

Meeting: Tempe, Arizona Apr 20

2017 Pacific Southwest Section Paper ID #20701

Modes of feedback in design review process: Implications for utility and effectiveness based on student gender and tone

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Modes of feedback in design review process: Implications for utility and effectiveness based on student gender

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Abstract

During classroom design reviews, presenters receive and respond to questions from reviewers. Prior work has shown that using a written feedback process instead of an oral question and answer (Q&A) feedback process increases fluency and usefulness of comments in an introduction to design course, E4, at Harvey Mudd College.¹ This study further examines written feedback in the same setting and quantifies the degree to which students of different genders benefit from providing and receiving written feedback compared to oral feedback. The peer feedback process is examined for design review presentations during a preliminary conceptual design project for first and second year college students in a conceptual design course. The authors of this study are able to note the differences in these topics as a function of the gender of the commenter. The study suggests that (1) Women strongly prefer written feedback to oral feedback and men did not show a statistical preference, (2) that both women and men saw an increase in written feedback quantity when compared to oral feedback, (3) that women were much more likely to find the written feedback process to be candid than the oral feedback process while men did not see a statistical difference, (4) that both women and men saw that oral feedback missed more aspects of their design that needed improvement than written feedback did, (5) that, in this case, women were statistically more likely to contribute the best comments than men and that men were statistically more likely to contribute the worst comments, (6) and that this difference in gender ratio for best and worst comments is not attributable to tone.

Keywords: peer review, feedback, written feedback, oral feedback, student comments, gendered feedback.

1. Background

The common approach to providing and receiving feedback in a problem-based learning design course involves a formal presentation followed by a Q&A session for which students are encouraged to provide feedback on the presentation.¹ Ideally, this peer feedback design review process would be objective and produce actionable observations. The ability of presenters to receive such feedback should be divorced from bias toward either the process they applied or resulting artifact they created. The review process should educate the reviewers on how to identify and share strengths and opportunities in the design process, resulting artifact, and design review presentation. ^{2, 3, 4} A larger quantity of comments has been shown to give presenters a greater opportunity for improvement and reinforcement of observed strengths.^{5, 6, 7} As such, the review process should generate a thorough review of the presenter's work.

While peer feedback has demonstrated the ability improve both the design process and outcome, traditionally solicited Q&A does not actually serve the designers or presenters as well as written feedback does.¹ This may be due to the unaddressed barriers and disincentives to be candid as reviewers or to be receptive as presenters.⁹ Issues that may prevent candid and useful feedback exchange include the social repercussions of critical public comments of peers, fear of reciprocal

criticism of the reviewer's design work when they present, and the presenters' desire to defend work rather than receive feedback. These barriers may lead to both a potential self-censorship of feedback by reviewers and rejection of feedback by reviewed teams.¹¹

The motivation for this study arises from prior research that examined the role of structural and social barriers in formal design review situations in a search for ways to mitigate the social pressures of Q&A. Design student teams presented their design process and artifact to student reviewers. Each of three sections of reviewers was assigned to provide either written or oral comments. The class section that only had oral comments was used as the control. An increase in quantity and quality was observed in the written sections as opposed to the oral Q&A section. It was also found that there was a higher preference for written feedback rather than oral Q&A feedback.



Figure 1: Quality, comment sufficiency, and helpfulness of feedback evaluated on a Likert Scale by presenting students.

Although the findings concluded that written feedback is overall better with respect to quantity and quality, the breakdown of who benefits from this process has yet to be examined. Particularly in the engineering profession, where women are underrepresented, it is of interest to determine how the choice of the type of design review can disproportionately affect individuals of different genders. Studies have shown that women are likely to self-silence due to genderbased rejection sensitivity, or more likely to censor themselves for fear of facing social repercussions.¹² It is possible that the oral Q&A process disproportionately puts women at a disadvantage. The aforementioned circumstances are particularly true in fields for which women are underrepresented and face stereotype threat on the basis of their gender. Women may be excising themselves from review and feedback conversations due to greater sensitivity to these issues.¹²

The course setting for this study, consisting of 45.2% women in the study and 47% for the entire college class, provides an opportunity to study the distribution of written feedback preference by gender. This study seeks to quantify the degree to which undergraduate students of different genders rate the effectiveness of different methods of providing and receiving feedback. The

study also measures the quality of each comment by gender and explores differences in the perception of two modes of feedback-- verbal questions and comments compared to written questions and comments by gender.

2. Null Hypotheses

Our statistical null hypotheses are listed as following:

- 1. In a college engineering design class, there is no gendered preference for oral Q&A vs. written feedback.
- 2. There is no change in perceived openness and candidness of oral or written comments based on gender.
- 3. There is no change in the perception of missing aspects of the design that require improvement for oral or written comments based on gender.
- 4. Reviewer gender does not affect the quality of written feedback.
- 5. If there is a gender difference in feedback quality, it is not attributable to the degree of professional tone.

3. Method

This study was set at Harvey Mudd College, an all undergraduate liberal arts college with 47% women in the year this study was conducted. It takes place in Engineering 004: Introduction to Engineering Design and Manufacturing, an introductory, multidisciplinary, undergraduate level, design course composed of three separate sections that hosted three different testing conditions. The gender breakdown for women in each section are as follows: Section 1, 10 women, 11 men; Section 2, 9 women, 8 men; Section 3, 8 women, 14 men A preliminary design project is assigned as a part of this project-based learning course and students in teams of three or four must follow a conceptual design process and present prototype progress in class. Each of the sections consisted of approximately 22 students and participate in a design review in which students present their unfinished prototype to receive suggestions for improvement from the rest of the section using Q & A as well as online written feedback forms. Each section hosted a different test setting and differed from the other sections; however, each was internally consistent. All students in each section completed tasks, presented, and received feedback in like manner. These test conditions were replicated from a prior study.¹² The final finished prototype presentation was reviewed and given suggestions for improvement from the rest of the section after completing the project: 1. Traditional oral presentation followed by oral question and answers, 2. Traditional oral presentation followed by written questions and comments forwarded to the teams via email after the class, 3. Online video presentations with online feedback and in class discussion of the feedback with reviewers. All sections were given the same amount of time to present their work (9 minutes) and sections were grouped by course section, which was randomly assigned by the college registrar. The study kept all other factors that could lead to differences between sections consistent, including the time allotted to give comments to the presenting team. Data from this study includes the initial feedback from the design review, the response to the initial feedback during the design review, and the final feedback process evaluation conducted after the final presentation. The evaluation of the feedback process was

evaluated on a 5 –point Likert scale (1- Strongly Disagree, 2- Disagree, 3 –Neutral, 4 – Agree, 5 – Strongly Agree).

- 4. Results
- 4.1 Treatment of Data

Different techniques for providing feedback are explored during design reviews in the course. The study considered different modes of presentation (in-class vs. video recorded), feedback format (written vs. oral Q&A), and reviewer interaction (absent, immediate, and delayed). The comparative benefits of written vs. oral Q&A are examined specifically.

Important metrics used to examine the feedback process included the quantity of best and worst comments for each gender, the professional tone of the comments as perceived by the presenter, the openness and candidness of the comments as perceived by the presenter, and the perception of the feedback process by all members. This information is collected on a 5 point Likert scale for each gender.

Other factors, such as the project or projects considered and the time available for presentations, were held constant between sections. Nevertheless, other factors may vary between sections resulting in differences between them. There are approximately the same number of men as women in each section so these different conditions equally affect men and women. The final feedback process evaluation after the final presentation was conducted after all students in the class had experienced written and oral feedback processes.

The statistics for this data was run using two way and one way ANOVAs in R.

4.2 Feedback Preference

To measure the feedback preference for the course, the students were asked the following queries: "Oral feedback was excellent" vs. "Written feedback was excellent" to answer on a Likert scale. As consistent with the previous study, analysis showed that the students overall preferred the written feedback process over the oral feedback process (Figure 2). That is, written feedback had a higher average student response than oral feedback. Upon running a two-way ANOVA, this finding was found to be significant with a p value of 0.0277 (Table 1).

When dividing the data set by gender (Figure 3), analysis showed that women preferred written feedback over oral Q&A feedback. A one-way ANOVA on women's' responses showed that this difference was significant with a p value of 0.0189. There was no preference for men, as the p value for the effect of comment type on responses from men was 0.5. Responses between men and women were not different, as shown by the p values from one way and two way ANOVAs with Gender as a source of variability.



Figure 2 and 3: (2 Left) The average student response for all sections rating written and oral feedback excellence on a Likert Scale. (3 Right) The average student response for all sections rating written and oral feedback excellence on a Likert Scale and divided by gender.

Subset Tested	Source of Variability	p value
All	Comment Type	0.0277
All	Gender	0.5365
Women	Comment Type	0.0189
Men	Comment Type	0.5000
Oral	Gender	0.5440
Written	Gender	0.1170

Table 1: Results of two way and one way ANOVAs displaying the p values due to Comment Type and Gender for various subsets of the data on feedback excellence.

4.3 Quantity

To measure the feedback quantity for the course, the students were asked following queries: "I received sufficient quantity of peer feedback on my design review during the question and answer period" vs. "I received sufficient quantity of peer feedback on my design review from the written comments" to answer on a 5 point Likert scale. As consistent with the previous study, analysis showed that the quantity of comments received as perceived by presenting students was higher for the written process than for the oral process (Figure 4). That is, written feedback had a higher average student response than oral Q&A feedback did. This difference was statistically significant with p < 0.0001 (Table 2).

Evaluation of the data set by gender showed that both men and women significantly reported receiving a larger quantity of comments from written than oral feedback with p values of 0.0003 for women and 0.0139 for men. There was no statistical difference between the responses from men as compared to women (Table 2).



Figure 4 and 5: (4 Left) The average student response for all sections rating written and oral feedback quantity sufficiency on a Likert Scale. (5 Right) The average student response for all sections rating written and oral feedback quantity sufficiency on a 5-point Likert scale and divided by gender.

Subset Tested	Source of Variability	p value
All	Comment Type	< 0.0001
All	Gender	0.4020
Women	Comment Type	0.0003
Men	Comment Type	0.0139
Oral	Gender	0.1980
Written	Gender	0.9600

Table 2: Results of two way and one way ANOVAs displaying the p values due to Comment Type and Gender for various subsets of the data on feedback quantity.

4.4 Openness and Candidness

To measure the feedback openness and candidness, the students were asked following queries: "The written feedback I received was open and candid." vs. "The question and answer period feedback I received was open and candid." to answer on a 5-point Likert scale. Analysis showed that the openness and candidness of comments as perceived by presenting students was not statistically different for the written process as compared to the oral process with a p value of 0.1783 (Table 3)

Evaluating student response by gender showed that only women considered the written feedback process more open and candid than the oral Q&A feedback process (Figure 7). This difference was statistically different with a p value of 0.0429. There was no statistically significant difference for men with a p value of 0.7720. There was no statistical difference between the responses from men as compared to women for the query on the openness and candidness of written feedback; however, there was a statistically significant difference between the responses

from men as compared to women for the query on the openness and candidness of oral Q&A feedback (Table 3). Women perceived oral feedback to be less open and candid than men did (Figure 7).



Figure 6 and 7: (6 Left) The average student response for all sections rating written and oral feedback open and candidness on a Likert Scale. (7 Right) The average student response for all sections rating written and oral feedback open and candidness on a Likert Scale and divided by gender.

Subset Tested	Source of Variability	p value
All	Comment Type	0.1783
All	Gender	0.2216
Women	Comment Type	0.0429
Men	Comment Type	0.7720
Oral	Gender	0.0250
Written	Gender	0.2280

Table 3: Results of two way and one way ANOVAs displaying the p values due to Comment Type and Gender for various subsets of the data on feedback openness and candidness.

4.5 Missing Aspects

To measure whether presentation teams are missing aspects in their design, the students were asked following queries: "The question and answer period feedback I received missed aspects of the design review that require improvement" vs. "The written feedback I received missed aspects of the design review that require improvement" to answer on a 5-point Likert scale. Analysis showed that written feedback missed fewer aspects of the design review that required improvement than the question and answer period did (Figure 8). This difference is statistically significant with a p value of 0.0001 (Table 4).

Evaluating student response by gender showed that men and women on average agree that written feedback missed fewer aspects of the design review that required improvement than the question and answer period did (Figure 9). This difference is statistically significant (Table 4). There was no difference between the responses from men as compared to women for the query on the missing aspects of written feedback; however, women perceived that oral feedback missed aspects that required improvement more than men did (Figure 9). This difference is significant with a p value of 0.0159 (Table 4).



Figure 8 and 9: (8 Left) The average student response for all sections rating missing aspects for written and oral feedback on a Likert Scale. (9 Right) The average student response for all sections rating missing aspects for written and oral feedback on a Likert Scale and divided by gender.

Subset Tested	Source of Variability	p value
All	Comment Type	0.0001
All	Gender	0.0183
Women	Comment Type	0.0012
Men	Comment Type	0.0393
Oral	Gender	0.0159
Written	Gender	0.5010

Table 4: Results of two way and one way ANOVAs displaying the p values due to Comment Type and Gender for various subsets of the data on feedback missing aspects.

4.6 Best and Worst Comments

To determine the quantity by gender of best and worst comments given to each presenter, the students were instructed: "Please identify the three best comments" and "Please identify the three worst comments." The students were then instructed to rate each comment on a 5-point Likert scale for relevance, application to future work, and professional tone. Best comments were not defined to the students and definition varied from student interpretation. Comments identified by

presenters as "best comments" are statistically more likely to come from women than to from men after normalizing for the number of women and men in the aggregate sections' data set (Figure 10).



Figure 10: The normalized ratio of best and worst comments divided by gender.

To determine the distribution of the best and worst comments for each individual in the class, a histogram was created for best and worst comments to determine if outliers are pushing the normalized ratio in a specific direction (Figure 11 and 12). This distribution was then used to create a sum of "best" and "worst" comments made by each person and separated by gender to be graphed on percentage basis. Each best comment counts as +1 and each worst comment counts as -1. The normal distribution of men has higher variance and lower average than that of women as shown in Figure 13.



Figure 11: The normalized percentage of individuals that gave different amounts of worst comments. There is a small percentage of men that can be outliers, as there is a person who gave 12 worst comments.



Figure 12: The normalized percentage of individuals that gave different amounts of best comments. There is a small percentage of men that can be outliers, as there is a person who gave 9 worst comments.



Figure 13: The normalized percentage of individuals that gave different sums of best and worst comments. This was separated by gender and the normal distribution is presented on the graph.

4.7 Tone

To measure the best and worst feedback professional tone, the students were asked following query: "The tone of this comment was professional and respectful" to answer on a Likert scale. Analysis showed that professional tone as perceived by presenting students was different for the best comments as compared to the worst comments (Figure 14). This difference had a p value of

0.067. Separating the best and worst comments by gender showed no statistical difference between the professional tone for men and women (Figure 15 and Table 5).



Figure 14 and 15: (14 Left) The average student response for all sections rating best and worst feedback professional tone on a Likert Scale. (15 Right) The average student response for all sections rating best and worst feedback professional tone on a Likert Scale and divided by gender.

Subset Tested	Source of Variability	p value
All	Comment Rating (Best/Worst)	0.0670
All	Gender	0.89

Table 5: Results of two-way ANOVA displaying the p values due to Comment Rating and Gender for all best and worst comments.

5. Discussion

5.1 Feedback Preference

As shown in Figure 2 there is a preference of written feedback over oral feedback. By splitting this data by gender, it becomes evident that this difference is driven by women who have a strong preference for written feedback. This difference is not driven by men, as men have no statistical difference for written feedback over oral feedback, however, there is no opposition to the written feedback by men. The reason for this strong preference and why it is only exhibited in women is unknown. In speculation, there is a veil of anonymity associated with written comments that is not present in the giving of oral questions and comments. Knowing that women are particularly in a position of alienation when giving comments in an oral Q&A STEM (science, technology, engineering, and mathematics) classroom setting,¹² this anonymity could mitigate the stereotype threat associated with women speaking in a public STEM settings. Stereotype threat is defined here as the burden from representing women as a whole or the worry of confirming stereotypes surrounding women in STEM. Lifting this could lead to the preference of written comments over oral Q&A by women. The authors would be interested in understanding if these results remain true for other fields of study where a stereotype threat

might be perceived, if they remain true in fields of study where such threat might not be perceived, and if they remain true in fields of study where the perceived stereotype threat is reversed by gender. In addition, other explanations such as the systematic selection of men over women in Q&A sessions may give women a greater opportunity to share their thoughts with the presenting teams. This could also explain the preference of written comments over oral comments among women.

5.2 Feedback Quantity

As shown in Figure 4 there is a statistical difference showing that the perceived sufficiency of comment quantity is greater for written comments than oral comments. This difference cannot be attributed to gender differences because both genders have statistical equivalent responses to the query. Note that this is the perception of the sufficiency of feedback quantity by the presenting student. Thus, this is not a qualitative amount of comments that is being evaluated. This is consistent with previous study on written versus oral feedback quantity.¹

5.3 Feedback Openness and Candidness

There is no statistical difference between written and oral Q&A feedback in terms of perceived openness and candidness when the data is composed of the aggregate data from men and women. However, when the data is separated by gender it is clear that women perceive written feedback as more open and candid than oral feedback and that no statistically significant preference is expressed by men. This finding would be otherwise unnoticed had it not been broken up by gender. The reason for this difference is unknown, but the result is still consistent with the prior findings considering that women prefer a written feedback process over the oral Q&A feedback process. As speculated earlier, women under the pressure of stereotype threat, could feel restricted in the types of comments they can give. This could lead into their perception of oral Q&A comments as less open and candid than written comments as women may feel they are unable to give candid and open comments. Investigation of this finding in other fields may help to identify if this or other factors are the cause of the difference in ranking by gender for this topic.

5.4 Missing Aspects

Figure 8 shows that women and men perceive that oral Q&A is missing aspects of their design that need to be improved. Women recognize this difference more than men do. The difference in Figure 8 between written and oral Q&A is driven by women recognizing that Q&A is missing more aspects of their design than men recognize. It is unclear if this difference is driven by the women being more aware of areas to improve their design than men originally or a comparatively higher receptiveness to and desire for feedback to improve.

Taken together with the information about open and candidness of comments these findings could suggest that when a review process misses areas of the design that the presenters believe need improvement, the perception of openness and candidness of that type of review decreases. Similarly, it is possible that when comments are perceived as less open and candid, the comment is perceived as missing more aspects of the design that needs improvement as a result. These findings may correlate as the perception of Q&A feedback is perceived as less open and candid

by women and as missing more aspects of the design by women, while this is not true to the same degree for men.

5.5 Feedback Best and Worst

As shown in Figure 10 with the comparison of best comments to worst comments by gender, there is a statistical difference in the ratio of women to men when comparing best comments to worst comments. Thus, women are statistically more likely to produce a best comment than produce a worst comment and men are statistically more likely to produce a worst comment than to produce a best comment in this particular data set.

Because this data was not expected to be statistically significant the histograms Figure 11 and 12 were produced. There are a few outliers for both Figures. Due to the relatively small sample size, the outliers may have been influential in the significance of the findings. There are a few men producing many worst comments and few women outliers producing many best comments. Figure 13 was created to look at the spread of best and worst comments for each individual person adding 1 for a best comment and subtracting 1 for a worst comment. On average, there should be the same amount of best comments as there are worst comments for each individual's (153 best comments total and 152 worst comments total). Based on this distribution, men have a much higher variance than women. Women have a lower variance but a higher average.

5.6 Tone

Figure 14 shows a statistically significant difference in tone for best and worst comments. The best comments have a better professional tone than the worst comments. The tone for men and women were separated to reveal whether the ratio difference in best and worst comments is attributable to a difference in tone between the genders. There is no statistically significant difference in tone when separated by gender. Thus, the difference in the gender ratio breakdown of best and worst comments cannot be attributed to a difference in tone among the genders.

5.7 Sample Size and Generalization

The sample size of teams in each section of this study (6) and the number of students in each section of this study is relatively small (n ~20). Differences between test conditions were examined to determine if they were statistically meaningful using two way and one way ANOVAs. Though the sample sizes were small, the differences noted as statistically significant are meaningful due to the amplitude of the difference between the mean values as well as the standard deviations of the populations. Though larger sample sizes are desirable, such populations may not be possible within the context of the course used as it is strongly desired to maintain a low student to faculty ratio. Similarly, this study was conducted in an introductory design course and the differences so noted may or may not persist in upper division courses or in other settings of introductory design courses. Nevertheless, it is noteworthy that the differences are statistically significant and that methods to increase the sample size in future work are of interest to the authors. Additionally, repetition of this research under similar conditions would be of interest.

5.8 Future Work

A drawback of the data retrieval process was that the data on overall process perception was gathered after the students had already completed their design projects. Examining the perception of the feedback process concurrent to the multiple stages of review could provide insight into how the perception of the feedback process changes over the course of review. Because the feedback evaluation process is time consuming in that it requires students to look over large quantities of individual comments and fill out multiple feedback forms, it would be helpful to streamline this process. Creating an application that organizes the feedback and makes it easier for the audience and presenters to review each other would be advantageous to the study participants and the investigators. It is possible that the process used for evaluation could have influenced the preference results.

The authors are interested in understanding why women were more likely to give a best than worst comment and why men were more likely to give a worse than best comment and if this finding is replicable. Additionally, it would be interesting to examine exactly why women perceive Q&A review as missing design improvement aspects and as less open and candid. Given that tone is a contributing factor toward making a comment either a best comment or a worst comment, investigating whether tone can be manipulated to increase feedback quality or quantity is a lingering question.

In future work, the authors intend to examine the relationship between the type of comment (positive, critical, balanced), the perceived tone, and quality of the comment. Although an increase in quantity of comments has been established for written feedback, the overall quality of comments remains to be investigated. It is possible that more feedback does not mean "better" feedback. The authors intend to understand the extent to which increasing the quantity of comments reduces the quality of comments. In addition, this study may benefit from analyzing instructor perspective on the process in addition to the student perspective.

6. Conclusions

Written feedback is preferred over oral feedback in an introductory engineering design class. Women strongly prefer written feedback over oral Q&A and find it more open and candid than oral Q&A. Women also perceive written oral feedback as missing aspects of their design that needed improvement. Men do not show a significant difference in open and candid feedback perception between oral and written comments. Men did find that oral comments missed aspects of their design that needed improvement, but this finding was not as significant as women's perception of missing aspects. In this study, women were more likely to give a "best comment" than men, who were more likely to give a "worst comment". The cause of this difference in comment quality was not attributable to comment tone. In future studies, the evaluation process will be streamlined for faster and more organized feedback. Other factors that may contribute to the quality, quantity and the perception of feedback will be examined as well.

This study was more feasible because of the near 50% gender representation of both men and women. Without this type of representation, many of the patterns that were observed would not have been significant enough to report, or would have been lost due to the uneven representation of one gender over another, namely men over women in the STEM field. Seeing that women greatly prefer written feedback over oral feedback, and men don't specifically have a preference

written feedback could make the review process much more accessible to women who may be silenced in a community consisting of a majority of men. Interestingly, this speculation presumes that the overall distribution by gender in the STEM field impacts behavior of students in a course and college where the gender balance is nearly equal. Whether this difference is similar at peer institutions with higher or lower ratios of men to women is an open and interesting question. Furthermore, because this study has seen that women are more likely to produce a best comment than a worst comment, this inclusion of women in the design review process would positively impact both the comment quantity and quality, benefiting those involved in the review process through a preferable process for women (neutral for men) with improved feedback quality for all presenters.

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