Student Status in Peer Conferences

Daniel L. Reinholz
San Diego State University

This paper provides an analysis of students' peer assessment conversations in introductory college calculus. In particular, it explores gender differences in the types of feedback and word choices used by students. Using computer-aided textual analysis, it draws connections between the types of words that students use and their relative status in the class. Surprisingly, the use of pronouns based on gender did not follow what one would predict based on prior studies. Possible explanations and implications for future research are discussed.

Keywords: peer assessment; status; feedback; equity.

Introduction

Imagine one hundred calculus students trading papers amongst themselves and providing constructive feedback. You overhear the following in a peer conference:

> It said in the beginning of the problem that each statement below is true sometimes, and it says give an example of a function when it's true and when it's not true. For yours you only put when it's true, but when it's not true you didn't really put anything there.

As you continue walking, you overhear another student:

> I think the main thing is that for part A, I think there should be just one equation dV/dt and you would incorporate both dh/dt and dr/dt. I think just somewhere in your differentiation you didn't do something…I'm not sure what. I think there should just be one equation for dV/dt.

What could you learn about these students and this classroom based on the words you overheard? In the first excerpt, the student gives process-focused feedback, telling their peer what is required to answer this type of question, but does not give the answer itself. In contrast, the second excerpt is product-focused, describing the correctness of an equation. While both of these types of feedback can promote learning, process-focused feedback tends to promote better learning (Hattie & Timperley, 2007; Reinholz, 2015a).

What else could you infer? In the first excerpt, few first-person pronouns are used. Rather than saying what they *think* about their peer's solution, the student simply makes statements about what their solution *should be*. In contrast, the second excerpt features a large number of "I" statements. The feedback is clearly coming from the perspective of *that student*. This difference in pronoun usage is often indicative of status hierarchies (Pennebaker, 2011). The first student, who uses many more second-person pronouns, is likely of higher status than the student who uses primarily first-person pronouns. Thus, simply by looking at the types of pronouns students use in the conversations, it may be possible to uncover subtle status hierarchies in the classroom.

This paper responds to recent calls to focus on issues of equity in undergraduate mathematics (Adiredja & Andrews-Larson, 2017). By studying the language use of students in calculus, it provides insight into status hierarchies, which are of consequence for understanding how students may have access to differential opportunities to learn (e.g., Cohen & Lotan, 1997). This

article focuses on the following research questions: *How does participation differ for individual students, or groups of students (e.g., by race, gender)?* In light of this question, the implications of using peer assessment as a tool to create more equitable learning opportunities are discussed.

Theoretical Framing

A large body of literature connects classroom discourse and learning (Bransford, Brown, & Cocking, 2000; Lampert, 1990; Sfard, 2008). This literature emphasizes opportunities to participate in meaningful discourse constitute opportunities to learn (Hufferd-Ackles, Fuson, & Sherin, 2004; Michaels, O'Connor, Hall, & Resnick, 2010). Simply speaking during class, for instance, in low-level, Initiate-Response-Evaluate (IRE) sequences (cf. Cazden, 2001; Mehan, 1979), is insufficient to promote deep learning. Rather, students need opportunities to engage with mathematics in cognitively demanding ways that push them to engage in mathematical sense making (cf. Stein, Grover, & Henningsen, 1996).

Simultaneously, a growing literature has examined issues of equity in classroom discourse (Esmonde & Langer-Osuna, 2013; e.g., Herbel-Eisenmann, Choppin, Wagner, & Pimm, 2012). This literature highlights how subtle inequities can emerge, particularly in terms of gender, race, and other social markers. For instance, some groups tend to receive lower-level participation opportunities, based on their gender (Sadker, Sadker, & Zittleman, 2009), race (McAfee, 2014), and immigration status (Planas & Gorgorió, 2004). While these patterns of marginalization often emerge unintentionally, they are nonetheless problematic and require attention.

For the purposes of this paper, equality is taken as a necessary but insufficient baseline for equity (Secada, 1989). While it may be impossible to decide exactly what instruction is required to provide *equitable* opportunities for all students, it is clear that if students from historically-marginalized groups receive proportionally less opportunities to participate than their historically-dominant peers (which literature shows is often the case), it is highly problematic. In other words, if all students receive at least *equal* opportunities to participate, it is a positive (yet insufficient) step in the right direction.

Accompanying the wealth of literature describing inequity in discourse, there are also valiant efforts to reduce such inequity. One well-known example is the set of techniques associated with Complex Instruction. These instructional moves (e.g., the multiple ability treatment, assigning status) help mitigate status hierarchies in heterogeneous classrooms, leading to more equitable outcomes for all students (Cohen & Lotan, 1997; Nasir, Cabana, Shreve, Woodbury, & Louie, 2014). In other words, power imbalances (e.g., who is perceived as an authority) lead to less equitable outcomes (Engle, Langer-Osuna, & Royston, 2014; Langer-Osuna, 2016), but when these imbalances can be addressed, learning becomes more equitable (Cohen & Lotan, 1997).

The above literature highlights how issues of inequity arise across a variety of mathematics classroom settings. This paper focuses particularly on calculus, which is known to significantly decrease student confidence, enjoyment, and interest in mathematics (Bressoud, Carlson, Mesa, & Rasmussen, 2013). While these effects impact all students, they differentially impact non-dominant students. For instance, women with the same grades as men are 1.5 times as likely to leave the calculus sequence (Ellis, Fosdick, & Rasmussen, 2016). Moreover, there are salient societal narratives about who can and cannot do mathematics, which can have a negative impact on students (e.g., Nasir & Shah, 2011; Stinson, 2008). In other words, the status quo for calculus is severe inequity. A classroom that were to achieve *equality* would be a considerable step in the right direction.

From this backdrop, the present study focuses on issues of equity and status in peer conferences. Peer conferences are an important feature of peer assessment (cf. Falchikov & Goldfinch, 2000; Topping, 2009), and offer unique opportunities for addressing issues of inequity in discourse. In particular, peer conferences generally involve only two students, so the complexities of promoting participation from all students in a small group or a whole class are reduced. Moreover, peer conferences position students as competent authorities, because they must critically judge the work of their peers, which provides them with space in the classroom to act as experts (cf. Engle & Conant, 2002; Reinholz, 2015b).

Method

Context

The present study took place in calculus I at a relatively large (over 30,000 students), racially diverse (e.g., ~65% students of color) research-extensive university in the US. The course consisted of a combination of large lectures (100-200 students) taught by full-time instructors and smaller breakout recitation sections (30-40 students) taught by Graduate Teaching Assistants. This paper focuses on a single large-lecture section (N=124), which met three times weekly for 50 minutes at a time. In addition, students in the lecture met twice weekly for 50 minutes for their recitation sessions, but those sessions are not a focus of this paper.

Design

Each week students engaged in a peer assessment learning activity called Peer-Assisted Reflection, or PAR (Reinholz, 2015b; Reinholz & Dounas-Frazer, 2016). The goal of PAR is for students to develop self-assessment skills as they assess the work of their peers (Black, Harrison, & Lee, 2003; Reinholz, 2015c). Specifically, PAR consists of a four-part cycle through which students: (1) complete a draft solution to a conceptual mathematics problem for homework, (2) reflect on their solution by identifying which aspects of their solution they would like to receive feedback on, (3) trade papers with a peer in class and exchange peer feedback, and (4) revise their work before turning in their solution. Students receive homework credit both for the correctness of their solution and for completing the PAR process, which encourages students to revise their work (in practice nearly all students do so). Prior studies show that PAR has a significant impact on student learning (Reinholz, 2015b, 2016), but the learning impact of PAR is not the focus of the present study.

This implementation of PAR differed from prior iterations (in nearly 20 courses), because it took place a large-lecture course, which imposed different logistical constraints. In terms of the actual PAR process, students were able to engage productively during their large lecture sessions: they simply turned to a peer, traded papers, and conferenced about their work. Yet, prior research suggested that PAR was most effective when students chose their partners randomly, as this allowed them to get a variety of perspectives and it changed the dynamics of peer relationships (Reinholz, 2015b). While students were encouraged to choose new partners each week, in practice, this was difficult to enforce because of the large-lecture environment. Moreover, the large number of students enrolled in the course (N = 124) meant that students received little feedback from the instructor on the quality of their PAR solutions and the feedback that they provided to their peers, in contrast to prior implementations of PAR. Because students received less feedback about the quality of their feedback, it was assumed that the learning impact of PAR would be lessened somewhat.

During the feedback exchange component of PAR (step 3), students read each other's work silently for five minutes and write comments, and then have five minutes to discuss their feedback. Forcing students to engage silently with each other's work before the discussion helps ensure that students actually talk about their peers' solutions, not just the problem. Moreover, PAR positions both students as competent, as they *both* provide feedback to one another, rather than creating an asymmetric relationship in which only one student provides feedback to the other. This was a feature designed to promote student authority (cf. Engle & Conant, 2002). In the context of a large-lecture course, this was intended to provide *all* students with opportunities to engage in meaningful talk around mathematics, which can otherwise be difficult to facilitate in whole-class conversations.

Participants and Data

A total of 84 students participated in the study (in a class of N=124). Demographic information was collected from the university's office of Institutional Research (see Table 1).

Table 1. Participant demographics (N = 84).

	Women	Men	**Total**
African American	0	3	**3**
Asian/Pacific Islander	4	11	**15**
Hispanic	8	16	**24**
International	0	1	**1**
Multiple Ethnicities	1	4	**5**
White	9	19	**28**
Unknown	4	4	**8**
Total	**26**	**58**	**84**

The primary data source for this article was students' peer conversations. During their PAR conferences students recorded their conversations (the second part of their feedback exchange) using audio recorders on their cellular phones. A total of 172 conversations were recorded in this way. While the majority of conversations consisted of student dyads, some of the conversations involved three students at a time. To account for a variable number of students in certain conversations, a unit of 'participant-conversations' was used for analysis, which represents how many times some student from a particular group participated in some conversation. This paper focuses on gender of students. There were 116 participant-conversations for women, and 254 for men.

Analytic Methods

To support data analysis, all conversations were transcribed and linked to student names. This allowed for demographic information to be attached to each individual student contribution. Cleaning of the dataset and data analysis was completed in R statistics, using a variety of text processing packages (e.g., stringi, lsr, lexicon). Student conferences were analyzed for the type of feedback provided using a prior coding scheme that focused on process, product, and person feedback (Reinholz, 2015a). Student conferences were also analyzed for their pronoun usage. In particular, when students have higher status, they tend to use fewer first-person singular pronouns, more first-person plural pronouns, and more second-person pronouns (Pennebaker, 2011). Thus, by looking at the relative use of pronouns in these three categories, it was possible

to explore issues of authority in peer conferences. One would expect that historically dominant students (e.g., White/Asian men) would speak as though they had more status.

All analyses must be interpreted with some caution. For instance, a wealth of literature highlights differences in word usage based on gender (Argamon, Koppel, Fine, & Shimoni, 2006), task characteristics (Newman, Groom, Handelman, & Pennebaker, 2008), topic (Bamman, Eisenstein, & Schnoebelen, 2014), and age (Huffaker & Calvert, 2005). Despite this level of nuance, some commonalities exist across settings. For instance, women tend to use first-person singular, cognitive, and social words more, while men use more articles, and there are no meaningful differences for first-person plural or positive emotion words (Pennebaker, 2011).

In sum, one can expect that there will be differences in word usage by different groups of students in the peer assessment process, simply by virtue of their membership in particular gender, racial, or other demographic groups. Simultaneously, it will be difficult to predict in advance what these differences may be. Nevertheless, as others continue to look at such patterns of word usage in other educational contexts, this paper will provide a baseline to compare to.

Finally, it is recognized that reducing socially-constructed identities (e.g., based on gender, race) can be potentially problematic, as it obscures that positioning individuals is a power-laden process (Davies & Harré, 1990). While it can potentially be problematic to essentialize such characteristics, it can also be 'strategic,' as a tool to highlight or address inequities (Gutierrez, 2002). In other words, this strategic essentialism makes it possible to illuminate subtle patterns of inequity (e.g., men speaking more than women), which are problematic and need to be addressed. As such, essentialism can be used as step towards greater equity, while acknowledging the need for complementary approaches that treat social markers more fluidly (e.g., Nasir, McLaughlin, & Jones, 2009).

Results

Table 3 summarizes students' word usage. To contextualize these results, they are compared to two prior iterations of PAR (Reinholz, 2015a). The table shows that in the present study each student contributed an average of 149.09 words to each conversation. These conversations were shorter than those in prior iterations. Also, at an absolute level, the Phase II conversations contained more feedback in these three categories than during the current study. Yet, when looking at density of feedback, the amount of feedback based on how many words were spoken is highest for the current study. In other words, it seems that students were saying more with fewer words, and likely there was less off-topic talk. Given differences in the implementation of PAR and student populations, it is difficult to identify exactly the source of these differences.

Table 3. Average word usage (by participant conversation)

	Present (N=370)	Phase I (N=116)	Phase II (N=184)
Total Words	149.09	163.17	295.19
Process Words	6.04	4.86	9.00
Product Words	1.32	0.70	1.07
Person Words	3.54	2.43	2.48

Figure 1 shows feedback types by gender. The data are expressed as an "equity ratio" (Reinholz & Shah, in press). This ratio describes the actual participation by students (in number of words), divided by what one would expect based on demographics alone. Thus, a ratio greater than one means that students contributed more than expected, a ratio of one is what would be expected, and a ratio less than one means that they contributed less than expected. Here we see

that men contributed more than one would expect for total words $\chi^2(1, N = 55284) = 102.67$, $p = 3.9 * 10^{-24}$, Cramer's V = 0.53 (large effect size). Women used more person-focused feedback (i.e. praise), $\chi^2(1, N = 1387) = 39.18$, $p = 3.85 * 10^{-10}$, Cramer's V = 0.33 (medium effect size). Men used more product feedback (i.e. describing right or wrong), $\chi^2(1, N = 484) = 19.2$, $p = 1.2 * 10^{-5}$, Cramer's V = 0.22. There were no significant differences for process words.

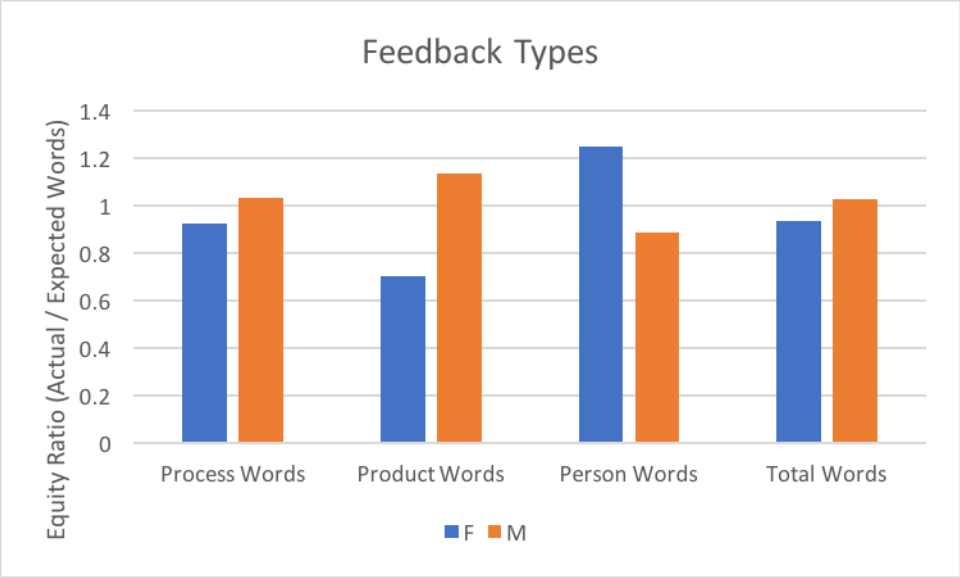

Figure 1. Feedback types by gender

What can be inferred from these results? Figure 1 indicates that men and women behaved the same when it came to giving process-focused feedback, which is the most valuable type for learning. Yet, there were also stylistic differences with men focusing more on correctness of the solution and women offering more praise. This provides contrast to some other settings, where women tended to use more positive emotion words (Pennebaker, 2011). On the whole, men did talk more, but the equity ratio for total words was near one. Thus, this statistically significant difference may have less practical significance.

Figure 2 shows pronoun usage by gender. Men used significantly more first-person singular pronouns $\chi^2(1, N = 3751) = 71.34$, $p = 3 * 10^{-17}$, Cramer's V = 0.44 (medium-large effect size), and more second-person pronouns, $\chi^2(1, N = 5121) = 24.25$, $p = 8.4 * 10^{-7}$, Cramer's V = 0.26 (medium effect size). There were no significant differences for first-person plural pronouns.

These results related to pronoun usage add a second layer of understanding. Across prior studies, women tended to use more first-person singular pronouns (Pennebaker, 2011), but the opposite was true here. This would generally indicate that the women were of higher status in these conversations, which is possible, but would contradict one would expect based on prior studies. Men used more second-person pronouns, which does provide some indication of higher status, but these equity ratios were much closer to one than for first-person singular.

To interpret such results, I considered the pairings of students based on gender. Of the conversations that included women, 42 of them were entirely women groups, and 29 of them were mixed gender. This indicates that women were mostly talking with their women peers, which may have had an impact on status differences. Moreover, in the cases where there were mixed-gender groups, these were chosen by the students, and they were typically friends in the class. This may have also had an impact. Finally, one must also consider that peer conferences

themselves could have been effective in mitigating some power differentials in the classroom, because they are highly-structured and generally take place between two students.

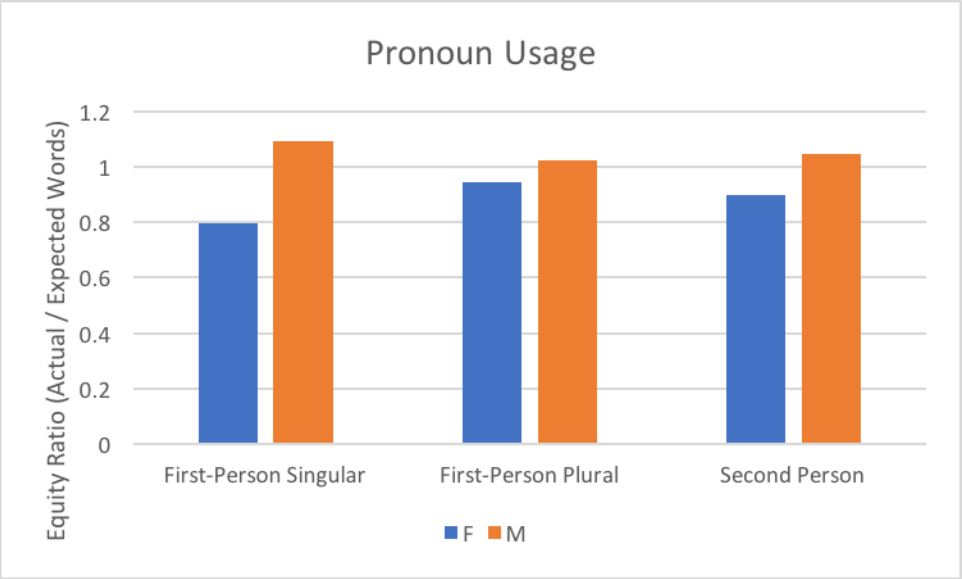

Figure 2. Pronoun usage by gender

Discussion

Promoting equity in classroom interactions is a challenge and an ongoing concern (e.g., Adiredja & Andrews-Larson, 2017). This paper offers a new method for studying such issues: analyzing pronoun usage in a peer discussion to study status differences. In future studies, this methodology could be used in conjunction with qualitative analyses to provide a deeper picture of such equity issues.

The paper also contributes a baseline understanding for gender differences in talk in undergraduate mathematics. The results are somewhat surprising, suggesting that the women in the class were actually of higher status in the peer conversations. Of course, further study is required, but this result suggests that peer conferences could be a powerful tool for promoting equity in the classroom space. They have a number of affordances that support more equitable interactions: they position students as competent, they are generally between two students, and they are highly structured. This structured nature of the activity makes it more likely that students from different groups will have an equal opportunity to contribute, rather than allowing historically dominant students to dominate. These are all issues for further study.

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