2F condition. Here, CMC is handicapped in its support for deliberation.

The theory-grounded uncovering of this difference leads to several important questions that help to orient research on collocated CMC, which has traditionally focused mostly on emergent patterns of collocated CMC interaction without strong theoretical direction. Firstly, in what ways could participants, in various mediated communication settings, better present reasoned claims? For an answer, one could analyze both successful and unsuccessful communications, thereby creating fuller understanding of how the inherent limitation of typing speed in CMC can be circumvented, with the result of more rational discussion. Secondly, what happens when rational discourse is not possible in collocated CMC? Considering the phenomenon of rationality's absence across several collocated CMC technologies and domains aids in ascertaining which collocated CMC technologies are best suited to settings wherein Habermasean values should be nurtured and reasoned claims should be easy to express.Thirdly, can previous successes and failures in the adoption of CMC technologies be attributed to their lack of support for presenting reasoned claims? These questions exemplify the benefit of a Habermasean perspective in steering the focus to more specific interaction phenomena in empirical studies.

A further benefit of theoretical underpinnings is related to the operationalization of research. The idea of the public sphere as a theory for understanding system use has been presented before for HCI but was not taken up [57]. Our work picked up the gauntlet by moving forward and adapting surveys and classification frameworks with origins in political science. One can conclude that this has borne fruit. For example, the survey items yielded good results pertaining to reliability.

The Public Sphere in Constructive Research

We also believe, proceeding from our study, that a normative framework such as that of Habermas will aid in the construction of new collocated CMC tools. Rational discussion again serves as an example. We observed that CMC and F2F communication were on a par for rationality of discussion. Previous work has explored how forcing participants to discuss pros and cons of a pertinent social problem would support more rational online discussions [46]. This approach could be considered for collocated CMC too, with participants being forced towards more claim-rooted discussion by the interface.

Our study showed that the public sphere is not easily created and helped to pinpoint where the most important opportunities for improvement are. Using F2F communication as a baseline, we found that CMC-based participation could be improved also with respect to civility and rationality. On these dimensions, CMC was not significantly better than the F2F communication. The main difference between the conditions was that F2F participants could better acknowledge each other's contributions positively by using brief comments such as "mm" or "yes" and engage in meta-discourse. In CMC, this was more difficult, although participants did adopt the practice of posting "+1" after valuable contributions.

This points to immediate needs for designing faster acknowledgment and respect-demonstration mechanisms for CMC. In many ways, there is a similarity to how Facebook has successfully made use of the "Like" feature, which nowadays allows for several flavors of emotion. More in-depth studies of acknowledgments could produce greater insight for constructive research. There could be support for more reactions, motivated by Habermas's framework, such as rapid expression via emoticons indicating "I agree with this message" or "I appreciate you sharing this point of view."

Limitations

The generalizability of this research is limited, because we studied a case of participants who had an active role as discussion participants and the topics were non-controversial. Varied contexts, among them performance settings [55] wherein the participants differ in role (e.g., performer or spectator), are common in collocated CMC. Further studies in such settings would be worthwhile because they prove particularly challenging in terms of equality of discussion. Furthermore, the classroom context might cause students to be overly polite in their interaction. While the students here were not evaluated for their contributions, their politeness might still have affected. Nonetheless, the classroom context allowed us to observe best practices that can be applied beyond the classroom.

We wanted to use anonymous-mode collocated CMC, recommended in various works [36, 54, 59]. This decision entailed two problems, though. Firstly, the anonymity was not perfect, because the group was rather small and, in principle, one could identify comments' authors in such a collocated setting. For example, if few people were typing, the author of each message could have been identified. In practice, this was not a problem, however, since such quiet moments did not occur and previous research has demonstrated that an experience of anonymity in collocated settings is achieved even with small groups [54]. Secondly, it may seem unjustified to compare non-anonymous F2F communication to anonymous CMC. We have to acknowledge in this connection that more research is needed, since the research design could not accommodate additional conditions within a six-week course. We believe that anonymity boosted the inclusivity of participation, as it increased the students' willingness to present their views openly [54]. Also, there may have been greater respectfulness in the non-anonymous setting because participants could identify others and refer to their comments accordingly. However, we can conclude that rationality was not affected: the main reason for the greater rationality in the F2F condition was related to contribution length, not the level of anonymity.

CONCLUSIONS

This paper represents an effort to think about collocated CMC in a theory-first manner. While there has been great interest in collocated CMC, the findings are scattered across isolated works rather than being properly situated. This diminishes the field's ability to develop collocated CMC systems and practices further.

As a starting point for theory-driven research, we examined participation in collocated CMC and adapted Habermas's theory on public spheres from political science as our interpretive lens. He claims that participation ought to be (a) inclusive, (b) civil and respectful, and (c) rationally oriented. We gained insight into such matters as the claims made in collocated CMC situations and ways in which CMC systems afford and limit showing respect to other participants.

We have suggested several reasons for applying Habermas's theory of the public sphere in the HCI and CSCW fields. Firstly, we have demonstrated its use outside its traditional realm by considering non-civic and non-political contexts. Secondly, our case study did not focus on communication about controversial topics. Instead, we successfully applied the theory to general collocated CSCW phenomena – classroom communication and shared tasks. Therefore, we believe that Habermas's framework and other theoretical lenses should be more actively applied in studies of collocated CMC phenomena and as input to developing new systems for collocated interaction.

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