Writing Manuscript "Bookends": Strategies to Effectively Frame Science

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Abstract

The introduction and discussion sections play pivotal roles in peer-reviewed manuscripts, yet many authors struggle with these sections. This commentary describes the significance of the introduction and discussion sections for successful publishing, identifies essential components of these sections, and provides recommendations for writing quality introductions and discussions. The introduction defines the problem to be addressed, identifies what is known and unknown about the problem, and states the study purpose. It begins broadly by introducing the area of interest, narrows to identify the specific focus and gap in knowledge, and finally ends with the aim of the present study, seamlessly leading to the methods and results sections. Discussion sections restate the study purpose, interpret the most compelling findings, situate them within the context of existing literature and frameworks, describe study limitations, and provide recommendations for future research and practice. The discussion ends with a brief conclusion paragraph explaining the study's relevance and implications to the field. The introduction and discussion sections are the "bookends" of the scientific manuscript. Successful bookends increase the chances of framing science, getting manuscripts published, and contributing to scientific literature.

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Writing Manuscript "Bookends":

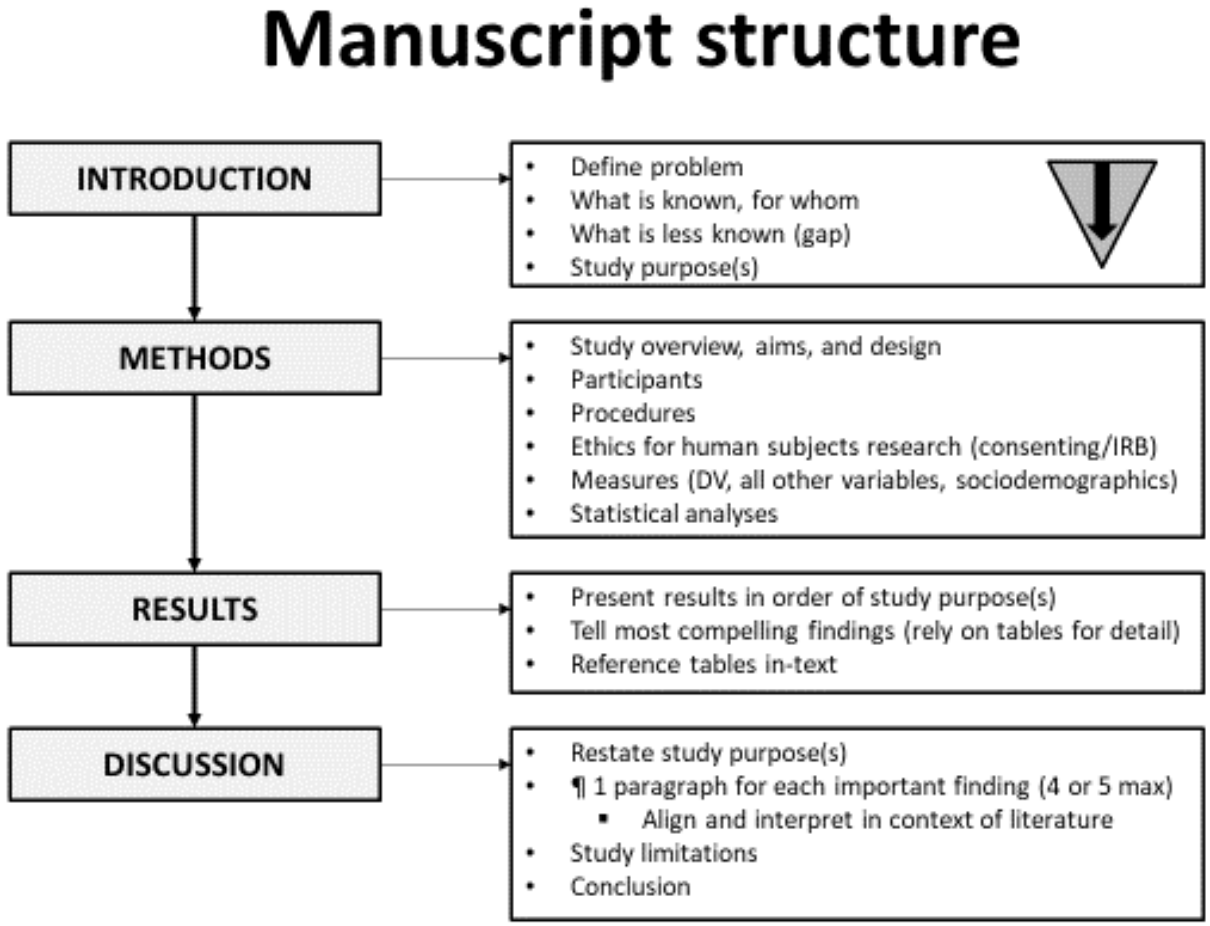
Strategies to Effectively Frame Science

In the world of scientific publishing, the introduction and discussion sections of a manuscript play a pivotal role. These sections are the "bookends" of peer-reviewed manuscripts that guide readers through the research process and contribute to the ongoing scientific discourse. A well-crafted introduction engages readers, provides essential background information, justifies the need for the study, and generally sets the stage for the whole report. The discussion section provides an interpretation of the findings, contextualizes them within the existing literature, and identifies future directions for research and practice. When these sections are articulate and compelling, they captivate readers, foster understanding about the research completed, and contribute to meaningful scientific dialogue through the published literature. When the introduction and/or discussion sections are underdeveloped, superficial, or otherwise weak, readers tend to lose interest in the report or overlook the potential value of the work. Therefore, the purposes of this article are to: (1) describe the significance of the introduction and discussions sections for successful publishing in peer-reviewed journals; (2) identify the essential components of these research report sections; and (3) provide practical recommendations for writing better quality bookends.

Many scientific writers particularly struggle with the purpose of introduction and discussion sections when crafting their manuscript (see Figure 1). These sections may lack an organization of coherent thought, making it difficult for the audience to

Figure 1

Manuscript Structure and Section Descriptions.



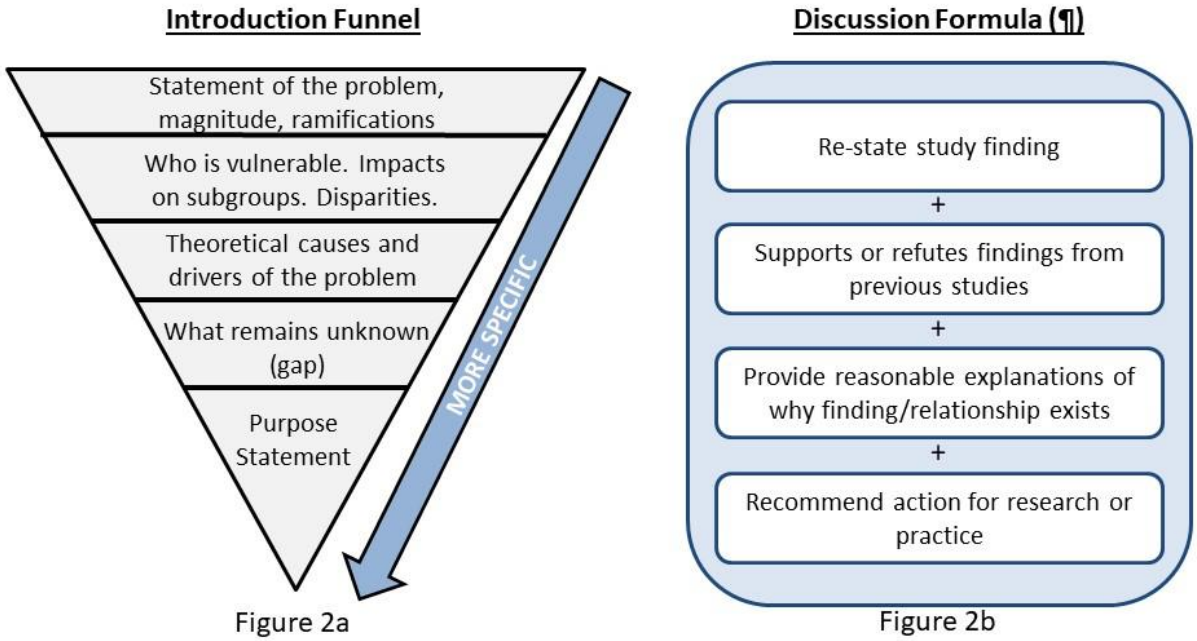
Footnote: IRB = Institutional Review Board; DV = Dependent Variable; ¶ = indicates a formula for writing each paragraph related to a main study finding, not the discussion section overall.

understand complex ideas being conveyed. Contributing factors of weak sections are often because researchers are unfamiliar with the relevant literature, attempt to write before synthesizing or contextualizing the research findings, and/or dive into writing their reports with minimal formal training. Reasons for a lack of formal scientific writing training are complex and multi-faceted, which may include a combination of academic pressures, time constraints to produce reports quickly, and a self-learning culture where scientists acquire writing skills through practice rather than formal training.

When scientists write underdeveloped bookends, they may engage in a lengthy back-and-forth revision process with their mentors and co-authors. This can cause unnecessary and avoidable frustration for the mentor and mentee, while ultimately delaying submission for publication (Prochnow, et al., 2017). Additionally, when reports without strong introduction and discussion sections are submitted for peer-

Figure 2

Introduction Funnel and Discussion Formula.



Footnote: ¶ = indicates a formula for writing each paragraph related to a main study finding, not the discussion section overall.

review at professional scientific journals, the reports may be criticized for a lack of substance or limited contributions to the published literature. Manuscripts in this state may not fare well during the peer-review process, which can lead to a lengthy review process (e.g., extensive requests for revision, multiple rounds of requested revisions, rejection that requires submission to a different journal) and delays publishing the new scientific knowledge.

Writing is a skill that requires frequent and consistent practice. As writers gain experience and receive guidance from mentors and peers, they can refine their approach and learn to communicate their scientific work more persuasively and engagingly. Learning the key components of introduction and discussion sections, and strategies to write them effectively within the context of the published literature and their study data, will help writers of all stages draft higher quality manuscripts and research reports. Here, we present common challenges, essential components, and strategies associated with writing introduction and discussion sections.

Introduction Sections of Peer-Reviewed Manuscripts

Crafting a strong introduction may be the most challenging aspect of writing a manuscript. Compared to the more objective and technical methods and results sections, the introduction must distill extensive and complex information in a creative, compelling, and succinct section that sets the

roadmap for the remainder of the manuscript. The introduction should provide the background and foundation for the study being presented, establish the need for and importance of the research, and set the stage for the research methods chosen for the study, all while enticing the reader to care about the topic and read the entire paper (Broad Research Communication Lab; Connely, 2019; Fried et al., 2019). When writing a research manuscript, best practice is to begin with the manuscript tables and statistics, then draft the methods and results section followed by the discussion, and finally conclude writing with the introduction section. Writing the introduction section of a research paper last can ensure that it aligns with the Methods, Results, and Discussion sections that follow. Otherwise, authors may have to rewrite the introduction to fit the remaining narrative.

The structure of an introduction can be thought of as an inverted triangle (see Figure 2a), beginning broadly with the area of interest, narrowing to the empirical evidence supporting the study focus, and terminating with the point of the current study (Wordvice, 2022). The introduction should start with a broad background, globally describing the study focus. It should be broad enough to set the stage for all the information to follow, but not so broad that it opens with content that is not related to the study focus or provides obvious information. It may be helpful to start with a hook, such as an important statistic that is directly related to the context and purpose of the current research study.

Having narrowed to the specific focus, the introduction should next highlight the empirical research describing what is already known on the topic and limitations and contradictions in the current evidence. This section establishes the importance of the topic and the necessity of the current study (Fried et al., 2019). It provides a mini-literature review summarizing the most relevant research, documenting what and how much is known about your research topic, and identifying gaps in the existing literature to make the case that not enough research has been done to answer the current report's question (Ahlstrom, 2017).

Aside from seminal works, references cited in the introduction section should be current (i.e., within the past 5 or so years), especially when proving epidemiological information. Authors should reference the primary work and take care to provide a balanced review, including and addressing contradictory work. Additionally, authors must identify the key references rather than overwhelm readers with excess citations. This section should also introduce and define key terms.

After reviewing the current evidence, it is critical to explicitly identify the gap in knowledge that the present study will address. Miles (2017) defined seven potential research gaps that authors can address with their study. These include: (a) knowledge gaps - when an issue has not been sufficiently studied; (b) evidence gaps - when research findings are contradictory; (c) theoretical gaps - when more research is needed for a theoretical understanding of a topic; (d) practical-knowledge gaps - when there is a discrepancy between practice and knowledge; (e) empirical gaps - when propositions need to be empirically validated; (f) population gaps - when existing research does not adequately represent underserved populations; and (g) methodological gaps - when there is an opportunity to develop or refine research methods (Miles, 2017). When writing introduction sections, the author should clearly state which gap(s) the current study will address. The author should also state why addressing this gap is important and the potential implications of addressing the gap.

This information about the gaps in knowledge introduces the novelty of the current study. Insufficiently demonstrating a

study's novelty is among the top reasons for manuscript rejection (Colwell et al., 2022; Menon et al., 2022; Wyness et al., 2009). However, it is also important not to overstate the novelty. Generally, writers must be mindful to provide enough context and background information in the introduction section so readers can identify the significance of the research topic and agree that additional research is needed to advance our current understanding. Finally, the introduction typically concludes with the aim of the present study. This may be accomplished through a purpose statement or statement of research questions. If applicable, sub-aims and research questions should be articulated. For quantitative reports, hypotheses should be considered for inclusion as appropriate. A discussion about the theory used to derive the hypotheses should also be presented when applicable. Qualitative research should not have hypotheses present; however, there should be language indicating the purpose of the investigation (e.g., developing an understanding of a phenomenon, theory building) (American Psychological Association, 2020). Information specific to methods, study data, and conclusions should not be discussed in the introduction.

The practicalities of writing an introduction section are heavily dependent on the target journal. Thus, it is critical to select a target journal carefully and adhere to the publisher guidelines. When selecting a journal, ensure that the topic is relevant to the target audience, and that the introduction is written with that audience in mind. It may be helpful to analyze papers published in the journal for writing style and factors such as length of the introduction and use of headers. Language in the introduction should be concise, use active voice, use present tense when referring to the current study, and past tense for previous studies (Fried et al., 2019). By the end of the introduction section, the reader should have sufficient knowledge to understand the background and rationale for the study, anticipate the methods, and be convinced of the need for and possible gains of the current study. The introduction should lead seamlessly to the methods and results sections that follow.

Discussion Sections of Peer-Reviewed Manuscripts

Crafting a strong discussion section requires a thoughtful synthesis and careful contextualization of study findings. Discussions must transcend the simple restatement of study results to provide a deeper analysis of the drivers and implications of study findings. The narrative about the results must remain within the scope of the current study, with careful attention not to draw conclusions that go beyond what the analyses suggest. Discussions should situate findings within the broader context of existing literature and theoretical frameworks, yet these sections should avoid over-interpretation or over-generalization. Discussion sections should not introduce new study results; rather, they are intended to reiterate important study findings, expound upon their meaning, and provide recommendations for future research and/or practice. When well-contrived, discussion sections effectively reaffirm the need for the study, confirm and/or reject posed hypotheses, describe how the study advances and aligns with what is known, and offer practical recommendations for future directions.

The structure of a discussion section is relatively universal in that it begins with a restatement of the study purpose(s), then interprets the most salient and compelling findings, transparently describes study limitations and potential shortcomings, and finishes with a succinct conclusion or summary paragraph. In the opening

paragraph, writers should clearly reiterate why the study was conducted and what it hoped to accomplish. It should restate any proposed hypotheses, and superficially provide a high-level overview of the most important study findings. This opening paragraph is among the most important paragraphs of the discussion section because it offers a brief synopsis of what the study set out to achieve and confirms whether the study met its defined objectives, which provides the reader with a consistent recap of the content provided in other sections of the manuscript (i.e., purpose statement, methods, and results).

Next, writers should identify about four or five of the most compelling study findings and draft a single paragraph about each finding. This will result in drafting about four or five paragraphs that are specific to the interpretation study's findings. While it is acceptable for studies to focus on fewer or additional study findings, writers should attempt to judiciously select the findings on which to elucidate and interpret to avoid overly lengthy or cumbersome discussion sections. Authors should be thorough in their write-ups about study findings, while emphasizing brevity and conciseness, recognizing that not every statistically significant result must be described or interpreted. In the discussion section, authors should also be mindful to avoid the common pitfall of merely repeating study findings; rather, they should delve deeper into the value and impact of their findings by providing relevant interpretations and/or implications.

As seen in Figure 2b, each paragraph about a particular study finding should be loosely guided by the Discussion Formula. In each paragraph, the writers should begin by re-stating a particular study finding of interest (clearly indicating the finding is from the current study to avoid confusion). Then, the writer should contextualize the finding within the existing published literature whether the current study finding supports or refutes findings from previous studies. Examples should be included from previous studies, with all relevant citations provided. Next, the writer should interpret the finding, describing a reasonable explanation of a particular finding or relationship. These interpretations should attempt to explain the drivers of the relationship while remaining in-scope of the current study (i.e., not an opportunity for far-reaching pontification about variables not included within the study). Again, examples and citations should be provided to support claims and root findings firmly within the existing literature. The last component in the Discussion Formula is to provide a recommendation to guide future research and/or practice. These recommendations should be practical, actionable, and tailored to the audience(s) of the manuscript.

After the writer writes a paragraph following the Discussion Formula for each study finding of interest, they should draft a realistic and transparent limitations section outlining the potential shortcomings of the current study. In this section, the writers should specify any potential deficiencies associated with their study, as it relates to the sample, research design, data collection procedures, and other issues. The writer should specify any potential biases in the study and describe potential threats to internal and external validity. The limitations section is an important aspect of the discussion because it shows that the writer is aware of the methodological issues associated with their work and these shortcomings were considered when interpreting and contextualizing study findings.

Finally, the discussion ends with a succinct conclusion paragraph, which explains the relevance of the current study and its overall implications to the field.

Implications to the field may include, but are not limited to, how study findings can inform intervention design, program implementation, research methodology, and/or policy making. This paragraph should be an overall summary of the study and how it fits within the broader body of research and can help drive research and practice in the field. The conclusion paragraph is not an opportunity to raise new information; rather, it should be considered the final thought in which to leave the reader.

Conclusion

The introduction and discussion sections of scientific manuscripts are bookends that support the structure and the impact of the research report. Writing these sections effectively requires careful consideration of the essential components to engage readers and contribute to meaningful scientific discourse through published literature. An introduction section should set the stage for the whole manuscript by providing background information on the research topic, establish significance, and identify gaps in the existing literature. The discussion section should provide interpretation of the main findings and contextualize these findings with the scientific literature. Scientific writers who have refined bookends of manuscripts increase their chances of successfully publishing and contributing to scientific literature.

Additionally, while peer-reviewed manuscripts are typically written for the scientific community, potential readers may also include public health and health behavior practitioners. These non-scientific audiences may be more inclined to pay more attention to the manuscript bookends than the methods and statistical results. As such, the manuscript bookends have the additional value of guiding practitioners to understand the context of new evidence, and associated implementation strategies and potential pitfalls to avoid, which may facilitate the translation of research to practice.

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