Explicitly Teaching Five Technical Genres to English First-Language Adults in a Multi-Major Technical Writing Course

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Abstract: In this paper, I report the effects of explicitly teaching five technical genres to English first-language students enrolled in a multi-major technical writing course. Previous experimental research has demonstrated the efficacy of explicitly teaching academic writing to English first-language adults, but no comparable study on technical writing exists. I used a mixed-method approach to examine these effects, including a control-group quasi-experimental design and a qualitative analysis to more fully describe the 534 texts produced by 316 student writers. Results indicated the genre participants constructed texts demonstrating a significantly greater awareness to audience, purpose, structure, design, style, and editing than participants taught through more traditional approaches. Within the technical genres, participants demonstrated greater awareness to audience, purpose, and editing in the job materials text type than with correspondence or procedures text types.

Keywords: explicit teaching, genre theory, quasi-experiment, technical communication, technical writing

1. Introduction

The purpose of this study is to offer an experimental perspective on how students in multi-major technical writing courses respond to the explicit teaching of genres. I also investigate whether meta-discoursal functions (such as broad text type as well as the participants' gender, year, and major) influence the effects of the treatment. Results from previous experimental studies have demonstrated that explicit approaches are effective in teaching academic writing conventions to diverse populations of English first-language adults (Carter, Ferzli, & Wiebe, 2004; Wilder & Wolfe, 2009), but no comparable study on technical writing exists. The multi-major technical writing course has become a mainstay across international institutions of higher education, and its popularity has led to classes full of diverse academic majors who require instruction specific to their discipline.

1.1 The Efficacy of Explicit Teaching

Explicit teaching is defined as any discussion that articulates the formal features of a genre, including any discussion of the cultural, political, or social factors that shape those features (Freedman, 1993, p. 224). Well-crafted explicit lessons are situated within a defined framework: instructors first establish the learning purpose, explain the new skill to students, show them how to respond, and, finally, facilitate practice of the skill until independence is attained (Boyles, 2002). A variety of strategies are used to achieve these aims, including modeling, scaffolding, coaching, articulation, reflection, and exploration.

Most North American genre scholars believe explicit teachings promote prescriptivism and an overgeneralization of rules that lead students to misapply conventions (Blakeslee, 2001; Freedman, 1993; Hengst & Miller, 1999). These scholars instead perceive genres as complex social practices that evolve from communal needs rather than linguistic templates that can be explicitly taught (Miller, 1984; Schryer, 1993). However, a substantial amount of research has established the efficacy of explicit teaching across multiple grade levels, multiple subject areas, and diverse student populations (Chall, 2000; Moni, Hryciw, & Moni, 2006; Rittle-Johnson, 2006; Walker, 1999, 2002; Watkins & Slocum, 2004).

Findings from meta-analyses validate the consistency of explicit approaches, and the education reform programs with the most significant results employed explicit strategies and produced higher student achievements than progressive methods (Adams & Engelmann, 1996; Borman, Hewes, Overmann, & Brown, 2003; Chall, 2000). Experimental control-group studies corroborate the positive effects of explicitly teaching academic disciplinary conventions to English first-language adults (Carter et al., 2004; Wilder & Wolfe, 2009). Carter et al. (2004) found students who used an online tool for learning the laboratory report genre constructed texts that were significantly more effective and scientifically reasoned than the control group. Wilder and Wolfe (2009)

also reported undergraduates who received explicit instruction in literary analysis conventions constructed essays English teachers rated higher than students who did not receive the treatment. Researchers from both studies concluded the treatment students were significantly more engaged in their learning and developed a more positive attitude toward writing.

While these studies demonstrate the efficacy of explicitly teaching genres that students produce in academic settings, no comparable study has addressed the effects of explicitly teaching genres that students produce in professional settings, such as job materials, correspondence, and procedures. The need for this investigation has increased because program administrators have placed a high value on the multi-major technical writing service course. For instance, the course satisfies not only students' core curriculum requirements but the professional communication requirements outlined by entities like the Accreditation Board for Engineering and Technology (ABET) (Meloncon & England, 2011; Wolfe, 2009). These purposes have impacted the student populations that enroll in the course and the type of instruction teachers provide.

1.2   The Multi-Major Technical Writing Course

The primary aim of the technical writing service course is to introduce students to the rhetorical, stylistic, and organizational principles of multiple technical texts. Because the course must also account for university and outside accreditation requirements, the typical student population is a mixture of academic majors, including but not limited to English, criminal justice, dance, biology, computer science, and engineering. Results from previous empirical studies have indicated that students' academic major can influence their writing performance as well as other meta-discoursal functions like gender, academic level, and native speaker status (Adamson, 1992; Boettger & Wulff, 2014; Fries, 1940; Jaeger, 2010; Römer, 2009a, 2009b; Wulff, Römer, & Swales, 2012). No experimental studies have examined how these social variables might impact the effects of explicit teaching in English first-language adults. This issue becomes more important due to the diverse student populations who enroll. Research findings on explicit teaching indicate it is an effective approach for populations with diverse performance levels and aptitudes and therefore might be pedagogically helpful to technical writing instructors and their students.

1.3   The Study's Aims and Research Questions

In this study, I measure the effects of explicitly teaching English first-language technical writing students the common conventions of five common genres: the job letter, the resume, the claim letter, the recruitment email, and the instruction set. I used a mixed-method approach to examine these effects, including a control-group quasi-experimental design and a qualitative analysis to more fully describe the 534 texts produced by the student writers. The design of the quasi-experiment was based on its use in the two previously discussed studies on explicitly teaching academic writing conventions to English first-language adults (Carter et al., 2004; Wilder & Wolfe, 2009).

Students in the present study's treatment group received a series of explicit lessons that first raised their awareness to genre principles and then emphasized the formal features of a specific genre. This pedagogical approach is unique because it considers the theoretical and pedagogical underpinnings of the three primary schools of genre theory: English for Specific Purposes, the Sydney School, and New Rhetoric Studies (see Hyon, 1996 for a description of each school). I designed the study around two research questions:

RQ1. What are the effects of explicit teaching on participants in an introductory technical writing class? Specifically, how does the treatment influence attention to the text's audience, purpose, structure, design, style, and editing?

RQ2. What effects do meta-discoursal functions have on the treatment? Specifically, how does the treatment influence experimental group; broad text type; and the participants' gender, academic major, and year?

The 534-text data sample was measured against a five-point scale on six dependent variables, which I identified from popular technical communication textbooks (Johnson-Sheehan, 2012; Markel, 2012). I anticipated students who received the explicit genre treatment would construct significantly higher-quality texts than students who did not receive the treatment. I posed the second research question to contribute to the growing body of research on how social variables interact with academic and technical writing performance (Boettger & Wulff, 2014; Hardy & Römer, 2013; Römer, 2009a; Wulff et al., 2012). While it is found to be an effective instructional mode, it is unclear if explicit teaching is universally effective or just with certain populations.

2. Methodology

In this section, I provide information on the study's participants and setting as well as the experimental materials, measures, and procedures.

2.1   Participants and Setting

The study's participants included 316 English first-language adults enrolled in introductory technical writing courses at a public research institution in West Texas. The control groups consisted of 161 participants, and the treatment groups consisted of 155 participants. Overall, 35% of participants where either freshmen or sophomores (n = 112), 34% were seniors (n = 106), and 31% were juniors (n = 98). Fifty-seven percent of participants were female (n = 179) and 43% were male (n = 137). Fifty-two percent of participants were humanities or business majors (n = 164) and 48% (n = 152) were STEM majors. No participants were technical communication majors.

Additionally, nine instructors across 18 sections of a sophomore-level technical writing course participated in the study. The instructors were full-time lecturers or

doctoral students in technical communication and rhetoric. They all had previous teaching experience and had also completed a graduate-level teaching methods course in their field.

This course was designed for a diverse number of academic majors and organized around a common syllabus of six instructional units. Instructors teach these units in a designated order, but they determine the content delivery and each unit's final deliverable. This study's treatment complied with these cross-sectional guidelines. The standard syllabus and instructional units also contributed to internal validity, ensuring the experimental groups learned the same text types for the same length of time at the same point in the semester.

2.2   Materials

The materials for this study included a pretest administered to all participants before the study and the explicit treatment began.

Pretest

Quasi-experiments include established groups, so researchers should account for between-group differences that could influence the results. Specifically, initial assessment of writing ability is suggested for writing-focused, classroom-based quasi-experiments (Beach, 1992). On the first day of class, the control and genre participants wrote a memo to their instructor that discussed their academic major and desired career and then described the writing they would likely encounter in their chosen profession. Participants completed this assignment in 20 minutes with a word processor, ensuring all sections received the same amount of writing time.

Two raters independently evaluated the memos using a 6-point rubric designed for timed, first-draft writing (White, 1995). The control group scored an average of 2.98 on the assessment ($sd = 0.95$), and the genre group scored an average of 3.08 ($sd = 0.98$). A Kruskal-Wallis rank sum test found no significant differences between the group's scores ($\chi^2 = 1.35$, $p > 0.05$). This result suggests both experimental groups were initially comparable in their writing abilities.

Treatment

The treatment was organized into two phases. The first phase raised participants' awareness to genre and its relationship with audience. A focus on genre awareness is promoted within the tenants and practices of New Rhetoric Studies, one of the three primary genre theory schools (Devitt, 2004, 2009). For this phase, students were assigned the first chapter of Hubert (1976), which used a popular fiction lens to explain genre as a concept driven by personal preferences. Students' reactions to this reading then transitioned into a teacher-led discussion on how students shape and are shaped by academic genres, such as the course syllabus.

The second phase emphasized the rules and conventions of a specific genre. Genre mastery is promoted within the tenants and practices of the Sydney School and English for Specific Purposes, the other primary genre theory schools. The four stages in this phase were inspired by the Australian Wheel Model, which organizes instruction into guided stages to emphasize how a text's structure and organization affects context and influences the reader and writer (Martin & Rothery, 1980). Within this approach, instructors first modeled the targeted text type. Participants then jointly negotiated this text, explored its historical context, and finally independently constructed their own version. Appendix A provides more information on both phases of the treatment.

2.3   Measures

I collected 524 technical texts for analysis, which included the final version of the five targeted genres from both experimental groups. Participants in the job materials and correspondence unit each constructed two texts (n = 214 and 202, respectively), and participants in the procedures unit constructed one longer text (n = 108). Additionally, 192 participants opted to submit a reflection, a required piece to every major assignment in this course. These reflections are cited throughout the results section to offer insight into how participants approached the independent construction stage. Prior to data collection, IRB approval was granted.

Variables

Each text was evaluated against six dependent variables (DV): Audience, Purpose, Structure, Design, Style, and Editing. I identified the DVs based on the recommendations in popular technical communication textbooks for planning a text: writers analyze their audience to understand the rhetorical purpose. This analysis informs the structure, design, style, and editing of the text. (Johnson-Sheehan, 2012; Markel, 2012). Table 1 includes a description of each variable and its levels.

The texts were also evaluated against five independent variables (IV) to determine if any meta-discoursal functions interacted with the treatment. These IVs were Group, Broad, Gender, Major, and Year (see Table 1).

Rubric

Raters assessed the texts on the DVs using a 5-point rubric. Appendix B includes definitions of these scales for each variable. This rubric was created before and independent from this study. The technical writing instructors at the research site created this instrument to provide more grading consistency across all sections. I chose to use this rubric here because it reflected the pedagogical input of many of the instructors who participated in this study.

I initially assessed the entire data sample and then assigned 20% of a random sample to two independent raters. The raters both held Master's degrees and were advanced lecturers in technical communication. These raters were not faculty members

at the research site but had taught the five text types in their home departments. A weighted Kappa test identified between-rater agreement of 81%, indicating a high level of consistency (Beach, 1992; Watt & van den Burg, 1995).

Table 1. Variables and variable levels considered in the present study.

Variable	Description
Audience (DV)	Classified how the texts matched the intended audience's needs (-2, -1, 0, 1, 2).
Purpose (DV)	Classified the statement of the texts' intended purpose (-2, -1, 0, 1, 2).
Structure (DV)	Classified how the texts followed the structural conventions of the text type (-2, -1, 0, 1, 2).
Design (DV)	Classified how the texts' design elements matched the text type (-2, -1, 0, 1, 2).
Style (DV)	Classified the clarity and succinctness the texts' prose, including an appropriate use formality and technicality (-2, -1, 0, 1, 2).
Editing (DV)	Classified the number of errors in the texts (-2, -1, 0, 1, 2).
Group (IV)	Classified the student by experimental group (control or genre).
Broad (IV)	Classified the texts by type (correspondence, job, or procedures).
Gender (IV)	Classified the students by sex (female or male).
Major (IV)	Broadly classified the students by major (non-STEM or STEM). Non-STEM majors included students in Architecture, Communication Studies, English, Hotel and Restaurant Management, Human Development and Family Studies, Interior Design, Journalism, Personal Financial Planning, Public Relations, Retailing, and Special Education. STEM majors included students in Agricultural and Applied Economics, Animal Science, Anthropology, Biochemistry, Biology, Chemistry, Civil Engineering, Exercise and Sport Sciences, Food Science, Political Science, Psychology, Speech and Hearing Sciences, Wildlife and Fisheries Management, and Zoology.
Year (IV)	Classified the student writers by academic year (freshman/sophomore, junior, or senior).

Data Analysis

A factorial between-groups multivariate analysis of variance (or MANOVA) was performed to investigate the effects of the treatment. Preliminary assumption testing was conducted to check for normality, multivariate outliers, and multicollinearity, with no serious violations noted. The pretest assessed pre-treatment equality within the experimental groups, but quasi-experiments include more validity challenges than true experiments. To account for this, results are reported with the Pillai's Trace multivariate test, the preferred test when all MANOVA assumptions are not met (Tabachnick &

Fidell, 2013). Additionally, the results section only includes main effects and interactions that fell within an adjusted alpha range of 0.008 (0.05/6 DVs).

This study also includes a qualitative analysis to more fully describe the MANOVA results. I selected excerpts from students' texts and reflections to contextualize how attention to the DVs varied between the experimental groups.

2.4   Procedure

This study employed a control-group quasi-experimental design. Both experimental groups were pretested on initial writing ability. Both experimental groups also received the same assignment description, so their final texts could be compared against the DVs.

Before the semester began, I randomly assigned one instructional unit (job materials, correspondence, or procedures) to each of the 9 instructors. All classes met twice a week, so I randomized unit assignments by morning and afternoon class times. Each instructor taught one treatment and one control group.

In my preliminary interviews, instructors agreed the treatment emphasized the features of the technical texts more explicitly than their current instructional approaches. However, it was important these instructors felt they were not neglecting the control participants by denying them access to information; rather I wanted them to feel as though they were teaching the same principles using two different approaches. I formally met with each instructor three times throughout the semester to train them on the treatment and ensure they implemented it as outlined. I did not divulge my research questions or share information about other participating instructors.

Instructors implemented the treatment into their genre group in two phases. The first phase, focused on genre awareness, was introduced during the second week of the semester because it complemented the required discussion of audience analysis. The second phase, focused on genre mastery, was implemented when instructors began to teach their assigned instructional unit.

The treatment filled 30-50 minutes of each class period, which allowed instructors to supplement this time in their control section with extended lectures, class discussions, and activities. For example, Instructor B assigned students to write a response to an article from a job search web site. These articles' topics included discussions of how college students should present their skills in a resume, 10 reasons why resumes "annoy" readers, and cover letter mistakes. In another example, both Instructors H and I supplemented their control sections' time with an in-class activity where students user-tested the course registration instructions listed on their university's web site. Both activities enforced content for the particular units but did not explicate the formal features of genre in a way the treatment did.

3. Results

Results from the MANOVA indicated three main effects and one interaction (see Appendix C for complete statistical output). Table 2 provides a statistical summary of these results. In this section, I organize the results around the two research questions.

The first research question examined the effects of the treatment. Specifically, I was interested in how participants constructed their technical texts to address audience, purpose, structure, design, style, and editing. To address this question, the following section reports the results from the main effect of Group.

Table 2. Statistical Summary of the Main Effects and Interaction.

Variable	Pillai	*F*	P
Group	0.28	29	0.00
Broad	0.23	10	0.00
Year	0.08	3	0.00
Broad:Gender	0.07	3	0.00

3.1 Main Effect of Group

There was a statistically significant difference between the control and genre groups on all six DVs ($V = 0.28$, $F_{(1, 450)} = 29$, p < .001; $\eta^2 = .20$). When considered separately, all DVs reached statistical significance. The following first reports these quantitative results, which are then supplemented with excerpts from the participants' texts and reflections.

Audience

Audience assessed how successfully the participants matched their technical texts to the intended audience's needs as well as the ethicality of this execution. The mean for the control group was -0.23 (*median* = 1.00, *sd* = 1.06) and 0.59 (*median* = 0.00, *sd* = 1.14) for the genre group, a statistically significant difference ($F_{(1, 455)} = 80.6$, p <.001, $\eta^2 = 0.11$).

Overall, both groups scored within the *Competent* range, indicating the texts typically included some mismatches to their audiences' needs, yet the students approached the communication situation ethically. The control group struggled slightly more with audience awareness. The following three examples from job letters illustrate some of these issues, including how participants tailored these texts and how they presented their qualifications to prospective employers:

> I am more than at home in an office environment after spending an entire summer and then a winter break working at a hospital. While working there I gained an excellent understanding of how an office needs to function in a world that can be

thrown into chaos at a single moment [job letter, economics major in his junior year]

Recently I did some research about your company and I took an interest in it. Not only are your headquarters located in a prime area in the Dallas, TX area, but you also provide great benefits for your employees and their families. [job letter, retailing major in her junior year]

A lot of the nurses in the field are in their 40's and 50's and I will be one of the younger nurses. This means that I will stay around longer and have the energy to work 12 hour shifts. [job letter, pre-nursing major in her junior year]

These examples all include some level of audience awareness, but the executions are not entirely successful. In his assignment reflection, the writer of (a) wrote that his experiences at the hospital differentiated him from the competition.
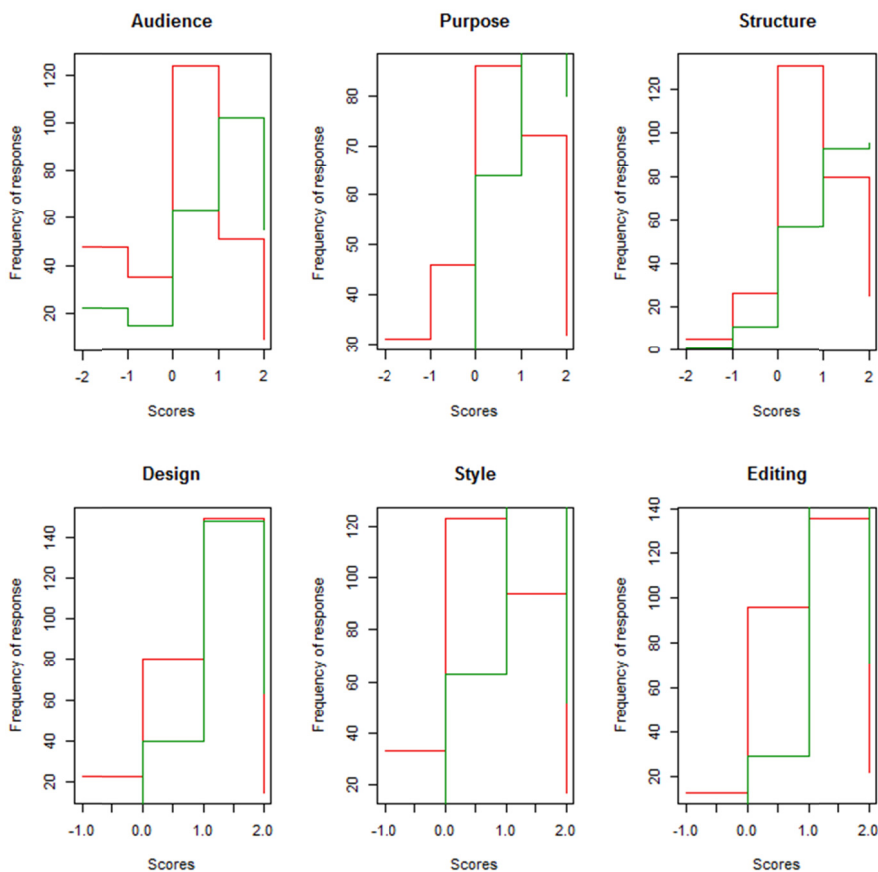

Figure 1. Frequency plot for Group main effect between the control and genre groups.

However, his execution did not include concrete details about this work. Similarly, the writer of (b) showed awareness by demonstrating his research on the company, but this presentation focused on what the company offered the student rather than what she offered the company. Finally, the writer of (c) promoted her youth and enthusiasm, likely in an attempt to show longevity, but it was at the expense of her prospective colleagues.

The genre group approached audience with similar misapplications as (a)-(c) but with less frequency. As shown in the Audience panel of Figure 1, the genre group, represented by the green line, constructed more texts with *Strong* or *Superior* awareness to audience than the control group, represented by the red line. The genre writers included more concrete details in their texts, such as the example below:

> My passion for animals, especially wolves, led me to pursue a degree in wildlife management. In my years at [university name], I took a variety of courses in wildlife management and earned a 3.79 GPA. I have been involved in the Range, Wildlife, and Fisheries Club, where I was elected Vice President, coordinated a telemetry activity with a few of the graduate students and ran two meetings when the President was unavailable. I was also a member of the Wildlife Quizbowl team, where I attended and competed in the Texas Chapter of The Wildlife Society meetings and Western Student Conclave meetings. I participated in small mammal trapping as well, and assisted with a mule deer study at Three Bar Ranch in Arizona. [job letter, wildlife and fisheries management major in her junior year]

This narrative could benefit from stronger organization and specifics relating to relevant coursework, but the writer included details that quantified her achievements (3.79 GPA) and supported the general statement ("My passion for animals…") with examples.

Purpose

Purpose assessed how successfully the participants stated the intended purpose of their technical texts. The mean for the control group was 0.10 (*median* = 0.00, *sd*= 1.17) and 0.86 (*median* = 1.00, *sd* = 1.04) for the genre group, a statistically significant difference ($F_{(1, 455)} = 63.40$, $p < .000$, $\eta^2 = .07$).

Overall, both groups scored within the *Competent* range, indicating students typically stated their intended purpose, but not clearly. Again, the control group struggled more with applying these statements (see Figure 1), often including implicit or undeveloped calls to action. The following examples illustrate some of these issues within multiple text types:

> We need to increase our membership by 50%. This can only happen by having new members of the [university name] family like you to join our organization. This organization is non-profit so we need all of the support from future active new members as well as current active members and alums. Please consider becoming

> an active member. [recruitment email, human development and family studies major in her junior year]

> Objectives: Looking to further my knowledge and experience in the Agriculture Industry. [resume, agricultural and applied economics majors his junior year]

> I am a junior biology major at [university name]. I came across your job advertisement for a veterinary technician in the newspaper….My current employer will be waiting for a response on my resignation. I will follow up on my application on the 2nd of October, if you are unable to talk with me on or before this time, please let me know either by phone or email [job letter, biology major in his junior year].

> On December 11, I purchased a pair of 179 Pontoons from your website. I had been looking at them for quite some time and finally decided that, out of all the skis and ski brands available to me, these were the skis that I wanted to invest my money in. My first venture on these particular skis was the weekend of January 26-28. For the first few runs, the Pontoons were fantastic. I thought these were most likely the best skis I had ever owned. [claim letter, biology major in his senior year].

The writer of (e) clearly stated her goal (to increase membership by 50%) and then asked the reader to join the organization. However, she failed to include details on how to join the organization. Next, the resume objective statement in (f) is general and not tailored to the company or the position. The writer of (g) referenced the advertised position in his job letter, but he never asked to be considered for this position. In his final paragraph, the writer of (g) also included an ambiguous "follow up," but never requested an interview, which is the purpose of a job letter. Finally, the writer of (h) buried the claim of his letter in the third paragraph of a four-paragraph letter.

The genre group approached purpose with similar misapplications as (e)-(h) but with less frequency. As illustrated in the Purpose panel of Figure 1, this group constructed more *Strong* or *Superior* calls to action that were characterized by their explicitness:

> The next meeting will be held on October 24th at 7 p.m. in room 122 in the Human Sciences building. Please plan to attend and take part in this great organization. In the meantime, call me at any questions at [phone number]. [recruitment email, human development and family studies major in her junior year]

> The following instructions will help you develop the skills for serving wine in an upscale restaurant environment. [instructions set, hotel restaurant management major in her sophomore year]

The writer of (i) concluded her recruitment email with a statement to attend a specific meeting. Similarly, the writer of (j) orients her reader before listing the steps to her instructions.

Structure

Structure evaluated how successfully the participants implemented the appropriate structural conventions in their technical texts, including the arrangement of major sections and the use of headings and transitions. The mean for the control group was 0.35 (*median* = 0.00, *sd* = 0.85) and 1.05 (*median* = 1.00, *sd* = 0.89) for the genre group, a statistically significant difference ($F_{(1, 455)}$ = 87.71, *p* < .000, η^2 = .09).

Overall, the control group scored in the *Competent* range, indicating participants typically followed the structural conventions of the texts but included unclear headings and transitions or minor illogical arraignments. For example, the excerpt from a recruitment email in (k) begins with an attention grabber (framed as a rhetorical question) and then transitions into the section titled, "What is ASTF?" But this writer never defines the organization, making the heading misleading and its transition illogical.

Did you ever have complaints of suggestions that may help improve the working atmosphere in the architecture building yet had no one to turn to?

What is ASTF?

This is your chance to learn that the Architecture Student Task Force is the backbone in establishing a bond between the student body and administration. You can be one of the few who enriches the College of Architecture program at our university! [recruitment email, architecture major in his junior year].

The control group also typically included underdeveloped structural conventions in their texts, which impaired readability and impacted safety. For example, a convention to instruction sets is a conclusion, which should state the task is completed and (or) describe what the reader should do next. Conclusions can also contain additional information, such as maintenance tips or a troubleshooting guide (Markel, 2012). The following conclusion on assembling a scuba diving cylinder did not apply these conventions and introduced potential safety concerns as a result:

The scuba cylinder should now be fully assembled and checked for safety. Remember to have the cylinder checked for completion by a certified scuba instructor. It is important to follow other procedures involved in the dive preparation process too. [instruction set, biology major in her senior year].

Because of the order of the sentences in (l), it is unclear if the reader should check the cylinder for safety or if the scuba instructor would assess the safety during the completion check. The conclusion also includes a vague statement about "other procedures" associated with diving. The assignment description asked students to target an audience with only basic knowledge of the subject; casually mentioning additional procedures was ambiguous and potentially dangerous.

Finally, the control group typically struggled with basic structural elements, such as letter format. The claim letter, by a civil engineering major in his senior year, is an extreme example (see Figure 2) but encapsulates the formatting issues that separated the experimental groups. This student's contact information is underlined and includes a comma after every line, impairing readability. The student's telephone number even includes an additional digit. The salutation is formatted incorrectly, and the closing provides no space for a signature. The most noticeable error was the format of the claim letter: the document is double-spaced and uses a semi-block indented format. Semi-block indented is a common business format, but the double spacing applied here makes the text resemble an academic essay more than a professional letter. Both APA and MLA styles use an indented paragraph structure, so perhaps this student was emulating the formats he learned in his college writing courses.

<div style="border:1px solid #000; padding:1em;">

Joe Smith,
123 Main St.,
Anywhere, USA 12345,
(806) 123-45678,

Lewisville Texas Department of Public Safety Office

PO Box 4087

Austin, Texas 78773-0001

Dear, Mr. Christian

    I am expressing a complaint concerning the service I received while replacing my driver license at the Lewisville Texas Department of Public Safety office on August 9, 2006.

    This past summer while in Europe studying abroad I managed to lose my wallet which included my Texas driver license. When I returned to the States I went to the Texas Department of Public Safety office in Lewisville and requested a new driver license. After I received my new license in the mail I then realized that I would have to go and renew my license in a year anyway.

Sincerely, Joe Smith

</div>

Figure 2. Example of structural elements issues in control group correspondence.

The genre group scored within the *Strong* range of Structure, indicating students typically followed the structural conventions of the texts: used mostly clear headings

and transitions, and arranged parts logically. As a contrast to (k), the following excerpt from a recruitment email (m) includes a stronger structure.

> *Why are we such a large organization?* Because we have so much to offer! The National FFA is the largest student organization in America. Texas is the leading state in membership with over 66,000 members. Every year there are conventions where you will meet other participants in the FFA. Elections are held every year to fill offices in various levels of membership. There are also many committees to serve on whose tasks involve planning, running, and funding events.

> *How much time is involved?* Everyone has a busy schedule and at FFA we know this. There are many ways you can participate in this great organization. Whether you want to be part of a team, compete as an individual, serve on committees, participate in talent contests, attend conventions, or run for offices, there is a place for you. No matter how much time you have to offer there is a way to get involved. Everyone is Someone in FFA. [recruitment email, agricultural and applied economics major in her sophomore year]

The complete text for (m) is organized into four headings that each target the AIDA conventions (Attention, Interest, Desire, and Action), the instructional approach used to model this text type. Each heading (i.e., "How much time is involved?") poses a question and then transitions readers between ideas.

The genre group also typically developed the structural conventions of their texts more effectively than the control group. As a contrast to (l), the following excerpt from an instruction set on flower arrangement (n) includes a clearer, more traditional conclusion.

> One you have completed your arrangement, you are now ready to prepare it for delivery. All you need to do now is simply add a bow to the front of the arrangement if you desire and attach the card. After this is complete, the flowers and vase can be placed back in the cooler to help maintain freshness until delivery.

> Some important questions to consider when you have completed the task are:

> - Will it meet the customer's expectations?
> - Did they get what they paid for?
> - And would I be happy if somebody delivered this to me? [instruction set, agricultural and applied economics major in her senior year]

The structure of (n) aligns more with the earlier-noted recommendations for writing a conclusion for instructions, including the additional maintenance tips or questions used to assess quality control.

Design

Design evaluated how successfully the participants used appropriate design elements (e.g., contrast, repetition, alignment, and proximity) in their technical texts. The mean for the control group was 0.58 (*median* = 1.00, *sd* = 0.73) and 1.05 (*median* = 1.00, *sd* = 0.69) for the genre group, a statistically significant difference ($F_{(1, 455)}$ = 64.45, $p < .001$, $\eta^2 = .10$).

Overall, the control group scored within the *Competent* range, indicating participants typically included an adequate match of design elements to their texts. Figure 3 shows a resume constructed by an exercise and sport sciences major in her junior year. The text is overcrowded with three different typefaces: one for the applicant's address information, one for the headings, and one for the body text. Similarly, the text includes three different heading levels: a main heading displays the applicant's name, a second level identifies each section's name, and a third levels serves as a sub-heading to the second level (i.e., the "Student Organizations and Scholarships" heading under "Educational Synopsis"). The multiple typefaces, sizes, heading levels, and page boarder mar the text's organizational hierarchy by providing the reader with no obvious visual cue to begin locating information.
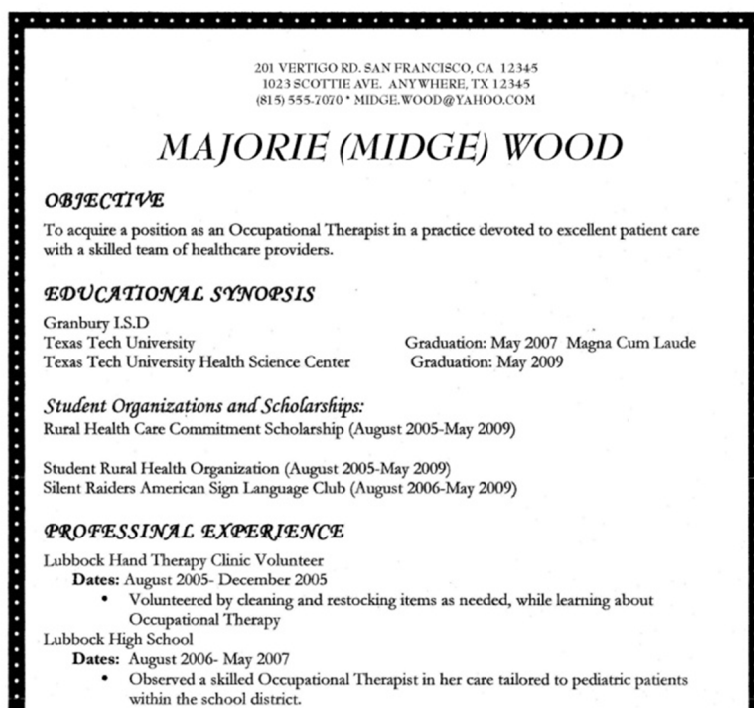

Figure 3. "Competent" design example from control group.

In contrast, the genre group scored within the *Strong* range of the DV, indicating students typically included a good match of design elements to their texts. Figure 4 shows a resume constructed by an interior design major in her junior year. Overall, the text includes a strong use of white space and creates a visual hierarchy with the boldface headings. The bullets promote an organizational hierarchy, but the three different bullet styles do not always group related information.
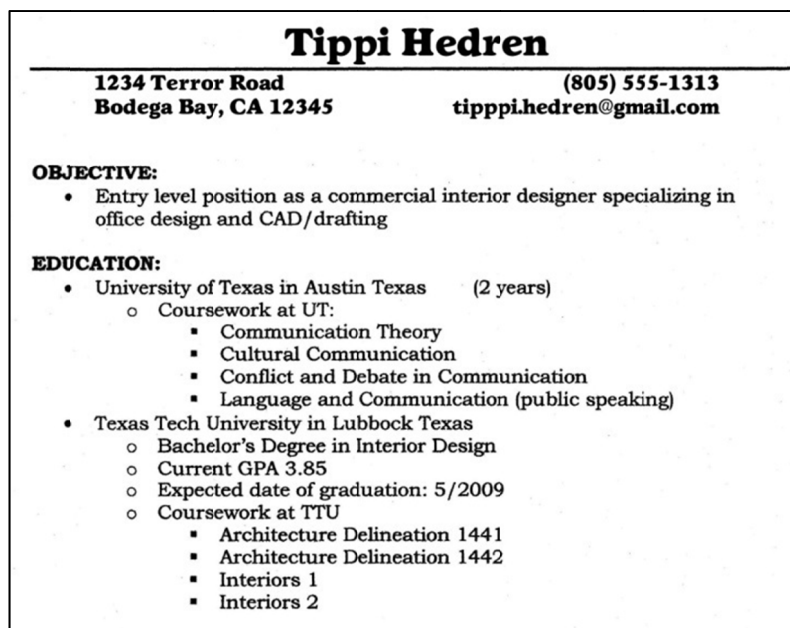

Figure 4. "Strong" design example from genre group.

Style

Style evaluated the clarity of the document's prose and appropriateness of the language. The mean for the control group was 0.36 (*median* = 0.00, *sd* = 0.78) and 0.88 (*median* = 1.00, *sd* = 0.77) for the genre group, a statistically significant difference ($F_{(1, 455)}$ = 64.90, $p < .001$, η^2 = .08).

Overall, both groups scored in the *Competent* range, indicating participants typically included somewhat wordy prose and a mostly good match of formality and technicality to audience. A majority of the style issues identified in both groups related to the three correspondence text types, including the preferred direct style for the claim letter. Examples (o) and (p) demonstrate a less direct approach to resolving the claim.

I request a box to return the defective Hard Drive. A newly working hard drive in return would be nice too. [genre group, advertising major in his senior year]

I'd prefer you replace the garment, but I'd also settle for store credit or receiving the same dress in a different color. [genre group, speech and hearing sciences major in her sophomore year]

Both (o) and (p) provide implicit action statements. The writer of (o) begins strong by requesting a box to return his hard drive, but then notes a replacement "would be nice too" rather than asking for it directly. Similarly, the writer of (p) provides multiple courses of action rather than instructing the reader how she would like her claim handled.

Additionally, the control participants typically made less effective tone choices than the genre participants. Examples (q)-(s) demonstrate the negative tone issues that could result from a direct writing style.

As a loyal customer for over 5 years, I have the right to demand several things out of your company. [control group, architecture major in his senior year]

I only hope you understand my concern and reimburse me $6.50 or credit my account. I would like to hear from you soon as to your feelings on the matter, or other actions may be taken. [control group, personal financial planning major in his senior year]

If I do not hear back from a company representative or the company's lawyer within a week, I will be taking further legal action against your company. [control group, computer science major in his junior year]

The use of the word "demand" in (q) and the veiled threat of "other actions may be taken" over a $6.50 charge in (r) signals a misuse of the direct approach.

Suggesting legal action, as done in (s) could be justified; however, the participant's claim was regarding a car bumper and grille he believed was incorrectly installed. The claim letter was this writer's first attempt to address this issue with the reader, making the threat of legal action extreme. The writer continues to misapply direct style with the following: "I will also refer anyone I talk with to a different shop because of this bad first experience with your shop, which will undo the thousands of dollars you have spent on advertisement." In his reflective piece, the writer wrote he used a "formal, but slightly more polite" tone than he normally would because he believed his reader, an owner of a small custom auto shop, would be less accustomed to receiving a claim letter than an executive at a larger company. The writer justified his comment about undoing the company's advertising initiatives with the following: "It is more likely that my demands would be met because smaller companies are trying to grow and one lost customer is more important to them than for a larger company who already has thousands of customers."

Editing

Editing evaluated how editing errors affected the usability of the technical texts. The mean for the control group was 0.63 (*median* = 1.00, *sd* = 0.71) and 1.16 (*median* = 1.00, *sd* = 0.60) for the genre group, a statistically significant difference ($F_{(1, 455)}$) = 100.04, $p < .001$, $\eta^2 = .13$).

Overall, the control group scored within the *Competent* range, indicating students typically constructed texts with 3-4 grammatical, mechanical, or typographical errors per page, which mildly affected usability. The following illustrates some of the editing issues identified in the texts:

> I am dissatisfied with my purchase because your Guitar Hero controller performed as it should. [claim letter, pre-occupational therapy major in her sophomore year]

> This step helps you remember your different cards as you're leaving a department store by reminding you each time you get on the program to entering your purchases to check and make sure you have your cards [recruitment email, speech and hearing sciences major in her sophomore year].

> Please fill out a trail form and experience a new you in less that a month. [recruitment email, pre-nursing student in her junior year]

Excluding the word "doesn't" from (t) is a minor editing error, but within the context of a claim letter, the missing word muddles the text's purpose. Next, the shift in verb tense in (u) could also be classified as minor, but it impacts how users should monitor their credit cards to avoid identity theft. Finally, the student's use of wrong words in (v)—"trail form" instead of "trial form" and "that" instead of "than"—impairs the action statement of the recruitment email.

The genre group scored within the *Strong* range of this DV, indicating participants typically constructed texts with fewer than two errors per page, which did not affect usability.

The second research question posed what affect the meta-discoursal functions had on the treatment. Specifically, I was interested in how experimental group; broad text type; and the participants' gender, major, and academic year influenced the results. To address this question, the following reports the results of the Broad and Year main effects as well as the Broad and Gender interaction.

3.2   Main Effect of Broad

There was a statistically significant difference among the broad text types on the DVs (V = 0.23, $F_{(2, 902)}$ = 10, $p < .001$; $\eta^2 = .08$). When considered separately, Audience, Purpose, Design, Style, and Editing reached significance. A Post Hoc Tukey HSD test identified multiple interactions, and the following summarizes those findings ($p = \leq 0.05$).

Table 3. Means scores (and standard deviations) for the three broad text types by Audience, Purpose, Design, Style, and Editing

	Audience	Purpose	Design	Style	Editing
Correspondence	0.12 (1.15)	0.30 (1.26)	0.94 (0.64)	0.48 (0.78)	0.75 (0.64)
Job materials	0.35 (1.00)	0.64 (1.00)	0.75 (0.84)	0.59 (0.84)	1.08 (0.70)
Procedures	-0.08 (1.45)	0.49 (1.29)	0.71 (0.72)	0.91 (0.77)	0.77 (0.77)

Overall, the job materials included significantly stronger appeals to audience than the procedures and stronger appeals to purpose than the correspondence. Job materials were also better edited than the other text types (see Table 3). Collectively, these results could suggest the participants attach more relevance to job materials.

Next, the correspondence included a stronger attention to design than the job materials and procedures. This result is likely attributed to the basic design features of correspondence, consisting mostly of letterheads and subheadings.

Finally, the procedures included more appropriate writing styles than the other text types. This result could relate to the writing style of procedures, in which participants instructed readers on completing a task. Stylistically, this aim was achieved primarily through imperative mood, a device used to give orders or to make requests. Comparatively, the correspondence unit included a direct style for the claim letter and a persuasive style for the recruitment email that could have been more difficult for participants to employ.

3.3 Main Effect of Year

There was a statistically significant difference within the juniors, seniors, and sophomores on the dependent variables (Pillai's Trace = 0.08, $F_{(2, 902)}$ = 12, p < .001; η^2 = .03). When considered separately, Audience, Structure, Design, Style, and Editing reached statistical significance; however, the Post Hoc Tukey HSD test only identified significant interactions within Editing.

Table 4. Means scores (and standard deviations) for sophomores, juniors, and seniors by Editing

	Editing
Sophomores	0.97 (0.72)
Juniors	0.73 (0.74)
Seniors	0.95 (0.65)

Both the senior- and sophomore-level participants edited their technical texts more effectively than the junior-level students (see Table 4). Junior writers had fewer scores in the *Superior* and *Strong* range and more scores in the *Competent* and *Weak* range than their peers (see Figure 5). The editing issues in (t)-(v) demonstrate some of the issues that separated juniors from their peers.
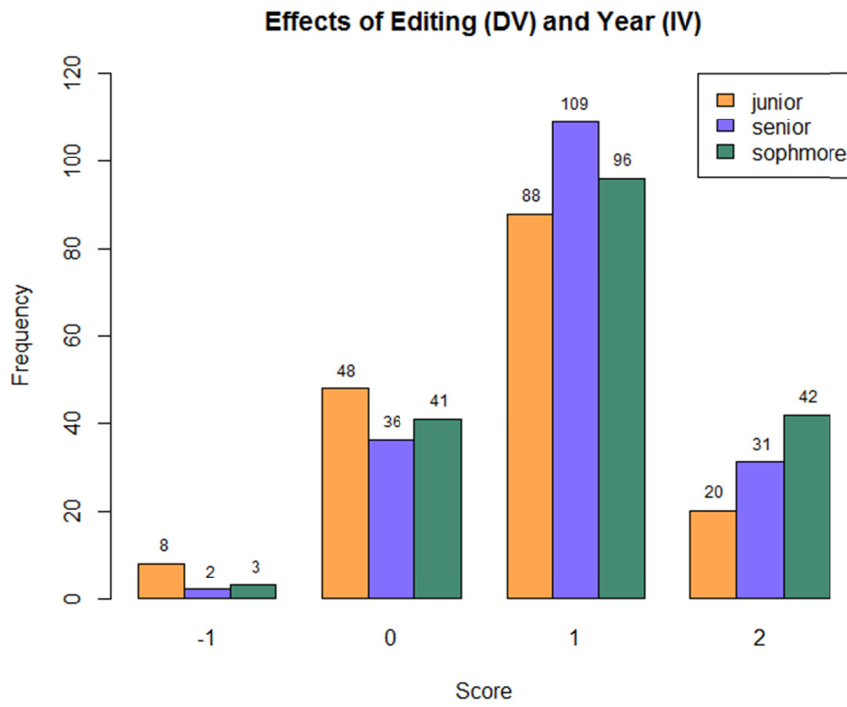
Effects of Editing (DV) and Year (IV)

Figure 5. Editing scores within year.

3.4 Interaction between Gender and Broad

A statistically significant interaction was found between the writers' sex and the broad text type ($V = 0.07$, $F_{(2, 902)} = 3$, $p < .001$; $\eta^2 = .04$). Purpose and Structure both reached significance. A Post Hoc Tukey HSD test identified multiple interactions, and the following summarizes those findings.

Table 5. Means scores (and standard deviations) for males and females by broad text type within Purpose and Structure

	Purpose			Structure		
Broad text type	Overall *m*	Female	Male	Overall *m*	Female	Male
Correspondence	0.30 (1.26)	0.29 (1.29)	0.31 (1.22)	0.68 (0.87)	0.72 (0.84)	0.62 (0.91)
Job materials	0.64 (1.00)	0.75 (0.92)	0.45 (1.41)	0.75(1.02)	0.96 (0.94)	0.42 (0.00)
Procedures	0.49 (1.29)	0.78 (1.17)	0.16 (1.37)	0.62 (0.90)	0.53(0.96)	0.72(0.84)

Female writers typically employed stronger purpose statements in their texts than males; however, the overall means for both sexes across text types were all within the *Competent* range (see left panel of Table 5). This score indicates all participants typically stated their intended purpose, but often with implicit or undeveloped calls to action. Examples [e]-[h] illustrate these issues across text types. In particular, females' use of purpose statements in their job materials was significantly stronger when compared with males' use of these statements in both their correspondence and procedures. Females also employed stronger purpose statements in their job materials than their correspondence as well as stronger purpose statements in their procedures than their correspondence. Interestingly, both sexes equally struggled with their correspondence, which arguably contains the most explicit purposes of the three texts types (e.g., the purpose of this memo is to outline new policies for using the office photocopier). Likewise, the male writers struggled most with the purpose of their procedures. In many of these instances, males would begin their text with a list of instructional tasks rather than a narrative that defined the text's purpose and intended use. Example [j] included a more accepted way to orient readers in a procedural text.

Female writers also included significantly stronger structures in their texts than males; however, the overall means for both sexes across texts types were, again, all within the *Competent* range (see right panel of Table 5). This score indicates writers typically followed the structural conventions of the texts, but included a few unclear headings and transitions or minor illogical arraignments. In particular, females structured their job materials significantly better than males. Structural issues with the job letter included a variety of the misapplied conventions best illustrated by Figure 2. Structural issues with the resume also contained a variety of issues, including illogically arranged sections and unclear headings. Additionally, females created significantly weaker structured procedures than job materials. In fact, procedures were the only text type where male writers created stronger structures than females.

4. Discussion

Results indicated that explicit teaching helped the genre groups produce technical texts that showed greater awareness to standard technical writing principles than the control groups. Further, broad text type and participants' academic year and gender significantly interacted with the DVs. In this section, I discuss these results as well as address methodological limitations, suggest future research, and offer implications for practice.

The first research question examined the effects of the explicit genre treatment. Students taught with the treatment produced texts that showed greater awareness to audience, purpose, structure, design, style, and editing than students taught with more traditional methods. These results provide the first experimental insights into how English first-language adults respond to the explicit teaching of technical texts. The findings also correlate with those from experimental control-group studies on explicitly teaching academic writing conventions (Carter et al., 2004; Wilder & Wolfe, 2009).

The most significant finding related to this first question was the cumulative impact the treatment had on the students across all the DVs. Effective technical writing involves communicating with real people to elicit an action, which usually benefits the writer. Writers' analysis of their audience and purpose informs the structure, design, style, and editing of the text. A major concern of North American genre scholars is explicit teaching promotes prescriptivism and an overgeneralization of rules that might harm students when they enter the workplace. These researchers have noted that the spontaneous learning environment of the workplace differs from the structured classroom setting where instructional units scaffold from each other (Freedman & Adam, 1996, 2000). Professional communicators write to produce institutional action, but classroom instructors assign writing to promote learning. These differing goals could influence the level of detail that student writers include in their work, such as an unnecessary amount of detail, to demonstrate their understanding of a concept (Freedman, Adam, & Smart, 1994). On the other hand, overgeneralization and misapplication are common behaviors of the developing writer's process and not necessarily synonymous with explicit teaching (Fahnestock, 1993; Römer, 2009b; Williams & Colomb, 1993). Results from this study suggest the genre students were able to transition from the goals of academic writing to technical writing as well as adjust this writing based on the course requirements and the assignment description instructions. Comparatively, the control students underperformed in these same areas and appeared to struggle more with audience awareness and the basic structural conventions of specific genres.

The second research question examined what affect meta-discoursal functions had on the treatment. Results indicated broad text type and students' academic year as a main effect as well as broad text type and students' gender as an interaction. The most significant finding related to this second question was perhaps the relevance the genre students attached to certain broad text types, primarily the job letter and resume. Overall, their job materials were more audience-aware, purposeful, and edited

compared to the control groups. All three instructional units emphasized audience analysis skills, but the genre groups seemed to relate most to the job materials. In his reflection, an international marketing major in his sophomore year wrote about the value he assigned to this unit:

> With summer quickly approaching, many of us are facing potential jobs or internships. The resume writing has proved to be an incredible experience, by providing a glimpse into the basic aspects of dealing with the job market. The job materials assignment will serve as a template and guide in the future jobs that I may apply for in the near future.

The upcoming job search likely allowed this participant to see this assignment's immediate relevance and perhaps suggests why job materials, which arguably have less of a defined structure and approach than correspondence and procedures, were typically better constructed. These results also support the earlier observations that the genre students appeared to successfully transition from the aims of academic writing to technical writing.

Additionally, females' use of purpose statements and structures in their job materials was significantly stronger compared to males'. Female speakers have been found to choose more formal registers than males (Finegan & Biber, 2001), which might explain the gender differences in this study's results. Both the senior- and sophomore-level participants also edited their texts more effectively than the junior-level students. Similarly, college juniors often choose less formal grammatical forms in their writing than their sophomore- and senior-level cohorts (Boettger & Wulff, 2014), which could account for the editing differences in this study's results. In brief, the effect size between the explicit treatment and meta-discoursal functions is small. The results indicate nothing definitive but can contribute to the increased interest in how these social variables influence students' reactions to writing and specific pedagogical approaches like explicit teaching.

4.1   Limitations

Though careful attention was given to the methodological design and with assessing the initial quality of participants, this study is not without its limitations. This study evaluated the effects of participants learning in only one of three genre-centered units in a 16-week course. It is possible any findings lacking statistical significance were the result of students' short exposure to the treatment. Likewise, the quasi-experiment was used to measure students' awareness to genre rather than their long-term acquisition. How students continued to apply these explicit teachings in their future professional writing were outside the scope of this study.

4.2   Future Research

The purpose of this study was to provide initial insights into how first-language adults in a multi-major technical writing classroom respond to an explicit genre pedagogy. The

results support previous studies on academic writing and suggest the value of using explicit approaches to teach students with diverse backgrounds and aptitude levels. Future research should explore these issues longitudinally, observing the same population throughout the semester, within their different writing courses, and eventually when they enter the workplace. These types of studies will also better address the transference concerns posed by North American genre theorists.

4.3   Implications

Explicit teaching has shown to be an effective tool, but instructors must still apply these strategies in ways that inspire students to discover how texts evolve, function, and influence people's lives. An aspect students seem to respond positively to was the real-world relevance of the assignment descriptions. In particular, the job materials assignment asked both experimental groups to construct a letter and resume for a job they were currently qualified for rather than an aspirational job. This approach possibly aided students in transitioning from academic writing styles to technical and, coupled with the explicit treatment, appeared to contextualize the writing tasks for the genre students. Within the technical writing classroom, instructors should also encourage their multi-major students to independently explore the technical genres in their own discipline. This can help limit the issues associated with a multi-major technical writing course. The approach described here—lessons that are initially instructor-led but transition into student-led activities—provides a framework that encourages these independent discoveries.

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Appendix A

Below is the general outline of the genre treatment

Pretest – Week 1 (Genre & Control Section)

- Administer writing pretest to both sections, ideally on the first day of class. I need unmarked, ungraded copies of both sections' pretests (20 mins)

Introduce Genre – Week 1 or 2 (Genre Section)

- Assign Hubert reading the class period before the lecture and In-class Exercise #1
- Lecture on genre—PowerPoint and notes relating to Hubert provided (20 mins)
- In-class Exercise #1 – In groups, students will revise one genre example based off a given context (i.e. a formal wedding invitation is revised for a casual, Country-style audience). Groups informally discuss final product with the class. (30 mins)

Genre-Centered Unit - Week 3-4 (Genre Section)

Please follow the major stages sequentially as you'll find they have a natural order. These stages should not all be completed in one class period; ideally, they should be taught over 3-4 different class periods. **Control class does not participate in the following instruction.**

Modeling of Genre

- Model the genre—audience, purpose, format, design, style, and editing—through he provided annotated examples (20 mins)
- Review the assignment description (10 mins)
- Discuss conventions and examples packet (10 mins)

Joint Negotiation of Genre

- In-class Exercise #2 - In groups of 2-3 members, students will construct an example of a genre based of a given scenario. As a class, students discuss/defend their final model while the instructor acts as the facilitator (40 mins)

Social Implications of Genre

- In-class Exercise #3 – In groups of 2-3 members, students will evaluate 3-4 historical examples of the genre. Group members should note how the genre evolves (or decays) over time and reflect on how these changes will influence their independent construction of the genre(s) (30 mins)

Independent Construction of Genre

- Students submit their final draft of the unit. I need unmarked, ungraded copies.

Appendix B

Assessment scale and definitions for the student texts

	+2 (Superior)	+1 (Strong)	0 (Competent)	-1 (Weak)	-2 (Incompetent)
Audience	□ Excellent match of document to intended audience needs □ An ethical approach to the communication situation	□ Adequate match of document to intended audience needs □ An ethical approach to the communication situation	□ Some mismatches of document to intended audience needs □ An ethical approach to the communication situation	□ Significant mismatches of document to intended audience needs □ Questionable ethics	□ Failure to match intended audience needs □ Unethical aspects
Purpose	□ States the intended purpose clearly	□ States the intended purpose mostly clearly	□ States the intended purpose, but not clearly.	□ States the intended purpose in a way that confuses the reader or is illogical.	□ Does not state the intended purpose
Structure	□ Follows structural conventions for the genre □ Uses clear headings and transitions □ Arranges parts logically	□ Follows structural conventions for the genre □ Uses mostly clear headings and transitions □ Arranges parts logically	□ Follows structural conventions for the genre □ Uses a few unclear headings and transitions □ Includes a few minor illogical arrangements	□ Fails to follow some structural conventions for the genre □ Uses ambiguous or nondescriptive headings and transitions □ Includes significant illogical arrangements that cause difficulty in reading	□ Fails to follow significant structural conventions for the genre □ Fails to use headings and transitions successfully □ Arranges parts illogically
Design	□ Excellent match of design elements to document genre □ Effective use of design principles such as repetition, alignment, contrast, and proximity □ Clear, readable typography □ Excellent and ethical use of graphics	□ Good match of design elements to document genre □ Good use of design principles □ Clear, readable typography □ Good and ethical use of graphics	□ Adequate match of design elements to document genre □ Implementation of design principles in most areas □ A few problems with typography □ Adequate and ethical use of graphics	□ Poor match of design elements to document genre □ Poor implementation of design principles □ Significant problems with typography □ Poor use of graphics or graphics with questionable ethics	□ Failure to match design elements to document genre □ Lack of implementation of design principles □ Problems with typography that defeat usability □ Lack of required graphics or unethical graphics
Style	□ Clear and succinct prose □ Excellent matching of level of formality and technicality to audience □ Gender- and culture-appropriate language	□ Almost always clear and succinct prose □ Good matching of level of formality and technicality to audience □ Gender- and culture-appropriate language	□ Somewhat unclear or wordy prose □ Mostly good matching of level of formality and technicality to audience □ Gender- and culture-appropriate language	□ Significantly unclear or wordy prose □ Clear mismatches of level of formality and technicality to audience □ Some problems with sexist or racist language	□ Unclear and wordy prose throughout □ Extensive mismatches of level of formality and technicality to audience □ Significant problems with sexist or racist language

	+2 (Superior)	+1 (Strong)	0 (Competent)	-1 (Weak)	-2 (Incompetent)
Editing	□ No grammatical errors or 1-2 minor typographical errors that do not disrupt the document flow	□ Fewer than 2 grammatical, mechanical, or typographical errors per page □ Errors do not affect usability	□ 3-4 grammatical, mechanical, or typographical errors per page □ Errors mildly affect usability	□ 5-6 grammatical, mechanical, or typographical errors per page □ Errors affect usability	□ Over 8 grammatical, mechanical, or typographical errors per page □ Errors make the document fail in its goals.

Appendix C

Statistical output from the MANOVA

	Df	Pillai approx.	F num	DF den	Df	Pr(>F)
(Intercept)	1	0.81	327	6	450	< 2e-16 ***
GROUP	1	0.28	29	6	450	< 2e-16 ***
BROAD	2	0.23	10	12	902	< 2e-16 ***
GENDER	1	0.04	3	6	450	0.01 *
YEAR	2	0.08	3	12	902	0.00 ***
MAJOR	1	0.02	1	6	450	0.26
GROUP:BROAD	2	0.04	2	12	902	0.11
GROUP:GENDER	1	0.01	1	6	450	0.53
BROAD:GENDER	2	0.07	3	12	902	0.00 ***
GROUP:YEAR	2	0.03	1	12	902	0.24
BROAD:YEAR	4	0.05	1	24	1812	0.63
GENDER:YEAR	2	0.04	1	12	902	0.17
GROUP:MAJOR	1	0.02	1	6	450	0.27
BROAD:MAJOR	2	0.05	2	12	902	0.03 *
GENDER:MAJOR	1	0.03	2	6	450	0.03 *
YEAR:MAJOR	2	0.05	2	12	902	0.02 *
GROUP:BROAD:GENDER	2	0.03	1	12	902	0.30
GROUP:BROAD:YEAR	4	0.08	2	24	1812	0.03 *
GROUP:GENDER:YEAR	2	0.04	2	12	902	0.09 .
BROAD:GENDER:YEAR	4	0.07	1	24	1812	0.10 .
GROUP:BROAD:MAJOR	2	0.05	2	12	902	0.04 *
GROUP:GENDER:MAJOR	1	0.03	2	6	450	0.03 *
BROAD:GENDER:MAJOR	2	0.03	1	12	902	0.47
GROUP:YEAR:MAJOR	2	0.04	2	12	902	0.07 .
BROAD:YEAR:MAJOR	4	0.06	1	24	1812	0.32
GENDER:YEAR:MAJOR	2	0.03	1	12	902	0.37
GROUP:BROAD:GENDER:YEAR	4	0.05	1	24	1812	0.64
GROUP:BROAD:GENDER:MAJOR	2	0.02	1	12	902	0.82
GROUP:BROAD:YEAR:MAJOR	4	0.04	1	24	1812	0.85
GROUP:GENDER:YEAR:MAJOR	2	0.03	1	12	902	0.49
BROAD:GENDER:YEAR:MAJOR	3	0.04	1	18	1356	0.34
GROUP:BROAD:GENDER:YEAR:MAJOR	2	0.03	1	12	902	0.34
Residuals	455					

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1