9. The Argumentative Structure of Paragraphs and the Importance of Models in Undergraduate Recommendation Reports

Mike Duncan, Ashleigh Petts, Jillian Hill, and Andy Hill
University of Houston Downtown

Abstract: Paragraphing has long been a concern in technical communication, but few empirical studies exist that study how paragraphs function in technical report genres and reflect student notions of persuasion. We provide an analysis of paragraph structure in student-authored recommendation reports, alongside pedagogical and practical implications, using a corpus of 1937 paragraphs from 74 student-authored recommendation reports coded at the sentence level by position (heading, sentence, list item, table, and image) and structure (the rhetorical function of the sentence within the paragraph). We combined sentence-level structural codes into a distinct structural string for each paragraph, leading to eight distinct coherence patterns. Students tended to use the three simplest patterns, but also relied heavily on headings for argumentative structure, and closely followed the paragraphing structure of report models that they were given by their instructors. We suggest that technical communication instructors should consider presenting students multiple models of paragraph structure and the report genre to foster variation, complexity, and adaptability in structural elements, given that the needs of future practical rhetorical situations for students are difficult to predict. Practitioners can also use these patterns and categories to analyze their own writings and that of others, allowing greater conscious control over structural elements.

Keywords: Technical Reports; Paragraph; Structure; Argumentation; Pedagogy

While the nature and function of paragraphs tend to recur as a concern in the related fields of technical communication and composition studies, this concern remains underexplored by empirical research. To further technical communication's understanding of paragraph structure and related pedagogy, this chapter explores paragraph structure in an area of pressing need: namely, the introductory level technical communication course taught at many American universities. While we consider the field of technical communication to collectively have a strong understanding of page design and genre expectations, we feel there is more to be learned about internal paragraphing structure and sentence-to-sentence argumentation.

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We examined a corpus of 3,184 structural elements identified as (paragraphs, headings, lists, and images) from 74 student-written recommendation reports in an introductory technical communication service course, taught by four different instructors in the spring 2019 semester. We coded each element both positionally and with attention to our perception of its rhetorical function within each paragraph and then analyzed the resulting structural patterns that emerged.

Our key findings are fourfold. First, students mimicked their teacher's provided models closely, with students in the same classes tending to follow the same paragraph structure and overall report structure, suggesting that models provided (or not provided) by the respective instructors strongly influenced how they structured paragraphs.

Second, most paragraph structure was relatively simple. The most used patterns in the corpus, comprising over two-thirds of the total paragraphs, were of three types. The first used topic sentences as the first sentence and then created a chain of cohesion with each new supporting sentence linked to the last—a "sequential" pattern. The second had all following sentences support that initial topic directly—a "nonsequential" pattern. The third pattern was single-sentence paragraphs, usually related to a heading. The popularity of these three paragraph types is not reducible to just their simplicity, however, as their use appears closely related both to the concentration of analysis in certain sections of the reports and even more so to the specific models provided by instructors.

Third, headings and lists did much argumentative work by replacing longer paragraphs. 60.83% of the 3184 structural elements we coded were prose paragraphs; the rest of the structural work in these reports was done by headings, subheadings, and lists. Reports without extensive headings, nested or otherwise, tended to have longer paragraphs.

Finally, exceptions to the first three observations tended to be more readable and persuasive. While most reports relied on headings, subheadings, and lists, the stronger reports, in our collective subjective opinion as instructors, used longer, more complex paragraph structures, especially in the concluding analytical sections.

Given these observations, we recommend that technical communication instructors offer multiple models of paragraph and report structure when teaching recommendation reports and similar complex genres. Our findings suggest that students will follow whatever model of paragraph usage is presented and produce predictable results. However, at least in our corpus, simpler models did not tend to lead to the structural and rhetorical flexibility that we would prefer a strongly argued and detailed report to contain, suggesting an almost inverse relationship between the model usage on one hand, and strong arguments and content on the other.

Literature Review

Compared to the long formal study of English sentence structure and style, examinations of paragraphing first appear comparatively late in prescriptive 18th and 19th

century textbooks, most notably Alexander Bain's (1866), forming a complicated tradition that continues to exert influence well after composition studies and technical writing established themselves as academic disciplines (Connors, 1997; Duncan, 2007; Kitzhaber, 1990; Tebeaux, 2011). Mike Duncan (2007) classified the major historical theoretical and pedagogical approaches to understanding paragraphs in writing-centric fields, such as technical communication, into three camps:

- The *prescriptive* approach (Bain, 1866) uses Bain-derived terminology like "emphasis," "force," and "coherence" that stem from the 19th century faculty psychology tradition to teach paragraph writing deductively. This approach stresses necessary topic sentence usage to increase objective comprehension by inexpert audiences and has a "generative" branch (Christensen, 1965) that claims hewing closely to such principles helps composition and eventually leads to more complex structures.
- The *descriptive* approach (Rodgers, 1966) values a no-rules, rhetorically expedient "functional" view of structural elements that may or may not reflect the chaos of actual usage, but has the advantage of a far wider range of techniques and an emphasis on stylistic mastery.
- The *cognitive* approach, found in cognitive psychology and computational linguistics and to a lesser extent in composition studies by way of visual rhetoric concepts, focuses on readability and cohesion at the expense of the pedagogical worries and rhetorical concerns of the *prescriptive* and *descriptive* approaches.

Ian McGee (2018) merged these three positions into a more comprehensive view that reflects the paragraph's myriad roles as "a discourse marker, a highlighting technique, a structural device, a unit of cohesion, an aid to readability, a crutch for developing writers, a pedagogical problem, or all these and more" (Duncan, 2020, p. 155). While it remains tempting to treat paragraphs as only conceptual patterns of arrangement in the long textbook tradition of the discourse modes (Connors, 1997; D'Angelo, 1974), paragraphs via McGee are too complex a phenomenon that we can reduce to just one of their many aspects; integration of their myriad aspects is desirable. Accordingly, McGee (2018, 2016), Eilzabeth Tebeaux (2011), and Duncan (2007, 2020) all call for more empirical work on paragraph usage.

The parallel cognitive approach to paragraphs is extensively represented elsewhere (Duncan, 2007, p. 484-486) but does not directly speak to the pedagogical and practitioner concerns of the writing-centric fields. And while several exploratory empirical studies exist in technical communication and composition studies, with the seminal work of Richard Braddock (1974) regarding topic sentence usage the most cited, treatments of paragraph usage remain rare since the 1990s (Baker, 1994; Bush, 1995; Colby, 1971; Markel et al., 1992; Popken, 1984, 1988, 1991; Thompson, 1986), with the report genre suffering likewise (Roundy, 1985; Rude, 1995). Few of these studies were empirical, with Braddock and Randall Popken

the major exceptions, and even those focused chiefly on the presence or absence of topic sentences.

A common, if indirect, pedagogical strategy for teaching paragraph use in technical report writing is through providing and examining models of complete reports for students. This approach is a contemporary version of the classical rhetorical practice of imitation (*mimesis* or *imitatio),* which Dale Sullivan (1989) characterized as "an essential pedagogical method even as late as the early nineteenth century" (p. 5). While *mimesis* and *imitatio* have multiple meanings in the classical tradition, imitation in writing pedagogy is commonly understood to mean the practice of emulating models (Corbett, 1971). The goal of imitation is not to engage students in simply copying exemplary texts, but rather to guide them in developing an effective style (D'Angelo, 1973). More recent approaches to imitation have taken it in broader directions, including discussing its (in)compatibility with the process movement in writing pedagogy (Farmer & Arrington, 1993) to arguing for its centrality in forming civically engaged students and citizens in a democratic society (Terrill, 2011).

Within technical and professional communication, several scholars have explored connections between classical rhetoric and technical communication pedagogy (e.g., Brizzee, 2015; Bourelle et al., 2015; Dubinsky, 2002; Reynolds, 1992). However, few studies focus on imitation in particular. A notable exception is Alan Jones and Terrance Freeman's 2003 study on the use of models in introductory physics reports. The authors argued that imitating models helps students develop their report writing skills through a process of "scaffolding their own writing on the linguistic structures contained in the models" (p. 182). However, instructors must take care to provide students with appropriate models and teach students how to use those models effectively (Jones & Freeman, 2003).

Aside from imitation through models, contemporary discussion of paragraph usage remains at the textbook and style level in technical communication, with the traditional discourse modes (Connors, 1997) still often used to explain paragraph structure in a myriad of writing textbooks, though the advice has slowly trended toward being more *descriptive* since the 1960s. Space remains for substantial data-driven empirical investigation that could direct pedagogy, rather than the lore of the textbook tradition and personal experience.

Method

Our study explores the function and structure of paragraphs located within recommendation reports assigned in an introductory level technical communication course. Given our interest in capturing the organic nature of each sentence and how those sentences functioned in a broad sense within and across paragraphs, we built a large corpus of student paragraphs from these reports and coded the sentences in the corpus with an iterative, grounded theory approach.

Participants

After obtaining Institutional Review Board approval (#13-19) in Fall of 2018, we began soliciting participants. Opting into the study was twofold, requiring first instructors and then individual students to consent to the study in writing. The course in question for all papers was a sixteen-week undergraduate upper-division class in report writing. This course serves as a requirement for many different majors at the University of Houston-Downtown, an American university that is federally designated as both a Minority-Serving Institution (MSI) and a Hispanic-Serving Institution (HSI). The course, TCOM 3302: Business and Technical Report Writing, is limited to 23 students per section, from a broad and diverse spectrum of junior and senior-level students across the university, and these sections are taught by a mixture of tenure-track professors, full-time lecturers, and adjunct professors. A recommendation report of some kind is a major required assignment that is also used for institutional assessment. All sections were taught face-to-face in the spring semester of 2019. The advent of the COVID-19 pandemic delayed our resulting analysis.

Data Set

We initially collected 88 reports across multiple sections taught by six full-time faculty members. Some reports were discarded due to being incomplete or not conforming to the genre features of a recommendation report; we wanted to reduce the variable of genre to offer more authoritative and focused results. We did not collect any data about the instructor's grading of the reports, only the text of the final assignments. The final data set was n=74 for students and recommendation reports with 3,184 structural elements, including but not limited to paragraphs, headings, and images.

Coding Scheme

Our first attempt at creating a coding scheme for the reports resulted in positional and structural data for all the sentences in the reports. Positional data included six objective codes for each textual unit: the text of each sentence, the type (prose, heading, list, etc.), a number for each individual student paper, and the specific paragraph, page number, and report section. Collecting this positional data allowed for easier analysis and data manipulation later in the process and allowed us to concentrate on our efforts on structural coding.

In contrast to positional data, our structural codes were subjective and comprised of eight codes: directs, supports, restates, complicates, refutes, pivots, transitions, and wanders. Together, we derived these codes inductively from the data by reading the reports and conducting open coding to discern the function of each sentence within the context of the paragraph in which it was situated. Sentences could be double coded.

Given the subjective nature of the structural codes and the large number of sentences to be coded, we conducted intercoder reliability (O'Connor & Joffe, 2020) with five norming sessions in which we coded the same 11 reports. Each norming session yielded robust discussions of different patterns being discerned in the corpus and reinforced the agreed upon coding scheme. We determined reliability by dividing the number of agreements by the total number of agreements plus disagreements (Miles & Huberman, 1994). Using this calculation, we reached a 93% rate of reliability for the last four reports that we coded in our last two norming sessions. With evidence that our coding scheme was reliable, we then subdivided the remaining 63 reports among three of us, which resulted in each coder individually coding 21 reports separately. While we each had our own reports to code, we still met on a regular basis to discuss our preliminary results, general observations from our coding, and eliminate typos in the growing database.

Our eight structural codes reflect a rhetorical understanding of argumentative structure and the larger work of the fields of informal logic and rhetoric (Perelman & Olbrechts-Tyteca, 1969; Toulmin, 2003; Walton, 2008). Namely, we approached the paragraphs in these reports with the assumption that the *claim* is the fundamental building block of argumentation, defined loosely as any statement or utterance that holds a position with seriousness. Therefore, given the professional nature of the report genre, we considered any sentence, heading, or image (all argumentative structures in the context of the report) to constitute a serious *claim* or *claims*, and when these structural elements are arranged on the page, they in turn form different patterns of *claims,* with each sentence performing a different function depending on its position in the paragraph and in relation to other paragraphs and argumentative structures. Given this, it is important to note that our total paragraph count includes headings, lists, and images in addition to traditional prose-based paragraphs. All these visual elements also do argumentative work in tandem, and accordingly, we felt they must be included and considered together when discussing how paragraphs function. If we treated only prose paragraphs in our coding, we would miss how they work together (or fail to do so) with other visual elements on the page to accomplish rhetorical goals.

Early studies of paragraph usage often focused on the T-unit (Christensen, 1965) as the principal linguistic atom of paragraph structure, but we judged a coding scheme built around principles of informal logic and Toulmin's *claim* to be more promising. For example, we considered the useful past distinction between "theme" and "rheme" (Thompson, 1986), sometimes called "topic" and "point," with the former noting the presence of a topic being discussed, and the latter representing the claim made about that topic, to be valuable when considering the role of sentences in a paragraph. However, such a distinction has a weakness in close analysis; namely, labeling a sentence as having only "theme" or "topic" content brushes past both the practical and epistemological implications that a "theme" or "topic" is also a *claim* that has its own rhetorical characteristics, as well as a particularly special argumentative role in the seemingly data-driven recommendation reports of this

study. We avoided, therefore, labeling any of these sentences as having just "topical" or "informative" content, and assumed, rather, that they all have some rhetorical function and purpose (Joswiak & Duncan, 2020) and that each sentence, heading, or image holistically constitutes a *claim*, no matter how many or few T-units, clauses, or other internal units it might contain.

In other words, these eight structural codes attempt to map how argumentation "flows" in a linear fashion from a reader's viewpoint through each paragraph, from sentence to heading to other *claims*, and to a more limited extent, between paragraphs as well. While paragraphs are traditionally (and still are, typically) classified by type in the so-called modes of discourse, i.e. "narrative" or "expository" paragraphs, our coding scheme sets such categories aside in favor of a more *endoskeletal* view of argumentative structure. Our intention, therefore, was not to have these codes "explain" the paragraphs in the corpus, detail how they were composed via this or that process or use them as a window into what the students were thinking, but rather *to explore how their final form on the page attempts to do argumentative work.* Studying this "flow" is an easier and more demonstrable goal when the entire corpus is from a single genre (the recommendation report) and the positional data allowed us to filter for differences in different sections of the report with different rhetorical goals.

Table 9.1. Structural Codes

Code	Label	Definition
DIRECTS	Px	The sentence makes a claim that "directs" or orders at least some of the rest of the content of the paragraph.
SUPPORTS	Sx	The sentence makes a claim that supports another claim in another sentence and in a way that is dependent on the other sentence's claim; the claim supported may be before or after the SUPPORTS sentence (usually before).
RESTATES	Rx	The sentence restates or explains the claim of a previous sentence in new language without performing the role of PIVOTS or COMPLICATES.
COMPLICATES	Cx	The sentence attempts to question or make an earlier claim problematic in some fashion but does not REFUTE it.
REFUTES	Fx	The sentence rejects an earlier claim (usually a DIRECTS or SUPPORTS) even if just temporarily and does so unambiguously in a way different from COMPLICATES.
PIVOTS	Vx	The sentence moves the paragraph in a new, tangential direction with a claim that differs substantially from previous DIRECTS, but does not challenge it as with COMPLICATES or REFUTES.
TRANSITIONS	Tx	The sentence primarily serves to set up a new topic in a following paragraph.
WANDERS	Wx	The sentence does not have any obvious coherence to previous sentences.

For example, the paragraph in this piece just before this one could be coded as p19.p19.r2.s3. The digit after the initial DIRECTS code (p19) is positional (noting it is the 19th paragraph in the hypothetical report and taking place of the 'x' placeholder) but the remaining digits are relational, referring to other sentences. The second sentence is also coded "p19" as it completes the thought of the first sentence and does DIRECTS work; the third sentence is coded as "r2" as it restates and clarifies the initial DIRECTS sentences, with the second sentence (the "2") closest; the fourth sentence "s3" supports the third. This short text string, p19.p19.r2.s3, forms an analyzable shorthand that gives a quick structural snapshot; it's the 19th paragraph and has four sentences: the first two sentences direct in tandem, the third restates, and the fourth supports. Most of the paragraphs in the corpus were less complex than that paragraph, but the coding scheme we developed allowed for many different kinds of emergent patterns. This level of coding granularity, coupled with the entire corpus entered sentence-by-sentence into a database along the positional data, allowed us to make increasingly complex database queries and juxtapose our experience of reading the sentences with the implications of macrostructural data.

Results

Table 9.2 gives a broad overview of the initial positional coding by structural type. We added several subcategories for different types of headings and list elements. LI (List Item) was any bulleted or numbered text, with LH (List Heading) indicating a heading immediately followed by a list item code, and LHP (List Heading in Paragraphs) indicating a heading embedded in the end of a paragraph.

Table 9.2. Positional Code Totals

All S (Sentence) Codes	**6850**
H (Heading)	512
H2 (Second Level Heading)	449
H3 (Third Level Heading)	153
All Heading Codes	**1114**
LI (List Item)	878
LI2 (Second Level List Item)	92
LH (List Heading)	50
LH2 (Second Level List Heading)	10
LH3 (Third Level List Heading)	8
LHP (List Headings In Paragraphs)	100
All List Codes	**1138**
All Images	**133**
Total Positional Codes	**9235**

After we completed the positional coding, we structurally coded the individual sentences. The total number of structural codes (8048) is slightly higher than the total of sentence and list elements (7988) due to 60 sentences that received two or more structural codes.

Table 9.3. Structural Code Totals

Code Name and Label	**Number**
Directs (Px)	1988
Supports (Sx)	5418
Restates (Rx)	88
Complicates (Cx)	141
Refutes (Fx)	8
Pivots (Vx)	365
Transitions (Tx)	32
Wanders (Wx)	8
Total Structural Codes	**8048 (61 are double coded)**

Analysis

In beginning our analysis, we attempted to maintain the integrity of what each sentence did by placing it in relation to the other sentences in the paragraph. We then saw, in the resulting strings of structural codes for each paragraph, eight major types of what we call *coherence patterns*. These patterns we define as paragraphs that have similar semantic/argumentative strategies for linking together sentences in meaningful ways for readers. In this way, the eight patterns form "stems" that "grow" into the 291 unique structural code patterns that we found in the corpus.

Table 9.4. The Eight Coherence Patterns

Type 1: Sequential
Type 2: Nonsequential
Type 3: One Sentence
Type 4: Sequential Veering
Type 5: Nonsequential Veering
Type 6: Distributed
Type 7: Advanced
Type 8: Dependent

Our two goals when solidifying these eight categories were to first eliminate any "miscellaneous" category—the patterns, however they are named, should be able to offer some explanation for the structure of all sentences—and second, to keep the overall number of categories below ten to make our axial and selective coding processes more manageable and digestible.

In this section, we examine each of these eight perceived patterns in turn.

Type 1: Sequential—"Each sentence supports the previous in an unbroken chain."

31.75% of paragraphs, or 615 total, formed *sequential* coherence patterns where each new sentence built upon information introduced in the previous sentence, with a first "topic" sentence beginning the argumentative sequence. In the following example, each sentence is dependent on the previous sentence to maintain a cohesive flow:

> The third option consists of Old School revising the current budget to decide if switching to healthier alternatives to current snacks is viable. Firstly, Old School would need to calculate the total amount of money currently being used on all snacks for both locations. Next, the total cost of healthier snacks bought from a wholesale retailer would need to be calculated. Lastly, a comparison of these two totals would need to be evaluated to consider which option is the most feasible.

Type 1 sentences, when executed well, are difficult to get lost in while reading, due to the constant signposting. Their high semantic coherence meets Alexander Bain's standards for topic sentence usage and subordination.

Type 2: Nonsequential—"Scramble the sentences after the first and it still makes sense."

28.45% of paragraphs, or 551 total, began with a "topic" sentence like Type 1, but instead used all subsequent sentences to discuss the first sentence's idea, with no necessary sequential chain between the following sentences. Each subsequent sentence, therefore, is an independent follow-up to the topic sentence, and they function much like a bulleted list with a heading (and in practice, we coded such bulleted lists as Type 2 paragraphs).

The majority were only two sentences long, such as the following example, coded px.v1:

> Because intermittent fasting is not based on one specific diet per se, this plan was the most flexible with regard to selecting menu items. However, one foreseeable issue is ensuring that dining out would take place in the allotted 6-hour window of eating.

We classified these two-sentence paragraphs as Type 2 with other nonsequential support chains (which could go as long as ten sentences) as they seem to be the germinal stem from which the longer Type 2 examples grow.

As noted before, much of the remainder of Type 2 paragraphs took the form of lists, bulleted or numbered, as they are structurally almost identical to their prose siblings. In this example, the individual options are not in formal ranked order, so the paragraph can be coded px.s1.s1.s1 even with numbers instead of bullets:

> In Task 3 we narrowed down our options based on our necessary criteria as listed above. The following options were considered to best fit the necessary criteria:
>
> 1. Optos Daytona
>
> 2. ZEISS CLARUS 500
>
> 3. TOPCON NW8F Retinal Camera

Type 3: One Sentence—"Just one, and usually a transition."

18.38% of paragraphs, or 356, consisted of one sentence. They usually appeared right after headings or served a transitional role to the next section of a report, though they did not need the heading to be understood (an important distinction from the much rarer Type 8, discussed later). We did not observe Type 3 paragraphs used for more dramatic purposes, as we might expect in other writing genres like fiction, but rather they appeared more in papers dependent on nested headings to provide structure.

> In this section, I will present conclusions based on my research related to the five questions I sought to answer.
>
> On October 30, I decided to study which kind of laptop would be the best kind to use while enrolled in University.

Type 4: Sequential Veering—"It starts with a chain, but the chain breaks."

We mentioned before that there were 291 unique structural patterns in the corpus. The majority of these unique variants are in Types 4–7.

7.59% of all paragraphs, or 147, began a sequential "stem" in the first three sentences like Type 1, but then veered off into more complex variants. In the following example, coded px.s1.s2.v3.s4, a new idea appears in the fourth sentence that constitutes a PIVOTS from the initial sequential chain. This fourth-sentence PIVOTS allows the paragraph to close in a quite different, but tangential, place from where it begins.

> Jessica's Maid Service employs four individuals including me. Our cleaning service uses cleaning products daily including Bleach as a disinfectant. Our employees have explained how dry their hands get, and how allergic they get after using Bleach. I suggested we start using a new disinfectant that doesn't have harsh fumes and harmful chemicals. This is what started my search for healthy disinfectants.

Type 5: Nonsequential Veering—"It doesn't start with a chain, but it breaks anyway."

4.23% of paragraphs, or 82, began with a nonsequential structure like Type 2, but then, much like Type 4 diverges from Type 1, split into many variants, with the initial nonsequential "stem" preparing for a later PIVOTS or COMPLICATES. Most PIVOTS/COMPLICATES codes in the corpus are Type 5, with the rest in Type 7.

Finding such structures felt intuitive to us, in retrospect. Instructors "know" that students are more likely to attempt a shift of some kind by the third sentence of a paragraph, but it is more striking with data on hand. In the following example, coded px.s1.v1.s3, a nonsequential structure is interrupted by a new idea that also references and is dependent upon a "proposal mentioned in a previous paragraph, but not referenced in the first two sentences, giving this paragraph a drifting, decentered feel:

> Currently there are only about 100 textbooks currently in the University X reserve system, with some of them being copies. This is a large contrast to the number of courses offered by University X, which is over 1000 classes several different majors. To accomplish the proposal and (sp?) purchase of at least 1500 textbooks will be needed. A majority of them being for upper level courses, as most books currently on reserve are only for low level courses.

Type 6: Distributed—"It has a thesis, but not in any one sentence."

5.52% of paragraphs, or 107, distributed DIRECTS codes in different parts of the paragraph other than the first sentence, but at the same time did not contain PIVOTS, COMPLICATES, or REFUTES codes. Some used the first two sentences to orientate the paragraph, others formed "bookends" after an initial topic sentence with a closing sentence that completed the overall thought, and others deferred the point to the second or third sentence.

A "bookends" variant follows, where both the first and the last sentence have DIRECTS codes, as the paragraph concerns both the process of a decision and, ultimately, what the decision was. There is a rhetorical choice to hold the decision to the last sentence rather than reveal it in the first sentence or follow the first

sentence with the decision in the second, among other options. These paragraphs, like Type 5, require more mental assembly and closer reading than Types 1–4, and the unresolved next two criteria grant momentum and anticipation.

> The process of this decision matrix on disinfectants that could replace the use of bleach depended on three criteria, accessibility, affordability and how healthy they are. Healthiness is the biggest concern to the employees in the cleaning service, so it got the highest weight. The rating depended on how safe the disinfectant was to people due to the number of harmful chemicals it has in its ingredients. Seventh Generation disinfectant spray got the highest rating in healthiness as it has minimal toxic chemicals in its ingredients.

Type 7: Advanced—"Follow the winding road closely."

2.48% of paragraphs, or 48, used either two or more PIVOTS, COMPLICATES, or REFUTES codes, or at least one of those three codes and multiple DIRECTS codes. We considered these the most "advanced" paragraphs in the corpus in that they demonstrate more willingness on the part of the author to challenge and test their own ideas, with the tradeoff being a risk of losing readability. Their low frequency in the corpus may suggest that most students either do not know how to use these structures, that they prefer the simpler (and typically shorter) types, or they are following models that do not contain them or split them into those simpler structures. The structural codes for this paragraph were px.s1.v2.c3.s1.s5.s6.v6.s8, using 1 COMPLICATES and 2 PIVOTS, which we've bolded:

> The mounting budgeting costs and debt associated to deferred maintenance is a growing trend that will affect many students and colleges in the coming decade. For the most part, campus buildings are required to have major renovations at 25 years, with further renovation, if not a complete replacement, before 50 years. **However, such renovations require budgeting concerning any maintenance updates issue, which increases debt for many college campuses, thus continuing the practice of deferred maintenance in certain prioritized areas of a campus. It estimated that as many as 300+ colleges face the issue of needed repairs to their aging buildings, which has since risen since the start of the 2008 recession.** Estimating any exact cost figures on deferred maintenance is hard to measure since inflations needs to be accounted for. Experts estimate that deferred maintenance afflicting college many campuses amounts to as much as $36-billion across the country, with at least $7-billion of that being considered "urgent" in priority repairs (Scott Carlson 2012). **To illustrate this problem in a real-setting context, Mr. Ender, the college president of Grand Rapids Community College, best describes the**

> **possible outcome and economic repercussion of neglecting repairs to buildings or, in the case of my report, designated student parking lots: "I am having a hard time limping along without fire-suppression systems in all of my buildings," he said. "I am having a hard time limping along in classrooms where you are so uncomfortable with the heat that it is hard to focus."** Because students look closely at buildings when they decide to enroll at a college, and because repair costs mount as time goes on, said the president, "limping along only puts us deeper in the hole." (Scott Carlson 2012).

The increased length of this example does not neatly correlate to the use of a more "complex" type: there are Type 1 and Type 2 paragraphs in the corpus with eight or more sentences, for example. However, for an illustrative metaphor, to build a winding road, the road needs to be long enough to accommodate the curves—in this case, the PIVOTS and COMPLICATES must respond to a previous sentence, which requires a minimum length for maneuvering.

The student in this case could have chosen to break their paragraph into several smaller chunks. However, we in all cases followed the actual paragraph breaks when coding; if the student decided, for whatever reason, to visually "end" a structure, we treated the new sentences as a new structure.

Type 8: Dependent—"Something is missing but it's still a paragraph."

1.60% of paragraphs, or 31, were extremely dependent on either a previous heading to be understood, or they exist only to smooth a transition to another paragraph—but they are not Type 3's single sentence. Of the 8 coherence patterns, they were the least "paragraph-y" to us despite their length, and play a heading-dependent function much like Type 3. In the following example, the "first option" is never clearly defined, as the heading (removed here to show the dependence) does that semantic work:

> The first option is based on one of the latest trends in the dieting world. There are many people who have shed major weight by using this regimen and have been able to maintain a healthy lifestyle by changing their food intake habits. This regimen consists of the drastic elimination of carbs and refined sugars and replacing them with foods high in fat and protein. Following the rigorous rules of the keto diet leads one's body into ketosis, further causing the body to burn fat instead of carbohydrates.

Headings and Images in Relation to Total Paragraphs

While we placed each of 1937 paragraphs as one of the eight types, there are 3184 "structures" in total if we also count headings and images. The following

table, in addition to displaying the aggregate totals for Types 1–8, demonstrates some of the complicated relationship between these different structural types:

Table 9.5. Paragraph Types Across All Reports

Paragraph Types	**Number**	**% Paragraphs**	**% "Structures"**
Type 1: Sequential	615	31.75%	19.32%
Type 2: Nonsequential	551	28.45%	17.31%
Type 3: One Sentence	356	18.38%	11.18%
Type 4: Sequential Veering	147	7.59%	4.62%
Type 5: Nonsequential Veering	82	4.23%	2.58%
Type 6: Distributed	107	5.52%	3.36%
Type 7: Advanced	48	2.48%	1.51%
Type 8: Dependent	31	1.60%	0.97%
Total Paragraphs	**1937**	**100%**	**60.84%**
Headings, Levels 1–3	1114	N/A	34.99%
Images	133	N/A	4.18%
Paragraphs with Lists	190	9.81%	5.97%
Paragraphs w/o Lists	1748	90.24%	54.90%
Total Structures	**3184**	**N/A**	**100.00%**

Lists

Table 9.5 also considers the presence of lists, which we decided to treat as paragraphs, though with additional care. Lists took several distinct forms: bulleted, numbered, with or without a heading, and either separate from paragraphs or embedded within them. We judged them to perform the same structural argumentative work as paragraphs and sentences, but with a distinctively different visual approach. For tallying purposes, we noted their presence as a percentage, 9.81%, in the 1937 coded paragraphs; this includes separate and/or embedded examples. As demonstrated in the second example for Type 2, we strongly felt that they were still "paragraphs" for all practical purposes.

The following example shows how an embedded list functions. Preceding with a second-level heading (H2) the following paragraph begins in a straightforward Type 2 manner, but concludes with an embedded list that we treated as part of the larger paragraph. The codes were px.s1.s2.s3.s3.s3.s3.s3, with the third sentence having the positional code LHP and the last five LI. The LHP list structures were twice as frequent as the freestanding LH.

Task 5: Follow up on the project

This period of the project will study the progress of how the Smart Development Zoning Area A is performing. For the Smart Development zoning program to be considered a success the program must pass a certain criterion. The criteria are listed as followed:

1. In a year's time, does project accumulate the amount invested in the project?
2. What are the majority of residents and business owners in the Zoning Area A outlook on the developed community?
3. What was the amount of flood activity in Harris County during the project period of task 4?
4. What was the amount of flood activity in Precinct 4 during the project period of task 4?
5. What was the amount of flood activity in Zoning Area A during the project period of task 4?

Instructors and Paragraph Types

We were also interested in whether there would be a difference in the paragraph types used by students with different instructors. The following table breaks down the appearance of the eight types, as well headings and images, in papers by instructor.

The majority of paragraphs for all four instructors were of Types 1–3, and headings and images were between one-third and nearly one-half of the structure of the papers for Professors 1, 3, and 4. Professor 2's students, however, for whom we had the smallest amount of papers available, had a noticeably higher percentage of more complex types, with only 59.22% of paragraphs using Types 1–3, and using headings and images rarely, with 76.73% of structural elements being prose paragraphs.

Table 9.6. Instructor Comparison

Paragraph Type	Prof "1"	Prof "2"	Prof "3"	Prof "4"	Total
Type 1: Sequential	149 (29.27%)	62 (29.38%)	171 (35.77%)	233 (31.29%)	615
Type 2: Nonsequential	140 (27.50%)	48 (22.74%)	132 (27.76%)	231 (31.25%)	551
Type 3: One Sentence	93 (18.27%)	15 (7.11%)	80 (16.74%)	168 (22.73%)	356
Type 4: Sequential Veering	48 (9.43%)	24 (11.37%)	28 (5.86%)	47 (6.36%)	147

Paragraph Type	Prof "1"	Prof "2"	Prof "3"	Prof "4"	Total
Type 5: Nonsequential Veering	25 (4.91%)	10 (4.74%)	26 (5.44%)	21 (2.84%)	82
Type 6: Distributed	29 (5.69%)	27 (12.79%)	26 (5.44%)	25 (3.38%)	107
Type 7: Advanced	7 (1.38%)	22 (10.43%)	11 (2.30%)	8 (1.08%)	48
Type 8: Dependent	18 (3.53%)	3 (1.42%)	4 (0.84%)	6 (0.81%)	31
Total	**509**	**211**	**478**	**739**	**1937**
Headings	334	75	408	416	1114
Images	62	10	9	52	133
Total w/other	**782**	**275**	**890**	**1104**	**3184**
Ratio: Paragraphs to H&I	**65.09%**	**76.73%**	**53.71%**	**66.94%**	

Professor 3's students, for the opposite extreme, used Types 1–3 for 80.01% of paragraphs, and also only used paragraphs for 53.71% of the structure of their overall papers. We see an inverse relationship between Type 1–3 paragraph usage and heading/image usage across all four professors; the simpler the overall paragraphs, the more likely the student used headings in their papers, and vice versa.

Early in the structural coding process, we noticed that student papers from a given instructor seemed to follow similar structural patterns. For example, Professor 3's students almost uniformly followed a strict nesting structure in which they relied heavily on headings and subheadings to construct their arguments, with any paragraphs much shorter than the reports of students in other classes.

Level 1 Results

Level 2 Result 1

Level 3 Criterion 1

Level 3 Criterion 2

Level 3 Criterion 3

Level 2 Result 2

Level 3 Criterion 1

Level 3 Criterion 2

Level 3 Criterion 3

Figure 9.1. Structure and Headings and Subheadings in Student Papers from Professor 3

The structure of the headings and subheadings in Professor 3's student papers is not surprising. Chunking information is a long-referenced technique in technical communication (Henschel, 2010; Horn, 1993) and we teach it ourselves, as we find this structural pattern to be mostly successful in helping students organize their ideas. The headings and subheadings themselves work to create meaning; they often carry the main argument of heading/level with little explanatory text underneath.

However, the remarkable consistency in structure among student papers in Professor 3's corpus led us to consider the unusually high importance of models for students in the matter of paragraph structure. Professor 3's students followed their model so closely that we could recognize their papers without checking the positional code that listed the instructor. While other instructors' student papers did not hew to models as closely as Professor 3's students did, we were able to discern structural patterns across the corpus that correlated with instructor. Professor 2's students, for example, wrote comparatively free-form papers with longer, more complex sentences and paragraphs that correlate with the lack of an explicitly required structure in the assignment instructions (Professor 2's documentation for the assignment was the least detailed of the four, covering required sections but offering much less on how the internal structure of each section should look). However, this complexity must be considered against the fact that the longest paragraphs in the corpus, upwards of 16+ sentences, are in Professor 2's student papers, and their sheer length and verbosity tended to destroy coherence and readability after eight sentences. We suspect a model would have helped to hedge in such unrestricted and counterproductive growth. But such a balance is easier said than done, given that for most of the students in the corpus, models seem to have been more than something to imitate, and rather, something to reproduce. The danger of reproduction is particularly acute in genre writing such as reports. Even if the instructor stresses the rhetorical nature of genres, when students follow a model closely, they are not benefiting from the affordances and flexibility of a broad rhetorical style; instead, a given genre becomes only a template for students to plug into. Students will learn the template, but not how to vary from it when needed by more complex and demanding contexts that might require a departure from the template.

Preceding and Following Paragraphs, and Report Sections

While we examined the relationship between adjacent paragraphs using a mix of positional and structural codes, we did not find interesting results from such investigation due to the preponderance of Type 1–3 structures in the corpus. For example, there are 330 px.s1 paragraphs in the corpus, classified as Type 2, Nonsequential. These two-sentence paragraphs were preceded by the positional codes in Table 9.7.

Table 9.7. Positional Codes Preceding px.s1 Patterns

H	61
H2	99
H3	33
Image	12
LH	3
LH2	1
LHP	2
LI	3
S	116
Positional codes preceding px.s1 patterns	**330**

We can view such correlations in two ways. One is that any two-sentence px.s1 pattern is more than likely going to be preceded by a heading; the other is that headings are often followed by two-sentence px.s1 paragraphs. If we dig deeper, however, by looking into the 116 "S" sentences preceding px.s1 paragraphs (the S code singling a paragraph rather than a heading), the overall lack of Type 4–8 paragraphs in the corpus does not leave us with much to conclude other than, again, the overall dominance of Types 1–3.

However, we did observe something interesting concerning the more infrequent paragraphs with PIVOTS and COMPLICATES codes; namely, it was much more likely that they would be followed by a S code, or in other words, another prose paragraph, whereas the other types were far more likely to be followed by a H, H2, or H3. Again, the relationship between headings and simpler coherence patterns seems to hold up, and perhaps, writing a more complex paragraph leads (in the habits of such student writers) to writing another complex paragraph instead of quickly transitioning to another heading.

We also attempted to find relationships between the formal sections of each report and the eight paragraph types, but we could not come to firm conclusions due to the students using a wide array of section names, with inconsistent use and length even when the papers were written for the same instructor. We would note however, that the concluding sections of reports, such as those labelled "recommendations," "conclusions," or "analysis" were more likely to contain Type 4–8 paragraphs, contain longer paragraphs, and more paragraphs overall than previous sections.

Takeaways

We would divide our closing thoughts into descriptive and prescriptive takeaways:

Descriptive

- The undergraduate students in the corpus used relatively simple paragraph structures to build over three-quarters of the prose of their reports—Type

1, 2, and 3 patterns constituted together 78.58% of the 1937 coded paragraphs. These ubiquitous structures correlate with the presence of more headings and images.

- The models and explicit structural instruction provided by each of the four instructors also correlate strongly with the structures that we found in their respective students' reports; students therefore seem to rely heavily on the models they have been provided. We wonder if student overreliance on simplistic forms hinders their ability to develop more rhetorically sophisticated structures as seen in Types 4–8.
- This study provides empirical evidence of what instructors of technical communication tend to know intuitively about report writing and paragraph construction and helps move our collective knowledge of writing instruction a little further away from the realm of lore.

Prescriptive

- Technical communication instructors should be intentional and careful about what structural models they choose to share when teaching the report genre. Our analysis of the corpus suggests that students will follow what they are given (or not given), even to a fault. We suggest presenting different strategies for structuring paragraphs, especially in relation to headings and lists in relation to the whole report, rather than a single authoritative model. In addition to teaching technical communication genres as rhetorical, instructors could provide multiple generic models of reports. For example, an instructor could provide students with three models that demonstrate three different ways of writing the results section of a report. Students could mix the features of several multiple models; either way, they could justify their rhetorical choices in a reflective piece and not be locked into a single path. After careful study of this corpus in conjunction with our own experience, we judge functional flexibility in structure is more important than adherence to any one model or method, especially to undergraduates that will be entering a wide variety of fields with rhetorical contexts and audiences that neither the instructor nor the students can predict.
- Providing multiple models and a separate reflective piece does demand more work and resources from students and instructors than the one-model approach we saw from the four instructors in our corpus, but we would temper that concern with another sobering observation; the reports in the corpus were, by and large, not strong reports. The authors of this study have over 40 years of teaching report writing between us, and we hold that nearly all the 74 reports we coded would have benefited from more complex and nuanced paragraph structures, especially the PIVOTS and COMPLICATES maneuvers. This is not to say that the percentage

of simpler types and the rarer types need to reverse places, but that even the inclusion of a few more of these maneuvers in a report was noticeable and positive, especially in the closing sections. The traditional, if out of style, recommendation for encouraging the composition of more complex sentences is the pedagogy of sentence combining exercises (Connors, 2000; Wolfe et al., 2011); we would note that manipulation of paragraph patterns through the presentation of multiple models could be seen as the same "exercise" strategy, but writ larger at the paragraph level. A closer examination of models is beyond the scope of this immediate paper.

- Practitioners can use these paragraph categories to analyze and critique their own writing, as well as the writing of others. We suggest reflecting on the differences between more heading-dependent and more paragraph-dependent argumentative structures, the presence (or lack of) PIVOTS and COMPLICATES maneuvers, and what constitutes ideal paragraph length, which may shift depending on section and context (longer, perhaps, in analysis and conclusion sections to accommodate more complex argumentation). We would not prescribe any specific ideal percentages/amounts, given rhetorical documents are driven by specific context; rather, the value of the analysis lies in an increased consciousness of textual structure, enabled by new vocabulary. Future research might include what kind of report paragraphs and related structures are actually being written in professional environments, and how those structures compare to this study.

Closing Thoughts

Historically speaking, this study recalls earlier style-centric studies of the 1960–80s, when usage remained a major theoretical concern and focus of the writing disciplines. Isolated treatments of paragraph structure tend to be placed within the small but dedicated subdiscipline of "style." As Ryan Boettger and Erin Friess (2020) note in their recent meta-analysis of technical communication journals, editing and style were once subjects at the forefront of the discipline, but they now represent the least populated corner in terms of published journal articles (pp. 18–19; refer also to Carradini, 2020). We do not imagine this study, however, as a corrective to such a trend. Rather, we would note that that the central issue of how to teach report writing and paragraph writing has not gone away, and regularly returning to this central matter to see "what is going on" in student writing with empirical, theoretical, and practical perspectives remains a worthwhile endeavor. Further, we would also like to promote the teaching of more complex paragraph structure. This px.s1.s2px.f3.c4.v5.px paragraph is an example of how paragraphs do not have to be simple to be effective and readable.

As we readied this piece for publication, concerns about the abilities of generative AI to mimic human sentence and paragraph structure became prevalent in

the media and the academy, and we considered how this study might address such concerns. We see strong parallels between the typical paragraph structures produced by ChatGPT and its chatbot competitors on one hand, and the most popular of the variant structures in our corpus on the other. When we query ChatGPT with prompts, we see its reliance on Type 1 and Type 2 paragraph structures to maintain strong paragraph cohesion, and its inability to produce more complex, unpredictable, or nuanced argumentative structures. While the bots can muster a COMPLICATES or PIVOTS maneuver, their "however" turn typically comes off as predictable and formulaic as a first-year Rogerian essay. With no evaluation or thought behind the turn, such attempts remain awkward and false. As Joseph Weizenbaum (1976) and many others have cautioned, digital computers do not have access to *qualia*, and therefore cannot evaluate subjective experience as humans can; their argumentative capabilities are therefore limited to a veneer of linguistic coherence that can only be emulated by pulling fragments from large numbers of human-written sample texts via LLM (large language model) methods.

Unless the student authors of these papers had photographic memory, they did not compose by such a method. Their attempts at evaluation and exposition may be clumsy, but they are human. We note the irony of suggesting multiple models for students even as chatbots sample millions of texts, but we also note that the many paragraphs in this corpus of often painfully awkward reports all have potential to grow from their "stems" into more robust and better rooted weeds.

Rather than see such technology as a pedagogical or existential threat, we see AI developments as an indicator that the field is once again brushing up against the deeper argumentative structure of student writing. Further, we suspect that the current (and we cannot stress "current" enough) inability of chatbot writing to break free of these simpler structural patterns in a rhetorically functional and coherent manner is not only one of the most straightforward ways to detect chatbot-composed language, but one of the easier ways to critique and improve student paragraph structure. However, if the LLM models on which generative AIs are trained contain primarily Type 1–3 sentences, we should not be surprised if they replicate them, especially if readers accept them. And if those models feed upon their own sentences, this trend will continue, much like it will for students.

The ability to break free of simpler structures and improvise more complex ones is one of the clearest indicators of strong critical thinking and composition in human-written paragraphs. Of the codes we generated, just the inclusion of a single PIVOTS or COMPLICATES is the easiest way for students to break out of Type 1–3 structures and create more unique variants. Each of the authors of this paper (all humans, to be clear) repeatedly mentioned during the collaborative work of the study that within the corpus, the longer, more structurally complex sentences that used more of the available "maneuvers" tended to contain the strongest writing by any measure, stylistic or otherwise. Every time a student relied on a simpler structure, they missed the opportunity to use a more complex one, even if unsuccessfully—and thus to build their skills.

The act of selection (Perelman & Olbrechts-Tyteca, 1969) is central to the enterprise of rhetoric, and as paragraph structure allows fine-tuning of that selection, careful attention to paragraph structure is warranted in writing pedagogy. As this study shows, even the generic recommendation report genre contains numerous opportunities for rhetorical variation that are not always taken. Facility with more complex paragraph structures, however, can be encouraged with the skillful use of multiple templates and models by instructors, in conjunction with descriptive research into how they actually write. The eight structural sentence types can be used as either tools for further analysis or for pedagogy, and accordingly, we offer here a unique, measurable, alternative way to listen to how students write by paying close attention to the internal argumentative structure of their paragraphs, and to help them listen to their own composing process.

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