

# Chapter 4

## The Process of Scientific Writing: Developing a Research Question, Conducting a Literature Review, and Creating an Outline



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The process of scientific writing is quite straightforward if you recognize the formulas involved in developing each component of research. The critical aspect of writing is to plan everything to the best of your knowledge. This spans from your own writing scheduled to collaboration with colleagues. In the middle of somewhere is the need to ensure you have a research question worth studying and the development of a thorough literature review. This chapter covers the steps you can follow in your scientific writing journey specific to the content you plan to explore.

### Creating a Research Question

As behavior science continues to branch out into new areas of practice so too does the research process. While a substantial amount of research involves interventions for individuals with disabilities, other areas of application have emerged, including business (Wilder et al., 2009), sports and fitness (Normand, 2008), and video game programming (Hopson, 2013). With these and other areas ripe for exploration, research possibilities are seemingly endless. But research is far more than simply the completion of an experiment. Inherent to any research study is the dissemination of information gleaned from that study. It is the process of identifying and organizing the empirical findings in a concise manner to justify relevance that often proves challenging, and in some ways more challenging than the experiment itself (Heard, 2016). The dissemination of those findings is typically done through the development of a scientific research paper. The process of developing a scientific paper can be considered as a series of steps performed in a not-so-linear fashion. However, the

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process is far from arbitrary, but rather should be seen as a dynamic work in progress until a conclusion has been met. What follows in the ensuing chapters are the general guidelines involved to successfully complete each component of a scientific research paper. To begin, a review of the paper's composition is necessary.

The canonical structure of the modern scientific paper is often referred to as IMRaD (Introduction, Methods, Results, Discussion) with each component serving its own unique purpose (Heard, 2016). While these components are clear and distinct, when brought together they are intended to tell a cohesive story. But, even before this IMRaD sequence can be initiated, the quintessential spark to the corresponding research experiment must commence, and that spark is the research question. This is where the true story begins. Before an introduction can be introduced, before a procedure can be described in a method, before any results or discussion of those results can be had, the reason for that study must be realized and coalesce into a cohesive purpose. As that purpose, a research question is a clear and concise statement that defines the problem or issue that a research study aims to investigate. It serves two primary functions: to narrow down a broad topic of interest into a specific area of study and sets the foundation and direction for the subsequent research study, guiding the selection of data collection methods, data analysis techniques, and the overall research design (Berger, 2015; Creswell, 2014). The development of a working research question that is relevant, decisive, and meaningful may be the most difficult part of the scientific writing process. In addition, it is also the part of the process that seemingly has the least amount of literature behind it guiding a path to its development (Doody & Bailey, 2016).

The first step involves choosing a topic of interest and to do this, it is important to cast the net wide starting with a broader area (Heard, 2016). Consider the general area of interest as the writer and/or to the wider research community. Which topics resonate as a student, as a clinician? A broad topic provides the writer with plenty of avenues and directions to explore. Even this step can be troublesome, however. Becoming acquainted with your local university's library search system (as well as other search systems) can also be beneficial at this stage as it will permit the user to conduct searches based on a whole host of criteria (e.g., keyword, title, author, range of years). This style of searching brings the writer in direct contact with the existing body of research. What is present and what is missing? These techniques are all designed to provide the writer with a base of interest but also to initiate the organization of thoughts as well as identify possible connections and relevant themes within the broad topic(s). It is likely that this initial search will yield a substantially high number of research studies. Typically, the broader the category the higher the number of results are returned. For example, a search through Ebscohost (a common search system used in many academic institutions) with the word "aggression" in the title produced over 13,000 results. If an area of interest does not present a high number of results, it is suggested to expand your search systems. If a limited number of returned results continue to be presented despite searching through several systems, it might mean that that area simply has not been explored yet or it might represent an area that has limited potential.

Following the initial broad area search, Farrugia et al. (2010) suggest a preliminary revision of the returned list of results. The two primary goals of this step are to review the existing literature surrounding those searched topics as well as to begin the identification of areas missing within the research. It is often through this process that the broad areas of research are narrowed down. Furthermore, this process of narrowing down topics often requires multiple iterations. While the search for the word “aggression” in the title resulted in over 13,000 results, the search for “aggression” and “children” in the title reduced that list of results to just over 1100. When the search criteria were expanded to include “aggression”, “children” and “autism”, the returned list of results was further reduced to 22 research articles. It is not uncommon to conduct concurrent searches across multiple broad areas as an initial way to begin isolating a topic.

Once the general topic has been isolated, the next step includes a series of additional searches aimed at narrowing down the search to a specific topic. At this stage, the writer should have the area of interest that will ultimately become the target of the future study, but the specific question may still be vague. From these searches, not only will the existing literature of a particular topic become apparent, but the areas of deficit will become more apparent as well. These are referred to as the gaps in the existing literature. These gaps offer potential areas of exploration, and as such gap-spotting is the most common strategy used by researchers. Gap-spotting refers to the active identification of limitations and/or overlooked areas within a particular area of study as well as identifying questions that potentially extend the findings of current existing literature. These are the limitations and future areas of research suggestions often cited by the experimenters themselves in published literature.

Sandberg and Alvesson (2011) identified three basic versions of gap-spotting: confusion, neglect and application. The focus of confusion spotting is to locate contradiction within the literature of a topic. Previous research has supported one perspective; however, opposing views have been empirically validated. The primary application of this mode of developing research questions is to search for competing explanations in the existing literature (Sandberg & Alvesson, 2011). Neglect spotting represents the most common form of gap-spotting whereby the focus is to identify a topic or area where limited research has been conducted. This can include areas that have been under-researched, overlooked entirely, or that have a lack of empirical support. The third mode is referred to as application spotting, and under this style searches are conducted for a shortage of a particular perspective and/or generalization within the literature. Under this style, researchers are attempting to locate areas where the literature can be extended to. This may include different populations, settings, or behaviors.

Gap-spotting is generally accepted as the most common way of identifying research questions; however, not all gaps provide acceptable areas to explore. That new area must be different enough from the previous literature while still connected by its conceptual roots. With this in mind, Sandberg and Alvesson (2011) suggest an alternative to gap-spotting known as problematization. Problematization refers to an approach whereby a research question is derived through challenging and scrutinizing

the current trends of a particular area of research. If the consensus of a topic moves in a specific direction, problematization would lead to a research question that challenges that stance. A central goal under this method is to attempt to disrupt the continuation and reproduction of an established line of research, and specifically the perspective that that line perpetuates. While gap-spotting is aimed at identifying various gaps in the research, that method is not directly focused on challenging the assumptions underlying that particular line. Conversely, problematization is predicated on disputing the norm. Just as there are differing degrees of gap-spotting, so too does problematization vary: from questioning minor assumptions to challenging an entire theoretical paradigm. Bold but necessary in any field of science. When trends are no longer challenged, progress can be limited. As such problematization has the opportunity to produce new and exciting departures from existing lines of research.

A third option exists for identifying potential research questions; one not based on either existing gaps or mainstream challenges, but rather on clinical necessity. Lipowski (2008) suggests a practice-based method. With this strategy, the researchers use their clinical experience as the primary motivation to guide the development of new research. The practice-based method is largely dependent on the unique characteristics of the primary care setting, as well as the relationship between patient and professional. The goal of most practice-based research is to foster effective and lasting change. Although it may be difficult to locate a socially significant and sound study, once one is targeted it has the potential to affect direct change. In any case, whether through research gaps or applied practice, the ending result of this step is the development of a potential or several potential research questions.

At this stage the writer has conducted several increasingly refined literature searches; first to generate a broad area of interest, then to narrow down that broad area to a specific focus, and finally to identify a potential or several potential research questions. However, not all questions are worth pursuing. The researcher may generate a series of interesting hypothetical questions, but only certain questions should be followed up. Hulley et al. (2007) suggested the use of the FINER criteria when determining the soundness of a potential research question. Consider the (F) feasibility of the study. Will the proposed study have access to adequate participants, be guided by those with adequate technical expertise, and will it be affordable in time and money? The research question should be (I) interesting and intriguing to the research community while also proposing (N) novel extensions of previous literature. At all times, the question should propose an (E) ethical study that is amenable to an institutional review board. Finally, a good research question is (R) relevant to scientific knowledge and future research. The FINER criteria outline the relevant aspects of the question in general, but when it comes to the specific elements needed for the study Richardson et al. (1995) details the PICOT framework. Under this format one is to take into consideration the (P) population of interest, the (I) intervention being studied, the (C) comparison group or what is the intervention being compared to, the (O) outcome of interest, and finally the (T) time frame over which the study will be conducted.

Collectively, the FINER criteria and the PICOT framework aid in constructing a sound and specific research question, which ultimately aids in the protocol development of the subsequent study itself. When the population of interest, intervention, and desired outcomes are clearly outlined, it allows the researcher to identify appropriate measurement tools, which in turn permits more valid, reliable, and accurate measures. The better defined the population of interest, the more stringent the inclusion and exclusion criteria can be allowing for a more accurate interpretation and subsequent generalization of the research findings. Similarly, a precisely defined intervention decreases bias and increases the internal validity of the study. Conversely, a poorly defined research question may result in the poor choice of a research design, potentially leading to a misrepresentation of the subsequent results.

The development of the research question is a dynamic and evolving process that often involves frequent revision (Maxwell, 2013). As more literature is reviewed more information is gained, and that progression leads to further revisions and refinement to a potential research question. Without devoting appropriate resources to developing that question, the quality of the study and subsequent results may be compromised. Therefore, it is imperative during the initial stages of any research study, to formulate a research question that is both clinically relevant and answerable (Farrugia et al., 2010).

## Conducting Literature Reviews

Once the research question has been developed the next step in the scientific writing process is to conduct a comprehensive literature review. The structure and function of this review differs from the earlier searches conducted while creating the research question. During that earlier process, searches were conducted to ascertain gaps in existing areas of research. However now, the focus of the comprehensive literature review is to conduct an in-depth analysis on the existing literature of a chosen topic (Galvan & Galvan, 2017). This may result in the review of new seminal studies and/or extension of the previous analysis conducted on the studies reviewed when developing the research question. In either case, the purpose of the comprehensive literature review is to extend the analysis somewhat deeper by extracting more specific details from each study and then to inform the researcher on the development of each subsequent component in the IMRaD sequence.

Organization is key to the development of a comprehensive literature review. As more articles are targeted and reviewed, vital information from each study will be extracted. A centralized place such as a table or spreadsheet will allow the writer to organize information in a single place across all studies, allowing for a better perspective to view similarities and differences (Galvan & Galvan, 2017). With the research question now front and center, a comprehensive search can be conducted through relevant academic articles, books, and other sources of information on the particular topic. It is likely that some of those sources may have already been

gathered through previous searches conducted to develop the chosen research question, but often additional sources are necessary to augment the literature already collected. Locating and reviewing the troves of literature can be streamlined through the use of relevant academic databases (Galvan & Galvan, 2017). Search parameters can target keywords, populations, treatments, and publication year. This will help the writer retrieve the most relevant and current articles to use in the review.

As the relevant research articles are identified, a thorough read of each article will need to be conducted distilling key information such as study purpose, participants, dependent and independent variables, generalization and maintenance, results, and limitations (Galvan & Galvan, 2017). Extracting and reorganizing the key information from the chosen articles into a central system enables the writer to identify patterns across the literature. This can include those studies that focused on certain features of a population such as age and/or diagnoses, similar or different measurement systems, behaviors, and treatment variations. In addition, this permits the writer to view which studies shared similar results and which did not; which filled in the previous research gaps and which gaps are still left unexplored, presumably opening the door for the purpose of the current study.

As the information from the literature is centralized and analyzed, the writer can begin to synthesize the details into a cohesive composition surrounding the question (Galvan & Galvan, 2017). What establishes a comprehensive literature review as a synthesis rather than a manuscript segmented by several distinct research studies, is the aggregation of that key information. How many participants took part across the studies reviewed? What behaviors functioned as the dependent variables and how were they collectively measured? Across all the studies what interventions were used? How were they related to each other? Ultimately what were the collective results? This will typically require the writer to reanalyze the results within and across the reviewed studies. However once completed, the writer will be able to provide a thorough and critical analysis of the existing literature.

The final stage is to create the actual comprehensive literature review using the data derived from the synthesized analysis. The literature review should be structured and organized in a way that is clear and easy to follow. The arrangement of the manuscript follows the traditional IMRaD structure with an introduction that provides an overview of the research question and the rationale for the review, a method section that describes the search strategy and selection criteria, a results section that summarizes the key findings of the analysis, and a discussion section that interprets the findings and identifies gaps in the research. Some additional tips for creating a quality literature review include: use clear and concise language to describe the research question and the methods used to select and analyze the studies, use tables, graphs, and other visual aids to present the data in a clear and concise manner, provide a critical evaluation of the quality and relevance of the studies included in the review, highlight areas where further research is needed and identify potential directions for future investigation, and finally be objective and avoid bias in your interpretation of the data (Galvan & Galvan, 2017). In conclusion, creating a scientific literature review requires a systematic and comprehensive approach that involves

defining the research question, conducting a comprehensive search for relevant studies, screening and selecting studies, extracting data, analyzing the data, and writing the review. By following these steps and tips, researchers can produce high-quality literature reviews that provide a critical analysis of the existing research and identify areas for future investigation.

## Outlining Your Paper

Once the comprehensive literature review has been completed, the next step is to create an outline. An outline is an ordered list of topics or points that summarizes the projected content within the main sections and subsections of the intended paper (Heard, 2016). While it may be tempting to dive directly into the body of the paper, constructing an outline permits the writer the ability to adhere to a formal narrative structure expected in a scientific paper.

The outline process begins by identifying the main sections of the paper, including Abstract, Introduction, Methods, Results, and Discussion (Heard, 2016). Each section can be identified with its own unique value (e.g., roman numerals, letters, numbers) differentiating main sections from subsections. The Abstract section can be further broken down into background or aim, methods, key findings, and conclusions or significance. Next is Introduction and this can include additional subheadings to organize the narrative flow such as why the topic is important, what is already known about the topic and what information is missing, and finally the research objective or purpose (Heard, 2016). Then comes the Methods where the subheadings will highlight the procedural blueprint of the study such as participants and settings (where the inclusion/exclusion criteria for participation will be described), experimental design, dependent and independent variables, and procedures for generalization and maintenance. The Results main section will vary depending on the format of the study and will likely be filled out following the completion of the study. However, placeholders can be created based on chosen protocols described in the Methods. If multiple procedures will be conducted throughout the duration of the study (e.g., functional analyses, treatment conditions, maintenance), then a subheading for each procedural result should be created (Heard, 2016). Finally, is the Discussion with subheadings that may relate to the questions or points raised in the Introduction as well as considerations pertaining to sources of data variability. This will also be where the writers address any potential limitations.

After the framework of the outline is complete, it can now be elaborated by inserting actual verbiage into the subheadings. For example, in the Introduction, the subheading delineating why the topic is important can now be replaced with a topic sentence that will spell out some of those important benefits. Each subsequent bullet within that subheading can then serve as supporting sentences providing specific details related to the topic sentence (Heard, 2016). Turning to the next subheading regarding what is known and what information is missing; the writer would follow

the same system described above where the first bullet would function as the topic sentence with each subsequent bullet providing additional details. However, in this section, the writer can apply the information gathered during the comprehensive literature review. The final subheading under the Introduction section outlines the specific research objective. Again, through the work conducted during the literature review, research gaps would have been identified, thus opening the door to the objective of the current project. The same process would be applied to each subsequent heading and subheading, adding more text until all of the relevant details are included. By starting with a detailed outline, the IMRaD structure will flow far easier, and a well-organized scientific paper can be written that makes the case that the research is meaningful and justifiable.

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