



Collaborative writing and text quality in Google Docs

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Abstract

Linking research on task-based collaborative L2 writing and computer-mediated writing, this study investigates the relationship between patterns of collaboration and the linguistic features of texts written during a computer-supported collaborative writing task using Google Docs. Qualitative analyses provide insights into the writing process of successful collaborative groups. Twenty-eight first-year learners of German at a U.S. university participated in the study. Working in small groups, they completed a creative writing task, developing a hypothesized ending to a German feature film. The results suggest that collaboratively-oriented groups produced texts with more propositional content and better coherence than less-collaborative groups. These findings confirm previous observations that learner-to-learner engagement encourages meaning-making. They also expand existing research by connecting collaborative patterns to the quality of L2 output. Other linguistic features typically used for evaluating writing quality in task-based language learning research (i.e., grammatical or lexical accuracy, syntactic complexity, or lexical diversity) did not seem to be related to collaborative patterns. The article concludes with pedagogical and research insights into computer-supported collaborative writing among lower-proficiency L2 learners and the possibilities and limitations of Google Docs for analyzing data in such environments.

Keywords: *Computer-Mediated Communication, L2 Writing, Task-Based Language Teaching, Computer-Supported Collaborative Writing*

Language(s) Learned in This Study: *German*

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Introduction

Research on second language (L2) writing has consistently shown that collaboration can foster L2 development via a recursive planning and editing process (Storch, 2011; Williams, 2012). By virtue of providing extended time for planning, drafting, and reflection, writing can help learners access different knowledge types, such as the lexicon, grammar, and discourse conventions. Collaborative L2 writing further increases the knowledge bases of the learners as they tap into their peers' writing skills (Swain & Lapkin, 2001). With the help of computer-mediated writing platforms, such as wikis or Google Docs, collaborative writing has become easier and more popular to use. Consequently, interest in how learners collaborate via computers has increased and become more urgent—especially studies which illuminate the unfolding of learner-to-learner interaction during collaboration (Abrams, 2017; Arnold, Ducate, & Kost, 2012; Blake, 2008; Grosbois, 2016; Strobl, 2015).

For the most part, research has focused on language-related episodes before or after writing, such as the use of synchronous or asynchronous chat before or during computer-supported writing (e.g., Antón & DiCamilla, 2009; Strobl, 2015). While these studies have improved our understanding of the L2 writing and learning process, they have left out analyses of the collaboratively written text itself. Due to their focus on the interpersonal conversations pre- and post-writing, the analytic methods focus on the synchronous aspects of collaboration (e.g., Meier, Spada, & Rummel, 2007). In contrast, the present study expands on Abrams' (2017) project of first-year L2 learners of German by examining the relationship between

collaborative patterns and the quality of the resultant written text in terms of syntactic complexity, grammatical and lexical accuracy, writing fluency, propositional content, and lexical richness. The article also identifies characteristics of successful collaboration and concludes with a critical review of the possibilities and limitations of Google Docs for analyzing computer-supported collaborative writing (CSCW). First, a review of relevant research on collaborative L2 writing is presented, followed by a description of the methodology used in this study. The findings and discussion are presented for each research question, while the conclusions offer pedagogical and research implications for using CSCW in L2 learning.

Review of the Literature

Collaborative L2 Writing

Significant developments in technology have made it possible to explore the effects of collaboration in writing, which Storch (2011) defined as “the joint production of a text by two or more writers” (p. 275). These developments are promising, because collaborative writing can combine the benefits of learner-to-learner interaction with the recursivity that writing encourages, such as “testing hypotheses, receiving and noticing feedback, and focusing on accuracy” (p. 276). L2 learners have been found to experiment more with language in the written modality than when speaking, because writing allows them to plan what they want to say and how to say it (Weissberg, 2000). Similarly, Watanabe and Swain (2007) found that after processing feedback collaboratively, learners were able to retain lexical information better than if they were working alone, possibly due to the fact that they had more opportunities to absorb information and make corrections with their peers (Harklau, 2002; Storch, 2011; Williams, 2012). In other words, collaborative writing has the potential for generating and solidifying shared knowledge (Wigglesworth & Storch, 2012) as learners plan and edit their texts in negotiation with other students (Kormos, 2014; Storch, 2011). However, Watanabe and Swain (2007) noted that effective collaboration was crucial for L2 learning; learners who collaborated more and more effectively achieved higher post-test scores than low-collaborative learners, regardless of their partners’ performance. In a seminal study, Storch (2002) examined collaborative quality based on recordings of dyadic learner interactions during peer-editing and developed a matrix along two axes to describe participatory patterns and learner engagement. Along the first axis, *equality* displays how evenly partners distributed turns and contributions to content as well as equal control over the task. Along the second axis, *mutuality* indicates the level of engagement a participant has with the other team members (e.g., by providing feedback, sharing ideas, etc.). The two axes form four possible quadrants, presented in [Figure 1](#).

	High Mutuality		
	expert–novice	collaborative	
	high levels of mutuality and low levels of equality	high levels of mutuality and equality	
Low Equality			High Equality
	low levels of mutuality and equality	high levels of equality and low levels of mutuality	
	passive–passive	dominant–dominant	
	Low Mutuality		

Figure 1. Storch’s (2002) matrix of equality and mutuality (reprinted with permission)

Based on her analyses, Storch (2002) found that collaboration led to learner-to-learner scaffolding during which learners took on the roles of novice and expert in a dynamic way (i.e., taking turns in each role). They also “pooled resources whenever uncertainties arose concerning language choices” (p. 147).

Whether collaboration is effective or not may depend on a number of variables, including learners’ L2 proficiency levels, the type of task they have to complete, or their attitude and motivation for learning the L2. For example, de la Colina and García Mayo (2007) and Storch (2011) found that low-proficiency learners were not able to resolve language problems effectively or accurately and focused their attention on lexical concerns instead of grammatical mistakes. In contrast, more advanced L2 learners were more likely to attend to both content and form. What a task requires learners to do can affect performance as well. Storch and Wigglesworth (2007) found that meaning-focused tasks tended to improve lexical performance more than grammatical accuracy. Research also suggests that learners’ orientation toward a task and their peers—how engaged they are with the task and the collaborative relationships they develop—may influence writing outcomes both in terms of quality and quantity (Storch, 2002; Watanabe & Swain, 2007). Active collaboration fosters L2 development, while passive observation does not. Additionally, writing expertise may influence how L2 learners approach writing. Expert writers regularly revise their work during the writing process, whereas less-experienced writers produce their text linearly, without much revision.

Studies analyzing collaborative writing (e.g., Antón & DiCamilla, 2009; Elola & Oskoz, 2010b; Tare et al., 2014) have focused mostly on language produced before or after the main writing task (i.e., during pre-task planning or during editing). However, the process of collaborative text development remains understudied (Abrams, 2017). Figuring out what happens during collaborative writing is important, because collaborative writing tasks can foster L2 development more broadly when learners use writing as a path to teach each other new vocabulary, expanding each other’s ideas and promoting grammatical accuracy (Storch, 2011; Swain & Lapkin, 2001). This issue also merits further investigation because L2 users often encounter collaborative writing in real-world situations and need to learn how to co-produce texts effectively (Elola & Oskoz, 2010a).

Computer-Supported Collaborative Writing

Synchronous and asynchronous collaboration in computer-mediated environments provides opportunities for students to complete formal and informal writing tasks, greatly expanding the boundaries of possible collaborative learner-to-learner writing (Arnold et al., 2012; Blake, 2008; Elola & Oskoz, 2010a, 2010b; Grosbois, 2016; Kessler, 2009; Strobl, 2014, 2015). One consequence of this conceptual shift is the discovery that learners prioritize meaning over grammatical or lexical accuracy (Elola & Oskoz, 2010a; Kessler, 2009; Kessler & Bikowski, 2010), helping them attend to ideational content (Kessler, Bikowski, & Boggs, 2012) and yielding language that is qualitatively better than what individual learners can produce by themselves.

Analyzing the writing of advanced learners, Strobl (2014) demonstrated that collaboratively written texts were of significantly better quality than what students wrote individually. Extensive online discussions on various topics yielded papers with more complex ideas and a greater number of higher-order revisions (e.g., content-development and organization revisions instead of localized grammatical corrections) than did essays without similar pre-discussions. Similarly, intermediate learners of German were found to make more content-based revisions than other types of errors when writing wikis, although their focus depended on whose text they were editing: While participants were willing to make language-related edits on their peers’ text, they edited only content in their own contributions (Arnold et al., 2012). Kessler et al. (2012) also found that learners added to, changed, or deleted their peers’ contributions mostly in terms of language-related mistakes (e.g., grammar), with very few learners making non-language related changes (e.g., content or organization). Kost (2011), likewise, found that when intermediate learners of German wrote an alternate ending for a radio play using wikis, they tended to focus on grammar rather than meaning, although there was significant variation among different dyads, possibly due to a misunderstanding of the task by some participants.

Tare et al. (2014) examined the role of collaborative writing by comparing interactive and individual writing assignments among intermediate learners of Russian over six weeks. Pre- and post-test results revealed that learners achieved significantly higher lexical scores as a result of collaboration than during individual work. However, grammatical accuracy, complexity, and overall writing quality were not affected by task condition. Moreover, the lexical benefits were evident during the treatment as learners in the interactive condition produced a larger variety of words, suggesting that collaborative writing supported L2 learning beyond just writing (Harklau, 2002). Such gains might in part be due to the role of multi-layered communication in CSCW, including asking peers about grammar or the meaning or definitions of words. Improvements may also arise as a result of more frequent exposure to lexical items and more modeling through interaction (Tare et al., 2014).

The aforementioned studies delve into collaborative L2 writing, but there is no consistent definition of *collaboration*, and different studies highlight complementary aspects of either the collaborative process or the text. For example, some studies analyze how partners talked about writing. In one such study, Strobl (2015) compared the effectiveness of video and script modeling of collaborative writing among advanced learners of German. The participants produced texts in German but the conversations during which they negotiated content and form were often in the learners' first language (L1), Dutch. Using framework of analysis by Meier et al. (2007), Strobl (2015) sorted exchanges into (a) interpersonal relationships, (b) task alignment and performance orientation, and (c) development of shared knowledge. The categories referred to interpersonal communication between participants and identity-formation as they conversed about their texts, but not to the nature of the collaboratively written texts.

Another type of study focuses on the editing and revision process after a group of learners is finished with the original writing task. Arnold et al. (2012) analyzed revision behavior and distinguished two types of group-work: cooperative learners, who divided the task and revised their own work, and collaborative learners, who revised their own work as well as that of their peers. However, Bernard and Lundgren-Cayrol (2001) defined these two terms based on motivational factors instead: *cooperation* referred to learners with intrinsic motivation who wanted to work together, while *collaboration* described participants who were required to share work. Interestingly, when learners in the study had more autonomy during the composition process, they tended to collaborate more than in instructor-controlled tasks, mirroring findings by Kessler (2009) and Grosbois (2016). In a related vein, Kessler et al. (2012) found three levels of contributions when they examined participatory patterns among their learners: high-level participants produced at least half, mid-level participants about a third, and low-level participants less than a quarter of the collaboratively written text by each group.

A third group of studies examines participatory patterns and learner engagement in collaborative writing, building on Storch's (2002) matrix described in Figure 1, measuring equality and mutuality. In a study analyzing CSCW in wikis, Li and Zhu (2017a) adapted Storch's model to examine how participants initiated and expanded communication and constructed emotion socially throughout the collaboration (in follow-up interviews). The results showed that learners shifted collaborative patterns during the study. For example, while one of the two groups the authors followed during the 9-week project evinced a collective pattern at the beginning (the collaborative quadrant in Storch's model), one participant became more dominant over time and the other became more withdrawn (Storch's dominant-passive quadrant). The other group analyzed by the authors shifted from a dominant-defensive pattern (Storch's expert-novice quadrant) to a collective one. In a related study, Li and Zhu (2017b) analyzed the wiki-based interactions of four focal groups (graduate-level ESL students) over the course of nine weeks. The authors examined language functions, writing change functions, and scaffolding strategies within the wiki environment itself, supplemented by interviews and reflection papers. The results suggested that the group with higher levels of engagement during the collaborative process—signaling “collective cognition” (p. 50)—developed more coherent research papers with a clearer rhetorical structure. Specifically, their collective group—the equivalent of Storch's (2002) collaborative quadrant—and the expert-novice group outperformed the other two groups, which Li and Zhu (2017b) labeled as dominant-defensive and cooperating-in-parallel.

Similarly, Abrams (2017) applied the matrix of equality and mutuality to investigate the collaborative writing among first-year learners of German in Google Docs. Using Storch's (2002) matrix along the two axes of mutuality (level of engagement with each other's text) and equality (distribution of comments by different participants), the nine groups in her study reflected three collaborative patterns (see Table 1):

- *collaborative* (high levels of mutuality and equality),
- *sequentially additive* (high level of equality, low level of mutuality), and
- *dominant-passive* (low levels of mutuality and equality).

Table 1. *Group Distribution by Quadrants in Computer-Mediated Collaborative Writing*

	Groups	Storch's (2011) Category	Abrams' (2017) Category
High mutuality, high equality	Groups 4, 5, 7, and 8	Collaborative	Collaborative
Low mutuality, high equality	Groups 1, 2, 3, and 9	Dominant-dominant	Sequentially-additive
Low mutuality, low equality	Group 6	Passive-passive	Passive-passive

In Abram's 2017 study, four groups were found to be collaborative, with high equality and mutuality, but these groups were relabeled as sequentially-additive instead of dominant-dominant, given the written nature of their work, where they contributed their ideas one after the other. This difference from Storch's proposed patterns might have been due to the fact that the learners were relatively inexperienced L2 writers, who tended to produce text more linearly—without much recursivity—whether they composed alone or collaboratively (Leblay, 2009, as cited in Grosbois, 2016). There was only one group in the original study, whose performance fell into the passive-passive quadrant, reflecting low equality and mutuality. No groups followed the expert-novice pattern (high mutuality, low equality). Since the groups were comprised of 3–4 participants, there was evidence of more within-group variation in terms of collaboration than in the dyadic studies discussed above. As others have reported (Elola & Oskoz, 2010a, 2010b; Kessler et al., 2012), participants in this study also focused primarily on content in their revisions and additions to others' texts. The present study expands on the original study by examining the relationship between participatory patterns and learners' L2 output in co-created texts by first-year learners of German.

Study Design

Rationale for the Study

Research on CSCW has been gaining interest both in computer-assisted language learning and L2 writing scholarship, and this article aims to contribute to this body of scholarship in three ways. First, CSCW is a promising locus of collaborative L2 writing, but it must be implemented carefully (Elola & Oskoz, 2010a; Kessler et al., 2012). CSCW tasks which foster effective collaboration and encourage learners to balance local and global aspects of writing need to be identified so that they can help provide crucial opportunities for L2 learning (Harklau, 2002; Ortega, 2012). In line with this objective, the present study examines the extent to which CSCW tasks encourage learners to attend to both content and linguistic aspects of the written text—particularly with groups instead of dyads (Wigglesworth & Storch, 2012), as such tasks arguably provide important scaffolding for L2 learning (Elola & Oskoz, 2010a; Harklau, 2002; Kessler et al., 2012). Second, while research on L2 writing using social software applications is an emergent field (Elola & Oskoz, 2010a, 2010b; Kessler, 2009), the relationship between collaboration and learners' L2 output has not yet been fully investigated (Kessler et al., 2012; Tare et al., 2014). This is especially true in contexts where the L2 is not spoken in the general environment and among early L2 learners, who remain an under-studied population in L2 research. Finally, although existing studies offer important insights into

CSCW processes, a critical review of online resources (e.g., Google Docs) as methodological, analytic resources is lacking. The present study aims to fill these gaps by answering two research questions:

1. In CSCW tasks, is there a relationship between a group's participatory pattern (Abrams, 2017; Storch, 2002) and learners' writing performance in terms of syntactic complexity, grammatical accuracy, writing fluency, propositional content, and lexical sophistication?
2. What are the characteristics of effective collaborative writing in Google Docs?

Participants and Pedagogical Context

The present study, which is a complement to Abrams (2017), was conducted at a U.S. university, with 28 learners of German, enrolled in two first-year language classes (approximately level A2–B1 on the Common European Framework or intermediate-low–intermediate-mid on the ACTFL scale in writing, following about 85 hours of formal instruction prior to the study (American Council on the Teaching of Foreign Languages, 2012; Council of Europe, 2001). The course followed a task-supported, communicative competence-oriented syllabus. The focal task in this study took place during the last two weeks of instruction. Students had completed bi-weekly writing tasks during the preceding eight weeks, both individually and collaboratively. The grading rubric (provided to students) emphasized meaningful and rich responses to prompts, comprehensibility, organization, and vocabulary (70%) as well as accuracy and syntactic variety (30%). For the task described here, 20% of the grade was for collaboration (for grading purposes, defined as contributing to the group's written text, responding to or editing the group's written text and teammates' questions or suggestions).

Prior to the task, participants watched most of the German movie *In July* in class, but they stopped 20 minutes before the end. Learners had to write a plausible ending for the film in small groups, as creative tasks have been shown to foster collaboration (Lee, 2010). While writing a screenplay is not a common real-world task, it is important for L2 learners to develop the skills necessary for building and testing hypotheses and writing collaboratively. Pre-, during-, and post-viewing tasks ensured thorough understanding of the content and characters. The writing task consisted of three distinct phases. First, working in self-selected groups of 3–4 students, the participants spent 10 minutes in class brainstorming possible plot developments, since pre-writing tasks foster successful L2 writing (Abrams & Byrd, 2016; Grosbois, 2016; Kormos, 2014). Afterward, groups wrote synchronously in class for 15 minutes using individual computers. The third phase of the task lasted until the beginning of the next class period, 48 hours later, during which groups completed their stories asynchronously.

Participants were informed that the screenplays would be shared in class the following day, in order to provide an audience for the screenplays and to encourage task completion. Google Docs was used for its ease of access and use, the availability of special characters needed in German, its ability to track learner contributions, its auto-save feature, and its familiarity to the participants. After completion, each group's final text was downloaded from Google Docs as a Word document for data analysis.

Data Analysis

To assess writing quality, each group's final text was analyzed for complexity, grammatical and lexical accuracy, fluency, lexical diversity, and propositional content, in line with published task-based language teaching (TBLT) research (e.g., Abrams & Byrd, 2016; Ellis & Yuan, 2004; Kormos, 2011; Révész, Kourtali, & Mazgutova, 2017). Two measures were used for syntactic complexity: (a) the mean length of communicative units (c-units),¹ including any subordinate clauses and adapted from t-unit analyses (Bulté & Housen, 2012), and (b) subordination (i.e., the ratio of clauses to c-units; see Ellis & Yuan, 2004). For example, the length of the following c-unit “Sie müssen aus dem Gefängnis bei Freitag brechen, damit Daniel kann mit Melek treffen” (*They have to break out of prison by Friday, so that Daniel can meet Melek*) is 14 words, the clause to c-unit ratio would be 2, because there are two clauses: one independent (*They have to break out of prison*) and one dependent (*so that Daniel can meet Melek*). It is important to note that complexity results must be interpreted with caution, since subordination and sentence length may be a function of L2 proficiency or personal style (Norris & Ortega, 2009; Ortega, 2003; Pallotti, 2009).

Grammatical accuracy was calculated as the ratio of the number of errors to the number of words (Storch, 2011), while lexical accuracy was calculated as the ratio of the number of correct words (i.e., word choice, gender, spelling, capitalization, missing and superfluous lexical items) per the total number of words (Abrams & Byrd, 2016). The c-unit from above has a grammatical accuracy score of .86, because there are two grammatical errors in the 14 words. The higher the ratio, the more grammatically accurate the text is. The same c-unit also has a lexical accuracy score of .86; two lexical items are inaccurate: *bei* (*at*) should be *bis* (*by, until*) and *mit* (*with*) is an extraneous lexical item that is incorrectly included with *treffen* (*to meet*) in German (incorrect L1 transfer).

Fluency was measured as the number of words (Kormos, 2011; Révész et al., 2017). As the task was not strictly limited in time (i.e., students could take six hours over two days or 20 minutes total), fluency was an inferred measure of production—contrary to how it is used TBLT research investigating spoken tasks (Kormos, 2014).

Propositional content was calculated as the number of pertinent and unique ideas written by each group (Abrams & Byrd, 2016). For example, there are two propositions in the previous excerpt: (a) *They have to break out of prison by Friday* and (b) *so that Daniel can meet Melek*. Repeated ideas were counted separately, since they often were part of conversational echoing (Abrams & Byrd, 2016) or were contributed by different participants.

Lexical diversity was analyzed using the measure of textual lexical diversity (TLD; McCarthy & Jarvis, 2010).² TLD was calculated by the mean length of sequential word strings that remained above a pre-set threshold of type–token ratio (.72). In the example cited above, the preceding sentence was “Daniel und Isa gehen in das Gefängnis” (*Daniel and Isa go to prison*), followed by “Sie müssen aus dem Gefängnis bei Freitag brechen, damit Daniel kann mit Melek treffen.” These two c-units contain 18 distinct lexical items: *Daniel, und, Isa, gehen, in, das, Gefängnis, sie, müssen, aus, bei, Freitag, brechen, damit, kann, mit, Melek, treffen*. The second *Daniel* and *Gefängnis* are excluded, as is the article *dem*, since it is the dative form of the lexical item *das* from the first sentence. As text length increased, it was more likely to repeat lexical items, but there was no correlation between text length and lexical diversity.

Finally, each text was analyzed for cohesion, examining discourse features such as adverbial clauses, lexical echoing (Abrams & Byrd, 2016), and continuity of narrative frames or ideas (Li & Zhu, 2017b). A qualitative score was assigned to each text, from 5 (*good coherence between ideas and text*) to 1 (*series of unrelated sentences*; see Scott, 1996). To ensure reliability, a second rater re-analyzed the data. Any discrepancies were negotiated until consistent scoring was achieved.

Spearman’s rank-order correlation analyses were conducted to measure the strength and direction of any potential association between collaborative group patterns and linguistic features, using SPSS (version 24, 2016).³ Given the small *n*-size, all quantitative analyses were exploratory in nature. α was set at .05. Effect sizes of $r = .10$ – $.29$ were small, $r = .30$ – $.49$ were medium, and $r = .50$ – 1.0 were large.

For the second research question, the collaborative groups’ storylines were analyzed in depth, in order to identify the characteristics of effective collaborative writing. Each iteration of the text produced by these groups was examined for language-related changes as well—categorized according to the linguistic aspect they addressed, such as the lexicon, grammar, or meaning—expanding on the analytic model by Kessler and Bikowski (2010). The instructor’s self-reflective notes were used in response to the second research question.

Findings and Discussion

Research Question 1. Participatory Patterns and Writing Performance

As established by Abrams (2017), the participants from Groups 4, 5, 7, and 8 were collaborative, showing high levels of equality of contribution and mutuality. They collaborated on several drafts during Phases 2 and 3 of the task, adding content, revising other people’s contributions, and making connections between

others' texts and their own, in terms of both language and ideas. The collaborative patterns of Groups 1, 2, 3, and 9 belonged in the dominant–dominant category: Participants produced similar amounts of text, but each group member simply added to what others had written, without changing their peers' contributions. Considering the written nature of these texts, Storch's (2002) dominant–dominant quadrant was relabeled as sequentially additive. Group 6 demonstrated a passive–passive pattern. Although the students in this group discussed their proposed screenplay in class, only one student took notes and wrote any text in Google Docs, without anybody else adding anything more to the text in Phases 2 or 3. Li and Zhu (2017b) referred to groups with low equality and low mutuality as dominant–defensive, based on interviews with their participants. Since the present study did not investigate learners' affective stances during the collaborative writing project, Storch's (2002) labels were retained.

The goal of the present study was to examine the potential relationship between collaborative patterns (i.e., passive, dominant, and collaborative) and linguistic performance (see [Appendix A](#)). The data revealed that different group dynamics did indeed result in divergent patterns of language use in terms of syntactic complexity, grammatical accuracy, fluency, propositional content, lexical diversity, and cohesion.

The results suggested that syntactic complexity was not a function of collaborative patterns, but rather of text-type. Groups 2, 6, and 8 had the highest complexity scores and wrote narrative continuations of the story instead of dialog-based screenplays. Their choice may reflect their personal, stylistic preference influencing how they approached the task (Norris & Ortega, 2009; Ortega, 2003; Pallotti, 2009). Similarly, the highest accuracy scores were spread out across collaborative patterns: Groups 3, 8, and 9 wrote the most accurate texts, both in terms of grammatical and lexical accuracy. This might reflect individual learners' attention to these linguistic features instead of group dynamics. Lexical diversity scores also varied greatly across groups, regardless of collaborative patterns. Group 3 used the most diverse vocabulary, followed by Group 5, while Group 9 incorporated the least diverse lexicon (28.50). Perhaps, like syntactic complexity, lexical diversity might reflect overall L2 development, not being as sensitive to task type or interaction (Norris & Ortega, 2009; Ortega, 2003). In contrast, fluency (i.e., the number of words produced) increased as groups exhibited more collaboration in their writing. Group 6, the only passive–passive group, wrote by far the shortest text (76 words), little over half of the next-shortest text (130 words, produced by Group 2). Correlation analyses evaluated whether these patterns were statistically significant.

The correlation analyses revealed three significant relationships between participatory patterns and writing quality, and four between pairs of linguistic features, as shown in [Table 2](#) (for the correlation table, see [Appendix B](#)).

Table 2. Significant Correlations Between Collaborative Patterns and Linguistic Features

Comparisons	95% CI	r^2	p
Collaborative pattern and fluency	.378–.963	.833	.005**
Collaborative pattern and propositional content	.378–.963	.833	.005**
Collaborative pattern and coherence	.211–.961	.797*	.018*
Fluency and propositional content	.996–1.000	1.000	.000**
Grammatical and lexical accuracy	.526–.975	.882	.002**
Coherence and fluency	.148–.956	.772*	.025*
Coherence and propositional content	.148–.956	.772*	.025

Notes. * $p < .05$ (2-tailed)

** $p < .01$ (2-tailed)

First, the more collaborative a group was, the longer its text was likely to be (fluency), concurrently increasing propositional content as well. Increased collaboration also yielded improved textual coherence, although this issue needed some elaboration. When the text written by Group 6 was included in the analysis,

there seemed to be no relationship between collaborative patterns and coherence. However, given the fact that the text was written by only one student, as mentioned earlier, it could be viewed as an outlier. When excluding this text, the correlation between collaborative patterns and text coherence proved to be significant ($r^2 = .797$). These findings confirm previous results that collaborative writing pushes content development and meaning over accuracy (Abrams & Byrd, 2016; Elola & Oskoz, 2010a; Kessler, 2009; Kessler & Bikowski, 2010; Li & Zhu, 2017b; Storch, 2002, 2011).

Several correlations emerged among the linguistic features as well. First, grammatical and lexical accuracy revealed a strong relationship—even though TBLT research is moving to separate analyses of syntax and lexicon (Polio & Shea, 2014). Possibly, this relationship depended on learners' overall L2 development: the students who could produce grammatically accurate texts were also the ones who were able to attend to lexical accuracy, and the distinction in lexical sophistication pertained to other aspects of learners' vocabulary, such as appropriate lexical choice (i.e., semantic fit). Second, propositional content increased alongside fluency. That is, the more text learners produced, the more ideas they were able to convey. When considered in connection with coherence, which was closely related to fluency and propositional content, it became evident that active collaboration among groups ensured the production not only of longer and richer texts, but also of more coherent ideas, in which contributions made by individual students could no longer be identified. This corroborates previous research findings (Li & Zhu, 2017b; Storch, 2013).

Interestingly, lexical richness did not correlate positively with collaboration, although lexical sophistication was a common outcome of collaborative writing (Abrams & Byrd, 2016; Kormos, 2014; Storch, 2002, 2011; Storch & Wigglesworth, 2007; Swain & Lapkin, 2001; Tare et al., 2014). Moreover, lexical accuracy negatively correlated to collaboration (albeit only at $\alpha = .10$; $r = -.600$; $p = .088$).⁴ It is unclear why this would be the case. Kormos (2011) found that the untimed condition of writing mitigated potential beneficial effects of content-provision, and the relatively broad timeframe here should have had the same impact. However, that would not explain the negative relationship to lexical accuracy, especially given the meaning-focused nature of the task (Storch & Wigglesworth, 2007) and the fact that the lexicon was a prime focus of collaborative problem-solving among peers at lower levels of proficiency (Storch, 2011). The next section explores the way in which learners co-constructed their texts, providing further insight into the quantitative analyses.

Research Question 2. Characteristics of Effective Collaborative Writing in Google Docs

Although the linguistic features analyzed for the first research question demonstrated limited relationships to collaborative writing patterns, qualitative analyses of the texts revealed several characteristics that distinguished the writing of more-collaborative groups from that of less-collaborative ones. These qualities ultimately yielded qualitatively better writing. First and foremost, all members started writing immediately during Phase 2 of the task (in-class, synchronous CSCW), as illustrated by Group 4 in [Excerpt 1](#).

Excerpt 1. Group 4, Drafts 1 and 2, Phase 2

June 1, 10:34 AM

Was wird mit Daniel, Isa, Juli und Melek passieren?
[What will happen with Daniel, Isa, Juli and Melek?]

Daniel hat
[Daniel has]

June 1, 10:37 AM

[Grenzposten betritt]
[The customs officer enters]

GrP:
[GrP:]

Was wird mit Daniel, Isa, Juli und Melek passieren?
 [*What will happen with Daniel, Isa, Juli and Melek?*]

Daniel: *Ich muss die Brücke finden-hat*
 [*Daniel: I have to find the bridge have-(past)*]

Each color denotes a different user. Immediately after opening their Google document, two students began writing different components of the text. The first student (assigned pink in Google Docs) focused the group's attention to one of the task's objectives, describing what happened to the main protagonists in the movie. The second student (teal) began a conversation, indicating screen-play stage instructions in square brackets (*The customs officer enters*) and an abbreviation for the customs officer, followed by a colon, which clearly signals to the group that they will follow with a dialogic format. In less-collaborative groups, in contrast, only one person typically took the lead. Establishing a collaborative pattern early may have had ramifications for the rest of the writing process, because all participants were engaged with the story and the text.

Participants in Group 7 included meta-comments for each other, as can be seen in [Excerpt 2](#).

[Excerpt 2](#). *Group 7, Draft 7*

June 1, 5:34 PM

“Im Juli”

Hey guys, [S2] here. I may have gotten carried away with my part... hope that's okay. I deleted the bullet points and wrote the script in its place.

OUTLINE

Daniel must escape (flüchten), so he can meet up with Melek.

Juli hatte ein Baby gefunden also geht sie zum Gefängnis. Dort sieht sie Daniel:
 [*Juli found a baby so she goes to prison. There she sees Daniel:*]

Juli: “Daniel!”
 [*Juli: “Daniel!”*]

Daniel schaut und mit großen Augen ist.
 [*Daniel looks with big eyes (stares)*]

Daniel: “Ju-Juli! Was passiert?!”
 [*Daniel: “Ju-Juli! What happened?!”*]

Juli schaut auf das Baby und zuckt die Schultern.
 [*Juli looks at the baby and shrugs her shoulders.*]

{researcher note: the story continues for another 19 lines}

This is next from our list.

Daniel and Juli go their separate ways. Juli ends up meeting with Daniel and Melek on Friday, under the bridge by the beach. There he chooses Juli over Melek, and to solidify his choice he says the speech Juli taught him. (sofia)

Daniel didn't water the plants!

The notes produced by one group member (purple) served as a record of their oral pre-task planning and provided an organizational framework for the story as well as the writing process itself—important components of L2 writing (Weissberg, 2000). This student included an idea that the group had agreed on during pre-task planning (Juli finds a baby) and began the story in dialogic format, indicated by the characters' names and punctuation (like Group 4 in [Excerpt 1](#)). At the end of her dialog and narration in

German, she identified tasks that they had agreed to do next (in English), providing scaffolding for her peers' contributions.

In collaborative groups, participants corrected both local and global aspects of each other's writing. For example, all three members in Group 8 worked on the same sentence, beginning their story in class (see Excerpt 3).

Excerpt 3. Group 8, Draft 3

June 1, 10:39 AM

Daniel und Isa gehen in das GefängnisGefngis. Sie müssenmussen aus demm GefängnisGefangis brechen bei Freitag brechen, damit Daniel kann mit Melek treffen.

[Daniel and Isa go to prisonprsn. They have to ~~live to~~ break out of prisonprsn break by Friday, so that Daniel can meet Melek.]

In this example, we see a sentence that had been developed in two previous drafts (shown in black), in which one student (teal) corrected the spelling for *prison* and *must*, while another student (purple) hypercorrected the article from the correct dative into the accusative case, and expanded the propositional content by providing an explanation for why Daniel had to get out of prison. In the same timeframe, before Google Docs autosaved and initiated a new draft, a third student (pink) added the verb *break* and then moved it to the correct clause-final position following a modal verb. Since previous research indicated that lower-proficiency learners were not able to resolve language problems easily (de la Colina & García Mayo, 2007; Storch, 2011), and given that the learners did not produce completely accurate texts here, it was reassuring to see that the participants were able to attend to both meaning and accuracy simultaneously. Especially noteworthy was that content additions were included both after and within other group members' texts, which encouraged noticing features required for textual cohesion, both in terms of content and form.

As noted earlier, the dominant–dominant and passive groups added content without making any revisions to their own or other participants' texts. In contrast, close analyses revealed the following distribution of language and content changes among the collaborative groups, shown in Table 3.

Table 3. Language Change Among Collaborative Groups

	Group 5	Group 8	Group 7	Group 4	Total
Add Content	10	9	8	11	38
Delete Content	2	0	4	0	6
Correct Grammar	1	8	1	1	11
Correct Lexicon	0	10	1	2	13
Add Meta-Comment	2	1	8	1	12
Delete Meta-Comment	2	1	8	1	12

While the instructor circulated among the groups during the in-class phases of the writing project and encouraged collaborative participation, many students lacked the experience to co-create texts. Nonetheless, collaboration was possible even among these intermediate L2 learners. Success, or lack thereof, depended on group dynamics rather than the learners' proficiency levels, with several characteristics of effective collaborative writing emerging from the excerpts and analyses above: (a) an active and productive pre-planning phrase to help generate ideas and a concrete plan of action for completing the task; (b) meta-comments among participants to distribute responsibilities, generate content, and engage peers throughout the task; (c) engagement with peers' work both in terms of content and form (i.e., editing); and (d) an even distribution of the workload. For learners to gain optimal benefits from collaborative writing, (e.g., to expand their knowledge base of lexicon, grammar, and writing conventions;

see Swain & Lapkin, 2001; Wigglesworth & Storch, 2012), they have to engage in the collaborative process itself and need explicit instruction for collaboration.

Conclusion and Implications

The present study sought answers to two research questions pertaining to (a) the potential relationship between participatory patterns identified by Storch (2002), modified by Abrams (2017), and the quality of learners' linguistic output and (b) the characteristics of effective collaboration among learners. In order to contextualize possible pedagogical and research implications, it is important to note the study's limitations. First, the study examined the work of only nine groups of learners. Any conclusions, therefore, must be interpreted with caution for other educational contexts. Second, only one writing task was included in this analysis. It is possible that over time, learners may have exhibited varying degrees of attention on form and content, as was the case in the study by Li and Zhu (2017a). Finally, due to the learners' level of L2 development, brainstorming was done in class and orally instead of in the chat interface of Google Docs. This was a pedagogical decision, but it is possible that including an online, synchronous component for brainstorming may have led learners to attend to different aspects of writing or made more groups collaborate from the beginning.

Nonetheless, it is possible to glean a few pedagogical implications from the study. Most importantly, there seems to be a reciprocal relationship between learner engagement in a task and the amount of output a group produces. Engagement leads to increased production, which enhances learners' engagement in the on-going task. The task itself (e.g., a creative writing assignment) can help engage learners' imagination, as Lee (2010) suggests, or instructors need to ensure that the pre-writing task generates sufficient engagement for the subsequent writing process. Filmic materials can activate learners' imagination, providing concrete ideas to pursue and characters to develop, as well as offering important linguistic scaffolding (Abrams, 2014, 2016). Group 4, for example, included a segment of the film dialog in their own text, in which Daniel, the protagonist, was supposed to express his devotion to Juli. The group had to re-watch the video on their own time in order to transcribe the text relatively accurately. Instructors can support this type of engagement by incorporating further details into the task, calling for the use of key phrases as well as emphasizing the dialogic nature of screen-plays, both in the task description and in the grading criteria—both of which should be shared with students prior to the writing process.

Also, the more collaborative and equal a group was, the more opportunities it had to generate L2 output, although formal aspects of language were not impacted. These findings partially echoed previous research (e.g., Storch, 2002; Storch & Wigglesworth, 2007; Swain & Lapkin, 2001; Watanabe & Swain, 2007) concluding that during collaborative writing, learners prioritized meaning-making. It appears that this was the case at lower levels of proficiency as well. Unlike earlier reports, however, the present study did not yield lexically more-sophisticated texts. Potentially, the extended writing time may have been a mitigating factor (Kormos, 2011). Structuring a task in multiple steps can help students take advantage of both the fluency component of collaborative writing and the benefits of revisions for accuracy (Lundstrom & Baker, 2009; Yu & Lee, 2015). At the initial stages, instructions can emphasize the idea of free-writing to generate ideas and engagement. Students can be told from the beginning that they will have an opportunity to revise their work and improve accuracy at later stages. A multi-stage process can reassure learners that increasing fluency will not come at the expense of accuracy.

The final pedagogical implication comes from the use of Google Docs for teaching L2 writing. Google Docs has been used in previous studies (Kessler et al., 2012; Strobl, 2014) and is an effective pedagogical tool in L2 CSCW. It is more readily available than are wikis and more familiar to many learners. It is easy for instructors or learners to set up groups, and the interface allows for the use of special characters, tables, images, and hyperlinks, among other features. Moreover, the time-stamp function can help instructors monitor how much time learners actually need to complete certain tasks, in order to harness the benefits of collaborative writing (Harklau, 2002; Kormos, 2012; Storch, 2011; Watanabe & Swain, 2007). In the present dataset, for example, it became evident that some groups, even after a 10-minute brainstorming pre-

task, took a long time to begin composing. Further research will have to tease out what happened. It is possible that beginning L2 learners need more time to complete tasks than we assume (Kormos, 2012). Tasks in L2 writing research and pedagogy need to reflect this difference in temporal demand. Alternately, certain task types—such as creative writing versus a summary or collaborative versus individual tasks—may require more time. Extended time-on-task is a benefit of L2 writing, as learners have more time for reflection and attend to multiple, competing aspects of writing over time (e.g., Harklau, 2002; Storch, 2011; Watanabe & Swain, 2007). The revision history function can also help reveal whether learners understand the task the same way as instructors do. (Interventions early on might ensure that participants benefit optimally from a task.) In addition, it can reveal areas of difficulty with vocabulary, grammar, pragmatics, or the writing process that instructors can address in class. Recapping this discussion, based on the works of Bernard and Lundgren-Cayrol (2001) and Grosbois (2016), the suggestions for implementing effective collaborative writing in the L2 classroom can be summarized as follows:

- Make early collaboration a requirement of the writing task.
- Encourage learners to create a task-plan within the document to help the group organize its writing, including a plan of action for task-completion.
- Show learners an effective, collaborative writing model and include collaboration as a criterion when assessing their writing, so they can visualize the task better.
- Allow participants to have autonomy in selecting their groups, as this can raise motivation and task engagement.

In addition to serving as an effective pedagogical tool, Google Docs has proven to be useful for storing and organizing data as well. All drafts are stored in one place without the need for keeping track of different iterations. Conveniently for research, individual learners' contributions are assigned different colors, which remain steady within each group throughout the writing process. This is a crucial contribution of Google Docs. In pencil-and-paper collaborative writing, we cannot see which participants are high contributors and which ones contribute little or no content to the process, and we rely solely on self- and peer-reporting to evaluate collaboration. Also, in Google Docs, deleted content remains in saved drafts, represented as crossed-out text. This feature provides a useful window for examining how and what each participant contributes toward the final draft of the text, what features they attend to (e.g., content, language, style), and how the writing is shaped collaboratively.

It is important to note that with its many positive affordances for teaching and data storage, Google Docs was cumbersome in terms of analytic capability. For example, each draft had to be downloaded to a computer for a simple word-count measure (a word count was available in Google Docs only for the last draft). A second limitation was the application's inability to collate individual contributions. The ability to compile content generated by individual authors would have been useful for pedagogical assessment and research (e.g., analyzing lexical development). Finally, analyses became challenging due to the organizational feature of Google Docs, which was simultaneously its major benefit for research. Drafts were saved according to individual timelines, even in collaborative work, so three identical versions of a text might have appeared in the revision history. Importantly, when a participant merely moved a segment of text written by another learner, it appeared as their own contribution in the next saved draft (and was deleted elsewhere). This had implications for analyzing individual contributions (Kessler et al., 2012) and patterns of collaboration (Storch, 2002), requiring a close analysis of the data to avoid duplication or misattribution. Similarly, Google Docs allowed the importation of entire texts from other sources (e.g., the Internet), which might have obscured the step-by-step development of longer texts or learners' original contributions.

Beyond pedagogical and data management implications, the study suggests potential areas of inquiry as well. For example, further research is needed investigating beginning L2 learners completing different task types (e.g., summary, analytic, or creative texts) to explore how task type may affect the collaborative process and the quality of learners' written product. By extension, researching task design should entail a commensurate focus on the pedagogical implementation of emergent technologies (Kessler et al., 2012).

Since collaborative writing may have a far-reaching impact on L2 learning in general (Harklau, 2002; Watanabe & Swain, 2007), it is important to optimize the process itself and find ways to make writing truly collaborative.

Notes

1. This study used c-units instead of t-units due to the conversational nature of screenplays. c-units allow for the analysis of casual phrases, which may be grammatically incomplete, but which still carry meaning (Crookes, 1990).
2. Voc-D was not used, as it is not consistently reliable with texts shorter than 100 words (McCarthy & Jarvis, 2010). [Text Inspector](#) was used to calculate TLD.
3. The [VassarStats rho calculator](#) was used to determine confidence intervals.
4. Larson-Hall (2015) encourages applied linguistics research to include results at the $\alpha = .10$ level, to avoid Type II errors.

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Appendix A. Collaborative Patterns and L2 Writing Performance

Participatory Patterns	Groups	Categories and Descriptions	COM							
			SUB	CUL	GA	LA	LD	FL	PC	CO
Passive	Group 6	limited participation <ul style="list-style-type: none"> • low equality • low mutuality • reported (but invisible) collaboration 	1.50	12.70	.05	.066	50.25	76	14	5
Dominant	Group 3	1 dominant participant, 1 low-collaborative, 1 passive <ul style="list-style-type: none"> • low equality • low mutuality • sequentially additive 	1.03	6.80	.054	.103	73.38	204	40	3
	Group 2	2 dominant participants, 1 passive <ul style="list-style-type: none"> • low equality • low mutuality • sequentially additive 	1.31	8.13	.054	.062	35.75	130	21	4
	Group 9	2 dominant participants, 1 passive <ul style="list-style-type: none"> • high equality • low mutuality • sequentially additive 	1.17	6.13	.082	.088	28.50	147	32	3
	Group 1	3 dominant participants <ul style="list-style-type: none"> • high equality • low mutuality • sequentially additive 	1.12	5.09	.026	.029	48.24	346	72	5
Collaborative	Group 5	2 collaborative participants, 1 passive <ul style="list-style-type: none"> • high equality • high mutuality 	1.07	5.38	.045	.051	71.56	156	35	4

Group 8	3 collaborative participants, 1 passive <ul style="list-style-type: none"> • high equality • high mutuality • sequentially additive (1 student) 	1.70	13.30	.109	.072	57.60	265	45	5
Group 7	2 collaborative participants, 1 dominant <ul style="list-style-type: none"> • high equality • high mutuality • sequentially additive (1 student) 	1.03	5.51	.045	.061	44.99	507	114	5
Group 4	2 collaborative participants, 1 dominant <ul style="list-style-type: none"> • high equality • high mutuality • sequentially additive (1 student) 	1.11	6.22	.025	.025	42.27	566	120	5

Notes. COM = Complexity; SUB = Subordination; CUL = c-unit length; GA = Grammatical accuracy; LA = Lexical Accuracy; LD = Lexical Diversity; FL = Fluency; PC = Propositional Content; CO = Coherence.

The data are presented in the order in which groups reflected each participatory pattern, from least collaborative (Group 6) at the top to the most collaborative (Group 4) at the bottom.

Appendix B. Full Correlation Table.

		1	2	3	4	5	6	7	8	9
1. Collaborative pattern	<i>r</i>	—								
	<i>p</i>	—								
2. Subordination	<i>r</i>	-.25	—							
	<i>p</i>	.510	—							
3. C-unit length	<i>r</i>	-.32	.63	—						
	<i>p</i>	.406	.070	—						
4. Grammatical accuracy	<i>r</i>	-.41	.49	.62	—					
	<i>p</i>	.271	.181	.074	—					
5. Lexical accuracy	<i>r</i>	-.60	.19	.53	.88**	—				
	<i>p</i>	.088	.620	.139	.002	—				
6. Fluency	<i>r</i>	.83**	-.48	-.38	-.53	-.52	—			
	<i>p</i>	.005	.194	.308	.143	.154	—			
7. Propositional content	<i>r</i>	.83**	-.48	-.38	-.53	-.52	1.00**	—		
	<i>p</i>	.005	.194	.308	.143	.154	.	—		
8. MTL D	<i>r</i>	-.17	-.23	.10	.04	.20	.02	.02	—	
	<i>p</i>	.668	.559	.798	.915	.606	.966	.966	—	
9. Coherence	<i>r</i>	.80*	.12	-.13	-.46	-.70	.77*	.77*	.00	—
	<i>p</i>	.018	.784	.762	.257	.056	.025	.025	1.000	—

Notes. $n = 9$ for all analyses, except for Coherence, where $n = 8$

* $p < 0.05$ (2-tailed)

** $p < 0.01$ (2-tailed).

About the Author

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