Illuminating the Role of Classmates in Reducing the Participation Gender Gap in Lecture-Based Engineering Classes

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Abstract—Contribution: This work sheds light on how classmate behaviors influence gender gaps in verbal participation in lecture-based engineering classes. It is found that after a woman participates in class, there is a temporarily increased likelihood a woman will participate again afterward.

Background: Women continue to be underrepresented in STEM higher education, particularly in engineering. Positive classroom experiences are key to retaining women undergraduates, but despite research into the value of interactive teaching that allows classmates to aid each other’s learning, lecturing is still most common in collegiate STEM classrooms.

Research Questions: This study considers how classmates influence gender gaps in student verbal participation, even during traditional lecturing.

Methodology: One thousand and three hundred and eighty seven student comments are observed over 89 class periods in ten engineering courses. The variation in student verbal participation levels with gender is analyzed, and its correlation with student speaking order, as well as other factors related to the classroom structure, is investigated.

Findings: A statistically significant gender gap in class participation is observed, which is not fully explained by factors like class size or comment type. It is found, however, that when one woman participates, it increases the likelihood a woman will participate afterward, pointing to the role of classmates. This trend and the participation gender gap overall are eliminated when isolating classes taught by women. These results suggest that hearing either a woman classmate or instructor speak in class makes other women more likely to do so. As participation is linked to everything from student performance to confidence, this provides an avenue to increase gender equity in classroom experiences through small pedagogical changes that can be readily implemented into traditional lecturing.

Index Terms—Class participation, gender, lecturing.

I. INTRODUCTION

UNDERREPRESENTATION of women has long been of concern in STEM higher education [1], particularly in engineering where just 20.9% of bachelor’s degrees were awarded to women in 2016 [2]. Part of the issue arises from the low retention of women undergraduates in STEM fields [3], [4], which brings attention to their experiences in the classroom. Among other key elements of the collegiate environment, such as mentors [5], [6] and peer groups [7], [8], numerous studies have tackled the role of “chilly” classroom climates [9]–[12] on women’s experiences in STEM. These works show how discomfort in class can decrease student well being and discourage women from continuing in STEM, an effect compounded for doubly marginalized groups such as women of color [13]–[15]. Previous research has shown how interactive teaching methods, such as Peer Instruction [16] or group work, can alleviate gender gaps in student experiences [17], [18]. However, barriers to large-scale pedagogical reform still limit their widespread adoption [19], [20], and ill-informed or inconsistent implementation of practices like teamwork can end up being counterproductive to combating gender inequities in the classroom [21]. Thus, in parallel to studies on interactive teaching practices, it is critical to also investigate how to more equitably engage students in the traditional, lecture-based teaching that continues to dominate STEM higher education today [20].

One metric with which to evaluate a student’s comfort and engagement in a lecture-based class is through their verbal participation. Extensive research has shown the benefits of class participation on student experiences and outcomes [22]. For instance, participating in class has been correlated with increased academic self-efficacy [23], which in turn has been linked to women’s plans to persist in engineering despite their underrepresentation [24]. Participation also affects the evaluation professors and peers make of a student’s academic ability, having been correlated with higher grades [25] and a higher estimation of intellect by classmates [26]. Thus, while speaking in class is only one possible display of engagement and the extent to which a student employs and benefits from it depends on their learning style and personality [27], [28], understanding gender gaps in participation in STEM classrooms is central to developing pedagogical strategies that offer equitable experiences to students of all genders.

Previous studies of gender gaps in verbal participation in STEM classrooms have shed light on the role of factors like class composition and instructor gender. Studies in the United States and Norway, for instance, found that women were less likely to verbally participate than men in introductory biology classrooms, even when women made up the majority of
students [29], [30]. The former did not identify an influence of instructor gender on the gender gap in student participation, but they did report a small influence on the gender gap in student achievement [29], and the influence of instructor gender on student participation overall has been documented in earlier works [10]–[12]. Notably, while these studies in the life sciences may not fully reflect the situation in engineering because of the relatively high representation of women in biology [2], recent work by Ballen et al. considered other STEM disciplines, including computer science, which is similar to engineering in its representation of women [2]. Here, they highlighted class size and use of group work as significant predictors of participation gender gaps [18]. Together, these results on what will henceforth be referred to as “structural factors” of the classroom are invaluable in envisioning an inclusive future for engineering education. Unfortunately, they are also limited by the fact that substantive changes to classroom structures or faculty demographics often require significant institutional overhaul and long timescales.

Notably absent from previous studies, meanwhile, are results to illuminate the role of classmates in influencing each other’s participation during lectures. Outside of the classroom, connections with supportive peers have been shown to improve women’s experiences and persistence in STEM majors [7], [8], [31], and the power of peers within the classroom is exemplified by the efficacy of aforementioned interactive teaching methods [16]–[18]. These findings lead to the hypothesis that classmate behavior may be as important as instructor behavior in promoting equitable participation, but whether this is true in a traditional, lecture-based class has not yet been explored. This limits the engineering community’s ability to develop pedagogical strategies specifically targeted at gender-inclusive teaching—particularly ones that may be implemented on relatively immediate timescales.

This work aims to fill this void in understanding by studying the influence of classmate behaviors on gender gaps in student verbal participation in lecture-based undergraduate engineering classrooms. In particular, the importance of the order of student comments is investigated, demonstrating that when one woman participates in class, there is an increased likelihood another woman will participate right after—an effect that is particularly pronounced in classes taught by men. The role of the timing of student comments is also considered, showing that as the time since the last comment from a woman increases, the likelihood of another comment from a woman decreases. These results highlight the power of women students to encourage participation from their classmates, even in highly traditional classroom environments. They reveal a new avenue for mitigating gender gaps in engineering classes, leading to a discussion of teaching tools that leverage these results and can be implemented on short timescales.

II. RESULTS

Observational data on student participation were collected from 89 lecture-based class periods in ten undergraduate engineering courses, as described in Section IV. A summary of the 1387 comments observed is shown in Fig. 1, broken down by speaker gender. In total, 45.5% of students observed were women, while only 20.3% of student comments came from women—a highly significant difference according to an exact, two-sided binomial test with \( \alpha = 0.05 \) (\( p < 0.001 \)). This effect varied with instructor gender, as shown by Fig. 2. Classes taught by men [Fig. 2(a)] showed a highly significant difference between the proportion of comments from women, 17.1%, and the proportion of women students, 40.7% (\( p < 0.001 \)). The same analysis of classes taught by women [Fig. 2(b)], meanwhile, did not meet the threshold for statistical significance, with 47.3% of comments from women compared to 54.7% of students (\( p = 0.072 \)).

In evaluating these results, it is worth noting that the total sample size of student participation was much higher for classes taught by men than it was for classes taught by women, with 1237 comments analyzed in the former compared to 150 in the latter. This was largely due to having a limited selection of classes taught by women, stemming from preexisting gender gaps in the engineering faculty, which led to fewer observed classes taught by women (30, compared to 59 taught by men) and an inability to choose courses with a range of participation levels. This limitation will be examined further in Section III. Overall, however, the gender gap in student participation was larger than those observed in previous studies of biology classrooms [29], [30] and indicated a dependence on instructor gender that, while not unilaterally observed in other works [29], was consistent with survey studies on the influence of instructor gender on women’s attitudes toward participation [12].

A. Role of Structural Factors

The results were further compared to previous works through the analysis of other structural factors like class
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Fig. 2. Gender breakdowns of students (left, blue) and student comments (right, red) over all class periods taught by a (a) man or (b) woman showed there was only a statistically significant gender gap in classes taught by men.

Fig. 3. Proportion of total comments from women versus average proportion of women students in each course. Solid gray line shows OLS regression with the shaded area representing 95% confidence interval. The dashed black line shows where the proportion of comments from women is equal to the proportion of women students. Marker sizes represent the average class size for each course.

composition (Fig. 3), class size (Fig. 3), content of the comment (Fig. 4), and the way the comment arose (Fig. 4). These analyses served to contribute engineering-specific information to the existing body of work summarized above and were necessary to aid interpretation of later results on the role of classmates that were the primary focus of the study.

1) Class Composition and Size: The proportion of comments from women versus the average proportion of women students and the average class size is plotted in Fig. 3. The analysis found the proportion of comments from women to be strongly correlated with the proportion of women students, yielding a Pearson’s correlation coefficient of 0.791. The ordinary least square (OLS) regression analysis also suggested a significant relationship, with an F-statistic of 38.1 ($p < 0.001$) for the solid gray line plotted in Fig. 3. For all but three courses, the proportion of comments from women is lower than the proportion of women students, as shown by data’s relation to the black-dashed line which represents when these two proportions are the same. Moreover, the lower the proportion of women students, the further below this expected line the proportion of comments from women tended to be, with the two classes with the highest proportions of women even showing the opposite effect (more comments from women than expected). These results were consistent with previous work that identified the importance of the proportion of women in the class to participation levels [12]. In the case of average class size, no clear trend was identified. As seen by the marker sizes in Fig. 3, the shape of the data did not suggest a strong correlation, nor did it justify the use of a linear regression. Previous studies found relationships between class size and the overall level of participation in the class [12] or the participation gender gap [18], [40], while others did not observe such effects [41]. Unfortunately, the present results could not bring additional clarity to this literature.

2) Type of Comment: Observers assigned each comment a category for how it arose (“solicited,” “unsolicited,” or “involuntary”) and its content (“concept question,” “clarifier,” “answer,” or “general comment”), described further in Section IV. The percentage of comments from women within each category is shown in Fig. 4, along with the overall percentage of women students observed. Again applying exact, two-sided binomial tests with $\alpha = 0.05$, every category except for involuntary showed a statistically significant gender gap, with around 20% of comments coming from women. The proportion of involuntary comments from women (45.5%) was the same as the proportion of women in the students observed.
Fig. 5. Analysis of comment order showed (a) in the classes overall and in the subgroup taught by men, women contributed a higher proportion of comments directly after another comment by a woman. No significant difference was observed in the subgroup taught by women. (b) This spike in the likelihood of comments from women decayed as the number of comments since the last comment from a woman increased. Error bars show Wilson score 90% confidence intervals.

(45.5%). Notably, this category had the smallest sample size, with only three instructors—two men and one woman—ever employing the strategy of calling on students who had not raised a hand. Still, the lack of a gender gap in this category suggests that the instructors who used involuntary calling were equally likely to select men and women students in the process. This will serve as a useful control in interpreting the results on the role of classmates described in the next section. Overall, however, the analyses of structural factors fail to fully explain the participation gender gap and point to the need to look beyond such factors and consider the role of classmates.

B. Role of Classmates

1) Comment Order: The role of classmates was first incorporated by analyzing how the order of student comments is related to the participation gender gap. As seen in Fig. 5(a), there was a statistically significant relationship between the gender of a speaker and the likelihood their comment was followed by one from a woman. Directly after a woman’s comment, 31.6% of comments were from women, but directly after a man’s comment, just 17.3% were from women. Note here that the use of “directly” refers only to the order of student comments and not their separation in time, which will be analyzed later. Both of these values were significantly different from the overall proportion of comments from women (20.3% as reported above), with \( p < 0.001 \) after a woman’s comment and \( p = 0.014 \) after a man’s comment. However, the significance of these \( p \)-values assumes the samples (in this case, individual comments) are independent, as required by the binomial tests. An alternative explanation, given the data, is that the samples are actually dependent—the probability of participation by a woman depends on the gender of the preceding speaker. This highlights the importance of considering the role of classmates, both for its influence on the participation gender gap and for its implications on the validity of statistical analyses used to analyze other factors.

Breaking the data down revealed that the effect of comment order varied with instructor gender, also illustrated by Fig. 5(a). After a woman’s comment in classes taught by men, 26.6% of comments were from women; after a man’s comment, this number dropped to 15.1%. The former deviated significantly from the overall proportion of comments from women (17.1% as reported in the previous section), with \( p < 0.001 \) after a woman and \( p = 0.090 \) after a man. Thus, women in classes taught by men were significantly more likely to speak if a woman had just spoken. Conversely, in classes taught by women, no such phenomenon was observed. Directly after a woman’s comment, 48.3% of comments were from women (\( p = 0.898 \)), while after a man’s comment, 50.8% were from women (\( p = 0.898 \)). This suggested that student comments in classes taught by women were truly independent, with no significant effect of comment order. As before, it should be noted that the sample size of 125 comments in classes taught by women was much smaller than the 1186 comments in classes taught by men.

To probe the longevity of this effect, the analysis was repeated for the second comment downstream, then the third, and so on, until the next comment from a woman, which restarted the count. As shown by Fig. 5(b), after a man’s comment, the proportion of comments from women remained relatively stagnant. After a woman’s comment, however, there was the initial spike to 31.6% of comments from women followed by a gradual decrease. By the third comment, there was no longer a significant difference from the overall proportion of comments from women, with \( p = 0.488 \) for the observed proportion of 17.4%. Correlation analysis showed the proportion of comments from women was strongly correlated with the number of comments elapsed since the last comment from a woman, with a Pearson’s correlation coefficient of \( -0.769 \). Note that these numbers only reflect the influence of a single comment from a woman and do not consider the possible compounding effects of several women speaking in succession. Still, these novel results suggest that overall and particularly 
in classes taught by men, a comment from a woman leads to a transient but significant increase in the probability of another comment from a woman.

2) Comment Timing: To further understand the independence of classmate comments, the effect of their timing was also analyzed. Fig. 5(b) shows an analogous plot to that in Fig. 5(b), but now considering the time (in minutes) elapsed since the last comment from a woman. Similar to the results on comment order, immediately after a comment from a woman, there was a significant spike in the proportion of subsequent comments from women—32.4% within the first minute ($p < 0.001$)—followed by a decay over time. The correlation between the proportion of comments from women and the elapsed time was somewhat less strong than in the analysis of comment order, with a Pearson’s correlation coefficient of $-0.699$. Furthermore, the significance of the increase in comments from women was lost after the first minute, with $p = 1.00$ for the 20.0% proportion observed within the second minute.

These results demonstrate that comments from women were often clustered in time, but that comment order was a more strongly correlated and longer lasting effect. It should be noted that the former was also generally true regardless of gender, as the average time between student comments overall was around 2 min. Thus, the combined analyses of the role of classmates on participation gender gaps yield the following three key results.

1) The gender of a student participant influences the likelihood that a woman will participate directly after them.
2) The strength of this effect decays with subsequent comments and elapsed time, though it is more strongly correlated with the former.
3) The effect is eliminated when considering only classes taught by women.

These point to the power of classmates to influence each other’s experiences and behaviors, even in a traditional, lecture-based setting.

III. Discussion

This study corroborated previous observational research showing a gender gap in verbal participation in collegiate STEM classrooms [18], [29], [30], though it was differentiated from these works by its focus on engineering classes specifically. Together, the classes observed had a larger proportion of women students than the national proportion of engineering bachelor’s degrees awarded to women [2], yet women still participated at less than half the expected rate. This raises red flags about the engagement of undergraduate women in engineering classrooms and whether efforts to recruit women into engineering will be sufficient to retain them and support their success. This participation gender gap was eliminated when considering only classes taught by women, consistent with previous survey studies in which men and women students reported more positive experiences with women instructors [10], [12].

Gender gaps in verbal participation can stem from a number of causes, but these can be primarily grouped based on the two sides of the interaction: 1) student and 2) instructor. On the part of the student, lower levels of confidence [4], [32], fear of making a mistake in front of the instructor [10], [11], imposter syndrome [33], [34], and other sentiments that have been observed of women in STEM fields may lead to a participation gender gap by discouraging women from volunteering to speak in class. The instructor, meanwhile, may induce a participation gender gap through unconscious biases [35], [36] that may lead to a gender imbalance in the students they call on, even if there is gender parity in volunteers. As there was no tracking of the number of hands raised that were not called on, these two effects cannot be separated in this analysis. That no gender gap was observed for involuntary comments (Fig. 4) suggested a lack of bias in instructors’ choices of students, but this conclusion was limited by the aforementioned small sample size in the category. Future work can track differences between the gender breakdown of volunteers and that of selected speakers, as well as additional data on instructor identity and behavior, to investigate the role of instructor biases more thoroughly. Within the scope of this study, however, and based on the involuntary comment data, it is hypothesized that the overall gender gap observed stemmed mainly from disparities in men and women students’ propensities to volunteer.

Bearing this in mind, the key contribution of this study was its novel exploration of the role of classmates. The analyses showed that in classes taught by men, after one woman participates, there was a significantly increased likelihood another woman would participate right after. This result, combined with the lack of a participation gender gap or effect of comment order in classes taught by women, suggested that women students felt more comfortable speaking after hearing any
woman speak, whether a woman instructor or a peer in a class taught by a man. This is highly encouraging for efforts to reduce the participation gender gap in engineering—while recruiting more women instructors is a necessary but long-term effort, leveraging the power of women peers in classes taught by men may be accomplished on a shorter timescale. Thus, introducing analyses of comment order and comment timing to the existing body of work exploring structural factors draws attention to the value and power of classmates in promoting equitable participation during lectures.

A. Implications for Teaching Strategies

These findings support a number of instructional strategies that have been proposed to engage students effectively and suggest they can also help to do so equitably, even when confined by the traditional, lecture-based formats that pervade STEM higher education [20]. For instance, the results plotted in Figs. 5 and 6 included all types of comments from women, including general comments unrelated to course content; yet it was still observed that a comment from a woman increased the proportion of additional comments from women right after. One way instructors can capitalize on the general nature of this effect is through the use of icebreakers—activities to promote casual conversation, which are commonly employed at the beginning of a course but have also been proposed for use throughout the semester as “re-energizers” [37]. Instructors can encourage participation from women by using icebreakers to seed initial comments from women at the beginning of a class period. A benefit of this strategy is that many icebreakers have no wrong answer, such as those that ask students about themselves or their interests; this may lower the bar for initial participation but still lead to a smaller gender gap in the future comments on course material.

Another way to ensure women speak at certain points in a class—thereby increasing the likelihood of voluntary participation from women afterward—is to involve women as co-instructors, guest lecturers, or teaching assistants in courses taught by men. The power of women role models to help younger women persist in STEM fields has already been established [38], [39], and this study suggests that using class time as an opportunity to introduce students to potential role models can have a direct impact on the participation gender gap as well. Inviting women to speak briefly on course content related to their research, for instance, can increase the helpful presence of women’s voices in classes otherwise instructed by men. Furthermore, this strategy can draw from early-career communities in engineering, such as postdocs or graduate students, where there is a greater representation of women than in university faculty [2]. This is helpful for temporarily overcoming the challenges posed by limited numbers of women instructors in engineering higher education—such as those that frequently restricted sample sizes in this study—until faculty diversity can be improved in the long term.

In conclusion, this work has identified a statistically significant gender gap in student verbal participation in lecture-based, undergraduate engineering classes. The analyses show that the gender of a student participant influences the likelihood that a woman will participate after them, pointing to the role of classmates. This effect is transient, losing significance as both the elapsed time and the number of subsequent comments increase. Finally, this effect, as well as the overall gender gap, are not observed when only considering classes taught by women. Together, these results suggest that any instance when a woman speaks in class—whether an instructor or a student, related to course content or conversational—has the potential to decrease the gender gap in subsequent participation, at least for some time. Thus, while long-term solutions for the participation gender gap should continue to focus on larger pedagogical, institutional, and societal overhauls, these findings may be leveraged to effect change in engineering education on a more immediate timescale.

IV. METHODS

A. Experimental Design

The study protocol was approved by Princeton University Institutional Review Board. The study included observational data collected from 89 class periods in ten engineering courses over the span of two semesters. Each course was taught by a different instructor, five of whom were men and five of whom were women; instructors were not informed of the content of the study. Course logistics determined how many individual class periods of a particular course were observed—e.g., the number of times the course met in the semester and the number of class periods for which the observation was readily nonobstructive. All courses were taught in a lecture format and met in person. The course content ranged from introductory to advanced (three introductory, four intermediate, and three advanced courses, judging by course numbers) and spanned mechanical and aerospace engineering, chemical and biological engineering, and civil and environmental engineering, with several courses cross-listed under multiple subjects.

Data on student verbal participation in each course were collected by an observer familiar with the course’s general subject area. An instance of verbal participation was defined as any time in the class period that a student spoke to the professor aloud and with the apparent intention that the whole class should hear. For each such comment made, the observer marked the minutes elapsed in class, the perceived gender of the speaker, and two categories referring to the way the comment arose and its content. Unfortunately, as this was a purely observational study, students were not able to self-identify their genders, and thus the results reflect the observers’ perceptions of students’ gender expressions as corresponding with “man,’’ “woman,’’ or “nonbinary.’’ The metric of perceived gender was also employed in a similar observational study of biology classrooms [29], but is not expected to match student gender identities in all cases.

To describe how the comment arose, the observer selected either “unprompted,’’ “solicited,’’ or “involuntary.’’ Unprompted comments were defined as those in which the student raised a hand or spoke without prompting from the instructor and the instructor then paused the lecture to address them. Solicited comments were defined as those in which the instructor asked the whole class for comments—for instance, by asking, “Does
anyone have any questions?” or, “Can anyone give the answer to this?”—and the student then raised their hand and was called on. Finally, involuntary comments were defined as those in which the instructor asked a specific student for a comment without the student having raised their hand. Observers also selected one of four categories to describe the content of the comment: 1) concept question; 2) clarifier; 3) answer; and 4) general comment. A concept question was defined as a question to aid the student’s understanding of course material, such as, “Why doesn’t Bernoulli’s principle apply here?” A clarifier was defined as a question clarifying a detail unrelated to the intellectual content of the course—for instance, “When is the homework due?” Observers were asked to use their own discretion as individuals familiar with the subject area of the course to distinguish between concept questions and clarifiers. Outside of questions, an answer was defined as a response to a question posed by the instructor, and a general comment was defined as anything that was neither a question nor an answer. Examples of general comments included anecdotes or conversational remarks that were said aloud for the whole class, such as, “We learned an acronym for this in another class!”

B. Statistical Analyses

Analyses were conducted in Python. To investigate the breakdown of verbal participation by student gender, the numbers of student comments from all classes were summed, amounting to 1387 total comments. The gender breakdown of the speakers of these comments was then calculated. For comparison, the numbers of students in all class periods were summed to give 4477 total students, and the gender breakdown of this group was calculated as well. Note that this number does not represent 4477 unique students—multiple class periods of single courses were observed and thus should have included repeat students. Furthermore, all courses were at the same university, so some students may have been enrolled in multiple courses included in the study. Since student identities remained confidential throughout data collection, it was not possible to identify the number of unique students observed, nor to know on how many occasions a specific student was observed. Summing the students in every class period accounted for this and was valid to test the null hypothesis that every student was equally likely to speak in class. To identify a statistically significant gender gap in student comments, an exact, two-sided binomial test was applied comparing the proportion of observed comments from women to the expected value, the proportion of women students. This analysis was repeated for the subsets of courses taught by men and taught by women to study the effects of instructor gender.

To study the effects of class composition and class size, the data were separated into ten groups for the ten individual courses observed. In this case, it was assumed the same students were present for all observed class periods within one course, give or take absences. Thus, the average number of students per class, rather than the sum over all classes, was used for each course. The gender breakdown of this average was compared to that of student comments to identify a gender gap in each course. OLS regression and Pearson’s correlation analyses were applied to identify relationships between the class gender breakdown or class size with the observed participation gender gap. The ability to study the former metric stemmed from this study’s focus on engineering as a whole, bringing together subfields with different levels of representation of women. This led to a mixed selection of class gender breakdowns, including five courses where men outnumbered women and five courses where women outnumbered men. This was in contrast to the previous observational studies that focused almost entirely on courses where women outnumbered men [29], [30]. To investigate differences between the comment types described above, the data were also broken down by category. Exact, two-sided binomial tests were applied to the data for each category to identify a statistically significant gender gap in student contributions of that comment type.

To analyze the effects of comment order, the data were divided into two groups based on whether the preceding comment came from a man or a woman. This reduced the sample size to 1311 total comments, since the first comment in each class period had nothing preceding it. The proportion of comments from women in each group was calculated, and exact, two-sided binomial tests were applied to determine if these deviated significantly from the expected value, the proportion of comments from women observed overall (note that this differed from the tests described above where the expected values were the proportions of women in the classes). These data were further broken down by instructor gender, with the same statistics calculated and hypothesis tests applied. To probe the longevity of the effect, this analysis was repeated for subsequent comments downstream of the initial comment, restarting the count at the next comment from a woman. A cutoff was applied once a sample size of less than 25 comments was reached; only qualifying points were plotted and used for Pearson’s correlation analysis.

Finally, the time dependence of the effect was probed by performing the same analysis as above but taking the minutes elapsed since the last comment from a woman, rather than the number of comments elapsed. All times were rounded up to the nearest minute for grouping purposes, so a time of “1 min” indicated comments that arose within the first minute, “2 min” within the second minute, and so on. A cutoff was again applied once the sample size decreased below 25 comments. As above, only qualifying points were plotted and used for Pearson’s correlation analysis.

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