BRIDGING THE GAP: ADAPTING IMRAD TO MEET STUDENT NEEDS

Kayleigh Di Brico and Katerina Zakonova | New York University

For many undergraduate and graduate students across disciplines, research reading and writing are major challenges and sources of anxiety (Huerta et al.) due in part to the limited writing instruction students receive in discipline-specific courses. Many instructors assume students have learned rhetorical conventions (Melzer) or feel too pressed for time while teaching disciplinary content (Goldsmith and Wiley). Meanwhile, for students, research writing can appear to be disconnected from "doing" research, even though these processes can productively inform one another (Carter). Our project sought to address this disconnect by adapting IMRaD into a reading assistant tool that could support students in performing rhetorical analysis on published research, which in turn would help students engage with model articles as repositories of rhetorical as well as expert knowledge within their field. To produce this tool, we performed a rhetorical analysis of 40 published research articles from across four knowledge domains: humanities, social sciences, natural sciences, and formal sciences. We then tested the tool in our experiences of reading an additional 23 articles. Analysis of resultant data showed that while performing rhetorical analyses on articles improved readers' comprehension and overall experience—confirming existing research on the efficacy of rhetorical analysis as a comprehensive aid—incorporating our tool could result in a more confusing reading experience, especially for articles in the humanities and social sciences. Going forward, we are adapting the tool to incorporate this feedback.

INTRODUCTION

For many undergraduate and graduate students, research reading and writing are integral components of their studies regardless of discipline. From capstone papers to dissertations, writing projects serve as measures of a researcher's ability to communicate the content and purpose of their work. When faced with such writing tasks, many students from across diverse backgrounds experience high levels of writing anxiety (Huerta et al.). Existing literature suggests that this anxiety develops from and contributes to feelings of unpreparedness, inability, and hopelessness when reading, writing, and discussing academic work (Bastug et al.; Bloom; Holladay).

Contributing factors to student writing anxiety can include a fear of underperforming (Bloom; Holladay), low self-efficacy (Bandura, "Exercise"; Bastug et al.), imposter syndrome (Bloom; Cisco), and writer's block (Bastug et

al.). Student respondents in both Bloom's 1981 and Holmes and colleagues' 2018 studies indicated that greater faculty involvement in the writing process would help alleviate their writing anxiety. However, some disciplinary professors feel too pressed for time while teaching disciplinary content (Goldsmith and Wiley), while others assume that students will learn or will have learned discipline-specific rhetorical conventions elsewhere (Melzer).

Today, most universities provide general writing instruction to incoming undergraduates. The purpose of this instruction is to help students transition from formulaic writing that strives only to meet assessment expectations—what Joseph Petraglia describes as "pseudotransactional" writing—to the dynamic creative demands of academic and professional writing—what Petraglia calls "transactional" writing. However, similar instruction tends to be lacking for discipline-specific writing (Bredan; Wu). Consequently, students new to research—ourselves included—may feel that writing is disconnected from the research itself (Carter; Lane et al.) and that good research writing is the product of some other obscure process that students must figure out by themselves.

Our ongoing project aims to address this disconnect by providing students with a reading tool that will help them engage with published research articles as repositories of not just discipline-specific subject knowledge but discipline-specific *rhetorical* knowledge as well. While analyzing an article's subject knowledge can inform student readers of expert knowledge within their discipline, an assessment of the same article's rhetorical knowledge can inform student readers of how expert knowledge is communicated within their field. In turn, awareness of communicative moves within their discipline can make even the most intimidating research paper seem more approachable—an experience that is crucial to building the confidence and self-efficacy of novice researchers—and can assist students in their own discipline-specific writing. Inspired by rhetorical analysis-based reading tools and approaches proposed by Philip Shon, Michael Nielsen, and Suzanne Lane and colleagues, our tool attempted to provide a one-size-fits-all approach to reading research articles that could help novice student researchers deconstruct the rhetorical strategies of articles within their discipline.

To discuss our reading tool, we first review research on undergraduate and graduate student writing anxiety, focusing on factors that contribute to student experiences of unpreparedness, inability, and hopelessness when it comes to writing academic or professional work. With this research in mind, we then consider the benefits of incorporating rhetorical analysis into student reading experiences for the purpose of decreasing writing anxiety, as well as the shortcomings of accepted structures, such as IMRaD, when it comes to teaching students how to read research effectively. Finally, we propose and test a reading tool modeled on IMRaD and consider what student feedback suggests about the effectiveness of such tools.

GROWING PAINS: FROM STUDENT TO EXPERT

WRITING (WITH) ANXIETY

Writing anxiety is characterized by feelings of tension, stress, and corresponding physical changes such as elevated heart rate (Huerta et al.). Students writing with anxiety tend to produce lower-quality work (Daly), avoid writing-based tasks and courses (Bastug et al.), and may experience other negative effects, such as lowered self-esteem (Gibriel). Student-reported contributors to writing anxiety have remained largely consistent across time and studies. Our project focused on four contributing factors: (1) fear of underperforming and/or negative evaluation, (2) low self-efficacy, (3) imposter syndrome, and (4) writer's block. We chose these four factors because each resulted from and contributed to feelings of unpreparedness, inability, and hopelessness that students experience when faced with a writing task, which in turn tended to drive students away from writing altogether.

Students who fear underperforming and/or receiving negative feedback tend to procrastinate when assigned a writing task (Bastug et al.; Bloom; Holladay; Holmes et al.). The same studies show that these students also tend to struggle to contextualize their own work appropriately and are more likely to fail to reach out for timely writing support, such as additional instruction or tutoring services. Consequently, students who fear underperforming and/or receiving negative feedback are less likely to develop productive writing habits and are more likely to produce the very low-quality work they were afraid of producing in the first place, making every writing exercise seem hopeless.

Albert Bandura described self-efficacy as a person's "judgment of their capabilities to organize and execute courses of action required" to achieve a desired performance (*Social Foundation of Thought* 391). Self-efficacy is built through mastery experiences, wherein a person succeeds on a task they perceive to be challenging and/or by observing the successes and failures of others (Bandura, *Social Foundation of Thought*). Students with lower self-efficacy are more likely to avoid writing and writing-related tasks, especially if they perceive those tasks to be challenging because they are more likely to assume themselves incapable of producing a written work of desired, or even acceptable, quality (Bandura, "Exercise").

Imposter syndrome occurs when a person "feel[s] their external markers of success are unwarranted" (Hawley 203). Students with imposter syndrome tend to underestimate their academic abilities and achievements and are likely to worry about being "found out" or "revealed as a fraud" (Hawley 207). Students writing with imposter syndrome may feel uniquely unqualified to speak on their chosen topics, regardless of how much research was done in preparation. These fears can become especially salient when students feel pressured to demonstrate competence by, for example, producing a research paper (Bloom).

Finally, writer's block was once described by Victoria Nelson as the "temporary or chronic incapacity to put pen to paper" (1). Bastug and colleagues found that student writer's block tends to arise from too little writing of

self-expressive exercises and too much standardized assessment: as student interest in writing and the writing process diminished, their writing experience and skill diminished as well, making it more difficult to communicate through writing. Students dealing with recurring writer's block reported experiencing emotional distress and tended to either stop writing, give up on producing quality writing, or give up on writing altogether (Bastug et al.).

To gain a better understanding of how college students across disciplines experience and deal with writing anxiety, we surveyed New York University undergraduates enrolled in *Reading, Writing, and Speaking in the Disciplines*, an advanced-level elective course designed for students interested in learning how to communicate research to various audiences, regardless of discipline (n=41; see Appendix A for complete demographic information). When asked to rate their writing anxiety on a scale of 0–7, 80 percent of respondents (33) rated their writing anxiety 4 out of 7 or greater. When asked to elaborate, respondents said that feeling unqualified, "the enormity of the task at hand," lack of experience, and being unsure of "how to go about actually writing the paper" were some of the most important factors contributing to their writing anxiety. Respondents also shared that "knowing enough" about their topic, having a complete understanding of key concepts, and "being able to draw from a plentiful bank of insight and understanding of the topic" made them feel more confident when working on their own research writing (see Appendix B for the complete set of survey questions).

Overall, 69 percent of survey respondents identified some variation of not knowing where to start, not knowing how to structure a research paper, and/or not knowing how to demonstrate mastery of their topic as the most important contributing factors to their research writing anxiety. Our findings support Lane and colleagues' assertion that "even small limitations on [students'] access to expert knowledge," including limitations that arise from insufficient knowledge of relevant rhetorical conventions, "can create confusion and disorganized or less effective texts" (138). Given these insights, our project questions whether an existing standard research article structure could be adapted into a reading support tool that (a) assisted novice student researchers in performing rhetorical analysis on research articles within their discipline, thereby allowing published research to be a source of both rhetorical and disciplinary knowledge; and (b) by doing so, increased student confidence in their knowledge of both rhetorical conventions and expert knowledge.

READING WITH RHETORICAL ANALYSIS

Rhetorical analysis is generally defined as an examination of how an author or speaker, when taken in context, is attempting to influence their audience. When a reader is performing rhetorical analysis on a text, they are considering the complete rhetorical situation of said text: what was written, how it was written, why it was written, for whom it was written, and in what circumstances. The authenticity of a rhetorical situation differentiates pseudotransactional and transactional writing, as defined by Petraglia. The rhetorical situation of a pseudotransactional task is artificially con-

structed: students are given unrealistically limited time and resources to respond to a standardized prompt, their writing must adhere to a standardized structure (such as the five-paragraph essay), and their reader—if they have one at all—is often their teacher or standardized assessor, neither of whom need be aligned with the stipulated target audience of the prompt (Davis; Petraglia; Warner). Transactional writing tasks, on the other hand, arise in response to varied and dynamic rhetorical situations, which in turn both influence and are influenced by the writing itself (Petraglia; Warner).

For students, the transition from the pseudotransactional writing tasks of high school to the transactional writing tasks of academic and professional life can be a daunting experience that makes or breaks their relationship to writing (Warner). Rhetorical analysis has already been incorporated into general and discipline-specific writing support for students struggling to make this transition. In "How to Read Journal Articles in the Social Sciences," Shon shares rhetorical coding strategies that can help student readers "synthesize the reading, note-taking, and organizing of voluminous amounts of information in an easily identifiable and retrievable format" (4), effectively assisting students in "deciphering" texts on a structural, mechanical, and grammatical level (3). For example, one coding strategy asks readers to attach labels to key rhetorical elements as they are identified, such as using "WTD" ("What They Do") to mark the main research question(s) posed by the author(s) (5, fig. 1). Shon suggests that this process of identification and labeling can help students synthesize ideas more effectively in their own writing because they "receive adequate practice in reducing and condensing complex ideas and sentences into one or two key words (thematic codes)" (4). Shon aims to improve students' research communication skills by helping them become more competent readers, regardless of discipline.

Suzanne Lane and colleagues provide another example of a tool that beneficially incorporates rhetorical analysis strategies into student reading and writing experiences. Through collaborations with STEM faculty and analysis of model research articles, Lane and colleagues created reasoning diagrams for Materials Science and Engineering, Brain and Cognitive Sciences, Mathematics Reasoning, and Computer Systems domains that sought to "reveal tacit knowledge in each of these domains for students, and to show where and how they intersect" (138). These knowledge domains included rhetoric, genre, discourse, process, and subject matter (Lane et al. 123). Lane et al.'s study found that reasoning diagrams helped students and instructors identify gaps in and limitations to their expert knowledge of their subjects, which, when unidentified, could reduce the quality of subsequent written work, and that "students have been able to use [reasoning diagrams] to resourcefully fill in those gaps on their own" (138). Creating tangible diagrams that map out information and visualize the organization of research-based writing can empower students to engage with and resolve gaps in their knowledge, which can bolster their self-efficacy and improve their written work.

Like Lane and colleagues, our project seeks to provide students with a concrete framework

that will support them in building an analytical eye for and awareness of the rhetorical conventions of their discipline. But, like Shon, our project wants to respond to the anxieties of the more general audience of student researchers, including those working in domains that are difficult to map comprehensively, such as the humanities.

Lastly, from our own experience as novice student researchers, we know that encountering articles that expose gaps in our knowledge can be a discouraging and demoralizing experience. These gaps need not be limited to subject knowledge. They can include grammatical and rhetorical knowledge, how to present oneself and one's work, and other concerns; and they can vary greatly between disciplines. James Paul Gee names these varying sets of communicative knowledge "Discourses": "forms of life which integrate words, acts, values, beliefs, attitudes, and social identities" (6–7). Understood in Gee's terms, a difficult article exposes not only a gap in knowledge but a gap in the Discourse—the way of being—that a novice researcher is trying to construct. Our hope for our reading tool is to provide "scaffolding," as both Gee (7) and Lane and colleagues (122) describe it, that will transform daunting interactions with masters of a given Discourse into positive learning experiences that improve student confidence and self-efficacy.

RECALL ABILITY AND RHETORICAL MOVES

Michael Nielsen's 2018 article, "Augmenting Long-Term Memory," articulates some strategies for reading research articles in unfamiliar disciplines, with the goal of becoming familiar with the basic terminology and key ideas of that field. Recall ability is crucial to this endeavor. Part of the challenge of reading unfamiliar literature is toggling effectively between the various conceptual layers of the article, such as between beginner and expert concepts, without missing key aspects of either. A similar challenge arises when readers need to toggle between big-picture and fine-grain rhetorical moves. To deal with this challenge, Nielsen suggests readers begin with "several rapid passes over the paper . . . each time getting deeper and deeper" and write down "elementary questions" as they read (Nielsen). These elementary questions can be as simple as "What is X?" or "How does X relate to Y?" After each reading, readers should answer their questions and then read again with the new information close at hand.

Over time, this approach allows readers to build from a broad understanding with limited expert knowledge to an in-depth understanding that includes accurate knowledge of key terms, concepts, and connections. Given that student respondents to our survey explicitly stated that a deeper and more holistic understanding of their field and/or topic(s) would improve their confidence when reading and writing research, we felt that incorporating aspects of Nielsen's reading strategies, combined with Shon's and Lane and colleague's rhetorical mapping strategies, could offer a promising start. Where Nielsen's approach helps readers engage with unfamiliar expert knowledge, Shon's approach helps readers understand how that expert knowledge was arranged within an article, and Lane and colleague's approach works to connect the two and to reveal published research articles as repositories of several kinds of knowledge, including subject

and rhetorical knowledge. Our tool aimed to do the same, but in a way that might serve a broader audience of novice researchers.

WHY IMRAD?

We chose the standard scientific structure IMRaD—an acronym for (I)ntroduction, (M)ethods, (R)esults, (a)nd, (D)iscussion—as the template for our tool (see fig. 1). IMRaD has been the simplest form of the standard structure for scientific research articles since the late 20th century because of three key benefits: it makes organizing information easier when writing, finding information easier when reading, and reviewing and evaluating easier when editing (Wu). While more detailed versions of IMRaD have been suggested—for example, versions that include the abstract, literature review, various graphs and figures, and other elements—we chose to build on the simplest version so as to be able to serve students in as many disciplines as possible.

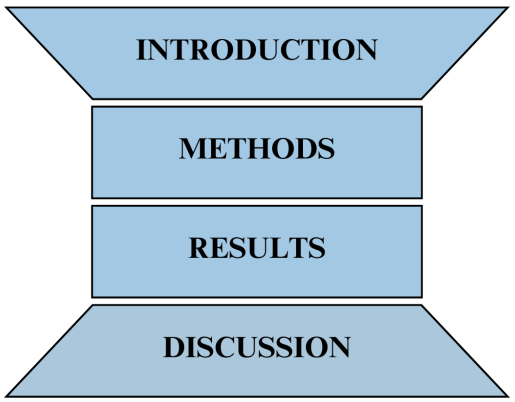

Fig. 1. IMRaD. Adapted from Wu (1346).

One key educational benefit of IMRaD is that it organizes research into four (or more) large blocks, which can be expanded upon in both general and discipline-specific ways. Jianguo Wu expands the most basic acronym as "Introduction – Why did you do it in the first place? Methods – How did you do it exactly? Results – What did you find? Discussion – What does it mean after all and so what?" Novice student researchers combing through a research paper will have little trouble locating these structural elements and can apply this or a more detailed structure to their own writing. Because of this, IMRaD is ubiquitous. A novice student researcher looking for guidance on how to write a research paper will find a version of IMRaD through a brief Google search of "how to write a research paper," "how to structure a research paper," and other variants.

However, this "building block" approach to reading and writing is also IMRaD's key shortcoming. Great detail goes into each of IMRaD's sections, most often tailored to the demands of the author's discipline and rhetorical situation (see Fig. 2), but explanations of more nuanced structures are not always as readily available as the basic blocks of IMRaD. Then, even if those explanations can be found, students may be unsure of which version or style is most appropriate for their rhetorical situation; or, having found a published article they wish to model, they may still lack an understanding of what made the model article as good as it was, and how they might mimic those features. In these cases, IMRaD is unsuited to helping novice researchers identify varying versions of the underlying structure, locating the key communicative moves made in each version, and comparatively evaluating them to determine which would best serve their own rhetorical situation—skills that budding researchers need to develop to become competent research readers and writers.

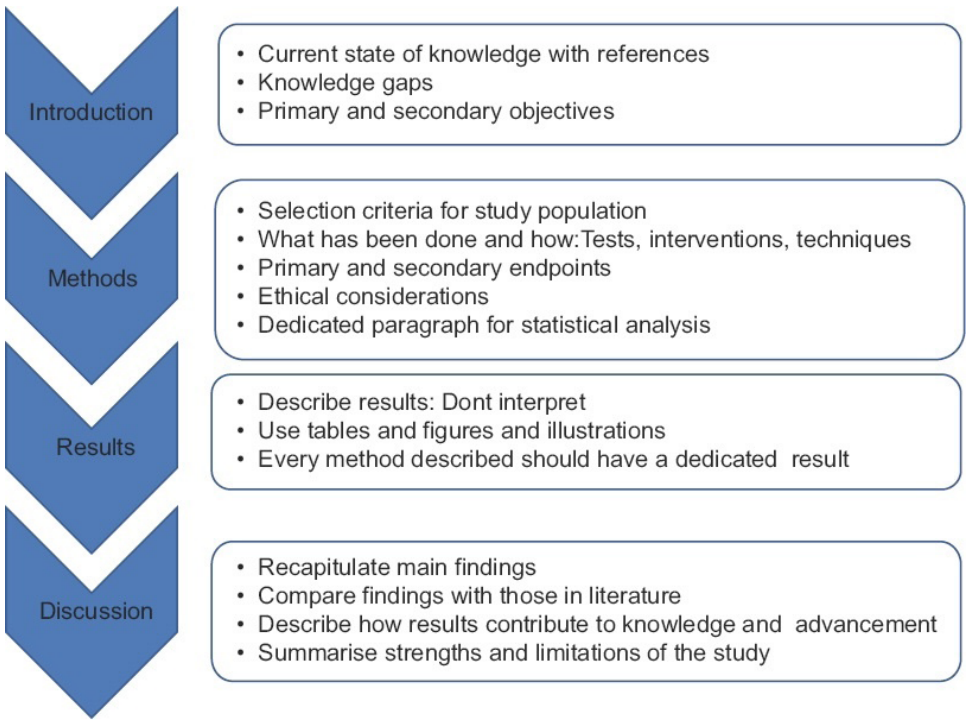

Fig. 2: What Actually Goes Into IMRaD (Subramanian and Hedge S293)

Finally, research writing is ever-changing, as are research authors (Wu). Whether the structure preferred by key journals changes, or the author's field of research changes, researchers must be able to adapt their reading and writing to the demands of the rhetorical situations they encounter. Our reading tool aims to bridge the gap between IMRaD's universally applicable simplicity and the dynamic demands of actual research reading and writing by helping novice readers look for, recognize, and evaluate rhetorical moves, regardless of changes over time in either the research or the researcher. We hope that developing these skills will enable students to become better readers and writers and more capable and confident researchers.

METHODS

Along with our survey of 41 New York University undergraduates, our research methods for developing our reading tool included the rhetorical coding of 40 published research articles from across the disciplines. To test the efficacy of our tool, which took the form of an expanded article structure, we collected qualitative responses from four New York University undergraduates, referred to as "coders," all of whom were members of our research team. Coders specialized in Philosophy,

Mathematics and Economics, Psychology, and Music. Coders were asked to apply the reading tool in their reading of an additional 23 articles from across the disciplines, then to evaluate the quality of their reading experience and to provide a file of the rhetorical code that they felt was most informative of their article's content and structure (see Appendix D for the complete coder questionnaire).

RHETORICAL CODING

All members of the research team had joined the project through Professor David Ellis' *Research, Writing, and Speaking in the Disciplines*, an advanced-level course designed for students across the disciplines who were interested in learning how to communicate research to various audiences. In this course, students explored the underlying links between "knowing, doing, and writing research" within their disciplines (Carter 388). One assignment asked students to develop a rhetorical "code" that reflected the quantity and organization of rhetorical elements most common to articles within that student's discipline. To accomplish this, students performed rhetorical analysis on three published articles within their discipline(s), developed a "theory" that articulated how research writing was structured within their field, and analyzed an additional three articles to test and tweak their theory and the code that it generated. Students drew inspiration from Shon's coding guide in "How to Read Journal Articles in the Social Sciences," their own reading and writing experiences, and class discussions. This assignment produced several unique organizational maps. Some students wrote out their codes as lists of key rhetorical elements, much like Shon had suggested, while others mapped out elements and the connections between them, producing codes that more resembled Lane and colleague's maps. Since all research team members were familiar with this assignment, their personal codes served as the foundation for the expanded IMRaD structure.

EXPANDING IMRAD

To build on the codes we created in the class, our research team performed rhetorical analyses on 40 published research articles from across four domains: humanities, social sciences, natural sciences, and formal sciences (see Appendix C for more information on these categories and the article counts within each). While we acknowledge that IMRaD is particular to natural and social science articles, our goal was to identify the rhetorical elements that bore the brunt of the author's communicative efforts, regardless of discipline, and to attempt to map them onto IMRaD. This effort resulted in an expanded structure that we thought could help students pierce through IMRaD's opaque blocks and analyze specific rhetorical moves, even when reading articles outside the sciences.

Our analysis generated the following expanded structure (see Table 1): critique of previous literature, summary of previous literature, articulation of gap, rationale for the work, objective(s) of the work, broad world impact, data acquisition, findings and interpretations, future avenues of research, and limitations of the study design.

Table 1: The Expanded Structure

Critique of Previous Literature	What are the shortcomings of existing research?
Summary of Previous Literature	What existing knowledge informs this project?
Articulation of Gap	How does the project fit into existing knowledge?
Rationale for the Work	Why is the project noteworthy?
Objective(s) of the Work	What are the specific goals of the project?
Broad World Impact	What is the broader contribution of the project?
Data Acquisition	How was the project carried out?
Findings and Interpretations	What were the results and what did they suggest?
Future Avenues of Research	What are some possible next steps?
Limitations of the Study Design	How was the project limited?

Each element of the expanded structure was derived from a more general block of the original IMRaD structure. For example, critique of previous literature, summary of previous literature, articulation of gap, rationale for the work, objective(s) of the work, and broad world impact can be taken together as the introduction; objective(s) of the work and data acquisition as the methods section; and findings and interpretations, future avenues of research, and limitations of the study design can variably form the results and/or discussion. Notably, individual elements can populate multiple sections of IMRaD. For example, the objective(s) of the work, broad impact, and data acquisition could be part of both the introduction and methods section. This detail is meant to capture how one rhetorical element might appear in multiple sections of the text and how it could serve a slightly different rhetorical function each time.

We are aware that our expanded structure is top-heavy: there are more elements that might appear in the introduction of a research article than there are elements that might appear in the methods, results, and/or discussion sections. This imbalance was the result of two main considerations. First, since our goal is to help students acquire a deeper and more holistic understanding of both subject and rhetorical knowledge within their discipline, we

decided that greater emphasis on the front end of any given research article, where more of the discussion of expert knowledge is likely to occur, would be more beneficial. This decision was informed, in large part, by our own reading challenges as novice student researchers. It was our experience that, oftentimes, the most intimidating part of an article was the beginning, when key terms and ideas are introduced, explained, and interwoven into a theoretical framework. We are certain that researchers of all experience levels can relate to starting to read an article and struggling to figure out what is going on, and this experience is especially demoralizing for those readers who are only just beginning to acquire reading strategies, research strategies, and a bank of expert knowledge of their own. Furthermore, being able to grasp the theoretical framework set up by the front end of a research article is often crucial to engaging with the more concrete information contained in the back end, such as the results and discussion. So, we aimed to provide the greatest support for the front end of research articles, hoping that early success will bolster student confidence and self-efficacy throughout the reading experience.

The second reason for our front-heavy design is that we wanted to keep the structure itself relatively short so as not to disincentivize students from using it. The longer the structure, the more work a student would have to put in to become well-versed in and accustomed to using it, which is likely to make any reading tool less appealing and, consequently, less useful. So, we created an expanded structure that emphasized deep reading in the front end of any given research article at the cost of simplifying the breakdown of the back end.

The expanded structure had two goals: 1) to help readers identify the key rhetorical elements present in published research articles, and 2) to help readers analyze the function of each rhetorical element within the article. To test the efficacy of the expanded structure, we asked coders to incorporate it into their reading experiences of an additional 23 published research articles from across domains (see Appendix C). As all coders were active undergraduate students in a variety of fields (music, philosophy, psychology, politics, computer science, economics, and mathematics), we drew the additional 23 articles from each coder's coursework or research. Coders selected the articles they read and coded. Articles were required to be peer-reviewed and published in an academic journal. Coders were encouraged to, and sometimes did, work with articles outside of their fields, but they were not required to do so. While we kept records of who read which article, we did not take this information into account when drafting our observations and conclusion; instead, we focused on which disciplines the articles had been drawn from. All coders were involved in creating the expanded structure (the authors of this paper account for two out of four) and, as such, were aware of the stated purpose of the expanded structure. For each article read with the assistance of the expanded structure, coders responded to the following questions about their assisted reading experience (see Appendix D for the complete coder questionnaire):

1. Did the expanded structure clarify the rhetorical conventions used to organize information in the article? Yes/No.

2. Did the expanded structure improve your comprehension of the article? Yes/No.

3. Did the article contain crucial rhetorical elements/conventions and/or organization features that were absent from the expanded structure? Yes/No.

Coders were asked to elaborate on their responses to questions (1) and (2). For question (3), coders were asked to provide a rhetorical code that they felt was most accurate to and informative of the structure of their article. All questions asked coders how their reading experience with the assistance of the expanded structure compared to their experience without.

RESULTS

We found that for most articles, assisted reading with the expanded structure was beneficial to coder comprehension of both expert and rhetorical knowledge (see Fig. 3). Out of the gathered responses, 87 percent (20 out of 23 articles) indicated that incorporating the expanded structure into the reading experience clarified the rhetorical moves used to organize information within the article, and 65 percent of responses (15 out of 23) indicated that incorporating the expanded structure improved coder comprehension of the article.

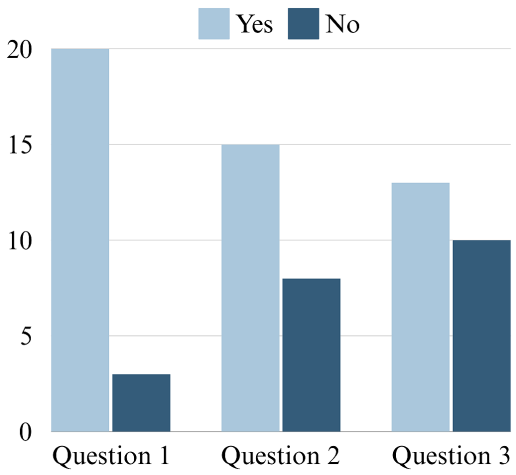

Fig. 3: Comparison of coder yes/no responses to questions (1), (2), and (3).

Question (3) is where responses showed the most variance, with 56 percent of responses (13 out of 23 articles) indicating that the article contained crucial rhetorical elements and/or features that were absent from our expanded structure. In their short responses, coders elaborated that while the expanded code helped them identify key elements to look for, the level of detail included in the expanded code could be confusing or misleading, such that some coders found themselves "searching for a category that didn't exist." One coder noted that using the code allowed them to locate specific elements but "made it difficult to anticipate how it might all fit together." Other responses indicated that the code became less effective as a reading tool when coders tried to determine how the rhetorical elements of the expanded structure were meant to interact with one

another, as they would in any research paper, and whether the interaction of elements of the code mapped onto the interaction of elements within the article at hand. One coder explicitly indicated that "understanding how concepts . . . interact would have been more helpful than the code by itself."

Article features that coders felt were important and unaccounted for by the expanded structure include objections, fieldwork accounts (for example, as in anthropology), establishment (summary, application, and critique of existing literature when setting up an argument, for example, as in philosophy), alphanumeric representations (such as tables and figures), and analytical frameworks. Overall, social science, natural science, and formal science articles tended to offer more intuitive reading experiences, while humanities articles tended to offer more confusing reading experiences. For example, one coder working on a humanities article wrote, "the article LACKED the majority of the rhetorical elements [identified in the structure], I think, and yet conveyed the appropriate message."

ANALYSIS

The challenges faced by humanities (and some social sciences) coders pose an invaluable question: What assumptions do coders bring into their assisted reading experiences, and how do these assumptions vary across disciplines? Given that our code is intended for use by novice student researchers, one additional factor to consider is the reading and writing experience of such researchers. Traditional students entering college from U.S. high schools are experienced in reading and writing pseudotransactional pieces, where success is a matter of adhering to simple, pre-determined structures and strategies for success (Davis; Petraglia; Warner).

While our expanded structure did assist coders with identifying the key rhetorical elements of most articles, coder feedback suggests that the expanded structure was often used as a checklist, where they expected the tool to contain all information necessary for the analysis of the article at hand, rather than as a basic tool that supported deeper independent analysis of the various rhetorical moves within the article. We suspect that this checklist approach, combined with IMRaD's fittingness to science articles, may have been responsible for the largely positive reading experience for social, natural, and formal science articles, which tend to be more patterned, and the largely negative experience for humanities articles, which tend to be more organic, even within the same discipline. For example, René Descartes' "Meditations," Lewis Carroll's "What the Tortoise Said to Achilles," and Susan Wolf's "Moral Saints" are all published articles within philosophy, but it is impossible for a single checklist-type structure to concurrently and accurately map the rhetorical moves within all three.

Another challenge was posed by coders' tendency to act as though the elements of the expanded structure were organized in order of appearance, even though they were aware that no such organization was explicitly part of the structure. While we organized the expanded structure based on where elements were most likely to appear, our goal was to assist and

encourage students in performing independent rhetorical analysis rather than impose on student reading experiences a rhetorical structuring that was unlikely to be accurate to the article they were reading.

With both the checklist approach and the order-of-appearance approach in mind, we suspect that our tool exposed coders' temptation to fix what Elizabeth Wardle describes as ill-structured (or "messy") problems, of which writing is a classic example by applying a well-structured problem-solving approach, such as imposing a checklist or an ordering where none exists. By doing so, coders forced a "single solution" where many might have been possible (Wardle). Rather than making coders' lives easier, the disconnect between the multi-faceted demands of research reading and writing and the oversimplified checklist and/or order-of-appearance approaches created difficulty and frustration when the code and the article failed to fit. For reading support tools such as our expanded structure to improve students' reading experiences, students must also transition from reading for the one correct answer to reading to explore, understand, and experiment—what Wardle calls an "explorative approach" for an ill-structured problem. Overall, the student-applied checklist and order-of-appearance approaches confirm the continuing influence of a pseudotransactional writing education on students writing at the undergraduate level.

CONCLUSION

In sum, our data suggest that analyzing the rhetorical moves of published research articles was effective at improving student reading experiences but that the effectiveness of such analysis tends to be hindered by assumptions and strategies that would have been more applicable to more pseudotransactional pieces, such as those worked with during high school. This confirms existing research on the efficacy of rhetorical coding as a comprehensive aid (McCloskey; Evans et al.), the negative impacts of traditional U.S. high school writing education on student reading and writing skills (Bastug et al.; Davis; Petraglia; Warner), and Nielsen's, Lane and colleagues, and Shon's insights.

Based on coders' short responses, we conclude that the expanded structure was almost equally helpful and confusing, largely because of the assumptions and strategies that coders brought with them into the reading process. Some coders searched for rhetorical elements that were present in the structure but not in the article at hand, while others tried to "make fit" elements that were present in the article but not in the structure. Then, coder-made rhetorical codes often expanded the structure further with additional elements rather than adjusting existing ones, suggesting again that coders tended to search for a "single solution" that accounted for every aspect of the "messy" problem that was their article (Wardle). Overall, the coder experience ranged from helpful to confusing, often depending on the discipline of the article being read—not a range we find acceptable for a reading tool intending to serve regardless of discipline.

Counteracting the temptation to treat rhetorical codes as rubrics for research papers, we have begun incorporating insights made

by John Swales and Michael Nielsen to develop a second version of our tool. Building on Wardle's observation that U.S. high school writing education prioritizes fast learning and answer-seeking methodology over explorative approaches, we want to adjust our expanded structure to work against the grain of "single solution" mentalities that only served to frustrate coders, especially when working with articles in the humanities. Instead, we can nudge novice student researchers toward creative engagement with both the expanded structure and the article at hand, which includes considering how they interact, even when they are not a perfect match. To counteract the order-of-appearance approach, we plan to move away from enumerated rhetorical elements and toward a variation of Swales' CARS model, which Swales developed to describe the "rhetorical moves" that research writers use to introduce their work. We also hope to adjust the elements of our structure to better emphasize the idea that "genre and discourse conventions are socially constructed over time" (Lane et al.) and that, as such, student readers ought to be aware of discrepancies between what is taught and what is used in published research. Through these adjustments, we aim for our tool to help students develop a "repurposing" mentality (Wardle), wherein students are able to draw information from but are not restricted by previous experiences and, as such, feel better equipped to engage with unfamiliar disciplines and reading experiences.

By creating a reading tool that accounts for the variation in structure across disciplines, we hope to further emphasize the concept of rhetorical situation (i.e., purpose, audience, topic, writer, and context) to frame and engage with the rhetorical elements of a research paper. Simultaneously, we hope to challenge unhelpful assumptions and strategies that students are bringing into research reading and writing from the pseudotransactional writing education that they were likely to receive in U.S. high schools. Two challenges for future research are (1) devising an impactful coding process that remains time-efficient for students and (2) developing a code that can accommodate the evolving standards of research articles within any discipline. We hope that successfully adapting tools like IMRaD to meet the learning needs of undergraduate researchers can produce a tool that helps students take on research reading and writing with confidence.

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APPENDIX A: DEMOGRAPHICS OF NYU SURVEY RESPONDENTS

We surveyed 41 NYU undergraduate students to determine their writing anxiety levels when faced with a research reading or writing task. Participation in the survey was voluntary and was conducted separately from any coursework. All questions were optional, and no identifying information was collected or kept.

Of the 17 respondents who volunteered information about their gender, 14 self-identified as women, and three self-identified as men. Of those who volunteered information about languages

spoken at home, 41 percent (7) reported that English was spoken at home, 41 percent (7) reported that another non-English language was spoken at home, and 18 percent (3) reported that English and another non-English language were spoken at home equally.

APPENDIX B: RESEARCH READING AND WRITING ANXIETY SURVEY

IRB#: IRB-FY2023-7842

1. How anxious did you feel, on average, during the last two weeks? Feeling anxious could include feeling uneasy, "on edge," worried, tense, nervous or the like.

   Answer options ranged from 1 (not at all) to 7 (extremely).

2. How anxious do you feel when you think about writing a research paper, article, or thesis?

   Answer options ranged from 1 (not at all) to 7 (extremely).

3. How anxious do you feel when you think about reading a research paper, research article, or other published scholarship? Feeling anxious could include feeling uneasy, "on edge," worried, tense, nervous or the like.

   Answer options ranged from 1 (not at all) to 7 (extremely).

4. How intimidated do you feel when you think about reading a research paper, research article, or other published scholarship?

   Answer options ranged from 1 (not at all) to 7 (extremely).

5. Which section of a research paper is the hardest for you to write?

   (i) Abstract
   (ii) Introduction
   (iii) Methods
   (iv) Results
   (v) Discussion

6. When reading a research paper, which section is the most confusing to you?

   (i) Abstract
   (ii) Introduction
   (iii) Methods
   (iv) Results
   (v) Discussion

7. What would you say are the most important factors contributing to research writing anxiety for you?

8. What makes you feel more confident when writing or reading a research paper (and/or writing your thesis)?
9. What kinds of outside interventions (writing guide, tutor, peer review, etc.) have helped you feel more confident?
10. What college/university do you attend?
11. What year are you in your undergraduate degree?
12. Do you consider yourself a "First Gen" college student (as far as you know, your parents did not complete a 4-year college degree)?
13. What is your major or intended major?
14. Which most closely describes your gender?
15. (Which race or ethnicity best describes you?
16. Is English the main language you speak at home?
    (i) Yes.
    (ii) No.
    iii) English and other languages are spoken/signed at home about equally.
17. If you use more than one language, which language do you prefer to speak/sign in?
18. If you use more than one language, which language do you prefer to write in?
19. How did you hear about this survey?

APPENDIX C: ARTICLE DOMAINS AND NUMBER OF ARTICLES PER CATEGORY

Humanities (language, art, cultural studies, etc.): 12 / 23 articles
Natural Sciences (physics, chemistry, and biology, etc.): 1 / 23
Formal Sciences (mathematics, computer science, etc.): 2 / 23
Social Sciences (psychology, anthropology, etc.): 8 / 2

APPENDIX D: CODER QUESTIONNAIRE

1. Article Title:
2. Year Published:

3. URL, or upload the article file here.
4. Which disciplinary category does your article fall into?
    (i) Humanities
    (ii) Social Sciences
    (iii) Natural Sciences
    (iv) Formal Sciences
5. If you are unsure between two categories, select the second choice here:
    (i) Humanities
    (ii) Social Sciences
    (iii) Natural Sciences
    (iv) Formal Sciences
6. Did the expanded structure clarify the rhetorical conventions used to organize information in the article?
    (i) Yes.
    (ii) No.
7. Please elaborate:
8. Did the expanded structure assist your comprehension of the article?
    (i) Yes.
    (ii) No.
9. Please elaborate:
10. Did the article contain crucial rhetorical elements, conventions, and/or organizational features that were absent from our structure?
    (i) Yes.
    (ii) No.
11. Type, paste, or link the code that you think best represents how information is organized in your article. This can be derived from our current code, or something you created from scratch. Or, upload a copy of your code here.