“It Looks Like You Don’t Agree”: Idiosyncratic Practices and Preferences in Collaborative Writing

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(a) Idea notes from G2.3. The Mediating Clippy that would prompt co-writers with questions to resolve alignment issues between co-writers.
(b) Excerpt of a storyboard from G3.1. They suggest bullet points at the side of a section with metatext information about its content.
(c) Excerpt of a storyboard from G3.3. The group suggests a feature to request attention from other co-writers. (Names have been blurred.)

Fig. 1. Participants’ handwritten notes and sketches from the workshops.

This paper addresses collaborative writing in academia. Recent research has indicated that while many tools for collaborative writing exist and continue to be developed, co-writers frequently employ workarounds and cumbersome substitutions to accommodate their writing approaches and collaborative needs. As part of a process to address these issues, we conducted a co-design study on collaborative academic writing with 18 participants. The paper details a three-stage co-design approach developed for this purpose. During this three-stage workshop series, the participants discussed needs, frustrations, and desires in their experiences with collaborative writing. These discussions revealed how participants’ different ways of practicing and experiencing collaborative writing entail contrasting needs that are difficult to balance. Based on an analysis of discussions and artifacts from the workshops, we argue that researchers and designers should aim to support diverse practices and propose a protocol for examining and drawing on the contradictions that arise from co-writers’ idiosyncratic preferences.

CCS Concepts: • Human-centered computing → Asynchronous editors; Synchronous editors; Empirical studies in collaborative and social computing; Computer supported cooperative work; Empirical studies in HCI; User centered design; Collaborative content creation.

Additional Key Words and Phrases: collaborative writing, academic writing, co-design, guidelines, individual needs, trade-offs

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Manuscript submitted to ACM
1 INTRODUCTION
The practice of collaborative writing is commonplace in the academic field: From undergraduate students collaborating on assignments and theses, through graduate students writing scientific papers, to professors and senior researchers who write, e.g., books as well as papers, to provide a few typical examples. As diverse as the co-writers carrying out collaborative writing processes together are the tools they bring together to support them in their endeavor. Beck [7] stresses the importance of addressing the dynamics of collaborative writing projects, along with the difficulty of anticipating particular dynamics. However, as recent research has indicated [20, 45, 62], the tools in use often do not fully support the idiosyncratic workflows of co-writers and push them towards workarounds and compromises to overcome limitations. The questions that we address in this paper are: What do co-writers experience as challenging in collaborative academic writing, and what steps can be taken to address those challenges?

While previous work has applied many approaches to investigate these issues (see section 3), the implications they present for tool design are mostly based on the analyses and interpretations of researchers without direct involvement from co-writers. To fill this gap, we conducted a three-stage co-design study with 18 participants that consisted of a series of workshops. We worked together with academic writers (Master’s level and higher) and involved them directly in the ideation and design process for tools to support their writing practices. Our goal was to identify themes of what they liked and disliked in their collaborative writing experiences, to generate ideas for possible design solutions, and to, finally, use a high-fidelity research prototype to experience how their ideas would pan out. The writers who participated were used to different kinds of collaboration; both co-located and remote, and at different levels of synchronicity. In conducting the study, we found that individual idiosyncrasies result in contrasting needs and desires among co-writers. Our findings point to a more general problem, namely that these idiosyncratic ways of writing collaboratively are often hard, if not impossible, to accommodate in one solution [74]. Accordingly, our contributions are: (i) an identification of themes in the challenges experienced by academic co-writers; and (ii) a proposal to supplement design guidelines by framing the design problem of collaborative writing in terms of contrasting needs and desires. We propose a protocol to help designers and others approach and draw on these contrasts. Additionally, section 3 thoroughly details the approach taken in order to allow others to draw inspiration from the study design.

2 RELATED WORK
This section, first, provides examples of the many topics addressed in guidelines for collaborative writing tools, in order to frame our argument that an approach is needed to help researchers and designers navigate and usefully apply these guidelines. Second, we also acknowledge existing work on ideas similar to those presented in this paper.

2.1 Guidelines for Collaborative Writing Tools
A number of authors have provided guidelines and recommendations for the design of collaborative writing environments, based on interviews [4, 20, 39, 56, 65, 68, 74, 81], questionnaires [56], observations [56], and/or logging or visualization of activity [62, 74]. One theme in these recommendations is the content and format of communication [4, 68]. Suggestions include, e.g., means for grabbing co-writers’ attention [62]. Related to this are recommendations to
provide an overview [68], typically of a document’s revision history [20, 39, 65] or of other writers’ current activities [4, 81]. Considerations about this, among other things, include the granularity of what is recorded [39] and enabling identification of who did what [20, 62, 65, 81]. Recommendations also address planning and structuring the writing according to divisions of work in the writing [4], including various degrees of enforced by the software. Yet another theme is support for multiple ways of writing, such as by facilitating regulation of co-writers’ access to individual parts of the writing [39, 81] and enabling different and potentially solitary activities that are part of the writing [65]. The general need to accommodate individual needs and preferences has also been acknowledged [20, 74, 81].

Building on literature, Neuwirth et al. [58] propose parameters to consider regarding communication and accessing and sharing content. These parameters are more open-ended than most guidelines but still include strong presumptions about the way the writing takes place.

2.2 Tools for Collaborative Writing

Collaborative writing tools have a long history and numerous features have been explored by authors during the past decades, covering a range of purposes. There are certain trends in this, which are reflected in our findings. We name relevant trends here, along with examples of features.

Features for communication and planning were among early developments: The tool Quilt [30] included ways to annotate and suggest changes in the text. A related theme is embedded information, such as highlighted background color in the text to indicate authorship [76] or “the age of a modification” by a background color fading over time [77]. Quilt [30] also enabled writers to track the status of the text; a feature also available in the tool Shared Books [46]. To support tracing and explanation of the development of the text, Neuwirth et al. [57] investigate diff-ing and annotation of edits, while others have shown how adding “meta-commentary” to documents could be used by co-writers to clarify edits [86] and how a “rational version control” could allow users to enrich their edits with explanations of the underlying rationale [82], features later recommended by Birnholtz and Ibara [9]. The early system AUGMENT [26] similarly included “abstract-like descriptions” of file contents. Shipman and Hsieh [37] suggest that insights into co-authors’ motivations could also be gleaned from “replaying” the development of a document, as was possible in their Visual Knowledge Builder system. A recent implementation of such a feature is Somers’ Draftback extension for Google Docs [72]. Other exploration has involved utilizing the revision history to visualize the development of a document [42, 54, 73, 78]. Neuwirth et al. [57] note the granularity of such information to be relevant, e.g. due to the ways visual clutter can impact co-writers’ reading experience [35]. Somewhat related to this is the possibility for allowing writers to have different views on the text and the workspace [18, 69]. Finally, privacy has been addressed, such as with private messages [30] or ShrEdit’s [52] private windows [22]. Ignat et al. [36], e.g., proposed several privacy levels that include features like “anonymous changes” and “ghost operations” to hide edits from other co-writers until authors decide to commit them.

3 CO-DESIGN STUDY

We conducted a three-stage series of co-design workshops over the course of five months. In this section, we first introduce our understanding of co-design and our motivation for employing the approach in this study. Next, we describe each of the three stages of workshops and how they connected to each other. Finally, the last subsections provide an overview of the participants and the data collected during the study, as well as how the data was analyzed.
3.1 Why Co-Design?
We use co-design to mean acts of joint creativity [70, 85] where we as researchers work together with end-users in a design process [13]. Taking outset in the Scandinavian tradition [3, 5], we aimed to empower co-writers to take part in shaping the tools they are using by actively participating in the design process. While this tradition emphasizes both co-creation and political agency, we focused on joint ideation and creation. We invited people with experience in collaborative academic writing to contribute and apply their perspective on the topic, as experts of their practice [70]. In this study, it was not a case of the authors not possessing experience with the domain in question, seeing as a large part of our own work involves collaborative academic writing. Rather, the aim was to include a broader set of perspectives than merely those of the authors. The primary purpose for us was to enhance our understanding of what works and what does not work for academic authors writing collaboratively, while ending up with a design or a prototype was secondary and part of the process to increase the participants’ and our understanding of their preferences. The research project of which this study is part will, in the long run, contribute to improved support for collaborative academic writing — this study is one stepping stone among several carried out or planned.

Collaborative writing has frequently been studied using interviews [e.g. 2, 20, 39, 65], lab studies [e.g. 4, 10, 11], and in recent years also visualizations of writing activity [e.g. 44, 73, 80]. Other approaches include questionnaire surveys [7, 60], field experiments [18, 41], document analyses [21, 23, 84], ethnographic inquiries [19, 56], and autoethnographic reflections [e.g. 6, 61]. Finally, collaborative writing tools have been described and assessed in lab evaluations [e.g. 43, 78, 86] and deployment studies [1, 54, 74]. While these bodies of work all shed light on collaborative writing practices and outcomes, their implications for the design of collaborative writing tools are generally derived from analyses of the main findings, i.e. they are second-hand interpretations, and are rarely confirmed with participants. Our study is filling this gap by involving participants directly in ideation and design for collaborative writing.

Co-design in a way sits in-between methods such as field studies, that obtain accounts and observations of practice, and evaluations that obtain opinions on and assessments of technological artifacts [13]. We have been unable to identify previous research on collaborative writing using co-design.

3.2 The Workshops
The workshops followed a three-stage process with each consecutive stage building on the previous. We conducted five workshops in total (see Figure 2), two in stage one (W1a and W1b), one in stage two (W2), and two in stage three (W3a and W3b). The authors acted as the facilitators in all five workshops. The date and time for each workshop were based on an indication of availability from each participant, to ensure that as many as possible could join. Some participants were unable to attend workshops in all three stages but participated in the ones they were available for. The first and the last stage were each split into two workshops, to accommodate a large number of participants without overcrowding the workshops. We opted to keep the workshops short — each lasting two hours — seeing as participants volunteered to take time out of their working days or free time in the evenings to participate in the workshops without any monetary compensation or relief from duties [13]. We invited participants to attend a joint meal after each workshop to thank them for their time.

The three stages were characterized by divergence (Stage 1) and convergence (Stages 2 and 3). The first stage aimed to identify themes in collaborative writing through discussions and creativity exercises. The second stage built on these themes to generate ideas for possible design solutions on paper. Between the second and third stage, we prepared a
software prototype implementing some of the ideas generated during the second stage. The prototype was used in the third stage of the study where participants could use and modify the prototype, to let them discuss something tangible.

By involving the same participants in several stages of ideation and design, we aimed for participants to experience their ideas evolve and come to life. Hence, bringing material from one workshop to use in the next was important. The project promised no direct benefit to participants; however, we were hoping for participants to still take something home from the workshops: By exchanging writing experiences with other participants, by getting insights into their own approach to writing collaboratively, and by being able to see their ideas manifest in a prototype, participants could reflect on and perhaps improve their own writing practice. In the following, we will describe the individual stages of workshops. An overview of the goals, employed methods, and outcomes of each stage is outlined in Figure 3.

Fig. 2. Timeline of the study, including the recruiting phase, conducted workshops, and the development phase of the prototype.

Stage 1: The aim of this stage was to identify themes in participants’ experiences with collaborative writing, as well as divergent thinking and ideation about how to address those themes. We wanted to help participants think beyond familiar tools and interfaces, to move away from suggesting feature improvements and instead envision freely what a desirable collaborative writing practice looked like, or could look like, for them. To accomplish this, we made use of brain writing [79] and a technique inspired by the notion of conceptual blending [28]. Conceptual blending is a theory of cognition that describes human understanding of concepts as arising from links between inputs from multiple “mental spaces”. To stimulate reflections and conversation, participants were paired up after an introduction to the facilitators and the study, and were asked to briefly discuss their most recent collaborative writing experiences. Then followed a group discussion where participants described and discussed “ups and downs” in these experiences as well as desires and wishes for collaborative writing tools. After this, participants were given a short introduction to the notion of conceptual blending and were then asked each to select one of the wishes (which had been noted on a board by a facilitator) to work with. Participants individually sketched diagrams of conceptual blends (see Figure 4 for an example), depicting their perception of their selected wish. They were asked to include a counterfactual mental space [28, ch. 11]
in which their wish was not fulfilled. This was inspired by Pierce and Paulos’ [64] idea of counterfunctional things as a means to explore and design alternative experiences.

Based on their counterfactual mental spaces participants were asked to phrase a design challenge aiming to make the counterfactual wish a reality. For example, P11 who created the mental space diagram in Figure 4 phrased the challenge to design “some structure where everybody will work independently without discussing the structure or the content” since his actual wish was to help co-writers create a structure before writing. We provided instructions on the brain writing method [79], where participants wrote ideas on index cards (henceforth idea cards) and passed them around to each other in silence, using others’ idea cards for inspiration. To further stimulate ideation, participants were instructed to always include an image as inspiration for each new idea, by picking a random image from a pile on the table containing 100 New Metaphors: Thing 2 image cards [48] (see Figure 5a).

Stage 2: In the second stage, the focus was on convergence and the refinement and elaboration of concrete ideas to support collaborative writing. As preparation for this stage, we grouped the idea cards created in the first stage into themes to be used in the Flip & Integrate exercise (described below).

(a) Stage 1: Participants used their mental space diagrams and image cards to create idea cards in the brain writing activity. (b) Stage 2: A group of two participants filled out elaborations of their idea in the lotus diagram exercise. (c) Stage 3: A group of three participants worked together on the prototype using their own laptops.
Participants started by discussing, in pairs and then in plenary, what they considered essential for collaborative writing. The facilitator took notes about the participants’ discussion on a whiteboard. Thereafter, the participants and the facilitator jointly identified focal points in the whiteboard notes after which the participants formed groups of two to three participants — four groups in total — based on which focal point they would most like to work with.

In the group work, the groups first carried out an exercise that we termed *Flip & Integrate*. The exercise was inspired by the SIL method, or *Successive Integration of Problem Elements* method, in which ideas are integrated into a joint idea one by one [79]. Each group was supplied with a folder for each of the pre-identified themes, containing copies of the idea cards in that theme. In the *Flip & Integrate* exercise, the groups were asked to pick the theme they felt was most important to their chosen focal point. From that theme they then selected one idea and “flipped” it into a useful or realistic idea. In the first round of the exercise, the flipped idea was described in more detail as a design solution for the focal point. In later rounds, the current flipped idea was integrated into the design idea. When a new round started, participants picked the theme most important to their current design idea. The exercise was repeated, integrating more and more idea cards into the groups’ design ideas, for about 20 minutes. During the exercise, the groups were also asked to consider how to adapt their current design idea to three scenarios (see Appendix A).

Second, we employed the *Lotus Diagram* exercise [55] (see Figure 5b). In this exercise, the groups had to reflect on eight concepts concerning their design idea. The eight concepts were derived from a previous study that focused on recent collaborate writing experiences of 11 of the participants (see subsection 3.3 and Larsen-Ledet and Korsgaard [44]). The concepts were: Alignment; Distractions; Presentation of Self; Drafting; Yours, Mine, and Ours; Etiquette; Double-Level Language; and Local Expertise. Each group was provided with definitions of the concepts, to consult as needed.

After the two exercises, each group presented their design idea to the other participants and discussed it with them.

**Stage 3:** The last stage of the study focused on giving the participants something more tangible than notes on paper. We developed a prototype in between the second and third stage (see Figure 2). The prototype was implemented using the Webstrates [40] and Codestrates [66] platforms including the latter’s package management [16]. Using these platforms allowed us to create an extensible and malleable prototype for participants to use as a sandbox to play with their ideas. While extensibility enabled participants to add or remove tools from the prototype while they were using it, malleability allowed them to re-program and modify the tools on a source code level directly within the platform.

The prototype included the following tools that were based on participants’ ideas: Edit Display; Edit Overview; Edit Overlay; “Where am I needed?”; Paragraph State; Paragraph Voting; Comments; Meta Notes; Paragraph Locking; and Inspiration Prompt. To give participants an overview, we created a pamphlet describing how to access and use the prototype and summarizing which tools were available — including scans of notes of the previous workshops to indicate the tools’ originating ideas. Giving participants a nice-looking pamphlet showcasing implementations of their ideas was part of our effort to show participants that their contributions were valued and taken seriously. After introducing the prototype and its tools to the participants, they were divided into groups of two to three participants — three groups per workshop, six groups in total. Each group was provided with an electronic document and were first asked to explore the prototype and the provided tools (participants used their own laptops for this; see Figure 5c).

Next, each group selected one of three scenarios (see Appendix A) and started (1) choosing which tools to use for their ideal editor for their scenario, (2) modifying tools to better fit the scenario and their own needs, (3) creating storyboards for modifications and ideas that they were unable to implement within the allotted time, and (4) filling out a questionnaire about the features and the malleability of the prototype (as part of a separate research focus of one of the facilitators). Halfway through the exercise, we introduced a disruption for every scenario, that changed the
task slightly (see Appendix B). During the second half, the participants continued to further adjust their editor to this change. Finally, the participants presented their results and discussed the topics of the questionnaire.

### 3.3 Participants

18 people participated in the co-design process (see Table 1). Five participants described their gender as female, 13 as male. Seven different European nationalities were represented, although most (11) participants were Danish. Participants had different native languages; thus, all workshops took place in English. Participants’ ages fell within the span 18–55 with the majority (10) being between 26 and 35 years of age. Participants’ occupations fell within the following categories: Master’s students (2), Ph.D. students (5), postdoctoral researchers (3), assistant professors (2), associate professors (2), recently graduated Ph.D. (1), and software engineers recently graduated from their master’s (3).

Participants were recruited with a focus on experience with collaborative academic writing. Participants’ writing experiences included, e.g., writing a Master’s thesis in groups, writing academic papers, and writing books. Some of these writing projects had been undertaken mainly co-located while others had been remote or mixed. The writers likewise applied different strategies in terms of the level of simultaneity of writing [45, 65]. Since participants needed to attend multiple workshops in person, we only recruited people from our own university (the only university in the region). We placed posters and flyers in departments in all of the university’s faculties — each slightly re-phrased to explicitly address the community that the poster was placed within, in the hopes that this would increase people’s motivation to sign up. Some departments circulated a recruitment email or shared a Facebook post. Additionally, some of our colleagues with students, for whom experiencing a co-design process could be relevant, informed their students of our study and encouraged them to participate. We also invited participants from a previous study on the same topic [44, 45], of whom 11 participants also participated in the present study. All of the new participants had current or recent experiences with collaborative academic writing, whereas some of the returning participants had finished their studies and were no longer doing collaborative academic writing. Despite the efforts to reach a diverse range of academic communities, six of the seven new participants, as well as all 11 returning participants, were studying or working in a technology- and/or design-related field. Most of the participants knew at least one of the other participants in advance. Only one had never met any, and one knew a couple by name but not personally.

### 3.4 Data Collection and Analysis

During the co-design study, we recorded video and audio, and took photos. We also collected artifacts made by the participants during the workshops: notes, mental spaces, and idea cards (Stage 1); notes and lotus diagrams (Stage 2); storyboards, a questionnaire with each group’s reflections, and the documents participants had used in the prototype as
well as their changes to the code (Stage 3). Each participant also filled out an anonymized demographic questionnaire in the first workshop they participated in. The study was approved by Aarhus University’s Research Ethics Committee and participants have been informed and have given full written consent per European Research Council ethical guidelines.

For the analysis, all artifacts created by the participants, i.e. notes, sketches, filled-out lotus diagrams, etc., were scanned. For all plenary discussions and presentations, the audio from the video recordings was transcribed by one of the authors. Both authors did individual inductive coding [8, 25] of the transcripts and artifacts from the first stage, coding with a focus on needs and problems in participants’ current writing experiences. The authors’ individual sets of codes were consolidated and a joint set of codes was agreed upon. The transcripts and artifacts from the second and third stages were coded against the joint set of codes. Based on the coding of all three stages, we identified five high-level themes which are discussed below.

4 FINDINGS

The findings are divided into five themes: First, we discuss participants’ ideas for supporting the alignment of individual contributions. Second, closely connected with this follows a discussion of planning and how to preserve an overview of past, present, and future activities throughout the writing project. Third, we outline participants’ reflections on communication, which can be divided into presentation, type, and purpose. Fourth, we present ideas about different views or modes for supporting different activities in the writing process. Finally, we discuss the spectrum between joint and separate writing, in particular addressing participants’ perspectives on managing boundaries. After the five themes, we end the section by drawing up the contrasting needs and desires in participants’ discussions and ideas. We refer to individual participants as P1–P18, to groups from the second stage as G2.1–G2.4, and to groups from the third stage as G3.1–G3.6. In the second and third stages, we refer to groups instead of individual participants when a statement or idea cannot be clearly attributed to a specific participant (such as is the case with, e.g., the notes and storyboards).

4.1 Alignment

Not surprisingly, the alignment of work contributed by multiple individuals to a common product was brought up by several participants, and was continuously addressed during the workshops. In this section, we use alignment to refer to aligning the text produced by writers [44], be it the content or the presentation of it. Planning and division of work — and hence alignment of expectations and of the work carried out — will be addressed in the next section.

For one, alignment entails coordinating the work of multiple actors towards a (more or less) shared goal. As P16 expressed it, “when you sort of delegate stuff […] the problem tends to be that then you write some arguments that don’t follow each other.” Participants suggested solutions explicitly for this task in the form of automatic or semi-automatic detection of incompatible arguments, as exemplified by G2.3’s design (a joking reference to the unpopular Clippy character [83] from Microsoft Office), which the authors refer to as “the Mediating Clippy”, shown in Figure 1a. The group clarified that the idea was not for the automatic tool to fix misalignment but for it to instigate communication:

“If you would say: "What is the main message of this paper?" and if you would ask every person that, you could say: "Oh, it looks like you don’t agree!" […] And then you could actually coordinate and communicate about these things and agree on them, and align your points. (P7)

Participants were also concerned with coherence in the writing style, or with how to “align the outward presentation” as G2.1 put it. This involves, according to participants, using consistent terminology and creating a text that “reads as one” (P9). This concern, which is likely particular to collaborative writing, played into a more general concern for
producing well-written text. Altogether, participants’ ideas served to develop a general notion of how features for language support could be augmented to support collaborative writing. For example, G2.1 played with the idea of an auto-complete feature that would suggest words or phrases based on a database of previous writing (e.g. the authors’ own writings or papers from target conferences). This group wrote in their notes about the idea that “[a]uto-complete can create a group identity” (G2.1). G2.4 came up with a tool that would enforce a style defined by the writers, or by a writer in charge. As opposed to the Mediating Clippy, this tool would relentlessly require writers to follow the style guide. The group’s motivation was that it would allow co-writers to focus on other parts of the work, “so that once you start writing you won’t waste time arguing about different styles” (P8). A participant from a different group argued that such a system would be cumbersome to work with, playing into a frequently encountered dichotomy between individual control and the convenience that automation or software-controlled procedures could provide.

Finally, G2.3 suggested that alignment is connected with joint accountability, as they described that by explicitly approving a piece of text written by a co-writer, one takes on part of the responsibility for that piece of text (construed as a positive thing, contrary to Wang et al.’s [81] findings). In addition to clear communication of a joint message, achieving alignment can thus also be about accountability and the individual’s and the group’s relationship to the text. P7 argued that a mechanism requiring co-writers to explicitly approve text passages for those passages to be included would “[f]orce everyone to actually look through the paper,” ensuring that everyone follows up on their commitment.

4.2 Planning and Overview

According to participants, planning serves to structure the text as well as the work that goes into creating it. At the beginning of a writing project, participants would try to align expectations among co-authors by outlining the structure of the text, agreeing on a writing style, and defining procedures. Many of them mentioned creating bullet points for each section as a way to ensure that meaning is not lost in the writing process (see Figure 1b). A suggested feature was a way to annotate sections with such bullet points without having them appear directly in the content text (P14).

While these steps create an overview of future work at the beginning of a project, this overview further needs to be preserved throughout the writing. Tools like version control (G2.4) or indications of what state individual sections or paragraphs are in (G2.3) (see also subsection 4.3) were among participants’ ideas for facilitating this. Version control allows co-writers to see how the text has evolved, and manual tagging of the state of a paragraph enables an overview of how much still needs to be done in a document. P1 expressed it this way:

Traces of use. What has changed to a text over time? Who made the changes? At what point were changes made? Being able to check the traces in the document. (Idea card of P1)

A couple of groups suggested ways of tying writers’ identities to their contributions, as part of providing an overview. G2.2, e.g., suggested that “[e]ach writer [should] have a colour that the text written is marked by” (also proposed by Wang et al. [81]) and that “[e]ach paragraph written [should be] annotated with the authors profile picture”. While G2.2’s approach focuses on the who, G2.3 made the note: “from who wrote → to status of it,” suggesting to move focus away from the individual to the jointly written text. G2.3 furthermore described reactive writing [49] as a benefit to live co-editing, noting how co-writers can “complete each other’s sentences” (G2.3’s notes), enabling them to keep up-to-date in real-time.
4.3 Communication

As mentioned, participants’ thoughts on communication mainly regard three aspects: presentation, type, and content. According to participants, the presentation of communication, e.g., how comments or suggestions are displayed, is significant for their collaborative writing experience. They brought up that while platforms often support comments, suggestions, and tracking changes, these features have no differentiation in granularity and can quickly clutter the interface. For example, P16 mentioned that all changes in Microsoft Word’s track changes feature look the same, making it hard to distinguish small fixes of grammar errors or typos from changes to the overall meaning of a paragraph of text:

[A]ll changes look the same and [have] the same space on the interface. So […] an obvious error that just needs to change has the same space as a […] discussion of the coherence. (P16)

Participants also discussed different types of communication, such as annotations and notifications. These discussions sometimes included the role of automation in communication. For example, P12 mentioned that he would like his “advisor to be forced to see whenever [he] make[s] a change.” In response to this, P3, who has supervised several students, replied that it would be better to get “a notification once something is finished” as “plenty of notifications all the time is actually pretty stressful.” This relates to the purpose of communication: In addition to communicating about plans or current activities, participants also stressed the ability to communicate their intentions, such as what they were aiming to achieve with a certain paragraph. They described how it can be problematic when someone loses track of the text’s connecting thread while editing:

So I’ve often had the discussion of “what is the goal of a certain paragraph” or something. And then the goal stays pretty constant throughout the writing, but the text changes. […] And sometimes I feel like, if you have co-authors they will sometimes forget the goal of a specific paragraph or subsection. (P12)

Making such goals or intentions explicit in the document were thought by participants to improve the coherence of the text, and hence support alignment. One suggestion was to allow “metatext”, as P16 called it (see also, e.g., Rimmer-shaw [68] and Engelbart [26]). The bullet points mentioned in subsection 4.2 served a similar purpose. Participants further discussed automatic generation of such metatext. Communication of intention could be supplemented by communicating the state of different parts of the text (as was possible in, e.g., Shared Books [46]). P1, for instance, suggested the phases: “In progress”, “Could you look at it? Suggestions”, “Don’t look at this yet”, “Don’t touch. Working on”, and “Finalized.”

4.4 Different Views

Participants also addressed the different activities involved in (collaborative) writing. A recurring theme was having different views or modes for different tasks (see also, e.g., the Col•laboració system [18, 69]). P14, for instance, differentiated between what he called “a focused” writing mode and a review mode with a more elaborate set of features for annotating, providing suggestions, and discussing changes, along with other forms of communication and revision:

So, in the reviewing process I will have annotations and the ability to suggest changes and stuff. But in the writing activity […] you wouldn’t have those tools available. And they also wouldn’t clutter the interface. (P14)

Another topic was how different views of the text impact the writing experience. For example, P4 argued that “[a] txt file can also help you [to] sharpen your argument, because you look away from everything else and just [work on] the exact wording of that specific sentence or passage.” And P3 brought up how clutter can make it hard to switch to a reader’s perspective (see also Kim and Eklundh [35]) — this contrasts with the feature-rich reviewing mode suggested by G2.2:
[S]wapping into reader mode [is] sometimes difficult if you have a text that is full of comments. Sometimes even exporting it to a different template or even a PDF version [...] you start seeing all the spelling errors and things like that. So [...] something that could help you become a reader rather than a writer of the text. (P3)

In addition to enabling different views on the document, ideas for tackling this issue also included starting off in a “bare-bones” editor with typing and deleting as the only available options, allowing authors to add necessary features as needed (suggested by G2.2. The idea is reminiscent of, e.g., CoDESK [75]).

Beyond the user interface, the desire for different views also applied to the representation of text. While some participants preferred a clear separation of markup and content as it is found, for example, in LaTeX, others preferred a WYSIWYG (“What You See Is What You Get”) interface, as found in, e.g., Microsoft Word or Google Docs. For some participants, the choice was based on their experience of the tools, such as P7 feeling more in control when using LaTeX’s automatic placement of figures than when using the manual placement in Microsoft Word. For other participants, deciding on the tool was not so much a question of choice, but of theirs or co-writers’ familiarity with certain tools, or of organizational regulations imposed on some co-writers effectively forcing everyone to use a particular tool. Optimally, both types of views on the text could be available at the same time, as P17 proposed in his thoughts on “workspaces”:

But we also were talking about having different workspaces, so if Ida, for instance, [prefers] the LaTeX-way of doing things, with markup and such, she could do that. And if I want WYSIWYG I could have that. (P17)

4.5 Joint and Separate Writing

Participants also discussed benefits and downsides to different forms of writing together: Simultaneous editing in a document that is updated live was seen by some as making it easy to contribute to each other’s work (see also subsection 4.2). Two groups thought of ways to tag co-writers in order to request help or feedback on a specific passage of the text. G3.3 created a storyboard for this feature (see Figure 1c) and G3.2 implemented a minimal working version of it during the last workshop. Some participants went even further and suggested ways to take over the viewport of other co-writers in a shared document and bring them to the paragraph where they are needed:

And we thought it would be really nice to actually, you know, request people’s attention to a certain spot. (P18)

Override others’ workspaces to focus on certain sections or work processes. Authors can lock other writers screens to their view, or freeze a section that people are forced to look at. (Lotus diagram notes from G2.2)

Others noted how live edits made by co-writers to one’s work could be immensely distracting or frustrating. As can be seen from this exchange, some likewise found it difficult to catch onto or respect such boundaries:

P6: I hate when somebody is editing the sentence that I’m writing, in the moment.
P7: Oh, I do that!
P6: (laughing) That’s super annoying!
P7: But if you see a typo …
P6: Yeah, exactly, but I’m like: “I saw that as well!”

Another contrasting desire that participants discussed was the ability to focus in an undisturbed space (resembling other recent findings [45]), which was seen as an advantage to not writing simultaneously in the same editor. This also related to distractions that do not stem from direct interaction between co-writers: P6 described how she would lose track of her position in a shared live document when the text she was writing got “pushed down the page” due to co-writers pasting in text further up in the document.
Another advantage of not writing simultaneously in the same editor that some participants mentioned was being able to control when text is shared. Participants often referred to text as being “ready” or not. For some, it was a question of not wanting to review someone else’s writing until it was coherent, as mentioned by P3 in subsection 4.3. Others named motivations having to do with presentation of self [32] and not wanting to share writings until they were no longer “bad text” (P8). Some also used phrases like: “someone looking over your shoulder” (P2) or “Big Brother” (P9) to describe live co-editing, explaining a desire to work on text without others being able to “watch” them. These sentiments echo other findings in recent research on collaborative writing [44, 81].

Participants came up with several ideas for managing boundaries in the writing: “Locking” sections or otherwise controlling collaborators’ (level of) access to text (e.g. G2.4) exemplify ideas that rely on enforcement by the software. Other ideas relied on the etiquette and discretion [44] of co-writers by adding means for writers to express how they would currently like others to treat their text, for example, by putting the text in certain visually apparent states, as described in subsection 4.3.

An issue that was not tied to a particular mode of collaborative editing was ownership and control of text. G2.4’s idea centered around managing co-writers’ access to particular sections, with the explicit aim of preventing co-writers from “trash-[ing]” each other’s work. This included an idea that writers would be notified if others “visit/review/edit” their sections. G2.3 presented an alternative in which co-writers would vote on changes. Modifications to this idea included being forced to suggest alternative text before being allowed to delete any. Both of these groups’ ideas were construed as ways to avoid edit wars — to align on the text.

5 IT LOOKS LIKE THEY DON’T AGREE — USING TRADE-OFFS CONSTRUCTIVELY

In the sections above we have described alignment of the writing, and the role that planning and maintaining an overview play in this, as well as the roles of communication and the significance of being able to communicate intentions. We have also described participants’ ideas for supporting different activities and for reconciling different preferences. Finally, we have described the balancing of writing together and managing boundaries. In this section, we discuss contrasting observations of what is needed in design for collaborative writing. Many of the participants’ reflections and ideas had clear roots in tools they knew (of), and many of them proposed things that have previously been addressed in the field of CSCW, such as the ability to locate collaborators [22, 33, 34]. What we want to highlight are the contrasts that are present in some of those reflections and ideas. These are contrasts between the needs and preferences of different co-writers, as well as between individual writers’ personal needs and preferences.

5.1 Contrasts

Calling Attention and Controlling Disruptions: On the one hand, participants wanted as much information as possible. They particularly wanted to be able to share information, and to some extent also to receive it. In participants’ discussions of notifications we noticed two contrasting perspectives: notifications as a service for the sender, and as a service for the recipient. In the first case, notifications were envisioned as a means for requesting someone’s presence or feedback. In the second, they were seen as a way to be made aware, e.g. that a piece of text is now coherent enough for feedback, or that a co-writer is making modifications to one’s writing. See, for instance, the discussion among P3 and P12 on page 11: For P12, notifications would be a way to keep up to speed with what is going on in a document, while P3 found this to be unnecessarily distracting and saw notifications from co-writers as a means to know when going over the text would actually be useful. This contrast, among other things, speaks to the granularity of information: Making minute changes apparent can serve to give an overall picture of activity in the document, but such a detailed overview
can make it hard to trace the development of overall arguments [39]. Neuwirth et al. [58] address this in terms of a solicit/subscribe setup, and in a discussion on calling attention to sections based on how much they have been edited, Olson et al. [62] caution that notifications should be subscribed to at the discretion of writers. However, none of them address how to balance the communication needs of one co-writer with those of another.

**Information Availability and Tidiness:** While participants discussed ways of enhancing the writing environment with embedded information, such as visual indications of the state of a piece of text, they were also concerned about clutter. For example, using annotations or formatting to support boundary management around specific paragraphs [44] contrasts with the need for a clean reading space for going over the text. Allowing co-writers to enter such a clean state would make the embedded communication unavailable to them, and its value for enabling boundary management (without enforcing it) would be lost — unless, of course, co-writers are instead notified about text they should leave alone, or manually check for this, both of which would interfere with the reading experience in other ways and would hinder easier switching from reading to commenting or editing. Similarly, having different views, e.g., a drafting and a reviewing mode as suggested by participants, could impede communication if, for instance, a commenting feature is only available in one mode. Posner and Baecker [65] include easy switching between activities as a requirement, but do not address potential problems in considering individual activities as separate. Olson et al. [62] disagree with Posner and Baecker’s view, but do not offer clarification beyond recommending that the tool be “unstructured.”

**Privacy and Availability:** On the one hand, participants described how having a sense of what co-writers are doing in a particular moment can be helpful [49, 81], but they also wanted to be able to withdraw [44] in order to focus or to have a sense of privacy. Support for private writing has been suggested before [22, 81], but the dilemma it poses alongside reactive writing has yet to be addressed. Wang et al. [81] propose augmenting private windows by displaying that a person is active, to avert assumptions that the person is not working. This, however, would not improve the possibility for reactive writing [49]. Posner and Baecker [65] argue that it should be possible to segment a document while maintaining connections with the entire document, but do not go into further detail about how to accomplish this.

Furthermore, this previous work only addresses privacy in the moment of editing. But we also noted diverging needs with respect to privacy over time: Participants saw a benefit to being able to trace from whom different ideas in the text originated, among other things in order to be able to align their arguments or seek explanation from each other. Being able to trace who wrote what clashes with the desire for privacy. Either the revision history of text written in private is kept unavailable, or part of the privacy of writing in a separate space is lost. G2.3, in fact, questioned the need to know who wrote what and suggested instead to focus on the state of the text. Several works mention the ability to distinguish who wrote what [20, 62, 81], but none of them address the place of privacy as regards what has happened. Although Wang et al. discuss balancing privacy and awareness they neglect privacy in their discussion of authorship indications.

**Sharing and Boundaries:** The notion of having the division of work manifest in the tool, for example by enabling writers to “lock” passages of text they are working on to keep others from interfering, contrasts with the aim to produce a text that “reads as one”; a contrast that was also voiced by a participant in response to the idea of locking text. Previous work has addressed support for differentiated levels of access to a document [30, 65], but although they also describe features supporting alignment (e.g., planning [65], status tracking [30]) they do not address the interplay between these sets of features, such as how differentiated access may negatively impact alignment.

**Automation and Manual Control:** Many of participants’ ideas involved automation to varying degrees. On the one hand, they envisioned how software could help them align their writing style or manage boundaries, as discussed
above. On the other hand, they also described needing to be able to fluently adjust in particular situations. For example, participants discussed having a “minimum threshold” for the text locking described above, where everyone is always allowed to make minor edits. It did not become clear, however, exactly when something counts as a minor edit. We find that such a definition is, in fact, not possible in any useful way, as it would likely change depending on the circumstances. Allowing co-writers to declare this for each project, similar to G2.4’s idea for enforcement of writing style, may introduce a kind of flexibility but would take away the moment-to-moment flexibility that the solution was supposed to introduce. Olson et al. [62] are critical of explicit declaration on the part of co-writers. They argue instead for a simple tool that can be used flexibly but do not go into further detail about what such a tool would look like.

Many existing guidelines are well-founded in empirical work and provide useful advice on how to design certain aspects of collaborative writing tools. However, by proposing standalone guidelines, the authors gloss over complexities that must be dealt with. Individual guidelines stand alone by pointing to particular recognizable aspects, such as desiring a clean reading experience or needing to know what co-writers are working on, leaving out the connections to other aspects. Hence, guidelines provide a reduced perspective that leaves out contrasts and results in a loss of nuances. By narrowing the focus to predetermined elements of a generically conceptualized writing situation, they fail to help researchers or designers explore what “could be”, given the particular characteristics of the people and context — i.e., they fail to serve an epistemic [59] function. Taking an epistemically generative [31] approach would entail leaving room for the particularities of each case rather than imposing a predetermined conceptualization. We propose that an epistemically generative layer may be added by framing the problem of designing for collaborative writing in terms of contrasts, like the ones we have outlined above. Contrasts can be seen as a resource for questioning assumptions [27] in order to press on from immediate possibilities for solutions that are anchored in what is recognizable from previous cases. The examination of these contrasts should instead be anchored in the particular case being addressed. Considering how to make space for a given contrast may result in a design that reconfigures the practice, in turn providing a new anchor for future solutions. With this paper, we intend to push for the elaboration of this framing. We expect that it will be helpful not only when studying and designing for collaborative writing but also with other kinds of collaborative work, not least if coupled with an iterative process directly involving users.

5.2 Trade-Off Protocol

As an aid in addressing contrasts, we propose the following protocol for framing design discussions using the contrasts as spectrums along which to discuss challenges. The protocol can be used both for ideation and for evaluating systems:

1. Select an aspect to work with (such as one of the five challenging aspects identified in the previous sections).
2. Identify (current or potential) mechanisms supporting that aspect.
3. For each mechanism, identify relevant contrasts and apply the following steps for each contrast:
   a. Using the two sides of the contrast as ends on a spectrum, note where the mechanism is on that spectrum.
   b. Consider (an) alternative design(s) that are more towards the opposite end of the spectrum.
   c. Consider what is lost and gained in the alternative design(s).

As an example, one might consider planning and overview and discuss G3.1’s metatext mechanism with bullet points hovering next to the text (see Figure 1b). One of the relevant contrasts to be discussed is information availability and tidiness. This mechanism is closer to information availability so the task would be to think of a design providing tidiness. This could for example be a version where the bullet points are shown only when the section heading is moused over.
With this design, writers lose the chance of serendipitously noticing information they were not expecting. But they gain the ability to control when they are viewing metatext.

The protocol is meant to help designers and researchers draw creatively on contrasts. It is intended as a guide for reflection on trade-offs and does not prescribe one side of a contrast as favorable. In some cases, it may be desirable to strike a balance between contrasts by favoring one side in some mechanisms and another in others; while sometimes this may not be the most suitable approach. The protocol should be seen as a supplement to existing guidelines that may be used to nuance their application.

The hardest problem to address is that of co-writers’ different preferences and intentions. Involving co-writers in co-design can help draw out contrasts, but co-design participants should not only participate in identifying the contrasts: Participants should also preferably take part in applying the procedure using those contrasts. This way they will be made to articulate their practice as well as discuss and question it. Thereby, the procedure could potentially help co-design participants negotiate and (re-) configure their practice.

6 DISCUSSION

In arguing that contrasts must be explicitly addressed, we are not saying that we should design our way out of compromises in collaboration. With the benefit of involving multiple people in a piece of work comes naturally a necessity to compromise. Others have similarly addressed how certain aspects of a writing collaboration are or should be negotiated, such as the order of appearance of authors’ names [24, 29]. However, compromises should be among people, not between people and computers. And software should not force unnecessary compromises between people.

Some of the dilemmas faced by participants in part come down to figuring out a joint practice and making it work — after all, some things are “solved outside the software” (P3) [65]. But as our participants — as well as our own collaboration on this paper — have taught us, shaping a joint practice is not an easy task. Designers should consider how to support this difficult task, and how to not inadvertently obstruct it.

Tammaro et al. [74] suggest that personalizable, or similarly flexible, groupware may be the only way to meet the needs of diverse groups. Advances in malleable software [17, 40, 67] make this worth exploring further. Malleable tools could enable different views, different representations of text, and adaptability over time — all things that were discussed by the participants. But while malleability can provide more flexible control over a tool on the technical side, this control is not necessarily aligned with the feeling of being in control on the user’s end. Some users do not feel in control when they can mold every aspect of a tool to their exact needs, they rather feel in control when there is no need to mold the interface at all [50]. Another way to provide writers with flexibility and control is to design for multiplicity [12, 14]. Rather than adaptations within tools, focus should then be on the potential to shape the artifact ecology [14, 38] by integrating new devices and software [15]. Such an approach would be in line with what Larsen-Ledet et al. [45] suggest. The open-ended nature of our proposed trade-off protocol is helpful in either approach.

6.1 Beyond Collaborative Writing

As we have noted in section 2 and while presenting the findings above, many of our participants’ ideas and concerns are recognizable when compared with existing literature on collaborative writing. Some of them have also been addressed in literature on topics beyond collaborative writing, e.g. reading and group work, including flexibly annotating documents [71] (including specific guidelines [51]), coordinating and communicating among individuals in group work [53], calling attention to specific parts of a text [63], or transitioning between private and joint group work activities [53]. The fact that much of this work, while not directly addressing collaborative writing, describes activities relevant to the writing
process further supports the assertion that flexible groupware and/or an ecological perspective is required, as suggested above.

6.2 Reflections on Co-Design

Whereas previous work has described practices and tool use in collaborative writing [e.g. 39, 45, 81], taking a co-design approach with people unfamiliar with research on collaborative writing has, in addition to confirming much of what has been proposed and discussed in previous work, provided a picture of the tensions among those things. While these tensions could possibly have been analytically teased out from previous work, co-design’s emphasis on exchanging perspectives brought them to light naturally by allowing the participating writers as well as ourselves to notice and jointly reflect on contrasts and compromises.

Exploring participants’ practices through ideation and design exercises served to bring out nuances to the experiences and preferences they described to us. The group discussions allowed participants to challenge each other’s preferences and opinions, which in particular contributed to the perspective on contrasts.

We chose to let all the artifacts created by the participants during the workshops be available to all participants throughout the three stages. Encouraging participants to build on each other’s ideas served to open alternative avenues for discussion and speculation and integrate more people’s perspectives in the ideas developed. Participants’ responses to each other’s ideas, both in the form of feedback and questions and in the form of new or modified concepts and designs, complemented the more opinion-centered discussions and further highlighted the contrasts. Although many of our participants’ ideas are recognizable in terms of existing work on collaborative writing, our participants have surely contributed novel ideas and angles that have helped us understand their perspectives as academic co-writers.

We see the three-stage co-design process presented in this paper as a viable approach to examining contrasts within communities of practice. Drawing on our experiences, we would recommend that if conducting a workshop similar to our third stage, with a pre-made prototype, participants be given more time to familiarize themselves with the prototype; if possible, by extending the workshop to a full day. We also recommend being careful to ensure that all participants find their practice reflected in such a prototype (see below).

6.3 Limitations and Future Work

The prototype design leaned towards a WYSIWYG style which naturally influenced what participants focused on in the third stage, and some participants may not have seen their practices reflected in the prototype as much as others. An approach to amend this in future work could be to augment the prototype in close cooperation with individual participants and deploy it with them for a longer duration. This would enable long-term development and let participants reflect on their use of the prototype for actual writing tasks over a longer period, generating further insight into the needs that arise for them in their collaborative writing practice. We are weighing this against potential difficulties of this approach, some of which are evident in our own findings: People need advanced tools that they are familiar with [20, 39, 53] in order to do their work, as do their collaborators.

Another point to be made is that all participants of our study had at some point worked or studied at the same university and, further, in mostly similar fields. While involving them broadened our horizon beyond our own individual perspectives, the findings presented still reflect a culturally narrow group. For this study, however, that has served to demonstrate that even within such a narrow group there were idiosyncrasies and contrasts in and among the practices represented. The aim of this paper has been to raise awareness about these contrasts and the importance of designing
for different practices, even when focusing on a particular community of practice, in this case academic writers with a background in design or technology.

Finally, we reflect on the mindset that this work was carried out with. By inviting academic writers to act as designers rather than informants, we wanted to expand the space given to their voice as regards tools for collaborative writing. But we have made decisions without the participants that they could have been involved in. For instance, we could have let the participants select the features to be implemented in the prototype but opted to spend our limited time with participants on other activities. Participants’ agency was restricted to what topics they wanted to address and what they chose to prioritize during ideation.

With the writing of this paper, the agency has fully shifted from 20 people to the two authors only. Light [47] articulates what she calls “the politics of describing others” and problematizes the typical approach to describing participatory design projects, in which the researchers speak on behalf of participants rather than letting them participate in the presentation as well. While we did not strive to live up to the participatory ideal in this project, we must remain aware of the fact that we have condensed the voices of multiple individuals into a simplified presentation of practices and experiences that are constantly in flux, and that we have made the choice to do so on behalf of the participants rather than jointly with them.

7 CONCLUSION

Research on collaborative writing often aims to provide guidelines and solutions that address a particular subset of co-writers’ needs and practices. However, research also continues to unearth difficulties or unmet needs similar to those described two, and even three, decades ago. Based on our three-stage co-design study we have presented five themes of challenges that reveal a number of contrasts within collaborative academic writing practices and show that, indeed, co-writers do not always agree in their collaborative writing needs and desires. Individual co-writers, even within the same or similar communities of practice, have idiosyncratic and diverse practices and preferences. With their descriptive nature, guidelines fail to capture such contrasting needs and desires. We propose supplementing guidelines with an epistemologically generative framing by focusing on how co-writers’ different needs relate to and influence each other. We have presented a protocol to examine and draw on contrasts when addressing the challenges experienced by co-writers. This trade-off protocol leaves room for others to identify a different set of challenges and contrasts and may prove useful in different collaborative settings; Being characterized by contrasting needs and preferences is likely not unique to collaborative writing but a feature of many collaborative practices. We have started with collaborative writing and encourage researchers and designers to explore this and other collaborative practices through contrasts by involving users in reflecting on individual preferences and trade-offs.

ACKNOWLEDGMENTS

We are grateful to the people who took the time to participate and share their thoughts and ideas with us — this work would not have been possible without you. We thank Susanne Bødker for the suggestion to do this study and for her feedback and guidance. We would also like to thank Anke van Oosterhout for her advice and feedback regarding facilitation of the ideation processes in the workshops and for feedback on the paper, and Henrik Korsgaard for an enriching discussion about the contribution. Thank you also to Mirzel Avdic for feedback on the paper. Finally, we appreciate the suggestions and methodological reflections from the anonymous reviewers.

This project has received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme (grant agreement No 740548).
REFERENCES


A SCENARIOS

(a) Scenario “Master’s Thesis.” (Photo by Dato (WMAM), CC 4.0, photo was cropped, https://commons.wikimedia.org/wiki/File:Collaboration_with_Yerevan_State_University_of_Languages_and_Social_Sciences_after_V_Brusov_01.jpg; icons made by Freepik from www.flaticon.com)

(b) Scenario “Book.” (Photo by University of Michigan School for Environment and Sustainability, CC 2.0, https://www.flickr.com/photos/snre/6721656127; icons made by Pixel perfect and Freepik from www.flaticon.com)


Fig. 6. Scenarios used in the second and third stage of the study.
### A
- Students
- Writing their joint master’s thesis
- Co-located
- Supervisor sometimes reviews and gives comments

**DISRUPTION:**
The ministry of education imposes a new set of rules:
- The supervisor must grade students separately by monitoring individual student contributions to the thesis.

(a) Disruption “Master’s Thesis.”

### B
- Researchers
- Mixed seniority
- Writing a book
  - A mix of co-located and distributed

**DISRUPTION:**
The print deadline for the book is approaching. The researchers get together for a two-week sprint to finish the book.
- They are now working intensely and in close physical proximity of each other.

(b) Disruption “Book.”

### C
- PhD student and supervisor
- Jointly writing a scientific paper
- Co-located

**DISRUPTION:**
The paper gets rejected. Meanwhile, the supervisor has gotten a job abroad.
- The PhD student and the supervisor must now work together remotely.
- They want to resubmit the paper in time for the student’s thesis deadline.

(c) Disruption “Scientific Paper.”

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**Fig. 7.** Disruptions of the scenarios used in the third stage of the study.