Why "why"? The Importance of Communicating Rationales for Edits in Collaborative Writing

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ABSTRACT

Collaborative writing is prevalent, yet is rife with issues of discomfort and miscommunication among others despite access to limitless text. Editing, one key activity in collaborative writing, is prone to such issues, and providing rationales could be a promising solution. To understand the efficacy of rationales in this context, we conducted an online experiment pairing 40 participants to co-write two essays on Google Docs—one without rationales (control) and another with rationales (treatment)—followed by post-experiment surveys (N=40) and interviews (N=11) with participants who received edits with and without rationales. Despite no significant differences between conditions in survey results, interviews revealed that most people preferred collaborating with those who provided rationales and perceived them more favorably. All interviewees deemed rationales important in collaborative writing and felt the pros outweighed the cons. We contribute design recommendations with illustrative examples for effective collaborative writing.

KEYWORDS

Collaborative writing, Online collaboration, Change awareness, Design recommendations, Mixed-methods investigation

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1 INTRODUCTION

Collaborative writing is one of the most ubiquitous forms of distributed work, whether it is researchers writing a manuscript together for a publication, students co-writing a project-based class report, or journalists writing and editing their articles. As such, collaborative writing has evolved from sending back and forth files, requiring version control [40, 41], to collaborative writing enabled by real-time synchronous editing services (e.g., Google Docs). Yet, despite extensive experience over the years, issues in collaborative writing still arise that cause people not to want to write together [42] and even get into conflict [10, 29].

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Even the actions we frequently take on these co-authoring platforms, such as editing and giving feedback, can be tricky. People still grapple with how to give feedback effectively to others, as they can be received in several ways that depend on one's alignment, valence (i.e., positive feedback is more readily accepted), goals, and credibility of those providing feedback, among others [9, 23, 27]. Interpretation of others and their motives critically affect how feedback is accepted; that to accept feedback, one must believe the "critic has good intentions and is being truthful" [9, 36]. Yet feedback and edits are not always positively received. Edits can be interpreted negatively because "visible actions in collaborative editing tools reveal only the actions themselves"and obscure the reason behind the edits [10]. This often leads to overinterpreting, misinterpreting, and even blaming others [8, 10].

People have been found to resort to various strategies to avoid such negative consequences. Collaborators made conscious efforts not to take edits personally [8, 10]. When leaving feedback, collaborators were found to "make and explain edits so as to minimize social conflict" [10], to be perceived more positively, and/or to curtail the negativity inherent in their actions [24, 38, 43].

While the efficacy of rationales has not been directly investigated, they emerged consistently (albeit tangentially) in several studies within the context of collaborative writing as an important, strategic aspect of editing. To those making and suggesting edits, rationales have been found to help explain and communicate with others and dampen the negativity that people may perceive in edits [10, 11, 28]. To those receiving edits, rationales make feedback seem more helpful, cohesive, and valuable [30, 45]. Rationales are not without their challenges—they can be difficult to explain clearly, lead to more discussions that may not contribute to the written product, and slow down the process of editing. Although rationales may be costly to provide, they ultimately helped to improve the co-written work [23] and influence the affect and comfort of ambiguous—and sometimes negative—actions in other contexts (i.e., social media) [35]. Yet we know little about what exactly are the roles and implications of rationales in the context of collaborative writing, despite hints of their promising potential. This gap motivates our main research question: *How does the presence of rationales affect perceptions of collaborators in collaborative writing?*

To answer this question, we designed a mixed-methods investigation that started with an experimental online study in which participants were randomly paired to anonymously write two essays using Google Docs. One participant in each dyad was designated as the First Author (FA) to write the initial drafts. FAs finalized the essays after receiving track-changed edits and comments from their paired collaborator, the Second Author (SA), who provided rationales in one essay (rationale condition) but not the other (non-rationale condition). This within-subjects study enabled us to capture how

people perceive collaborators who provide rationales and who do not while controlling for factors of collaboration dynamics and collaborator's writing (e.g., style, expertise). This was followed by post-experiment surveys with all FA/SA (N=40) and semi-structured interviews with a subset of the FAs (N=11).

Through surveys designed to quantify the FAs' perceptions of their collaborators, we found that SAs in the rationale condition (rationale-providers) were seen as providing the amount of comments FAs desired while the non-rationale-providers did not. While there was no statistically significant difference in the other survey results, we found that FAs had more positive perceptions of their rationale-providing collaborators through our interviews. Most FAs preferred rationale-providers, who were considered more dedicated, mature, and knowledgeable, among other traits. Providing rationales not only positively impacted FAs' perspectives of their collaborators but also their collaborative experiences. All unanimously highlighted that rationales are important in the context of collaborative writing—that rationales help collaborations and that their benefits outweigh the disadvantages.

In addition to contributing a novel experimental approach and presenting a compelling case for rationales, we provide design principles for platforms offering such collaborative opportunities: nudge collaborators to provide rationales, facilitate quick and easy communication of rationales, provide guidance on how to write rationales, and provider greater agency to users for their online actions. We believe these considerations for collaborative editing platforms can help facilitate positive collaboration experiences for users. Through this work, we contribute to a deeper understanding of how communicating rationales in the context of collaborative editing affects a collaborator's perception of their collaborators and suggest ways in which our tools can encourage writers to exchange rationales and thereby improve our collaborations online.

2 RELATED WORKS

2.1 Collaborative writing

Collaborative writing has long been a topic of HCI research alongside technological advances since early text processing in the 1980s and 1990s [4, 20, 22]. Early work highlighted multiple aspects to be addressed (e.g., version control [31], awareness [19, 41]) as well as formed a taxonomy of collaborative writing that delineated roles, activities, document management methods, and strategies employed in the process of writing [4].

Today, collaborative writing has become ubiquitous through a multitude of commercial, online collaborative editing platforms (e.g., Google Docs,[1] Microsoft Word,[2] Overleaf[3]). Much effort to understand how people write together has continued. Kim and Eklundh found in reviewing 15 writing tasks that collaborative writing usually entailed an asynchronous aspect, 57% were dyadic collaborations, and four authors were commonly the maximum number of collaborators [28]. Territorial behaviors that collaborators display have implications for introducing private spaces [17, 19] and are also further investigated in the context of collaborative writing in consideration of various aspects: considering the power differentials (e.g., students not wanting to directly edit their advisors' words), misattribution of credit, and privacy [42]. Researchers also found that the different stages of the writing process can affect collaborators' writing mode, thereby changing tools and assistance needed at different stages by analyzing interaction log [14, 32, 37].

2.2 Communicative actions in collaborative writing

There are various actions in collaborative writing that have communicative value; two common actions are giving feedback using track changes (or suggestions) and comments.

2.2.1 Track changes and communication around them. Track changes is a tool that one can turn on or off and enables collaborators "a way to make changes that are easy to spot" as they are displayed using different fonts (e.g., different color for added content, strikethrough for deleted content) [2]. The changes made by users in track changes mode "are like suggestions that you can review, and then remove them or make them permanent".

The visibility of track changes can be both helpful and detrimental: it can "improve collaborators' knowledge" or "incite social conflict" [10]. The authors found that receiving extensive edits, for example, could not only be interpreted as collaborators' thoughtful interaction but also be seen as "butcher[ing]" or being "overly critical" of their work; such interpretations, in turn, hurt their ego [10] and demotivate them [11]. Further, they found that how software presents collaborators' actions (e.g., track changes being displayed in red contributed to others' edits being perceived as "harsh and negative in tone") [10] and how it is mediated can also impact the recipients' perception [9]. "Maladaptive attributions", have also been found to occur due to technological constraints of distributed work in virtual teams [8], impacting performance quality [7]. Negative feedback as well as negatively perceived feedback had less likelihood of being accepted and incorporated [9, 27].

This kind of social tension persists for those who give feedback in collaborative writing as well. Researchers found that writers considered how their own edits would be interpreted and employed strategies to mitigate conflict (e.g., contacting the collaborator before edits were made, providing an explanation to avoid hurting others' feelings, or using annotation instead of track changes) [10, 28].

These findings gave rise to the design implications of incorporating communication features (e.g., chat function) to better support group dynamics. Birnholtz et al. found that communicating around documents was critical when finalizing documents together in dyads [11]. Relational effects of communication were not straightforward, however, as they found asynchronous communication amount to be inversely proportional to collaborator attraction and document ownership, while synchronous communication amount was positively correlated with attraction and ownership. Implications from this work included enabling users to show positive intent through language or features in addition to increasing collaborators' change awareness [41].

2.2.2 Comments and annotations. Comments are another tool that users can use to communicate with others [3]. Comments in collaborative writing serve various purposes, including sharing about

[1] https://www.google.com/docs/about/, Accessed May 9, 2022.
[2] https://www.microsoft.com/en-us/microsoft-365/word, Accessed May 9, 2022.
[3] https://www.overleaf.com/about, Accessed May 9, 2022.

progress, asking for clarification, and communicating about prior comments made [33]. Suchman and Trigg found that communication around collaborative writing included those around topic development (substantive communication); questions, clarifications, elaborations, and acceptances (annotative communication); and discussions around collaboration itself (procedural communication, e.g., topic transitions, conventions) [39]. Yet such communication in the form of comments was privy to numerous issues: "Writers don't understand comments, they think the comments reflect confused readings rather than problems in their texts, they are frustrated by perceived lack of consistency in comments and contradictory comments" [33, 34], suggesting designers to support various modalities of comments(e.g., text, voice, drawings) [4, 13].

Prior work has also found various aspects of specific practices and needs around comments. Weng and Gennari found comments used for various reasons, from asking questions to suggesting changes, yet the existing commenting tools available were insufficient as many opted to communicate in a separate medium (e.g., notes, emails) [44]. Cadiz et al. uncovered a need for annotation notifications while also finding that comments were not used when deadlines were imminent as the turnaround time was not fast enough [13]. People also avoided making minor comments, as they could be seen as "nitpicky" and "a waste of time for all writers to see comments on grammatical or spelling errors". Despite these shortcomings, researchers found that comments still allowed for discussions, negotiations, and explanations [10].

Despite the relatively greater richness afforded by textual input, in contrast with Like buttons on social media [25, 35], users have divergent opinions regarding the richness of annotations. Cadiz et al. found users avoided making high-level comments, as they felt it would be difficult to express such concepts through text, and some opted not to use annotations to clear up confusion [13]. Conversely, Birnholtz and Ibara found that comments "allow for explanation"; their interview study participants used comments to "handl[e] the tension between two desires: one to change a document and another to avoid conflicts" [10]. These contrasting findings obfuscate how collaborative platforms ought to design for their users. Further, while prior works have touched upon annotation usage, we need to better understand whether annotations themselves are problematic or whether there are particular aspects of them that can help or worsen collaborations. In our paper, we aim to elucidate the impact of one aspect of the annotation that we deem as critical to the reception of collaborative edits: *rationales*.

2.3 Role of rationales in writing

While prior works in the domain of collaborative writing have primarily focused on who, what, when, where, and how it progresses, another aspect of it is looking at *why*. The 'why' communicated between collaborators—as explanations, justifications, rationales—has been shown to be promising and important. In Kim and Severinson's work, collaborators exhibited group maintenance behaviors: some opted to suggest changes rather than revise other members' text, and some provided reasons for making edits (e.g., to avoid hurting others' feelings) [28]. Birnholtz and Ibara also found that group maintenance behaviors persist: writers seldom made direct changes in others' writing; if they did, they were found to provide explanations of changes (e.g., not with the intent to "attack" but rather to be "straightforward and constructive") in addition to using humor or emoticons [10]. Few research works have investigated the effects of rationale (and their absence) on the writers' perception of their collaborators and collaborations.

Rationales have also been shown to be helpful in various ways in the context of writing and design critique. Gielen et al. found that justified comments in peer feedback improved the performance of writing assignments in secondary school students [23]. These justified comments containing explanations or reasons for the suggestions helped recipients understand why, and the effect of rationales was superior to the accuracy of comments. Hicks et al. hypothesized that "peer review systems could benefit from design that elicits more explanations"; they found such explanatory feedback could be elicited from reviewers in the context of peer assessment, but that framing effects of eliciting more explanatory reviews could be at the expense of the quality of reviews [26]. Rationales are also important in the perceived value of design feedback. Yuan et al. found that "expertise did not correlate with any of the linguistic features" (e.g., writing style) in feedback, but rather the experts' ability to "produce clear justifications of the issues and suggestions" lead to "more cohesive pieces of feedback which facilitate understanding and applicability" [45]. Among many factors considered in crowdsourced design feedback, Krause et al. found that justifications were linearly correlated with the helpfulness of feedback [30].

In our investigation, we aimed to focus on the *why* in collaborative writing. beyond other facets emphasized in earlier work [19]. For this, we designed a mixed-methods study to investigate how rationale presence (or lack thereof) influence the collaborative experience. While prior works in this context have shown that rationales lead others to perceive the feedback received as being more valuable, cohesive, and helpful, we still do not know the extent to which this impacts the collaborative writing experience with collaborators. Therefore, we have set out to conduct a within-subjects experiment with only the existence of rationales while controlling for other factors (e.g., collaborator dynamics, and writing style).

3 METHOD

We conducted a mixed methods study involving largely three parts: collaborative writing experiment, post-experiment survey, and follow-up semi-structured interviews.

3.1 Collaborative writing experiment

The collaborative writing experiment was designed to investigate writers' perceptions of their collaborators with the existence of rationales in edits as the main independent variable: edits **without** rationales as the control condition and edits **with** rationales as the treatment condition. Two participants were randomly paired together to co-write two essays (§ 3.1.2) similar to previous work [11]. While these participants were told that they would collaborate with two different participants, they wrote essays together asynchronously in an anonymous writing environment (§ 3.1.1). To create the control and treatment conditions, we provided the same instructions for writing the two essays, then the researchers reviewed and modified the comments in one randomly selected essay that resulted in essays with and without rationales (§ 3.1.3).

3.1.1 Anonymous writing environment. We created an anonymous environment in which collaborators would write two essays together. This entailed creating two Google accounts—one for the First Author (FA) and one for the Second Author (SA)—through which the participants would contribute to the essays. Researchers provided the relevant login details[4] to the participants and facilitated the exchange between the collaborators—providing the links to Google Docs, where the essays were written—for anonymity to be kept. Each FA collaborated with **one SA (i.e., the same collaborator)** on two essays. Doing so enabled us to control individual factors (e.g., writing style, editing tone) of FA's collaborator; we were, in essence, creating an experiment with a within-subjects design.[5] However, FAs were told that they would collaborate with **two different SAs**. The anonymity facilitated by the platform and the researcher's mediation enabled FA participants to believe that they were collaborating with two separate participants. For each collaborating pair, researcher(s) intervened and removed all the comments with rationales from one of the two essays—one essay, from which rationales would be removed, was decided randomly with even distribution before the participants started writing in order to prevent researcher bias, with the randomization accounting for balanced conditions (more details about how the researchers intervened are in Step 3 of § 3.1.3).

3.1.2 Essay topics. Among various essay topics, we decided to use the topics for the Analytical Writing section of the Graduate Record Examinations (GRE) General Test. We selected this test, as it is a test that most students applying for graduate schools in the United States are required to take. By recruiting graduate students, we were able to control for the participants' experience in having taken this test. Deciding to use GRE essay topics also ensured choosing from a set of comparable essay topics. Furthermore, as these would be analytical writing prompts, they would be one type of academic writing that could motivate participants to be engaged in the collaborative writing task.

Of the two types of GRE essay topics—"issue" and "argument"—we decided to use two "issue topics" that were made available by Educational Testing Service (ETS), the entity that owns and administers the GRE tests [1].The issue topics were used, as their prompts were consistent and simple in their presentation. Issue topics usually consist of a single-sentence statement followed by instructions to write a response discussing the extent of one's agreement or disagreement with the statement. Among the issue topics available, we randomly chose two different topics.

- Government Topic (G): Governments should focus on solving the immediate problems of today rather than on trying to solve the anticipated problems of the future.
- Society Topic (S): To understand the most important characteristics of a society, one must study its major cities.

Instruction given below these statements were the same as those typically presented in GRE writing prompts: "Write a response in which you discuss the extent to which you agree or disagree with the recommendation and explain your reasoning for the position you take. In developing and supporting your position, describe specific circumstances in which adopting the recommendation would or would not be advantageous and explain how these examples shape your position".

3.1.3 Study design. Before engaging the participants, researchers randomly paired two participants and assigned each participant as the FA or the SA with consideration of the participants' desire to be audio-/video-recorded (as per noted in the consent form), which was a prerequisite for being an FA as they would later be invited to participate in follow-up interviews. The participants were assigned participant numbers, which consisted of a three-digit number preceded by "FA" or "SA" depending on the assigned role (e.g., FA489, SA784). The experimental study design consisted of five main steps delineated as the "Collaborative writing process" as shown in Figure 1.

Step 1: FA writing two initial drafts. As the first step, the FA was asked to write initial drafts of the essays. In addition to a link to a spreadsheet with the writing evaluation criteria (see Appendix A.2), the FA was given Google Docs links that were titled "G" or "S" followed by a three-digit number and contained the study prompt (§ 3.1.2) for topics of Government and Society respectively. We gave up to 50 minutes for each essay to be completed.[6] The order of essays written was randomized so that the number of FAs writing the Government essay first and the number of FAs writing the Society essay first would be balanced. Once the initial drafts were written, the FA was asked to complete a pre-study survey, gauging their collaborative writing expertise, familiarity with editing tools, demographics, etc. At the end of the survey, the FA was asked to book two times to finalize the essays.

Step 2: SA editing and making suggestions on the drafts with rationales. Prior to SA making edits to the essays, the researcher sent the SA a link to the pre-study survey that was similar to that which the FA completed; the survey contained the same questions and asked participants to book two times to contribute to the essays.[7] This pre-study survey was sent by the researcher in a timely manner such that the times scheduled by SA would follow the completion of the first drafts by the FA. For this step of the collaborative writing process, the SA was requested to provide contributions to the drafts of up to 50 minutes for each essay in the same order as the FAs; this ensured that the order in which SAs contributed was balanced in terms of the essay topics.[8] We provided concrete

[4]Passwords to these accounts were changed periodically so that participants who completed the study would not have access to the account.

[5]We considered designating one person as the SA and having the same SA interacting with multiple FAs to control for consistency of SA feedback. However, upon piloting this, we found that having one SA for the collaborations meant their expertise and experience with the essay topics increased with the number of essays they worked on. We felt this would lead to unfair evaluations of essay performance and opted to have a different SA for each pair; each FA would still work with the same SA on the two essays to allow for within-pair consistency.

[6]We informed the FA that they did not have to complete the two essays at once.

[7]We had SAs contribute in a different way than FAs' initial drafting method (Step 1) just in case the SAs' scheduled times were before their collaborator completed both essays. This method in which SAs contributed to the essays is the same as that of FAs finalizing the essays (Step 4).

[8]We chose to have the SAs collaborate on essays in the same order that FAs worked on the initial drafts; essay order was not statistically significant in any of the survey results (§ 4). There are four factors that we can randomize: (Factor 1) the order of FA's initial draft, (Factor 2) the order of SA's revision, (Factor 3) which essay to remove rational comments and (Factor 4) the order of FA's final revision. We randomized Factors 1 and 3 and kept the sequence to four options (vs 2^4 randomized options) to avoid confusion for the FAs and to simplify the study. Given the scale of the experiment (N=40, 20 pairs), randomizing all factors would cause imbalances in the number of dyads receiving the randomized conditions.

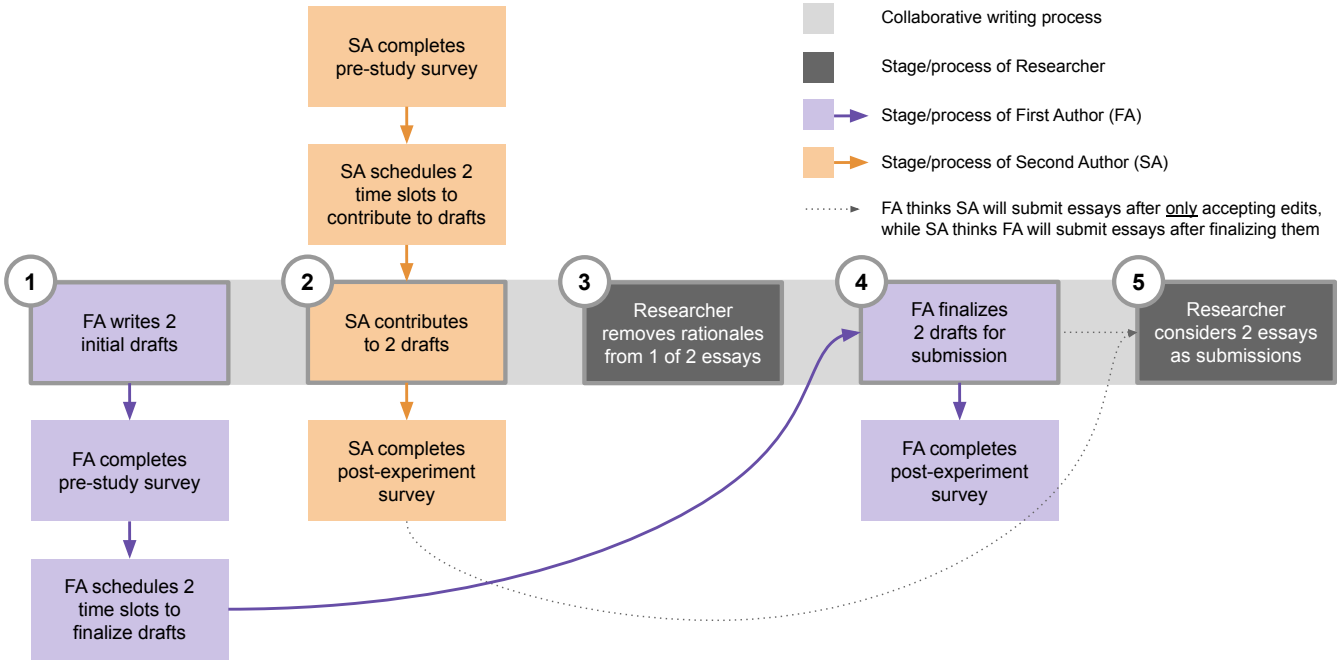

Figure 1: A diagram showing the process for the First Author (FA; in purple) and the Second Author (SA; in orange) to collaborate on two essays with the process of collaborative writing highlighted (in gray). Removing rationales from one of the two essays meant that one essay would be without rationales (control condition) while the other would be left with rationales (treatment condition). Numbers indicate the steps outlined in § 3.1.3.

guidelines asking the SA to contribute to the drafts in "Suggesting" mode—in which they can suggest changes without losing the original text that the FA can approve or reject—and to write comments. Particularly, *SAs were asked to provide rationales*—the reason why they suggested changes—for all changes and comments made (see Appendix A.1 for requirements that were communicated to SAs via email in written and visual forms).

Step 3: Researcher's intervention of removing rationales from comments. Once the SA completed their edits, the researcher reviewed the contributions made by SA to ensure that the requirements were met. For example, if an SA edited without providing rationales, the researcher reminded the SA of the required instructions and was asked to book an additional time to go through their edits to provide rationales. For one of the two essays, the researchers reviewed all comments and removed all the rationales present in the comments left by the SA so that one essay would have no rationales. For example, a comment such as the following was added by SA068 for the Society essay: "Rephrasing the ideas so as to connect them to the thesis statement". The researcher removed the rationale part of this comment starting with "so as to" for the without-rationale condition; doing so resulted in the comment being truncated to "Rephrasing the ideas". Rationales did not always have such phrases clearly indicating them as such and were presented as context for the suggested change, as in the case of a comment by SA922 for the Society essay: "this seems like a rather extensive list to add "etc." to at the end, consider picking specific themes that you will address later"; this comment was truncated to "consider picking specific themes that you will address later" after the rationale deletion process. This process was taken for all comments in the essay designated to be without rationales, which was predetermined randomly before both authors wrote the essay to prevent researcher bias as well as to ensure essays with and without rationales were balanced for both topics.

Step 4: FA taking SA's feedback and finalizing essays. Links to the revised essays were sent via email to the FA five to ten minutes before the times they had booked.[9] During the scheduled times, the FA made final changes to the two essays. The FA was told that SA would be able to review the final changes and comments, but they would not make any further changes and simply accept all the changes made by the FA. These instructions were given to keep our study lean (i.e., minimize the number of iterations) and maintain ecological validity by allowing for further communication from FA to SA if desired; additionally, this ensured that the FA would finalize the essays for review by the researchers. The FA was allowed up to 50 minutes to finalize each essay and was instructed to make all the necessary changes to the drafts. Upon completion of each essay, the FA was asked to complete the post-experiment survey, which probed their impressions of the two collaborators (who were essentially the same SA) they were asked to work with, including their perceived writing expertise, usage of track changes and comments, confidence, and trust in collaborator, etc.

[9] As the essay topic order and conditions were randomized with even distribution, the order in which FAs received and further collaborated on the essays with and without rationales was also balanced.

Step 5: Researcher validating study completion. As a final step, the researcher verified that the FA and SA had each completed their respective writing for the experiment. The drafts left in the essay links were taken to be the final submission made by the FA.

3.1.4 Collaborative writing study participants. The study was approved by the Institutional Review Boards at both authors' universities. Participants were recruited through listservs, social media posts, and word of mouth. Those who were 18 years old or above and had collaborative writing experience on an online platform (e.g., Google Docs, Overleaf) were eligible to participate. All participants were recruited individually. A total of 20 pairs of FAs and SAs participated (N=40, 20 FAs and 20 SAs) in the study from June 2021 to March 2022. FAs and SAs were compensated with a $50 and $20 Amazon gift card, respectively.

3.2 Survey study

We conducted post-experiment surveys with all FAs (N=20) to quantify their perceptions of the collaborative writing experience depending on whether their collaborators (i.e., SAs) provided rationales or not with their edits. In this survey, we focused on understanding (1) how the FA felt about their respective *collaborator/SA* and (2) their *collaborations* with the SA depending on whether they gave rationales or not. In terms of the individual collaborator, we aimed to compare FAs' perception of the rationale-provider and non-rationale-provider from various perspectives: writing expertise, the quantity of feedback, characteristics, and how pleased they would be to collaborate again. In terms of collaboration, we probed into their perceived effectiveness. Analyses of the relevant questions from the post-experiment surveys are in § 4 and the survey questions can be found in Appendix B.1.

We also conducted post-experiment surveys with all SAs (N=20) to understand specifically their perceptions of collaborative writing experience with respect to providing rationales, as SAs were asked to provide rationales for both essays. In these surveys, we asked SAs whether they provided rationales as per their preferred level of doing so; what they felt were advantages and disadvantages to providing reasons when writing collaboratively; agreement with statements of helpfulness, comfort, and effort regarding giving/receiving rationales; and their likelihood of providing reasons for collaborators as a result of participation in this study. Exact questions can be found in Appendix B.2.

3.3 Follow-up interview study

As a follow-up study to the experimental collaborative writing study, FAs were invited to participate in the interview study. The semi-structured interview method was chosen for its suitability in exploring "perceptions and opinions of respondents" and "probing for more information and clarification of answers" [5].

3.3.1 Interview questions. The semi-structured interviews consisted of largely two main parts, preceded by gathering an understanding of participants' general experience in collaborative writing and feedback. We asked questions including how long they had been writing collaboratively, general practices and expectations in giving and receiving feedback, and perceptions of track changes and comments. The two parts of our follow-up interviews consisted of questions about the collaboration asked *before* revealing the study condition—one essay with rationale and another without—and more general questions about the efficacy of rationales in collaborative writing *after* the reveal.

Before-reveal questions (Q1-Q5). We presented the drafts of the essays with SAs' contributions (i.e., essays after Step 3 of § 3.1.3 and before FA made final edits in Step 4) in shared screen mode, and asked participants about their perceptions of the two collaborators: (Q1) How did you feel about the collaborations with one SA versus another? (Q2) Who did you feel more communicative, and why did you feel this way? (Q3) Who did you like working with more? Tell us more about what made one collaborator better/easier to work with than the other. (Q4) Which essay do you think was written better, and why do you think that's the case? (Q5) Who would you like to work with to produce high-quality/better essays? And why?

After-reveal questions (Q6-Q7). We revealed the study conditions—that in one essay, rationales were present (i.e., SA was "rationale-provider") and that there were no rationales in the other essay (i.e., SA was "non-rationale-provider"). Before revealing which essay was in which condition, we asked whether they felt the difference in the presence of rationales between the two essays. We did not reveal the deceptive aspect of the study—that the rationale-provider and non-rationale-provider were in fact the same person—to avoid bias in the following questions. Once we revealed which essay was the one with rationales and which was without, we confirmed with the FA whether they agreed with this (all but one agreed). Then we asked questions regarding rationales: (Q6) Do you think providing reasons when writing collaboratively helps or hinders in achieving better outcomes? (Q7a) What would be the pros and cons of *receiving* rationales as a collaborator? (Q7b) What would be the pros and cons of *giving* rationales as a collaborator?

Finally, we inquired how similar or different our writing study was to their current collaborative writing practices with colleagues to confirm perceived ecological validity.

3.3.2 Interview participants. Once the FAs completed the writing experiment, they were invited to participate in the follow-up interviews. Of the 20 FAs invited, 12 opted to participate in the follow-up interview study. However, one FA did not feel that the study was ecologically valid; all others felt there were similarities between their usual collaborative writing and the study. Therefore, N=11 responses (Table 1) are analyzed and reported. All interviews were conducted online via Zoom and were approximately an hour long. Each interview participant was compensated with a $15 Amazon gift card for their participation in the interview study.

3.4 Analysis

We treated survey responses as non-parametric results and reported median responses. To understand the differences between conditions (i.e., with or without rationale) and essay writing order, we conducted Wilcoxon signed-rank tests. For survey questions that contained multiple responses (e.g., agreement to statements), p-values were corrected for multiple comparisons using False Discovery Rate (FDR) and reported as p_{FDR}.

As for interview results, audio recordings of the interviews were first transcribed and then separated by the questions asked in the

semi-structured interviews. Then we followed the six steps of reflexive thematic analysis for the responses; this started with familiarization of data and coding, followed by generating, developing, and finalizing themes within the respective categories [12]. For example, in understanding the pros and cons of providing and receiving rationales in collaborative writing, we defined themes within this template [21]. For this question, in particular, SA post-experiment survey responses were also included in this stage as we had relevant answers. This analysis was a recursive process that entailed reviewing responses across various questions and led to themes and counts of the responses for each as delineated in Table 2.

4 RESULTS

In this section, we report results from both perspectives—of providing and receiving rationales—gleaned from surveys and interviews. We interweave insights from post-experiment surveys that both FAs (N=20) and SAs (N=20) completed after their final contributions to each of the essays, as well as from 1:1 follow-up interviews with a subset of the FAs (N=11) to avoid redundancy of findings.

With Wilcoxon signed-rank tests, we verified that for all FA and SA survey responses, the essay topic (i.e., G, S) and the order in which these essays were written (i.e., G then S, S then G) were not significant. We conducted additional analyses for SA survey responses and found that the study condition (i.e., essay chosen as the one with a rationale) was also not significant for any responses (e.g., perceived level of rationale provision for the two essays).

4.1 Providing rationales reflects a collaborator's maturity and competence

From interview responses to Q1 and Q3 (before-reveal questions), we found that more than half of the FAs (7/11) preferred working with the rationale-provider. Many stated that **providing rationales** was what made the rationale-provider their preferred collaborator, with some even specifying this as a necessity: *"you obviously need explanations"* (FA271).

FAs felt that by providing rationales their collaborators **facilitated *"more discussion"*** (FA172) by creating *"room for us to discuss"* and ask follow-up questions such as *"should we collapse? ... should I use mine or use yours?"*. For similar reasons, FA461 preferred the rationale-provider: *"the collaboration experience [was] much better [with the rationale-provider] because there's more going backward and forwards between the two people who wrote this. The other one there is not really a lot of communication"*.

The rationale-provider came across as being **more dedicated**. FA687 preferred the rationale-provider *"because of a little more engagement with the content"*, as did FA026, who felt that the rationale-provider made an effort to *"understand my thought process"*. Providing rationales made the collaborator seem **more mature**: *"comparatively [the rationale-provider] felt more mature"* (FA172). Moreover, FA360 specified that the act of providing rationales leads to perceptions of a collaborator being **considerate** of others: *"It feels like they're trying to feel what you're feeling as they edit it. They tried to be cautious on editing and trying to explain why they are trying to edit it ... trying to assess their [collaborators'] feelings"*.

Finally, the rationale-provider came across as being more of an **expert** in writing and in the subject matter. FA360 associated rationales with greater **writing expertise** due to their ability to explain their thoughts: *"[the rationale-provider] also has the expertise to writing because, you are able to explain why ... saying something about it, or explaining it defines you're an expert on this kind of stuff"*. FA436, on the other hand, *"could sense [the rationale-provider] knew what he or she was talking about [and] was on point on their particular subjects"*, thereby highlighting that rationales enable collaborators to appear more **knowledgeable** about the subject matter.

These positive feelings for the rationale-provider were visible in FA survey responses (Fig. 2; Figs. 6 and 7 in Appendix D). Though not statistically significant (except for Fig. 2G), we found rationale-providers to be comparable to, or perceived slightly more positively than (i.e., higher medians or distributions skewing higher), non-rationale-providers. Comparing medians, the rationale-provider was seen as slightly more advanced in their academic writing capability (Fig. 2D). Further, collaborations with the rationale-providers were seen as being "Very effective" (median) while that with the non-rationale-providers seemed "Moderately effective" (Fig. 2A).

4.2 Providing rationales contributes to greater perceived communicativeness

Most FAs (8/11) felt that the rationale-provider was more communicative when answering Q2 (before-reveal question). They described that the presence of **explanations** and **context** made the rationale-provider seem more communicative: *"[The rationale-provider] added a comment to kind of elaborate on the changes that they made or sort of to explain the changes that they made, whereas [the non-rationale-provider] just changed things, but didn't say why they changed things, or why they felt that"* (FA594). Some specifically mentioned that this communicative characteristic was **not due to the quantity** of comments: *"the [rationale-provider] was more communicative ... it was not the quantity"* (FA271).

Rationales also contributed to the ensuing edits being easier and more comfortable. Communicating why SAs made the changes helped FAs feel **comfortable** receiving the suggestions and enhanced their perceived quality of writing as well: *"why I feel better about that essay [with the rationale-provider was] perhaps because of some of those few explanations"* (FA727). This communicative spirit also enabled FAs to comfortably **accept** the suggested edits: *"[the rationale-provider] made room for other changes for me to accept or [have] more discussion"* (FA172). Having rationales accompanying the suggestions led FA461 to feel *"I can just accept all the changes. I feel like this kind of collaboration is more interesting than the other paper [with the non-rationale-provider]"*.

Other factors that contributed to perceived communicativeness included one's **verbosity**, ability to **understand**, and **critical views** that manifested in suggested edits, as FA643 said of the non-rationale-provider: *"because their comments were longer, they started to address more fundamental flaws in my paper ... they understood my argument ... they were providing a critical eye ... [they] took the time to understand that argument first ... [the non-rationale provider] was actually trying to pick apart part of my argument ... most of my track changes are surface level arguments or fixes."* Still, FA643 noted that *"they're both good reviewers for sure ... if I had a reviewer like this on any of my papers, I wouldn't feel dissatisfied"*. Similarly, some FAs felt that both were equally communicative.

Table 1: List of First Author (FA) interviewees (more details in Appendix C) and their (1) collaborative writing experience captured in pre-experiment surveys, (2) assigned experiment conditions, and (3) interview responses regarding their collaborators. Collaborator comparisons include who the FA felt was more communicative ("Communicative"), who they liked working with ("Preference"), and who they would want to work with again ("Future"). G is for Government; S is for Society.

First Author (FA)	Pre-experiment survey responses				Study condition		Interview responses (before researcher revealed study condition)			
	Collaborative academic writing			Asynchronous collaborative writing frequency	Essay topic writing order	Essay topic with rationale	Mentioned one collaborator provided rationales	Collaborator comparison		
	Proficiency	Comfort	Preference					Communicative	Preference	Future
FA026 (28 M)	Competent	Somewhat comfortable	Prefer to write on my own	Sometimes	S then G	G	No	Both	Rationale-provider	Rationale-provider
FA271 (25 M)	Novice	Somewhat comfortable	Prefer to write with others	About half the time	S then G	G	Yes	Rationale-provider	Rationale-provider	Rationale-provider
FA687 (24 M)	Competent	Somewhat comfortable	Strongly prefer to write with others	Most of the time	S then G	G	Yes	Rationale-provider	Rationale-provider	Rationale-provider
FA594 (26 F)	Advanced beginner	Somewhat comfortable	Prefer to write with others	Most of the time	S then G	S	Yes	Rationale-provider	Non-rationale-provider	Non-rationale-provider
FA436 (34 F)	Competent	Very comfortable	Strongly prefer to write with others	Always	G then S	S	No	Rationale-provider	Non-rationale-provider	Non-rationale-provider
FA643 (22 M)	Advanced beginner	Somewhat comfortable	Prefer to write with others	Most of the time	S then G	G	No	Non-rationale-provider	Both	Non-rationale-provider
FA360 (23 F)	Proficient	Very comfortable	Prefer to write with others	Always	S then G	S	Yes	Rationale-provider	Rationale-provider	Rationale-provider
FA060 (27 F)	Advanced beginner	Neither	Prefer to write on my own	Always	G then S	S	No	Both	Both	Rationale-provider
FA461 (25 M)	Advanced beginner	Very comfortable	Prefer to write on my own	About half the time	G then S	G	Yes	Rationale-provider	Rationale-provider	Rationale-provider
FA172 (27 M)	Novice	Neither	No preference	Most of the time	S then G	S	Yes	Rationale-provider	Rationale-provider	Rationale-provider
FA727 (21 F)	Advanced beginner	Somewhat comfortable	Prefer to write with others	Most of the time	S then G	G	Yes	Rationale-provider	Rationale-provider	Rationale-provider

The communicativeness of rationale-providers was evidenced in FAs' survey responses as well. Rationale-providers used comments "as much as I [(FA)] wished to receive" (median), while non-rationale-providers "used it less than I [(FA)] wished to receive" (Fig. 2G). This difference was statistically significant ($p < 0.05$, paired Wilcoxon signed-rank test). This indicates that the number of comments in the rationale (i.e., treatment) condition matched the FAs' expectation and that this amount was perceptibly more than that in the non-rationale (i.e., control) condition.

SAs also completed post-experiment surveys—after collaborating on each essay—probing at how they felt about providing rationales. Their median response to the question "How would you describe your provision of reasons collaborating on this essay?" was "Provided reasons as much as I wished to" across all essays. Thus, rationales given sufficiently from the providers' perspective were, from the recipients' perspective, at the desired level.

4.3 Collaborator preference depended on many aspects including provision of rationales

All seven FAs who preferred the rationale-provider selected them again as the collaborator they would like to work with to produce high-quality/better essays if given a chance to collaborate again (Q5; before-reveal question). FA271 noted that this was *"because there was more **collaboration** and **communication**"* with the rationale-provider. Likewise, FA461 felt that *"the experience [with the rationale-provider] was more communicative so I feel it's a more **interesting** experience"* and wanted to continue that collaboration.

Two FAs, however, preferred the non-rationale-provider for their **alignment** despite being less communicative. **Similar writing styles** led FA594 to prefer the non-rationale-provider: *"while the [rationale-provider] was more communicative, I think I actually liked working on the paper better with the [non-rationale-provider] because we just wrote more similarly"* (FA594). **Aligned thinking** led FA436 to prefer the non-rationale-provider: *"I agree[d] with most of the comments [the non-rationale-provider] made."*

Finally, two FAs (FA060, FA643) felt that a clear distinction could not be made in favor of one collaborator over the other. Yet they diverged in who they would want to work with again. FA643, who felt that the study condition had been flipped, preferred working with the non-rationale-provider again because they seemed to have more **depth** of thought on the topic that would enable a more *"meaningful collaboration"*. To FA643, the rationale-provider felt like one of their *"undergrad collaborators"*, while the non-rationale-provider seemed like *"a grad student"*, but reiterated that *"both feedbacks was awesome in terms of the scope of people I've seen"*.

4.4 Even those providing rationales (SAs) see rationales as being helpful

SAs indicated their agreement with statements regarding the helpfulness, perceived comfort, and effort entailed in giving and receiving rationales (Fig. 3). We found the median responses to the **helpfulness** of rationales to themselves, collaborators, and collaboration were "Somewhat agree" and consistently skewed towards

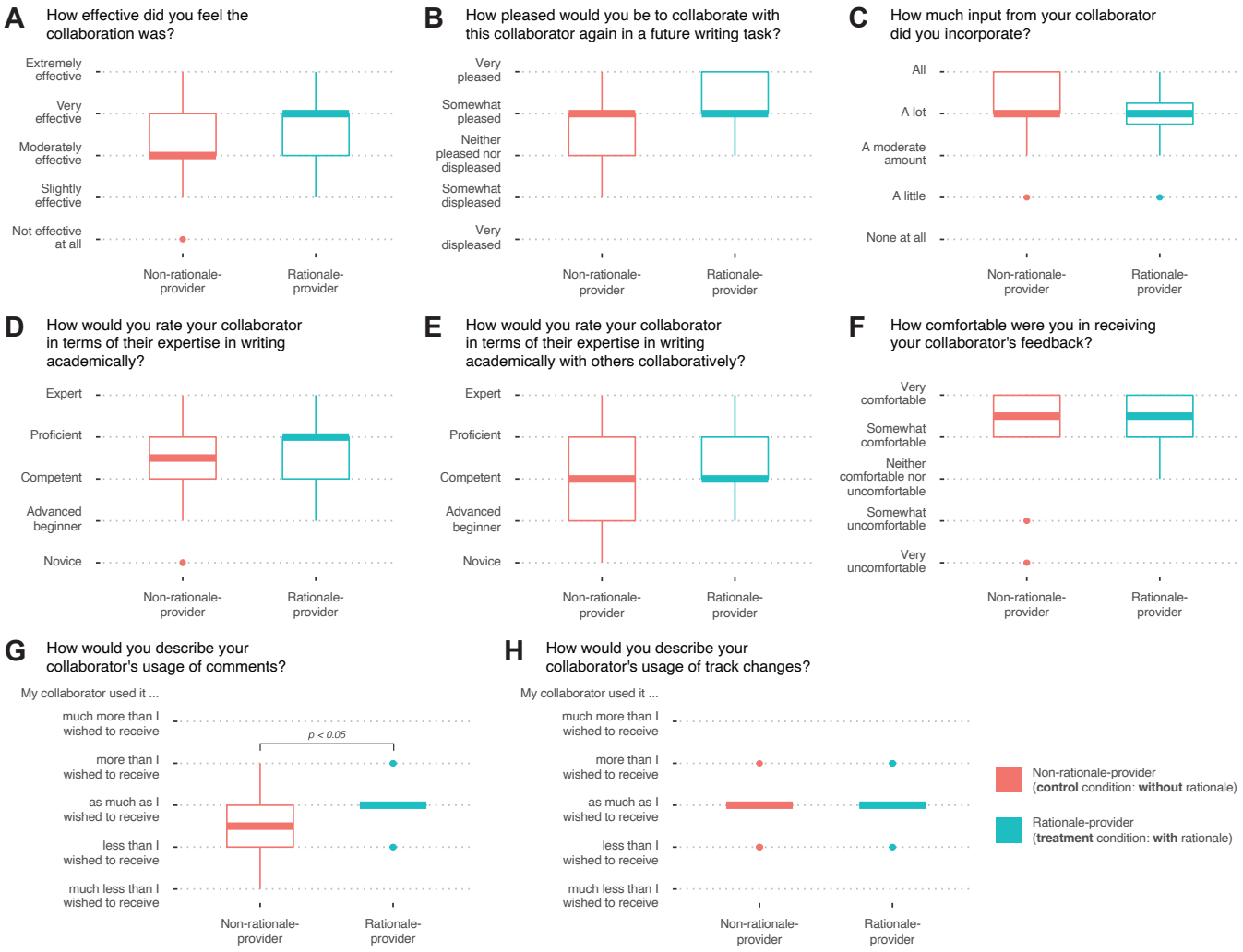

Figure 2: Boxplots of First Authors' (N=20) survey responses comparing perceptions of the collaborations with (A) as well as the collaborators (B-H) who provided rationales and those who did not. Overall, the medians skew higher for rationale-providers than non-rationale-providers. However, Wilcoxon signed-rank tests do not show any statistical significance between the rationale-provider and non-rationale-provider, except for their usage of comments (G).

greater agreement (Fig. 3-Left). We found statistically significant differences between the 'helpful' statements with the Kruskal-Wallis test ($p < 0.05$). Despite the same median vales across the three statements, we found that the differences between the statement "It was helpful for me to provide reasons" and the two others were significant through Wilcoxon rank sum tests for multiple pairwise comparisons (both $p_{FDR} < 0.05$). This indicates that while the SAs acknowledged that providing rationales could benefit themselves, they felt rationales would be more helpful to their collaborators and the collaborative process.

Agreement to statements relating to how **comfortable** collaborators are with providing and receiving rationales also had medians of "Somewhat agree". There was no significant difference in SAs' agreement between the two 'comfort' statements (Fig. 3-Middle).

SAs' median response to how **demanding (cumbersome)** providing rationales were was "Somewhat agree", yet their responses for their collaborators to receive these reasons ranged from "Somewhat disagree" to "Somewhat agree" and had a median of "Neither agree nor disagree" (Fig. 3-Right).

4.5 Rationales contribute to perceived writing quality in limited ways

From interview responses to Q4 (before-reveal question), inquiring which essay the FAs thought was written better, we found that most (8/11) felt that the essay with the rationale-providers was written better. In probing why, we found that four FAs associated their perceptions of collaborative writing output quality with the reception

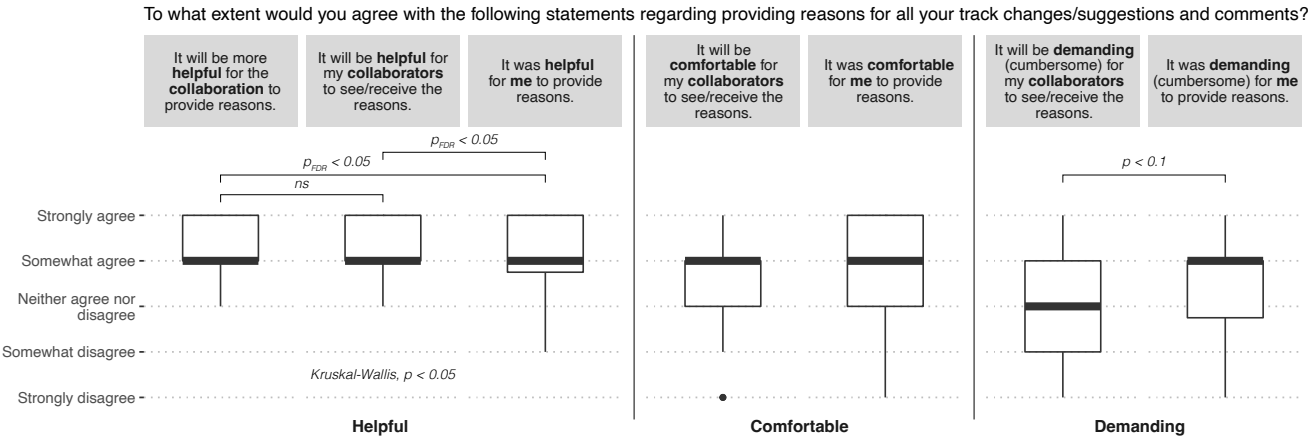

Figure 3: Boxplots of Second Authors' (N=20) survey responses regarding statements of how helpful, comfortable, and demanding it was/will be to provide rationales in collaborative writing. Kruskal-Wallis test showed differences in agreement between 'helpful' statements were statistically significant. We followed up with pairwise Wilcoxon rank sum tests (corrected using FDR), which showed the differences between two pairs were significant and one pair was not (ns). Paired Wilcoxon signed-rank test showed a difference in agreement between 'demanding' statements as marginally significant.

of **rationales**. Rationales helped FA026 to **incorporate** their collaborator's suggestions: *"[the rationale-provider's] comments provided also were more helpful because I felt understood what I was trying to write ... [the rationale provider] produced some positive suggestions which I surely included in my end and making the essay better"*.

The most prominent factor for FAs determining their final essay quality was their **topic preference/ease** (6/11 FAs). FA594 stated *"I had a better thesis statement for that paper, so I feel like just going into it I had a stronger stance in that paper than the society paper"*. FA436 felt one essay was written better *"because I enjoyed the topic"*. For FA060, the better essay was the one they could *"put together my thoughts easily"*; on the other hand, the other essay *"took me a lot of time and thinking to write"*. FA643, too, felt the topic ease led to their verdict of the better essay: *"I think my comfort with that topic was more important than necessarily the collaboration itself"*.

Additionally, the non-rationale-provider's **additions** led FA594 (one of two FAs who felt that essay with the non-rationale-provider was written better) to feel that the final essay with them was greatly improved: *"they were able to echo and extend the writing style and they elevated it with their additions"*. Lastly, some FAs felt the creative process and efforts that they put into the writing made the final outcome better, as did FA026, who specified that it was their own **time commitment** that led to a better essay: *"that was my first [essay], so I put in a lot of energy there during writing"*.

4.6 All interviewees feel rationales are important and the pros outweigh the cons

For many FAs (7/11), the presence of rationales was one of the main distinguishing factors between the two SAs they interacted with *prior* to revealing the study condition. After revealing the study condition, all but FA643 agreed with the study condition that the rationale-provider did indeed present rationales.[10]

After revealing the experimental conditions, we explicitly asked whether providing rationales helps or hinders in achieving better collaborative writing outcomes (Q6). FAs unanimously agreed that providing rationales is ***"very helpful"*** (FA643). FA026 felt that *"with proper reasoning, it helps a lot; at least it gives **clarity** on what the other person is thinking, and tells you whether to take that point of view or not"* (i.e., **accept/reject** the collaborator's edit/suggestion). FA436 also deemed *"giving reasons is the best way to go"* because *"you get to know where that person is coming from ... I can know your thought process and that helps me to also make the needed changes"*.

We also probed the pros and cons of receiving and providing rationales (Q7a and Q7b respectively). Conducting thematic analysis with interview responses to Q7a and Q7b along with Q6,[11] as well as responses from SAs' post-experiment surveys,[12] led to the formation of the Pros and Cons of Rationales (Table 2). We distilled three main themes: Collaboration (§ 4.6.1), Individual collaborator (§ 4.6.2), and Practical aspects (§ 4.6.3). We expand upon each theme with subthemes (+ for pros, − for cons) and relevant quotes.

4.6.1 How providing/receiving rationales impacts the collaboration. Rationales was seen as supporting collaboration in several ways.

+ **Enhance clarity and understanding between collaborators:** *"pros are bringing clarity to the conversation, explaining what you intend to say rather than what you say"* (FA026), *"it helps you understand what the other person is thinking and where they're coming from, their perspective"* (FA687), *"Providing reasons would eliminate ambiguities, and help other collaborators better understand the underlying reasons for changes"* (SA465), *"it is beneficial for the collaborator(s) as much-needed input in order to understand the made-comments/editing"* (SA939),

[10] FA643 felt that the non-rationale-provider was the rationale-provider and vice versa.

[11] Q6 responses also contained advantages and disadvantages of providing rationales

[12] SAs (N=20) were also asked what they thought were pros and cons of providing reasons when writing collaboratively. As they only answered about *providing* rationales, these answers were analyzed with Q7b in particular.

Table 2: Pros (+) and cons (–) of providing and receiving rationales categorized by how rationales help or hinder in achieving collaboration, individual collaborator, and practical goals (i.e., themes). Counts of the interviewees (out of a total of 11) who have mentioned the subthemes are in parentheses.

	Providing rationales	Receiving rationales
Collaboration	+ Enhance clarity/understanding (7) + Help explain/convince (4) + Improve collaboration (3) – Uncertainty of reception (4) – Unintended consequences (3)	+ Enhance clarity/understanding (9) + Improve collaboration (7)
Individual collaborator	+ Help improve/learn (7) + Demonstrate positive characteristics (2) + Increase motivation (1) – Discomfort (1) – Upset/Hurt (1)	+ Increase motivation (2) + Attribute positive characteristics (2) – Discomfort (1)
Practical	+ Support decision-making (2) + Less inference/Less time-consuming (1) + Act as a reminder (1) – Time-consuming/More work (5)	+ Support decision-making (5) + Less inference/Less time-consuming (4) – Time-consuming/More work (5)
None	– None (2)	– None (5)

+ **Help explain themselves or convince other collaborators:** *"better persuade or make it easier to show the other person why this change was made"* (FA727), *"Provides the other collaborator with your point of view and the changes become persuasive"* (SA920), *"my collaborator (and me) can understand the reasons for the edits I make and the contexts in which I made them"* (SA944),
+ **Improve collaboration:** *"it enhances discussion ... more meaningful collaboration, greater sense of community, you feel like you're both engaging on the topic and writing the article together"* (FA643), *"Might help in solving some dissensus between the collaborators"* (SA692), *"might benefit the relationship between collaborators since it makes edits feel less like personal attacks"* (SA925).

Importantly, as noted by FA026, in addition to providing clarity of what the edit is and why it exists, rationales could also help clarify the intent/spirit behind the feedback. FA594 also noted that the benefit of providing rationales was the ability to *"communicate to the collaborators that I'm not trying to put my foot down and say, 'we have to make this change', but just merely presenting an alternate perspective ... it kind of makes me feel like it's less overstepping"*.

As several pointed out, collaboration itself could be improved by exchanging rationales, as they facilitated further conversation. FA643 noted that *"reasoning just makes an inroad for deeper conversation to think"* and recalled *"I probably even put that in my response after the first study like, 'thank you, great reasons' "*. SAs also echoed this point: *"it allows for discussion depending on the nature of the edit"* (SA925), *"provides a starting point for discussion on the proposed changes"* (SA068). FA026 even maintained that *"it makes conversation more honest with the reason"*.

Despite many pros for exchanging rationales, many cons were also mentioned in relation to the theme of collaboration.

– **Uncertainty of reception:** *"it's the ambiguity of whether you're approaching the topic from the same perspective as the author ... I'm not 100% sure if I leave a comment on something, 'is that actually what they were trying to go for? Or maybe in their discipline, they don't consider this effect? Or maybe it's irrelevant or something?' "* (FA643), *"it still can be irrelevant, especially if collaborators expertise does not align from one to another"* (SA939),
– **Unintended consequences:** *"if it's a bad comment or it comes as a bad comment towards that person, maybe if it sounds bad, then the other person will be demotivated ... [they] wouldn't want to collaborate anymore"* (FA360), *"the reasoning might not make sense so even then there could be conflict"* (FA727), *"The reasons might not be well written themselves and have the potential for miscommunication"* (SA068), *"when not written well, they can create even more confusion"* (SA533).

A few of the SAs' survey responses implied that while rationales themselves were helpful, unintended consequences could arise as a result of the medium used for the exchange (i.e., asynchronous, limited text): *"it may not be as clear as it would be if I explained my reasoning in-person"* (SA819), *"if I could not explain it well, it will confuse the reader. So, maybe sometimes, giving reasons verbally would work best"* (SA829). FA727 speculated that rationale exchange could also have negative consequences for the progress of the collaboration: *"maybe they won't take that reasoning, or they won't really accept it, so then we're at a stalemate"*. This, to them, would not be *"a horrible experience"*, but could lead to some tensions arising in the midst of *"trying to figure out a compromise"*.

4.6.2 How providing/receiving rationales impacts perceptions of the collaborator. Pros of providing rationales within the theme of individual collaborators included several subthemes.

+ **Increase motivation:** *"leaving those [rationales] also makes you feel like reading the feedbacks because that gives you a much [deeper] level of understanding ... and you feel like you're communicating and understanding each other while making those changes"*

(FA271), *"I'm able to be motivated, especially if they are good comments ... I would definitely want to ... try to ask more questions so that I can get more ideas for my part of the essay"* (FA360),

+ **Demonstrate positive characteristics:** *"I would maybe also come off as a good person ... as more friendly ... as more involved in the essay"* (FA360), *"better shows how you understand this question [(i.e., prompt)]"* (FA461), *"it seems less aggressive than just changing a lot of someone's work"* (SA068), *"avoids making them feel disrespected if we base our edits on logical reasoning"* (SA187),
+ **Attribute positive characteristics:** *"the other person comes off as a kinder person or more of a collaborative person who wants to really collaborate ... you feel like this person would work with you well because that person is able to communicate with you"* (FA360),
+ **Help improve/learn:** *"Receiving reason would also make me think twice about what I've written and maybe do a little bit more research into it as well"* (FA436), *"[it's] an avenue for you to enhance your own understanding, so you're sure that you're actually giving somewhat coherent comments"* (FA643), *"if you see that this is probably something that a person recognizes often, maybe I could work on that to improve [so] that I don't repeat that [mistake] all the time"* (FA687), *"can help improve writing for everyone as a form of feedback ... can help you reflect on what your writing intent is and make the writing more clear"* (SA617), *"they can use that information to improve their writing in the future"* (SA922).

As found earlier in the interviews (§ 4.1, § 4.2), there were many positive collaborator characteristics that could be demonstrated or attributed due to the presence of rationales: communicative nature, maturity, writing expertise, discernment, knowledge, kindness, dedication, and willingness to collaborate among others. Conversely, those who did not provide rationales came across as being *"just indifferent to everything that's happening"* (FA360).

Within individual collaborators, there was notably one subtheme pertaining to the cons of providing rationales: discomfort.

– **Discomfort in providing rationales:** *"I have that social anxiety piece and that imposter syndrome of 'I don't know anything, I shouldn't be working on this'. I imagine that there's a scenario wherein I make a change that they think is good, but then I give them my reasoning for the change and they're like 'that makes no sense at all, why would we think about it that way?' So that's the only potential con I feel like if the rationale that I give isn't sound, that could be weird" (FA594), "Providing a whole lot of reasons might be looked up[on] as doubting their skill and capability. It might create discontent amongst the collaborators if they both don't agree with the reasons"* (SA692), *"It's also really easy to come across a bit harsh in them. It can also feel a little impersonal"* (SA758),
– **Discomfort in receiving rationales:** *"the way you phrase the reasoning definitely does have an impact, at least for me ... I've had experiences where the other person's communication style is more straightforward, not necessarily bossy but ... at that point, I was feeling more defensive of my idea, because of the way they preached it, [which was] not necessarily rude but not friendly"* (FA727).

Collaborators notably felt more anxiety in providing than receiving rationales. While FA727 pointed out the importance of the tone of these rationales, others felt that simply the act of disagreeing could upset others: *"I feel [that statements] like 'I don't agree with you' [might make someone] feel hurt ... [comments] like, 'hey, I think this is better' means I disagree with someone ... this person could have hurt from my opinion that I disagree with someone"* (FA172).

4.6.3 How providing/receiving rationales impacts the practical aspects of collaborative writing. Pros of providing rationales within the theme of practicalities included several subthemes.

+ **Less inference to be made/Less time-consuming:** *"with [rationales], inferring [the motivation] was faster and hence making the changes and everything was faster"* (FA271), *"concrete thoughts are in front of me so I don't have to assume anything"* (FA060), *"It won't waste their time in figuring out why I made the edit"* (SA187),
+ **Support decision-making:** *" if they said, 'I changed the structure of this paper to get this point across' but let's say that's not the point that I was trying to get across, I can say, 'I see why you did that and because I disagree with why you did it, I'm not going to make that change'; so it's not only helpful for learning why changes should happen, but it's also helpful for justifying whether or not to keep certain changes"* (FA594),
+ **Act as reminder:** *"sometimes you will forget about why you changed it ... [a rationale will] help you to better understand why you want[ed] to change it* (FA461), *"it lets you communicate ideas and tie them to a specific section of the paper versus discussing them over email and potentially forgetting about them when you actually write"* (SA925).

FA594 further mentioned the decision-making and time-consuming aspects expressed as the con of not providing rationales: *"the cons of not having feedback are that it's really unhelpful to sort through ... how do I decide what to keep and what not to keep? ... without those comments, it takes a little bit longer, and I was having to kind of think about how things fit in the paper, overall, rather than having the specific person be like 'this didn't work here because of this'; that would have been much more helpful to me".*

The cons of exchanging rationales within the theme of practical were the most commonly cited—for receiving and providing combined—and also expressed as *"the biggest disadvantage"* (FA643).

– **Time-consuming to provide rationales:** *"it might take a lot of time for each one [(i.e., rationale)], more so for the person giving the rationales, but I think for the other person it is OK"* (FA687), *"providing reasons for each and every change is cumbersome and slows down the process of editing ... a lot of overhead in doing so. It makes editing slow and tiresome"* (SA187),
– **Time-consuming to receive rationales:** *"when I get a lot of comments, it's a lot of time reading and rewriting [the] comments ... whereas for the things [that] are just changed with track changes I just say 'okay', and then it's not as much work for me"* (FA594), *"It can be annoying for the editor/collaborator as it takes much more time than just making changes/in-line changes ... takes time on the part of the editor, can feel unnecessary at times when the editor knows why changes are necessary"* (SA922),
– **More work to provide rationales:** *"it was really hard to provide reasons when editing a lot of the writing"* (SA068), *"sometimes it is difficult to think of a reason to support your change"* (SA484),
– **More work to receive rationales:** *"if I received a rationale, then it means that I need to process that, I need to think about it, [and] I need to answer back"* (FA172).

FA643 succinctly expressed the above sentiments noting the time constraint: *"we're all trying to publish papers on a tight budget [so] either as the giver of the feedback, or the receiver of the feedback, sometimes getting lots of reasons is more time-consuming, or more time-intensive to process"*. FA271 noted that *"if you're just giving too many of them, the other person's gonna get bucked"* as it would take time to go through them. It could be *"mentally stressful to see all of those comments in an essay"* (SA936) due to the prospect of having to spend a proportionate amount of time and effort. As evidenced in earlier quotes, the lack of clarity in the rationales provided could also lead to longer time taken, as the collaborators would have to ask for further clarification and explanation, entailing more work. The confusion and resulting slow progress could also lead to frustration.

4.6.4 Some feel there are no cons to exchanging rationales. Some argued that there were **no cons** to receiving or providing rationales: *"I wouldn't associate any cons with [receiving rationales]"* (FA436), *"it's certainly nothing bad from my side [to provide rationales]"* (FA026). FA436 mentioned that while the time taken to provide rationales could be seen as a disadvantage, this is a necessary cost for a bigger benefit and should not be a concern: *it takes a long time [to provide rationales], but in the end, it's very helpful ... if you want something done right then you shouldn't worry about the time"*. They also felt that providing rationales would not take too much time because their own rationales would be short and concise to begin with. Even FA594, who preferred the non-rationale-provider, felt that not providing rationales was a missed opportunity: *"I think the [essay with the non-rationale-provider] could have been made better if that collaborator had written comments to kind of explain where they were coming from ... and I feel like if the [non-rationale-provider] had been able to make comments ... that would have increased or improved the the final edits that I was able to make"*. Moreover, four of the 20 SAs did not articulate any cons associated with providing rationales.

4.6.5 The importance of rationales was felt resoundingly by participants, who stated they were more likely to incorporate rationales in collaborative writing. All interviewees underscored the importance of rationales. In fact, most felt that the value of rationales was generalizable to collaborative writing contexts beyond this study and stated they would incorporate more rationales in their next collaborative writing endeavors (e.g., class/academic papers). FA461, who also expected to provide rationales in future collaborations, felt that *"if you don't leave the comments, don't leave the reasons, there's not really any communication ... it feels like Grammarly"*. The importance of rationales resonated with all 20 SAs, who noted their likelihood of providing them in future collaborations: *"I am more likely to provide reasons to my collaborators, this likelihood has changed from participating in this study because I have now seen the many benefits of providing reasons"* (SA936), *"I usually provide just enough reasons ... but this study has probably shown me more reasons would not hurt"* (SA944).

4.7 Still, many contextual factors contribute to actual rationale exchange

The importance of rationales was expressed as being generally applicable to other collaborative writing contexts. However, nuances of when rationales would be more/less preferred emerged. In particular, collaborator, authorship, media, writing phase, type of suggestion, and document length were surfaced.

One factor that impacted preference for, and applicability of, rationales was who the **collaborator** was and their dynamics. FA461, who currently only collaborated with their principal investigator on academic publications, stated they would try to provide rationales more in their next group project with peers: *"I [will] probably communicate more, and leave more reasons in the comments about the things I've changed"*. Opting to incorporate more rationales in peer-based collaborations hinted that rationales were perhaps less necessary or improper in one that involved their superior or an expert, as FA643 expressed regarding their uncertainty of feedback reception to peers in a different domain (§ 4.6.1). In such cases, where collaborator dynamics are affected by expertise in the subject matter, rationales would prove to be more helpful in contextualizing the suggestions. Rationales were also seen as more necessary or helpful for less experienced collaborators: *"if I collaborate with someone that has less experience in technical writing, I should provide more comments"* (SA922). Indeed, rationales were felt as being more useful and appreciated when provided by mentors and advisors in an educational capacity, as did FA594's advisor—by providing rationales for suggestions, *"she actually is doing it as a professional development opportunity and she's trying to hone my ability"*.

Authorship also mattered to how much one would contribute with rationales. FA594 previously took *"a hands-off approach"* when collaborating as a third author: *"I mostly see that as their paper ... I don't feel like I contributed as much intellectually to the actual study and so ... I don't feel like it's my work, I don't feel like I have ownership over the paper even though I have authorship"*. In such authorship roles, FA594 typically left more suggestions and rationales rather than *"actually changing with track changes"* as it felt *"less overstepping"*. Participating in this study furthered their perceived value of rationales, and they expected to incorporate more rationales in future collaborations where they take on similar authorship roles.

Interviewees also alluded to using different **media** for rationale communication, including using email to communicate rationales around topics of *"how I want to write it, how he or she thinks when he or she make these changes"* (FA461). FA594 relied on emails and other real-time media as they were more conducive to discussions: *"we can expand on comments and things like that in the body of the email ... [for] collaborative projects that I'm working on right now with people from other institutions, we have at least one meeting—phone calls meeting or in-person meeting per round of edits"*. FA360 used instant messaging to ping collaborators for quick discussions around crafting a thesis. Age and familiarity with technology seemed to also affect the preferred mode of communicating rationales: *"my advisor here is also pretty senior, so sometimes he prefers to just mention the basics and talk more on phone or Zoom later"* (FA687).

Writing phase/stage was another factor. FA643 felt they would appreciate thoughtful feedback more during the early stages of the writing: *"generally if it's earlier in the designs, or in the writing phase, deeper comments are always appreciated because essentially they open up holes and your arguments ... then you have the time to fill in or address"*. SA617 echoed this from a provider's perspective: *"Likely to do so [(i.e., provide rationales] when needed. But really depends on the stage of the draft. Less necessary when it's a more polished draft and changes are small"*. Still, FA643 preferred—but

concurrently experienced frustrations with—receiving rationales during the final stages than not at all: *"on a time budget, I would prefer deeper feedback over grammatical fixes or very surface level topics ... [but] the biggest disadvantage is sometimes they can completely throw you for a loop ... 'Why are you telling me this two days before the deadline?' I mean, that's less of a disadvantage [of rationales] in practice ... that's always just the frustrating thing"*. Counterintuitive to what we might expect of collaborators during crunch time (i.e., that one would simply accept or reject changes without carefully considering the feedback), FA727 felt that rationales were more critical in the later stages, as it would make accepting their collaborator's changes more compelling: *"there were a lot of times where I feel like I would reject the changes. For example, during the final editing of one of the papers, I could definitely see why the other person added [content], but I felt like maybe I couldn't understand specifically why they added it, so I just rejected some of the changes. But maybe [if] I understood the reasoning, then it could have been better [in accepting those changes]"*.

As mentioned above by FA643, value for and prioritization of rationales depended on the **type of suggestion**, with many desiring more rationales around *"deeper feedback"*. To FA271 and several others, rationales for spelling and grammatical suggestions were redundant: *"for those, it's obvious ... doesn't need an explanation"*. Providing rationales for such errors would take much time and effort: *"having comments, where there are a lot of repetitions of the same error is helpful, but expecting [a] rationale for everything, such as grammar, might be a little too much; not that it would hurt, just that it would take a lot of time"* (FA687). Many including FA172 felt that track changes were sufficient for grammatical changes: *"my advisor just changes it and leaves the track [changes;] that is really helpful"*. While the general opinion was that rationales are not necessary for every grammatical or spelling error, some appreciated having a rationale shared at least once for them to learn from and to avoid repeating the same mistake: *"[if] they simply changed it and they don't point out whether that's a good or bad way to write it, you will never know how you write and you will keep making these mistakes again and again"* (FA461). SA692 similarly expressed that *"the errors would be very few"* as a consequence. Not pointing out these errors—whether through track changes or comments—could further lead collaborators to assume there are no such errors: *"I would think my grammar is actually pretty good"* (FA643).

Document length was also a factor to how likely one would provide, and value, rationales. FA060 mentioned *"if it is a short essay ... I can actually leave a lot of comments with rationales"*; for longer essays or journals, however, they preferred receiving fewer but more *"precise and short"* rationales to better understand the feedback. Doing so would *"actually save their time and also work on the comments"* as opposed to ignoring the feedback. FA436, on the other hand, noted that their papers (usually longer than the essays in this study) contained more feedback and felt that greater document length afforded more feedback and rationales.

5 DISCUSSION

We conducted a within-subjects experiment to expose participants to two comparable collaborative writing scenarios with the provision of rationales for edits being the main difference in those collaborations. In doing so, we were able to conduct quantitative analyses with survey data and collect rich anecdotes through interviews that were based on recent controlled experiences. We uniquely contribute statistical and anecdotal evidence that is focused on, and directly tests, the presence of rationales in collaborative writing.

Given the social messaging function that online actions in the context of collaborative writing has and are used for, platforms can help users to better achieve their social goals around collaboration. We believe these results with our experimental study sample are the first step towards building a rigorous understanding of the impact that rationales can have. Below our synthesis of results from this study, we present design recommendations (§ 5.4) generated from our insights with examples of how they may be implemented.

5.1 Rationales improve perceptions of the collaborator providing them and the collaboration itself

Our interviews underscored the importance of providing rationales in the context of collaborative writing. Contrary to prior finding that feedback from those who are "neither visible nor audible" are deemed more negative and less credible [9], FAs regarded their rationale-providing collaborators positively and with credibility. Accompanying edits with rationales made the collaborators seem more competent, considerate, mature, and dedicated, among other positive traits (§ 4.1, § 4.2, § 4.6.2). Moreover, we found that it was not only comments that led FAs to perceive their collaborators as thoughtfully interacting and engaging with their essays [10], but also that rationales specifically contributed to this perception. These perceptions of rationale-providers, despite being anonymous, could be because rationales, by nature, bring greater understanding, which implicates one's desire to engage meaningfully with others. Having a reason for an edit could also show thoughtfulness about the change made as it offers self-reflection, as evidenced by SAs' agreement to the statement of rationales being helpful to themselves as providers (Fig. 3-Left). Moreover, by adding rationales, the tone of the comment could be less curt and help collaborators seem less aggressive and disrespectful, as SA068 and SA187 noted.

Probing at the perceived communicativeness of collaborators, we found interview findings consistent with our statistically significant survey result regarding the amount of received comments (§ 4.2). Rationales, in addition to affording clarity, also furthered conversation amongst the collaborators, improving collaboration itself (e.g., imbue a *"greater sense of community"* (FA643)). These benefits of rationales resoundingly outweighed the disadvantages such as taking time and effort to provide and receive (§ 4.6.3). Overall, we show with compelling qualitative evidence that this form of communication—providing rationales—is "positively related to social relations" also in the case of "asynchronous commenting and editing", despite earlier findings indicating otherwise [11].

5.2 SAs shared more cons of unintended consequences in providing rationales

FAs and SAs expressed similar pros and cons of providing rationales, including the frequently mentioned disadvantage of providing rationales being that it is time-consuming and demanding/cumbersome. Despite the similarities, SAs stated more cons with respect to unintended consequences than did FAs. This may explain their agreement to the projected comfort of seeing/receiving rationales skewing lower than that of their own comfort in providing reasons (the latter ranged in both directions). This contrasts with FAs' survey responses to comfort in receiving SAs' feedback—the median agreement was between "Very comfortable" and "Somewhat comfortable" (Fig. 2F). These results highlight the imbalance collaborators feel in the comfort of providing vs receiving rationales.

Unintended consequences SAs worried about included rationales leading to more confusion and miscommunication, as well as causing mental stress for collaborators—more verbose comments could indicate much more work to be done. This indicates that while the benefits of communicating rationales are clear to both parties, the value that the recipients would derive from them may not be as clear to the rationale-providers. Uneasiness around the reception of rationales could lead collaborators to err on the side of providing fewer rationales and inadvertently come across as being less kind, respectful, and pleasant. To avoid these unintended consequences, whether from providing or not providing rationales, many FAs expressed their practice and desire around sharing rationales synchronously or without text limit (i.e., email) (§ 4.7). FAs relying on Zoom or 1:1 direct messages speak to media richness theory [16], which identifies a range of communication media with richer means taking less time to disambiguate and providing more channels of receiving information (e.g., facial expression, body language).

5.3 Presence of rationales was a critical factor for collaboration, but not the only factor

Our results showed that providing rationales was not the only factor that determined the collaborative experience and collaborator perception. For some, alignment in stance or writing styles was more important; for others, a more approachable essay topic was the deciding factor. These factors could also influence each other: as FA026 mentioned, one essay being *"easier to understand for the people or the collaborators when compared to [the] more philosophical one"* perhaps made it easier to provide better quality feedback. Being easier to write also implies that perhaps the initial draft produced by the FA was better, leading them to receive more substantial feedback. About half of the participants felt that the preference for or familiarity with the topic was the best predictor of final essay quality. Analysis of survey results pertaining to FAs' perceived effectiveness of their collaborations around the Society essay being greater than that of Government evidences this (§ 4.1).

5.4 Design recommendations

Rationales are regarded as important by both those providing them (SAs) and receiving them (FAs). Yet there were some inconvenience and discomfort that people associated with communicating rationales. We believe that platforms can play a critical role in better facilitating the rationale exchange between collaborators. Therefore, we present design recommendations with visualizations that platforms can adopt and/or apply to encourage rationale exchange for improved collaborations, and ultimately better mediate the collaborations between users in collaborative writing and beyond.

5.4.1 Encourage collaborators to provide rationales. While the feature of providing comments may seem enough, having this feature alone does not encourage collaborators to share rationales through them. Even the word 'comment' that is associated with this feature, is defined as "something that you say or write that expresses your opinion",[13] prompts users to share opinions, which are distinct from the reasons *why* such opinions were formed.

Collaborative writing platforms, as they design and scaffold our interactions, can implement various interventions to nudge users toward providing rationales. FAs and SAs reaffirmed the importance of rationales and anticipated incorporating them more in future collaborative writing endeavors (§ 4.6.5). Encouragement to exchange rationales can stem from platform design (in addition to heightened intrinsic motivation from participating in such studies). Various features can be incorporated to nudge collaborators to share rationales whenever they suggest edits (Fig. 4-A):

- explicitly ask users with pop-ups to provide rationales when they start editing;
- include contextualized messaging to encourage rationales (e.g., reminder on the comment bubble saying "Please note that collaborators appreciate knowing why you're providing these comments", comment field pre-filled with "Suggestions, reasons, etc.");
- prompt users to communicate why they are making big changes if many are made consecutively without any explanations;
- add a button called 'share why' that cues users that this is an action they can take.

On writing platforms (e.g., Google Docs) today, a suggested edit automatically generates a bubble with information pertaining to *who* made the suggested edit; *what* the suggested edit was (Add, Replace, Delete); *when* the suggested edit was made; and *where* the suggested addition, modification, or deletion is in relation to the original—but not *why*. This bubble does not have a placeholder for reasoning/rationale by default. While it is possible to start a thread and input the rationale as a comment, due to the aforementioned reasons, collaborators are not always inclined to do so. Therefore, alternative designs of how this information bubble is presented, such as having a placeholder for rationales can signal the importance of these to the collaborators and encourage them to share rationales. Such functionality could also help distinguish rationales from other types of comments, which could, in turn, make the comments less daunting to receive, as the number of comments may be reduced and the comment itself might be shorter.

One participant in our pilot study equated the number of comments with workload; they stated that because communication of rationales would increase the comment tally (i.e., the total number of comments as shown in Microsoft Word), they would not like to receive them. Similar sentiments often lead writers to quickly resolve suggested edits and comments to reduce the perceived workload and declutter the document. As a result, rationales can get

[13] https://dictionary.cambridge.org/dictionary/english/comment, Accessed May 24, 2022.

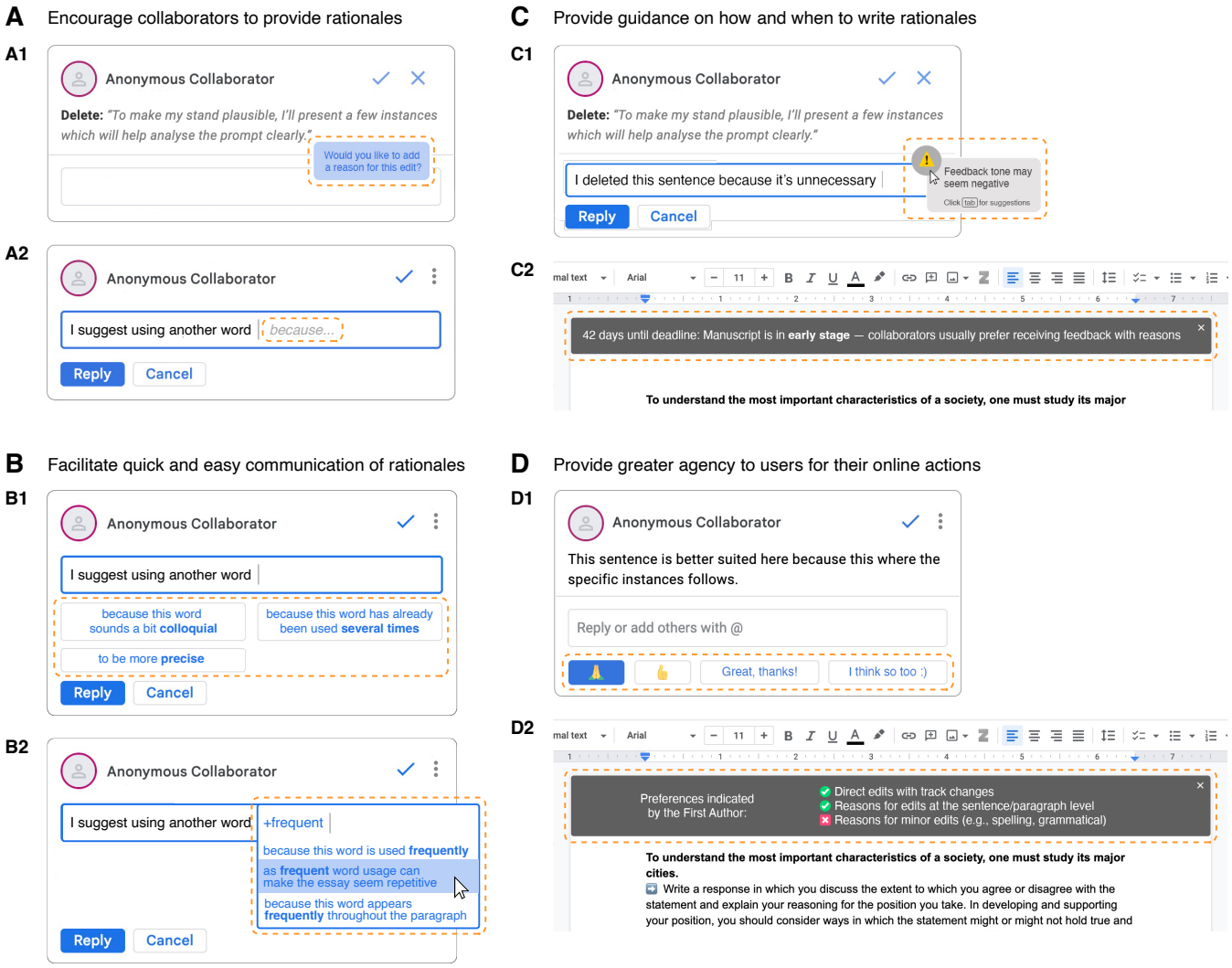

Figure 4: Prototype illustrations of design recommendations based on current features in Google Docs, the platform used in this study, with modified parts identified with orange dashed lines: (A1) Pop-up asking collaborators if they want to provide rationales, (A2) Writing suggestion of "because" after collaborator's comment input to encourage providing a rationale, (B1) Various reasons for "using another word" provided as button clicks, (B2) Options for reasons pertaining to "frequent" suggested by calling for rationale suggestions with the plus '+' sign, (C1) Pop-up alerting the negative tone the rationale could have, (C2) Pop-up at the top of the document noting writing stage given the deadline along with what collaborators usually expect during this stage, (D1) Customized buttons for reactions to feedback and rationales to better show appreciation for them, (D2) Pop-up at the top of the document presenting the feedback and rationale preference input by author(s).

lost as resolved comments and then get archived with accept/reject decisions. Thus, separating rationales out within the comment (e.g., different font color), or placing them separately, would help recipients not gloss over comments, especially when deadlines are imminent.

Platforms can also directly promote the notion that providing rationale makes a user a good collaborator. They can inform their users that collaborators who provide rationales appear more positive to others (e.g., more dedicated, mature, and knowledgeable). Sharing some of these benefits users might be able to enjoy in taking extra time and effort to provide such additional information could further encourage collaborators towards rationales.

Analogous to encouraging users to communicate rationales, platforms can also provide ways in which users can also ask for rationales from their collaborators. Enabling users to quickly identify and ask for explanations around a change or comment made (e.g., "tell me more" button, one of the response options being "I'd love to know your reasoning") will be helpful in collaborators realizing the importance of rationales. This will be especially helpful for those

who are relatively new to collaborating with others and may not be aware of the importance of communicating rationales. Such features can lead to the adoption of rationale provision in collaborative practices that extend beyond the collaborative writing context and lead to more fruitful collaborations.

5.4.2 Facilitate quick and easy communication of rationales. The primary disadvantage of communicating rationales expressed by most participants is that it can be time-intensive and demanding (§ 4.6.3, Fig. 3-Right), yet this is partially a result of how features are designed. Thus, despite knowing how helpful rationales can be to their collaborations, collaborators have often mentioned that they do not provide as much as they desire in their existing practice. This was also one of the reasons interviewees attested to actively communicating with their collaborators using other media alongside co-writing in collaborative editing platforms (§ 4.7).

To lighten the workload for those who wish to communicate rationales, platforms can provide basic explanations for users to choose from (Fig. 4-B). In the spirit of the emoji reactions to comments that Google Docs included at one point,[14] platforms can identify the most common reasons for suggestions (e.g., to enhance clarity, to ensure consistency of sentence structure) and provide buttons with these as pre-determined options to quickly and easily express rationales. It may be difficult to be exhaustive in the list of reasons collaborators may wish to express, and the tone in which collaborators wish to express their rationales may not completely align with suggestions. One way to solve this could be to provide a way to search for rationales by looking up a key term for rationales after a symbol (e.g., plus sign is used with the word "frequent" in Fig. 4-B2 similar to the way hashtags are used). In doing so, not only will it be easier for those making edits to communicate their thoughts, but this would also lessen the workload of those receiving such edits as the interface simplify this for the recipient (e.g., "I suggest using another word because the word is used frequently throughout the essay" could be shown as "Suggestion: replace with less frequently used word"). As mentioned by several FAs (§ 4.7), providing rationales for recurring issues (e.g., grammatical errors) felt tiresome. Implementing a way to reference previous comments (e.g., similar to @ symbol in Google Docs)[15] so that collaborators do not have to repeat themselves but note the same reason could also be helpful.

Finally, platforms could enable other forms of capturing rationales. FA687 stated their preference for *"something a little more hybrid than just text-based communication"*. They mentioned preferring features such as *"a handwriting feature so to make it more collaborative"* or *"voice notes or audio"* because they felt that rationale communication was important: *"it's better to just leave comments that way when you're not able to talk directly on Zoom or phone"*. As such, providing additional modalities (video, audio comments)—often used in other communication tools (e.g., Slack, Messenger)—can be another way to reduce the time that it takes to leave comments and allow writers to convey the rationale in more effective ways, as suggested in earlier works [4, 13]. Audio recordings implemented similarly to voice snippets available on various messaging platforms (e.g., WhatsApp)[16] would be not only easy to use (as they would have used similar features on other platforms) but also helpful for the collaborators give even more context and cues (e.g., tone of voice) around the rationales. Making this process easier by integrating existing tools so that collaborators can seamlessly alternate between collaborative writing and synchronous communication—as Google Workspace products have done by enabling a video-conferencing option on their respective interfaces of Google Docs, Sheets, and Slides—may also facilitate easier rationale exchange.[17]

5.4.3 Provide guidance on how and when to write rationales. Collaborators were not sure of (and uneasy with) how others would receive the feedback. Participants did not want to create confusion or hurt others in the process of sharing why certain changes were made or suggested (§ 4.6.1, § 4.6.2, § 5.2). To address this, platforms can take an active role in providing guidance to alleviate collaborators' uneasiness and to ensure rationale communication as per their intentions (Fig. 4-C). One area that platforms can pursue in particular is the tone of rationales, which was highlighted as an important but not always heeded aspect of collaboration: *"people aren't very conscious when they're writing ... more bit of humbleness and subtleness has to be included when they collaborate with others"* (FA026). Platforms can identify the tone in which collaborators are communicating their rationales. Presenting this to collaborators can help them to reflect on what they have written and raise awareness of how they may come across to others (e.g., as respectful as they wish to be). Platforms can even suggest ways in which the tone can better represent their intention by offering options such as "I think making this change would help ..." or "Perhaps editing in this way would ..." that soften the way rationales are communicated. A cumulative analysis could also be provided based on the characteristics that one wishes to embody as a collaborator. For example, scores on aggressiveness or rudeness of one's tone across comments on a number of documents can be provided to enhance one's awareness. Taking this one step further, platforms can build an understanding of the tones in which particular users accept the edits and provide customized suggestions for their collaborators to communicate rationales more effectively.

When to provide rationales, and to what extent, can also be ambiguous. For one, rationales could be seen as *"over-information"* (FA172) that collaborators neither desired nor expected, especially when communicated via comments rather than through in-person discussions or video-conferencing. This perception of rationales as over-information, despite FAs' comfort with receiving them (Fig. 2F), presents a design opportunity. Platforms can mediate collaborators' expectations and suggest when might be appropriate to insert rationales based on individual preferences. An understanding of individual preferences may include to what extent collaborators appreciate rationales for content-based suggestions and/or grammatical errors and for certain document lengths (§ 4.7). The writing stage could also dictate how much rationale is needed and at what resolution; platforms can provide guidance on rationales depending on the stage selected by the collaborators (e.g., "final stages") or as detected through interaction logs [37]. Finally, collaborators

[14] https://mashable.com/article/google-docs-emoji, Accessed May 24, 2022.
[15] https://www.techtimes.com/articles/266870/20211020/google-docs-symbol-gets-upgrade-literally-insert-almost-anything.htm, Accessed December 12, 2022.
[16] https://faq.whatsapp.com/657157755756612/, Accessed December 8, 2022.
[17] https://support.google.com/docs/answer/10540294?hl=en, Accessed May 24, 2022.

may also have different preferences regarding the medium used for exchanging rationales. Given this, platforms can be designed to recommend collaborator-specific medium. These implementations can all help to ease the worry around rationales and increase collaborators' psychological safety when providing them.

5.4.4 Provide greater agency to users for their online actions. FAs noted that the display of track changes contributed to edits seeming "harsh and negative in tone" [10], and bubbles appearing next to each change caused uncomfortable visual clutter. The harsh visual of strikethroughs were noted as well: *"what really makes me a little bit uncomfortable is just the crossing out ... I feel like the collaborator is a teacher marking you or something"* (FA436), *"[makes text] more difficult to read ... disturb the way you think"* (FA461). Additionally, the old and new text presented together with multiple visual indicators (e.g., font color, strikethrough) was *"overwhelming"* and *"hard to track"* (FA172). Platforms can help rectify this.

While many editing platforms provide the option to view the document without tracked changes (e.g., Viewing mode in Google Docs, No Markup option on Microsoft Word), the features can further provide greater agency in displaying change awareness. Platforms could allow users to choose the color of their suggested edits and assign meanings to them; for example, collaborators could choose red for important changes that they strongly recommend be accepted and use blue for edits that they would not mind being rejected. More controls for deletions could be helpful as well; for example, users could choose green to have strikethrough lines or remove the strikethroughs altogether and choose to present deleted content in light gray font. Platforms could also offer the option for deleted content to be shown in aggregate so that even if multiple parts of a sentence were changed, the sentence with changes is presented as one solid addition and the old sentence crossed out altogether. These options could be document-specific, such that everyone on the same document abides by the same rules, or be user-specific. The latter would allow users to personalize their settings for such that track changes and comments can appear in their preferred ways, regardless of which document they work on, in the likes of various color settings that we have on our browsers and devices (e.g., dark mode).

Another way in which platforms can provide flexibility is how collaborators receive and respond to rationales. Currently, suggestions and comments can be addressed with words or icons of neutral tone (e.g., checkmark in Google Docs, "resolve" in Overleaf). Platforms can enable users to change their response buttons to more positive signals or informal messages such as a thumbs-up emoji, thank you emoji, "awesome", "thanks", or "got it" (Fig. 4-D1). Giving users the option to create their own pop-ups (e.g., announcement in KakaoTalk)[18] could also be helpful. This would allow collaborators to, for example, specify what kind of feedback and/or rationales they would like to receive in the particular round of editing (Fig. 4-D2). Such customizability of writing platforms could greatly alter the user experience, which was found as one of the reasons why co-writers moved to different writing platforms [32].

[18]https://www.facebook.com/kakaotalk/photos/did-you-know-that-you-can-make-an-announcement-in-your-group-chatroom-just-long-/621100791246797/, Accessed December 11, 2022.

6 LIMITATIONS & FUTURE WORKS

We took multiple steps to minimize confounding factors that could impact the findings from this experimental study. We used Google Docs, a widely-used platform for collaborative writing, for ecological validity; created separate accounts to contribute to essays anonymously; and paired participants to work on two essays together to control for collaborator dynamics, writing styles, etc. However, these study design decisions led to our experimental study having some differences from the participants' actual collaborative experience. Ecological shortcomings included communicating only through comments within the Google Docs platform,[19] working only asynchronously,[20] performing writing tasks different from participants' actual co-writing projects,[21] and having only one round of back and forth between collaborators.[22] Despite these limitations, most participants felt that the study was akin to their actual collaborative writing experience (i.e., realistic) due to similar elements such as scheduling issues, asynchronous collaboration, writing platform, and usage of certain features.

While there were challenges entailed in conducting an experimental study with high ecological validity, this study design has helped to effectively elucidate and ascertain the value of rationales in the collaborative writing context. We can derive further insights by leveraging the current dataset from this study. This includes analyzing the impact of other individual factors (e.g., preference for collaboration); examining FAs' actions upon receiving the contributions from their collaborators (e.g., how much of the suggestions were incorporated); and evaluating the essays (e.g., number of comments, whether there was dialogue between FA and SA, writing performance). Following up with SA interviews regarding how they felt about providing rationales in the essays they were collaborating on would also enable us to gather insights from the perspective of providing rationales. Follow-up studies could also test the efficacy of the concepts (Fig. 4) to support platform design decisions. Finally, this study design can be applied in different ways and leveraged in other contexts to deepen our understanding of the diverse factors (e.g., collaborator dynamics) that contribute to our rationale preferences. Following up on this study with shorter, more manageable writing tasks, or any other collaborative activities that lead to other outputs (e.g., designing an app, brainstorming), could also enable us to draw statistically meaningful distinctions between collaborators' perceptions and performance with respect to rationales.

7 CONCLUSION

Collaborative writing is one form of distributed work that many of us engage in various capacities and is very much part of our lives, e.g., publications, reports, manuals, and encyclopedia entries. Yet, despite its prominence and development over the years, issues of

[19]Many resorted to other channels (e.g., Zoom, Slack) in addition to communicating through the shared document.

[20]A few participants mentioned writing synchronously with their collaborators.

[21]We chose the task of writing GRE essays as they would be more feasible and manageable than producing class project papers and academic papers. Additionally, while essay order was found insignificant in all survey results, carryover effects from not conducting full randomization could be present.

[22]We designed the study with only one round of feedback in the interest of participants' time and effort. Participants, however, had more *"back and forth"* (FA594) in their collaborative writing outside this study.

misinterpreting and blaming others (i.e., ineffective collaboration) persist. Rationales is a promising direction in addressing this.

We set out to understand the role of rationales in the context of collaborative writing—in particular how collaborators feel about rationales and their perceptions of others who provide rationales. Through a mixed-method investigation, we found that the majority of the collaborators preferred working with the collaborator who provided rationales and felt they were more communicative, among other positive traits that were attributed. Rationales were also seen as enabling discussions and improving collaboration. Although few preferred the collaborator who did not provide rationales, all unanimously expressed the importance of rationales. Participants felt that rationales helped to improve the collaboration (e.g., reach understanding), to be perceived more positively (e.g., more motivated), and to have practical benefits (e.g., less time taken to infer). Despite identifying some of the drawbacks of rationales, such as being time-consuming to provide, most if not all felt that the pros of rationales outweighed the cons.

These findings of rationales in collaborative writing highlight the role that platforms can play—that platforms can intervene and prompt users towards more collaborative behaviors. We present four design recommendations with prototype illustrations to improve rationale communication and collaboration at large. As we explore user perceptions of others through the mediation of the platforms we use, we will be able to derive more design principles to empower users to collaborate better together online.

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A COLLABORATIVE WRITING STUDY INFORMATION

A.1 Second Author requirements

The following requirements were communicated to the SA with the links to the essays as well as a visual aid demonstrating these requirements (Fig. 5):[23]

- DO NOT simply edit the drafts, but CONTRIBUTE (e.g., additional content, modifications, suggestions, feedback) as much as possible.
- USE track changes/suggesting mode in the draft. DO NOT change directly in Editing mode.
- PROVIDE REASONS for the modifications and suggestions you're making using comments as much as you can.
- You DO NOT need to provide reasons for minor grammatical/spelling corrections.

A.2 Writing evaluation criteria

A link to this writing evaluation criteria as specified below (Table 3) was contained in the pre-study surveys that participants filled out prior to working on the essays. The criteria was developed based upon a close inspection of existing GRE scoring criteria for issue topics[24] and finding common writing aspects called out for each of the scores that could be assigned to the GRE essay. We also decided that instead of giving one score ranging from zero to six for the whole essay, as how GRE essays are scored, we would score each of aspects from zero to six.

B POST-COLLABORATION SURVEY

Both First Authors and Second Authors completed surveys after their collaboration. Second Authors were asked to complete a post-essay survey after collaborating on each of the essays. First Authors were asked to complete one post-experiment survey after collaborating on both essays. We opted to have one post-experiment survey for the First Authors rather than after each essay as we would conduct follow-up interviews with them.

B.1 Post-experiment survey for First Authors

The following ten questions were included in the post-experiment FA; quantitative analysis can be found in § **??**. Answer choices for the survey questions are presented below the each question or at the end of the statements in the question. Relevant references from where the questions have stemmed are indicated as well, if applicable.

Q1: How effective did you feel the collaboration was?
Answer choices: Not effective at all (1), Slightly effective (2), Moderately effective (3), Very effective (4), Extremely effective (5)

Q2: How pleased would you be to collaborate with this collaborator again in a future writing task?
Answer choices: Very displeased (1), Somewhat displeased (2), Neither pleased nor displeased (3), Somewhat pleased (4), Very pleased (5)

Q3: How much input from your collaborator did you incorporate?
Answer choices: None at all (1), A little (2), A moderate amount (3), A lot (4), All (5)

Q4: How would you rate your collaborator in terms of their expertise in writing academically?
Answer choices: Novice (1), Advanced beginner (2), Competent (3), Proficient (4), Expert (5)
*Note: The answer choices for this question are from [18].

Q5: How would you rate your collaborator in terms of their expertise in writing academically with others collaboratively?
Answer choices: Novice (1), Advanced beginner (2), Competent (3), Proficient (4), Expert (5)
*Note: The answer choices for this question are from [18].

Q6: How comfortable were you in receiving your collaborator's feedback?
Answer choices: Very uncomfortable (1), Somewhat uncomfortable (2), Neither comfortable nor uncomfortable (3), Somewhat comfortable (4), Very comfortable (5)

Q7: How would you describe your collaborator's usage of comments?
Answer choices: My collaborator used it much less than I wished to receive (1), My collaborator used it less than I wished to receive (2), My collaborator used it as much as I wished to receive (3), My collaborator used it more than I wished to receive (4), My collaborator used it much more than I wished to receive (5)

Q8: How would you describe your collaborator's usage of track changes?
Answer choices: My collaborator used it much less than I wished to receive (1), My collaborator used it less than I wished to receive (2), My collaborator used it as much as I wished to receive (3), My collaborator used it more than I wished to receive (4), My collaborator used it much more than I wished to receive (5)

Q9: Please select the circle that best represents your collaborator on the following dimensions based your collaborative experience.

- *Agitated (1) – Calm (5)*
- *Anxious (1) – Relaxed (5)*
- *Awful (1) – Nice (5)*
- *Disrespectful (1) – Respectful (5)*
- *Foolish (1) – Sensible (5)*
- *Ignorant (1) – Knowledgeable (5)*
- *Incompetent (1) – Competent (5)*
- *Irresponsible (1) – Responsible (5)*
- *Quiescent (1) – Surprised (5)*
- *Unfriendly (1) – Friendly (5)*
- *Unhelpful (1) – Helpful (5)*
- *Unintelligent (1) – Intelligent (5)*
- *Unkind (1) – Kind (5)*
- *Unpleasant (1) – Pleasant (5)*
- *Untrustworthy (1) – Trustworthy (5)*

[23] A visual aid was drawn and included as part of the email to the SA describing the requirements for the expectations as the SA to be made clear, as per findings from pilot tests that showed the lack of adherence to the requirements.
[24] https://www.ets.org/gre/revised_general/prepare/analytical_writing/issue/scoring_guide, Accessed December 21, 2021.

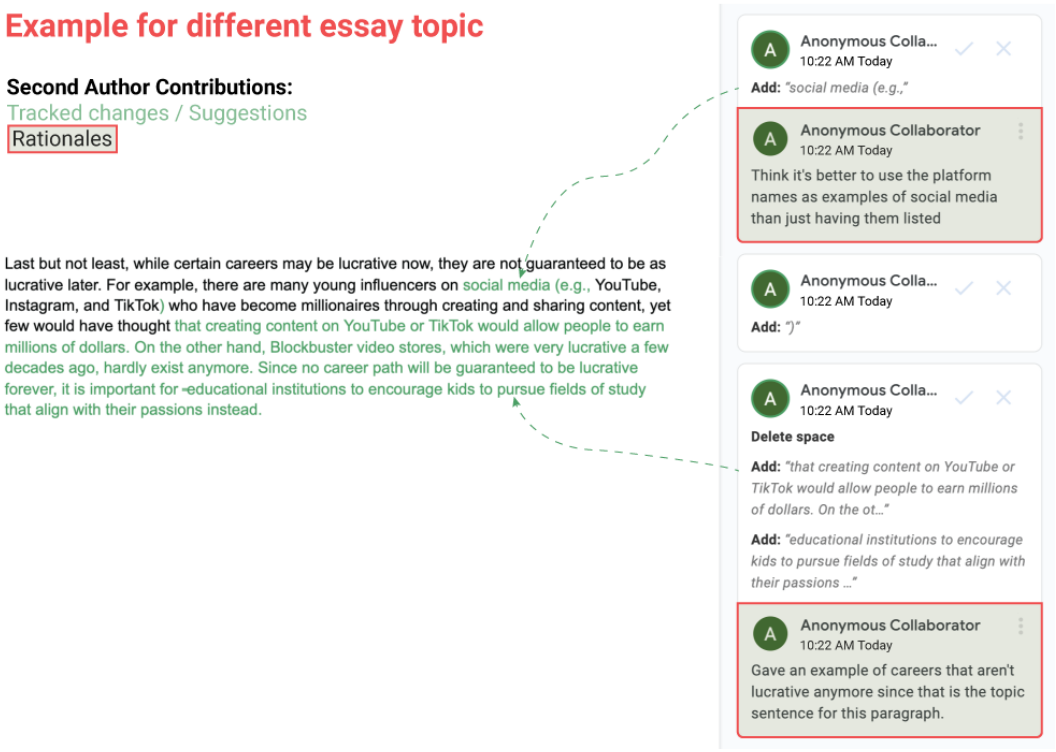

Figure 5: A visual representation of the type of contributions requested of the Second Author (SA) with an example that accompanied the email sent to SA with links to contribute to the essays. This was included in addition to written instructions to make the expectations of an SA clear to the participants.

Table 3: Writing evaluation criteria for collaborative writing study.

Essay criteria	Explanation of essay criteria	Scale
Positional clarity	Articulates a clear and insightful position on the issue	0 – 6
Relevance/Focused argument	Sustains a well-focused argument throughout in accordance with the assigned task	0 – 6
Reasoning/Development	Develops the position fully with compelling reasons and/or persuasive examples	0 – 6
Organization/Structure	Well-organized analysis, connecting ideas logically	0 – 6
Facility of written English	Demonstrates superior facility with the conventions of standard written English (i.e., grammar, usage and mechanics), but may have minor errors	0 – 6

*Note: The bipolar answer choices for this question are from [6]. Only the applicable choices were incorporated in this survey.

Q10: The following are some statement which express opinions that people might hold about the confidence and trust that can be placed in your collaborator. Please indicate whether you agree or disagree with each statement, and consider how much you disagree or agree with them.

- I can rely on my collaborator not to make my job more difficult by careless work.
- I can trust the collaborator to lend me a hand if I needed it.
- I have full confidence in the skills of my collaborator.
- If I got into difficulties in writing, I know my collaborator would try and help me out.
- My collaborator can be relied upon to do as they say they will do.

- My collaborator would get on with their work even if the researchers were not checking their work.

Answer choices: Strongly disagree (1), Somewhat disagree (2), Neither agree nor disagree (3), Somewhat agree (4), Strongly agree (5) *Note: The statements and answer choices for this question are from [15].

B.2 Post-experiment survey for Second Authors

The following three questions were included in the post-essay SA survey; quantitative analysis can be found in § 4.4.

Q1-SA: In this exercise, you were asked to provide reasons for your track changes/suggestions and comments as much as you could. How would you describe your provision of reasons collaborating on this essay?
Answer choices: Provided reasons much less than I wished to (1), Provided reasons less than I wished to (2), Provided reasons as much as I wished to (3), Provided more reasons than I wished to (4), Provided much more reasons than I wished to (5)

Q2-SA: What are the advantages and disadvantages of providing reasons when writing collaboratively?
Open-text response

Q3-SA: To what extent would you agree with the following statements regarding providing reasons for all your track changes/suggestions and comments?
Answer choices: Strongly disagree (1), Somewhat disagree (2), Neither agree nor disagree (3), Somewhat agree (4), Strongly agree (5)

- It was demanding (cumbersome) for me to provide reasons.
- It was comfortable for me to provide reasons.
- It was helpful for me to provide reasons.
- It will be demanding (cumbersome) for my collaborators to see/receive the reasons.
- It will be comfortable for my collaborators to see/receive the reasons.
- It will be helpful for my collaborators to see/receive the reasons.
- It will be more helpful for the collaboration to provide reasons.

C ADDITIONAL INTERVIEWEE INFORMATION

More detailed information about interviewees can be found in Table 4.

D ADDITIONAL FIRST AUTHOR (FA) POST-EXPERIMENT SURVEY RESULTS

Additional FA post-experiment survey results comparing perceptions regarding rationale-provider and non-rationale-provider can be found in Figs. 6 and 7.

Table 4: More details regarding interviewee including their academic and collaborative writing frequency, proficiency, comfort level, platform usage, preference, and frequency with which they engage in asynchronous collaborative writing.

First Author (FA)	Academic writing		Collaborative academic writing					Asynchronous collaborative writing frequency
	Frequency	Proficiency	Frequency	Proficiency	Comfort	Preference	Platform(s) used	
FA026 (28 M)	At least a few times per year	Proficient	At least a few times per month	Competent	Somewhat comfortable	Prefer to write on my own	Google Docs, Microsoft Word	Sometimes
FA271 (25 M)	At least a few times per year	Advanced beginner	At least a few times per year	Novice	Somewhat comfortable	Prefer to write with others	Google Docs, Online LaTeX (Overleaf)	About half the time
FA687 (24 M)	At least a few times per month	Competent	At least a few times per month	Competent	Somewhat comfortable	Strongly prefer to write on my own	Google Docs, Microsoft Word	Most of the time
FA594 (26 F)	At least a few times per week	Competent	At least a few times per month	Advanced beginner	Somewhat comfortable	Prefer to write with others	Google Docs	Most of the time
FA436 (34 F)	At least a few times per month	Competent	At least a few times per month	Competent	Very comfortable	Strongly prefer to write with others	Google Docs	Always
FA643 (22 M)	At least a few times per year	Advanced beginner	At least a few times per year	Advanced beginner	Somewhat comfortable	Prefer to write with others	Google Docs, Microsoft Word, Online LaTeX (Overleaf)	Most of the time
FA360 (23 F)	At least a few times per month	Competent	At least a few times per week	Proficient	Very comfortable	Prefer to write with others	Google Docs	Always
FA060 (27 F)	At least a few times per week	Competent	At least a few times per month	Advanced beginner	Neither	Prefer to write on my own	Online LaTeX (Overleaf)	Always
FA461 (25 M)	At least a few times per month	Competent	At least a few times per year	Advanced beginner	Very comfortable	Prefer to write on my own	Google Docs	About half the time
FA172 (27 M)	At least a few times per month	Competent	At least a few times per year	Novice	Neither	No preference for either	Google Docs	Most of the time
FA727 (21 F)	At least a few times per month	Competent	At least a few times per year	Advanced beginner	Somewhat comfortable	Prefer to write with others	Google Docs, Online LaTeX (Overleaf)	Most of the time

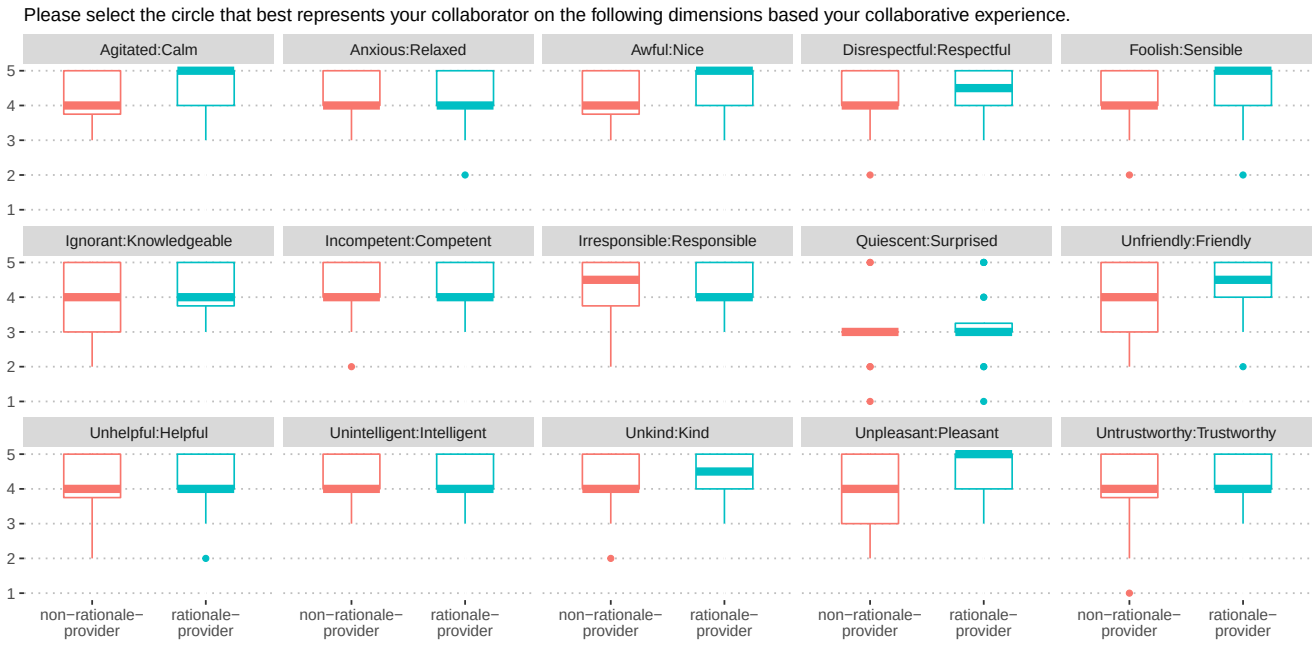

Figure 6: Boxplots of First Authors' (N=20) survey responses comparing the characteristics of their collaborators who provided rationales and those who did not. The characteristics, referenced and adapted from [6], were was presented as bipolar scales. In this figure, the word on the left is 1 and the word on the right is 5, e.g., Agitated is 1 and Calm is 5 in "Agitated:Calm". While, the medians are similar or skew higher for rationale-providers than non-rationale-providers overall, Wilcoxon signed-rank tests do not show any statistical significance between the two collaborators as perceived by the First Authors.

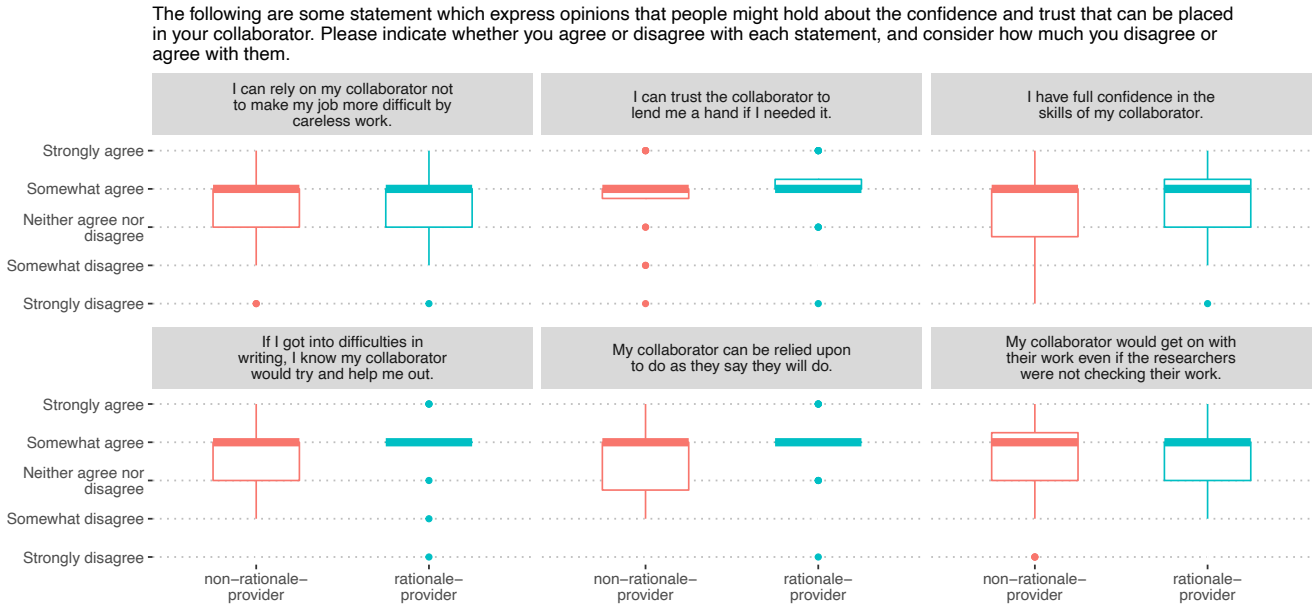

Figure 7: Boxplots of First Authors' (N=20) survey responses comparing the confidence in their collaborators who provided rationales and those who did not. First Authors were asked to indicate their agreement to the statements referenced from [15]. While, the medians are similar or skew higher for rationale-providers than non-rationale-providers overall, Wilcoxon signed-rank tests do not show any statistical significance between the two collaborators as perceived by the First Authors.