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How To Write Your First Thesis

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ISBN 978-3-319-61853-1 ISBN 978-3-319-61854-8 (eBook)
DOI 10.1007/978-3-319-61854-8

Library of Congress Control Number: 2017952060

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

This book is dedicated to our children, Tobias Gruba and Anna, Alex, and Sonia Zobel, who sometimes have to tell their fathers to get away from the keyboard.

Preface

Completion of a minor thesis involves mastery of a range of accomplishments. It requires that you read other theses, undertake an investigation, manage a large number of references, assess the work of others, objectively interpret data, critically reflect on your own work, and master basics such as writing a long document efficiently on a computer. Throughout this book we discuss the components of a minor thesis—typically, the first thesis that a student ever writes—and set out the various tasks that you need to complete in order to finish the work successfully.

This isn't our first book on thesis writing; we are also the authors of the companion volume, *How to Write a Better Thesis*, originally written by David Evans and published in 1995, and revised by us in 2003 and 2011. That book is primarily intended for senior research students undertaking a thesis across a period of years. In writing this new book, we focus solely on first theses. Although we have relied on content from the other volume (from which about half of this book is taken), we have observed that the challenges of writing a minor thesis, especially given the time and resource constraints, are very different. Another factor is that senior research projects such as PhDs take a range of forms, whereas a minor thesis is—and should be—the product of a more or less standard approach. Our goal here is to help guide you through your first piece of substantial research.

As in the earlier book, we have blended our voices to make the reading easier, so we write 'I' rather than 'we' (except in this preface). We have blended our research perspectives too, as one of us (Paul) has a background in the social sciences and the other (Justin) works primarily in computer science. By combining our perspectives and backgrounds, we believe that the book is made more accessible, and captures the best of what each of us has to offer across the disciplines.

David's voice is prominent in our companion volume, and we are deeply grateful to him and his estate for his text, and for inspiring us in our supervision of students. While this new volume contains fewer of his words, it is strongly influenced by his approach.

We are also grateful to Anna Zobel for the illustrations. Her sketches capture for us the spirit of intensity and joy that successful study can bring.

Two Introductions

In this book, we draw on the experiences of two of our students. We introduce you to them here, so that, when you come to our discussion of issues they faced, you understand their background.

Let us first introduce you to Anouck. Although she had been in Australia for a few years, she was originally from France. Fluent in French and English, she had also studied some Chinese. Anouck had completed one semester of a Master's degree, and during that time she earned good marks in each of her four subjects. Having been in one of my (Paul's) classes, she approached me before the start of her second semester to discuss a minor thesis. Anouck told me that she was interested in language and media, a subject that I taught, and we agreed to meet to discuss some ideas. Later, at our first meeting, she told me that she wanted to do a minor thesis because she was considering doing a PhD. Anouck didn't, however, know much about theses, how they are structured, or how they are examined. As her supervisor, I knew that she would need some guidance, but I was certainly interested in her project.

Like Anouck, Mickey also had an interest in language, but his interests stemmed from being an avid reader of stories, such as fiction published free by authors on the internet. As an IT student, Mickey had observed that web search tools were unhelpful for the task of finding new things to read, and that recommendations on websites were unreliable. When he first spoke to me (Justin), he brought a broad question: What are the alternatives to conventional search methods for finding fiction? This question combined some of my own interests, so, after a couple of meetings in which we talked through possible approaches, we decided to work together, and in the process turned his rather vague idea into a well-defined project.

The experiences of Mickey and Anouck (and our many other research students) have helped us to appreciate the challenges of undertaking a minor thesis, and this is why we use their experiences as examples throughout this book.

How to Use This Book

In Chaps. 1–3, we explain what a minor thesis is and how the task of undertaking a minor thesis should be approached. In Chaps. 4–8, we review the components of a minor thesis in turn, from the introduction to the conclusion, and discuss what is expected in each. In Chap. 9, we give guidance on editing and on preparation of your thesis for submission.

You can read the book cover to cover, or dip in and out of the chapters. We suggest that you turn to sections that you need at the time that you need them, and compare our advice to that of your classmates and supervisor. But remember that your minor thesis is your own work, and, when you have understood our advice (and its limitations), you should feel confident about doing what seems to best fit

your own particular project and style, even if this differs from the approach we have described.

You should also seek out additional resources. Other books give detailed advice on writing style, referencing, development of effective graphs, experimental design, and so on; these are issues of relevance to academic writing of every level, and our experience is that many students benefit from such resources far more than they had anticipated. Our focus here is entirely on the challenges that are specific to a minor thesis. Use of this book will, we hope, set you on the path to completion of a successful and satisfying project.

Paul Gruba
Justin Zobel

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Chapter 1
Transition to Your First Thesis

Study at a college or university typically consists of a sequence of degrees: undergraduate, graduate, and research. The pattern of coursework study is familiar to every student. Across a sequence of subjects, where each one is somewhat independent of the rest, you learn the fundamentals through a series of constrained and discrete assessment tasks. In a research degree, in contrast, a student typically works with a supervisor (or advisor) to undertake an investigation over a period of years with little progressive assessment. To make the transition between coursework and research, students undertake a minor thesis.

I wrote this book to help you produce a first thesis. In this first chapter, I situate the work that lies ahead by defining a minor thesis, setting out its purpose, sketching the roles of the student and the supervisor, considering the work that is reported in the thesis, and indicating how it is likely to be examined.

Defining a Minor Thesis

A first, or minor, thesis is an extended argument of 5000–20,000 words that reports on the outcomes of a supervised, individual research project, as part of a graduate degree such as Honours or a Masters by Coursework.

A thesis, minor or otherwise, is an *extended argument*. That is, a thesis consists of logical, structured, and defensible reasoning based on credible and verifiable evidence.

In undergraduate degrees, a key task is to show that you understand a particular concept or procedure through lab reports, tests, or essays. Much of the work is descriptive: you provide some background information, check for completeness, and then explain how you responded to the task at hand. For your undergraduate assignments, you were responding to specific questions and prompts; in your

P. Gruba, J. Zobel, *How To Write Your First Thesis*, DOI 10.1007/978-3-319-61854-8_1

minor thesis, you are primarily in charge of the project. To be successful in a thesis, you need to *argue*, and continue to argue for thousands of words until you reach a conclusion. Throughout that argument, though, you will have a fair degree of freedom in your approach and style.

A thesis is much more than an extended essay or lab report. An essay is likely to be a descriptive exercise aimed at the learning of fundamentals, or of writing and reasoning skills; in contrast, a thesis is a proposition or claim that is defended through a high level of insight or creativity.

Just as a minor thesis is not an extended essay, it is also not a Ph.D. thesis. A minor thesis is typically a tightly supervised one- or two-semester project; a Ph.D. is the outcome of years of substantially independent research. A minor thesis reports on a single, straightforward investigation; a Ph.D. could well encompass a series of studies, innovations, or types of analyses. While the two kinds of thesis have many elements in common, the skills needed to complete a minor thesis can be very different to those required for larger projects.

The Purpose of a First Thesis

A first thesis provides an opportunity for high-achieving students to demonstrate their ability to conduct an open-ended investigation.

The academic community views the minor thesis as a signal of ability and preparation for undertaking a larger piece of work. Doing well on a minor thesis demonstrates that you are ready to pursue a higher degree such as a Ph.D. Some students, however, choose to do a minor thesis as a way of completing their study; for them, the thesis helps to synthesize their overall learning and demonstrates their maturity. Some students choose to do a minor thesis to see if they like research, to help them decide whether they are going to continue in an academic career or seek opportunities elsewhere. And some students have no choice—they are enrolled in programs in which a minor thesis is mandatory.

You should use the minor thesis to acquire the learning that is of the most value to you. If the thesis will be the end of your academic study, then you may want to use it to develop your practical skills, or to deepen your understanding of a particular area. If the thesis is a stepping stone to a Ph.D., you may want to use it to understand the current research literature in a particular field, or to gain an appreciation of different experimental methodologies. You may find that you have a great deal of freedom in terms of the kind of work that is done as part of the minor thesis, and you can use this freedom to focus on the activities that give you the greatest benefit. It follows that it is helpful if you know *why* you are doing a minor thesis—a question that will affect the research area of the thesis, the kind of activities you undertake, and, perhaps, who you choose as a supervisor.

The Role of the Student

A minor-thesis student works with a supervisor to complete an independent research project, and develops self-discipline, maturity, critical thinking, and a strong awareness of the wider field.

As you work to complete a minor thesis, you are signalling that you would like to make an initial entry into a community of scholars. To be respected as a member of that community, you must make appropriate use of specialized vocabulary, have discipline-specific knowledge, demonstrate an understanding of major works and researchers in the field, and show that you can effectively apply accepted methods of investigation. A successful minor-thesis student demonstrates independence and maturity, and a sustained drive and resilience. Such attributes may seem like a lot to expect, but, by undertaking a minor thesis, you should appreciate that you are both producing a relatively large piece of work and becoming socialized into a specific academic field.

Though you have prepared for the project in your previous studies, undertaking a thesis will accelerate your academic development. Perhaps for the first time, you must judge the value of contradictory research literature, gather materials that haven't previously been assembled, build an apparatus without knowing whether it will work, and make sense of raw data. You may be working with other researchers who are themselves uncertain about the outcomes they are striving towards—and you must then explain their work and discoveries to others in an academically rigorous way.

In contrast to an assignment such as an essay or lab report, it is very important to know—now, and from this point forward—that a thesis cannot be left until the final days or weeks before submission. Self-direction, a sense of purpose, and discipline are essential. You need to start strongly and make sure you are mastering all of the elements of the thesis as early as possible. You also need to remember that you are doing the work in conjunction with your supervisor, not alone, and thus you need to respect your supervisor's constraints; for example, it isn't reasonable to take your time to complete your project, then dump a 20,000-word thesis draft on a busy supervisor and expect feedback in a few days' time. To get feedback, you will need to have completed drafts some weeks before the thesis is due. Sadly, not all students produce a draft before submission, and such students rarely achieve a high grade.

Regular feedback on your thesis while it is in progress is critical to success. With an essay, you may have revised it once or twice and not shown it to anyone before you handed it in. As you complete a thesis, you will need feedback from your supervisor several times. Feedback on drafts of thesis chapters or an entire manuscript typically consists of questions ('What did you mean to say here?' 'Can this be clarified?'), recommendations ('Remove this, it seems unnecessary'; 'This would be a good place to discuss so-and-so's results'), and criticism. Many students, at first, are much too sensitive to criticism, and take it as a judgment on

their intellect or ability; however, to be a good researcher, it is essential that you make the transition to seeing criticism as a necessary and productive aspect of the overall writing process. To help students, I remind them that the manuscript is what I'm criticizing, not them, and that I do respect their work. I also remind them that some of my published work has been heavily criticized, and that I have to revise much of my own writing in response to such comments from my colleagues. Critical review is part of the academic writing process.

The process of becoming socialized into the field demands that you better understand how academic researchers work. Earlier in your studies you probably saw your supervisor mostly as a lecturer. Away from the lecture theatre and in the office, your supervisor is likely to seem 'more human' and yet, at the same time, more demanding. Up close, you'll better understand how academics produce research, and how they work across the global communities of their subject area.

Successful minor-thesis students are mature, comfortable, and respectful; they ask insightful questions, but understand the boundaries of the supervisor's expertise; they show initiative, but seek their own answers once given a bit of guidance. My advice is to keep in mind that you are in transition from one form of learning to another (that is, from directed study to independent searching), that you recognize your abilities, and, most importantly, that you stay alert for opportunities to grow.

The Role of the Supervisor

The supervisor works with the student to identify a research area and research question, find research literature, define tasks and milestones, and organize the thesis.

Students who are commencing a first thesis typically know very little about research. They may be inspired by research outcomes that they have encountered in their studies—or, perhaps, heard about in the media—or by the academics they have met. However, they usually haven't yet grasped what 'doing research' involves.

The role of the supervisor is to guide students through the task of doing a thesis. Students bring experience and skills in a range of areas, such as technical ability in the laboratory or familiarity with analysis of written materials, and all students have extensive experience of writing smaller documents, such as essays. However, students do not have the depth of experience that lets them judge whether a research question is suitable for a minor thesis, or that lets them assess how to balance the effort of the many tasks that must be completed to yield a finished thesis. They are unlikely to even have a clear idea of what those tasks are! The supervisor should help shape the research question, introduce the student to the different activities that comprise a minor thesis, and regularly meet with the student to give feedback and guidance.

In other words, a supervisor is, in effect, explaining to the student how to do research. This is a challenging task. In a very limited time—as little as one semester—the supervisor must explain several kinds of activity that may be entirely new to the student, while constraining and directing the project so that it can be completed on time and with a strong outcome.

Another aspect of minor thesis supervision is that the student must be guided to think, and act, like someone in the field. By using appropriate style guidelines, or using an accepted methodology, or approaching problems from a certain perspective, you indicate that you would like to be accepted in the field. In some ways, you are like a new member who is learning the tacit rules and cultural practices of an established club.

The Student–Supervisor Relationship

Supervisors of theses have to strike a balance, between hands-on management of the project and encouragement of independence, for students working under the constraints of a tightly defined project with pressing deadlines.

Supervisors are likely to work with you in three main ways. First, of course, a supervisor 'supervises' you in your project. In this part of the role, a supervisor will cover the technical aspects of your project such as guidance on methodology, the significance of a research question, and the ways in which research is presented and described in your discipline. In this way, the role of a supervisor may also include management of the project, development of deadlines, and assistance with tools or techniques.

The second aspect of supervision is the provision of advice. Your supervisor should help you to develop the ability to produce independent research. As a supervisor, I can assess, for example, where a student's project is going and what literature has been covered to date, but I may challenge the student to go further, or to take bigger risks or a more daring approach—thus stretching essential skills, such as critical thinking. At times, I may advise students to work harder and be more disciplined; or alternatively to stop working too hard and enjoy life a bit more. This is a rewarding part of being a supervisor, and happens as I get to know my students in the later stages of their projects.

A third aspect of supervision is to be a preliminary examiner. In addition to reading each part of the thesis as it is completed—the literature review, methodology and experimental design, description of data sources, and so on—a supervisor should read a complete draft and give considered feedback. When I do this, I detach myself from the experience of supervision and treat the document as a stand-alone piece of research. I find it valuable to ask students to self-assess their own work, and then meet with me to compare notes and consider questions such as how well the draft meets the examination criteria. Further, I consider inconsistencies in structure: for example, was what was promised in the first chapter actually delivered in the final chapter? After our discussion, students revise their work before final submission.

It bears thinking about what a supervisor does *not* do for minor-thesis students. A supervisor can give advice, but on some occasions I have had to tell my students, 'it is your decision', when they run into difficult choices—ultimately, the thesis is their work, not mine. Students need to learn to 'own the project' and be proud of their eventual achievements, and should not regard themselves as an assembly-line worker in an industrial knowledge factory. The content must be primarily their own, and the writing even more so. A supervisor cannot step in and rescue students who have found that they are unable to complete the work themselves. A supervisor can advise and assist, but cannot take the project over—when I see a project getting into difficulties, particularly in the late stages, after the student has had ample advice and support, there may not be much more that I can do. Such situations are not a pleasant experience, but they reflect the fact that the student is probably not ready for extended research projects such as a Ph.D. thesis.

As a supervisor, I am limited in the ways that I can be a time-keeper, disciplinarian, or friend. Some students have asked me to set hard deadlines and severely reprimand them if they do not meet them; I did not do this. Other students have sought to become my friend—and may have observed that supervisors often have close relationships with their Ph.D. students—but I need to maintain a professional distance so that I don't lose my ability to objectively evaluate the thesis. (A difference between a minor thesis and a Ph.D. is that, for the latter, the research is often the product of long-term teamwork, and the supervisor may be as much colleague as mentor; also, for a minor thesis the supervisor and colleagues will be the examiners.) Finally, as happens from time to time, students seek help or advice on personal issues, but it is best to get such advice elsewhere; you should avoid anything that undermines the ability of the supervisor to judge your work.

Find a supervisor you can work with. If you wonder whether the relationship is going to be successful—perhaps the supervisor is too busy, or is patronizing, unreliable, or insensitive to your interests or skills—then maybe you need to look elsewhere.

Research Questions

Take the time to develop a good research question; once the question is settled, the undertaking of the project itself is often relatively straightforward.

A key step in a thesis is to identify and develop a good research question. You may be surprised to discover that there are entire books about research questions, but such books have been written for good reason: development or clarification of a question can be the inventive step of the research.

Indeed, it is often the case that a whole program of work can be characterized by a question and the methods used to answer it. Similarly, work can be characterized as investigation of a *hypothesis*, that is, a tentative claim or statement, where

the aim of the research is to help establish whether the hypothesis is true or false. In this book—in the context of a minor thesis—we use the terms 'question' and 'hypothesis' more or less interchangeably (but note that in other contexts they can mean very different things).

Once you come to understand the question at hand, it may be that the whole process of doing the thesis falls into place; it guides you to what literature to read, what data needs to be gathered, and what methodology to apply.

On the other hand, with a poor question, it can be difficult to get to any outcome at all. If the question is vague, too ambitious, or so specific that the answer is obvious, then you will struggle to find a structure for your project or to produce an interesting thesis. If the question doesn't seem right, or troubles you in some way, revise it.

A good research question has the following characteristics: it can be answered within the scope of the study; the answer is not obvious at the outset and is likely to be interesting; and it provides a starting point and direction for the study. A research question crystallizes your learning and experience, as it is the result of careful thinking about the literature and knowledge in your area, and more importantly about what is not known. A good research question demonstrates a keen understanding of the field.

Here are the factors I consider when assessing the suitability of a question for a minor thesis:

- whether it is achievable within the time and resources available to the student
- whether it is a good match to the strengths of the student, and whether it is within the student's competence
- whether answering the question involves access to data and if so, whether the necessary data can be obtained or created
- whether the question is of interest to the field and can be clearly linked to existing research literature
- the extent to which the volume of research literature is likely to be manageable
- whether the answer to the question is already essentially known
- whether there is an obvious or straightforward methodology for investigating the question
- the extent to which it is likely that a positive answer will be found.

As you think about your question, consider, for example, if little data is available or if the data is so voluminous that it cannot be analyzed in the available time; or if software must be written and you do not have the skill to write it; or if the investigation depends on insights and subtlety of understanding that only an experienced researcher would be likely to have; or if the aim is to improve an existing technology that is already highly refined (meaning that success is highly unlikely).

When I first begin to work with a new student, I meet with the student over a period of weeks, or even longer (often this is before the project has formally commenced), to talk through the student's interests and brainstorm ideas. The list of

criteria above helps us to reject or refine possibilities, and I find that a cycle of meetings, reading, and reflection soon leads to a question that is worth pursuing.

Part of what made Mickey's project (described in the Preface) attractive to me was that the question met many of the criteria listed above. There was good data that could be used to test whether our ideas worked. Mickey and other members of the online network of fans had built up lists of stories they had read and recommended, and the websites where some of the stories were published could be automatically (and legally) browsed to analyze the stories' statistical properties; thus reader evaluations could be matched against statistical evaluations. I also liked this project because, once we had decided on a question ('Can simple automatic assessments of writing style predict whether a reader will like a story?'), and had identified a source of data, it was reasonably clear how to do the project.

The project appealed to me for other reasons. It would require Mickey to consider different methods for analysis of text, and to bring together and compare the performance of different pieces of public-domain software. This in turn required understanding of a range of technologies, via the research literature. The project would also require him to think through the precise question he was trying to ask, and to make sure that his tests actually addressed that question—a rigour that is lacking in a great deal of research. As the project could be seen as part of a wider field of work, on problems such as analysis of tweets, news articles, and so on, and indeed the field of web search in general, I was confident that it would build up a range of skills that would be of value to him.

The Perfect Question?

You should seek a strong question that suits your abilities, but other issues, such as choice of supervisor, must not be neglected.

It is a mistake to focus on finding the 'perfect question' to the exclusion of other issues. I have known students who felt that their minor thesis would only be satisfying if the question was dramatic in some way, or addressed a problem of global significance, or would lead to a major breakthrough. Students like this are misguided, and are likely to find themselves disappointed by the more disciplined questions that a responsible supervisor will be prepared to consider. Other students feel that there must be a question that is the best fit to their own existing abilities, and haven't realized that a key purpose for doing a minor thesis is for them to develop as researchers—and that any good question that suits their skills and background will do this, and will be satisfying to pursue. Being overly concerned with a 'perfect question' can lead to the student neglecting to consider whether they are talking to the right supervisor. A poor fit with the supervisor, I have found, is a much greater threat to success of the project than a not-quite-perfect question.

Keep in mind that being unrealistic about what can be achieved is a common cause of failure. Some students attempt to undertake a project that is appealing,

but of an utterly implausible scale (often against the direct advice of their supervisor), and approach the end of their project with nothing to report but a few fragments of preliminary work. These questions are like any over-ambitious goal: foolish and unachievable. Such goals cannot be pursued in a systematic way, and experienced researchers have little respect for colleagues who show poor judgment by pursuing impossible aims. It is helpful to have a broad context for a project—a global aim, such as, for example, rethinking the technologies underlying the web so as to improve online privacy. But a single minor thesis can only be a small part of this broad context, and should be as limited as possible.

A simple piece of advice about research questions is that they should be as specific as possible yet touch on significant issues. You will likely draft, and redraft, and draft again your research question as your project proceeds, a process that is an effective way of helping you to clarify your thinking. Remember that your research question is crucial as a signal of your understanding of the area, of what has been accomplished by previous researchers, and of what is currently unknown.

Expect the Unexpected

A strong thesis demonstrates the ability of the student as much as it reports on a piece of research.

The trajectory of a thesis is that you identify a problem that is motivated and interesting, review the relevant literature, conduct a study, and set out to convince examiners that your work makes a contribution. You have to write concisely, under the constraint of limited time and resources, in a way that signals that you can conduct research that aligns with what is done by scholars in your field. Written in these plain terms, it all sounds straightforward! If only it were always the case. In a great many projects, as is true for any voyage into the unknown, something unanticipated happens: you find previous work on a similar question; the data is incoherent and cannot be used; no clear answer is found; and so on. Happily, such events are rarely a disaster. Dealing with the unexpected is a routine part of the life of a researcher, and you can demonstrate your strengths by proving yourself to be adaptable and, in the worst case, producing a strong thesis even when good answers aren't found.

I have seen many strong theses based on research that was essentially incomplete. What made them strong was the fact that they showed that the student was capable—after all, it is the student, not the research, that is being examined. In these cases, the thesis demonstrated that the research had been done in a robust way and that the outcomes were plausible. With a frank description of the work and a careful critical analysis of the strengths and shortcomings of the project outcomes, the student showed the ability to do research and produce a persuasive contribution to the discipline. These attributes, rather than a clever

question or strong positive results, are the qualities that signal the arrival of a new, talented researcher.

Thesis Examination

From the start, keep in mind that your thesis is a document that is to be examined.

Your primary purpose in writing a thesis is to pass an examination. Throughout the process of research and writing, you will have multiple opportunities for academic development: you read literature, analyze data, build tools, and so on for the sole purpose of informing the content that is included in your thesis. While the doing of research and creation of new knowledge can be extremely rewarding, from this perspective it is also a distraction, and you need to find a balance between the time you spend doing research and the effort you put into the thesis.

Areas for examination typically include:

- organization of the thesis
- clarity of expression
- demonstrated grasp of the problem and of the area
- understanding of and insight into the research literature
- appropriateness and correctness of the research methodology
- quality of the presentation and interpretation of the results
- understanding of the outcomes as demonstrated by critical analysis of the research
- understanding of the implications of the results
- novelty of the question and resulting contribution.

Note that areas such as 'significance of the research', 'importance of the outcomes', and 'theory building' are not listed here. The project is likely to have embodied original research, but the focus in examination is on the standard to which the work was done. Indeed, the main thing being examined is the student. If the thesis makes a persuasive case that the author is a careful, insightful, and resourceful learner and author, then it will pass.

Typically, minor theses are examined internally within your department, often by academics who may have taught you in coursework subjects. If you haven't done so already, obtain a copy of your departmental or faculty guidelines for minor theses, which may well include specific criteria for examination. Though such criteria can vary a great deal in the detail, the three main criteria for success are: to show that you can sustain a critical, well-supported argument; that you can insightfully review previous work; and that you can competently do research—that is, depending on your discipline, undertake activities such as the gathering of data, implementation of tools, examination of materials, and interpretation of outcomes.

Of the criteria, the demonstration of critical thinking is evidenced in attitude. Was the student sceptical, yet respectful, of the material at hand? To what degree was the thesis synthesized and insightful (thus demonstrating intellectual mastery of the subject matter), or to what extent was it summarized and treated with either awe or disdain? Solid critical thinking comes through maturity, confidence, and authority, and is shown by students who seek to engage with issues and not just simply comment on them.

Methodological competence is evidenced by a critical, reflective approach to design of the project. For me, such competence is shown when several options are available, but the student has argued that, of the many choices, one is preferable, and has then assembled evidence to support the claim. It is also shown when the thesis includes a reflection on the activities that were part of the project, discussing what could have been done better, and showing that the student has a clear understanding of the shortcomings of the work.

In my department, we are each assigned a couple of minor theses to examine and mark at the end of every semester; sometimes we are assigned theses that are outside our areas of expertise. Individually, we read and assess the projects, and then hold a collective examiners' meeting to discuss and calibrate our scores. At these meetings, the supervisor is present as well as senior and junior academic staff. Each examiner must justify the reasons for giving a minor thesis a particular score; the supervisor has some say, but, in general, the collective view of my colleagues determines the outcome.

As I've listened to my colleagues over the years at such meetings, I've come to recognise a range of shortcomings typical of weaker projects. First, one key criticism is that the work has a strong start but a poor finish; we tend to suspect that the student started with enthusiasm, but did not sustain sufficient interest and discipline. The scope of the project may have not been sufficiently constrained, or it was simply too ambitious for a minor thesis. Second, I've heard many times that the methodology is unclear and thus the project could not be easily replicated, which makes the work seem preliminary or exploratory. Third, examiners do not take kindly to work where there is a lack of structure, signposting, or awareness of the needs of the reader. Academics are busy, and do not like to have to search for information or details that a student has not organized in a convenient way. Fourth, examiners have noted that a thesis has interesting results but overall is sketchy, perhaps because the student didn't allow time to do the writing. Fifth, and perhaps most serious of all, the student has treated the project as an undergraduate exercise in reporting, description, tool building, or data gathering; the work does not demonstrate that the student has done much actual research, and the thesis appears to be more like a diary of the project rather than a critical investigation. In my view, these shortcomings stem from a lack of organization from the start of the project, a failure to appreciate the time that is required at each stage, or a failure to understand what it means to be a research student.

To some extent, such issues can result from poor supervision, but, in my experience, more often the cause is that the student hasn't reflected on what the project is supposed to accomplish. If you take the time to appreciate the role that a thesis plays in the creation of, and argument for, some new knowledge, it will help you to produce a strong thesis of enduring value.

Chapter 2
Getting Organized

Completion of a minor thesis can be like a sustained run. While an essay can seem like a dash from start to finish over a short distance, a minor thesis requires greater endurance, a more measured pace, and a controlled intensity of effort. There is little scope for delay or false starts, and to finish well you must start well. A strong start for a thesis involves understanding what is required and preparing appropriately, as well as the development of productive habits and attitudes. These issues are the topic of this chapter.

The Right Attitude

From the start, strive to be independent, resilient, and productive, and learn to work at a sustained high level of activity.

Many students, accustomed to the pace of coursework subjects, have little experience of long-term or medium-term projects. Some students have achieved in their earlier studies by last-minute cramming for exams and by completing their assignments in intense bursts of activity over a few days, even staying up all night as a deadline approaches. These students, seemingly strong in their coursework, often flounder when they undertake a thesis. Despite advice about setting deadlines, milestones, and working steadily, some students still attempt to do everything at the last minute—and fail to get a good outcome. In contrast to their success in undergraduate or early graduate coursework, which largely consisted of completing defined tasks and short-term goals, they struggle to work independently across an entire semester or two.

To successfully complete a minor thesis, you must be organized from the very start. In particular, you need to shift your attitude from being a sprinter to being a mid-distance runner. A sprinter covers a good distance very quickly, and then

P. Gruba, J. Zobel, *How To Write Your First Thesis*, DOI 10.1007/978-3-319-61854-8_2

collapses in exhaustion. A mid-distance runner maintains a moderate but steady pace, even holding back a little to conserve energy, then picks up speed towards the end. As you proceed, you do not just head straight for a distant goal, but you need to pass a range of landmarks: reading, analyzing, gathering data, doing laboratory work, drafting, drafting again, and polishing, and all this while coming to grips, for the first time, with what is involved in doing research.

Thus you need to shift your attitude from *coursework student* to *researcher*. For example, a key shift in attitude is to understand that all of your chapters will need to be drafted, revised, and substantially rewritten. One draft is not sufficient to meet the standard of quality that is required at this level of research, and even two or three may not be enough.

A second shift is to set and maintain milestones as you undertake your journey. With milestones in place, you are able to quickly judge and self-assess your abilities at any given point along the way. Those milestones must be substantial, measurable, and taken seriously. Some possible milestones are listed later in this chapter.

The third shift concerns your relationship to your supervisor. As a research student, you work individually with one or two academic staff, or perhaps with a small group of more senior students. The project is yours alone, and you are not replicating work that other students are doing at the same time; you are not part of a larger cohort all doing the same thing. Meetings are usually very focused, with an expectation of progress every week. You must learn to be accountable for your work, and be ready to receive detailed critical review.

Discipline

Amid competing demands, make a strong effort to stay on track.

Projects, big or small, often take longer than originally expected. Even if you set a realistic time schedule and milestones, you are likely to slip over the course of your project; you probably won't achieve all the milestones on time. I've had very few minor thesis students who have completed them early! However, these milestones are the best mechanism you have for ensuring that you are on track to successful completion. They remind you to stay alert, and, if you get behind schedule, you are able to quickly respond.

If the timetable is to be useful, you need to be honest with yourself about the amount of time you are spending on your project; if you are missing milestones, you need to increase your weekly commitment. It is your job to stay on track and produce the work. To do this, you must remain disciplined and conscious of your own work habits and style. My main suggestion is to be systematic, habitual, and predictable as you work so that you make regular progress at a steady pace. This is easy to say, but very difficult to do in practice.

At my university, the usual expectation for a minor thesis is that it is equivalent to two to six subjects, where a subject requires a total of around 150 hours, or

10 hours per week; some theses are as small as a single subject, or as large as 10. Many students do not always maintain the necessary twenty or forty hours per week on their project, but the best ones make steady progress over the time they have available. As a supervisor, it is difficult to respond well to work that is seemingly done over just a week or two. Sometimes, I feel as if I'm being held hostage to a deadline. However, as a busy academic, I cannot always respond as quickly as a student under pressure would like, and such delay can cause conflict. Keep in mind that your supervisor is likely to have many commitments and deadlines in addition to working with you.

Often, I've said to my students, 'Everyone is smart, but the best students are organized'. I do mean this. Eventually, everyone passes a point where their smartness (whatever that is) is no longer enough; they have to be systematic in order to achieve.

The pacing depends on the scale of the thesis. For theses that must be completed in a single semester, equivalent in size to two to four subjects, being successful means that a significant milestone passes almost every week, a speed of work that is a challenge to both student and supervisor. For a two-subject thesis, you are likely to be simultaneously undertaking other subjects, with their own demands: assignments, workshops, and so on. Almost no one is good at balancing short-term deadlines ('My assignment is due this Friday.') with vague longer-term goals ('I need to make progress on my thesis.'). For this reason, it is critical to take milestones seriously.

Some minor theses are spread over multiple semesters, which also means that progress can be made between semesters. For a student who is simultaneously doing coursework, it is very easy to think that this current semester is difficult or exceptional in some way, and to almost forget about the thesis for a while—a behaviour that is likely to have disastrous consequences. (It is for this reason that some departments impose intermediate deadlines, such as submission of a literature review, a seminar presentation, or an experimental design.) While it may seem that, with multiple semesters, you will have ample time, this is an illusion—a great many students enter the final semester of their minor thesis far behind schedule, and must work desperately hard to finish. Early discipline will make your thesis a much more rewarding, and pleasant, experience.

Milestones and Schedule

Anticipate the time and effort needed to meet deadlines and complete the thesis.

One of the first steps in a thesis project—once the area and question have been established, and perhaps even before the question is finalized—is to establish a realistic timetable. A work schedule needs to cover every aspect of the project, not just the thesis writing, so it needs to allow time for elements such as reading the literature, gathering and analyzing data, lodging and waiting for a response to an ethics application, building tools, and waiting for a supervisor to finish reading

thesis drafts. There may also be explicit milestones imposed as requirements by your department.

The timetable is likely to evolve as the project develops, but in my experience it is essential to have a current version right from the start. The timetable forces you to break the project into separate activities, and this may be the first time that you have to think through what the activities are. Also, the timetable commits your supervisor to some activities too, and thus is a useful way for you to ensure that your supervisor will be available when needed; you may find out, for example, that your supervisor will be away at some point during your project, and the timetable means that you must figure out suitable arrangements for that period.

Once you have a supervisor, in very broad terms the four main activities involved in a minor thesis are:

1. Get started: find a problem and question, and establish milestones and a timetable. (Yes, a key milestone is establishment of the milestones!)
2. Discover, read, and synthesize the relevant literature.
3. Build tools, gather and analyze data, and develop the key arguments—that is, 'do the research'.
4. Write the thesis.

You will find that these things overlap; in all likelihood, at some stages in the project you will be reading literature, doing research, and writing all at the same time.

My suggestions here may be too high-level to use as specific, measurable milestones, but they are a starting point for figuring out what the milestones should be. These will vary from project to project, but some examples follow. I've indicated a percentage on each as an indication of how far through your project you might be when you reach that milestone. (Of course, every project will vary.) For example, 25 per cent means that you should be a quarter of the way through, and 90 per cent means that you should be almost done.

- Get yourself organized: set up your workstation, list some milestones with plausible dates, and write an initial draft of your problem and question. (10 per cent)
- Lodge a research ethics application, if needed, and identify your data sources. (15 per cent)
- Identify what tools you need to build and an approach to building them. (20 per cent)
- Complete a first round of identifying relevant literature and organizing it into an early draft of the literature review. (25 per cent)
- Create a draft of the first chapter to set out the context, motivation, purpose, scope, and overall approach to the study. (40 per cent)
- Run a cycle of preliminary experiments, to gather observations and verify that your systems work as expected. (40 per cent)
- Complete the final experiments. (60 per cent)
- Analyze the data and produce a draft results chapter. (70 per cent)

- Give a full draft to the supervisor, and hold a discussion about the strengths and weaknesses based on examination criteria. (80 per cent)
- Respond to supervisor comments, and edit a complete final draft of the thesis. Print and submit the thesis, on time. (100 per cent)

These really are just examples, but illustrate the kinds of activity that should be captured. Note how early the 'research' part of the project should be complete—I've suggested 60 per cent as a reasonable mark for wrapping up experiments and 70 per cent for completing the analysis of the results.

The milestones break the monolithic task of 'doing a project' into small, achievable goals, each one of which takes you closer to a completed thesis. This is a good point to remind you of the importance of attitude: steadily achieving each milestone in turn, at a consistent rate of work, is the most certain way of completing a strong thesis on time.

I encourage students to submit substantial work to me on a regular basis, either for review or simply as a way of being open about progress; if the work has been reviewed, I expect the student to act and revise in line with those reviews to improve the work. However, I notice two contradictory patterns of behaviour. Some students repeatedly delay and make excuses when I ask them for work, because they don't want me to see the manuscript until it is polished. Delays, in the hope of perfection, are a serious mistake. It means the student may be revising material that isn't suitable for a thesis at all, or is much too detailed, or is discussing topics that are irrelevant. These students may not have understood that a thesis is shaped by both the student *and* the supervisor.

On the other hand, some students use me as a sort of dumping ground for poorly written drafts that consist mainly of brainstormed material. They seek immediate response, and wait to be given the signal to continue. My role in the early stages, however, is not to clean up the writing, but rather to give feedback on what should or shouldn't be included, and on how the subject matter should be approached. I often suggest to students that they form collaborative writing and review groups with other students, to gain mutual feedback on drafts and ideas.

Writing at a Computer

Make an effort to learn word processing well, especially the challenges of authoring a long document.

Writing an extended document such as a minor thesis is very different from writing a shorter work. Many students know the elementary features of word processors that are sufficient for a 2000-word essay, but not the more advanced features that help authors to maintain consistency of style and presentation across a greater scale of work, for which manual checking can become painfully laborious and where it is essential to have automatic maintenance of elements such as section and figure numbers. You need to become acquainted with software that automatically maintains

bibliographies; mechanisms that create indexes and tables of contents; tools for professional-standard illustrations; and strategies for keeping versions and backups.

On the other hand, some students tend to over-rely on some of the functions of word processors, such as grammar and spelling checkers, which may be designed for general writing rather than the demands of communication within a specific academic community. Learning to make effective, appropriate use of a word processor is a key step towards timely completion of your thesis, and it is a mistake to assume that even long familiarity with a particular word processor means that you are using it well as a research tool (or that it is the right choice for your new activity).

Today, the most widely used general-purpose word processor is Microsoft Word, or the OpenOffice equivalent; in the mathematical and physical sciences many researchers use the more technically oriented markup-based LaTeX. I will not go into the specifics of these word processors, but encourage you to use resources such as advanced guides and manuals to ensure that you are using them well—even an occasional online tutorial can be surprisingly rewarding.

A typical word processor can be viewed as a suite of separate tools, perhaps bundled together under a common user interface. These tools might include an editor, for entering and modifying text; spelling and grammar checkers; a bibliography database; a line-art environment; and a system for laying out the text in a form suitable for printing or for viewing on screen. A word processor allows the *style* of a document to be separated from its *content*, and the two issues are important at different stages of the thesis creation process.

Writing Tools

Make appropriate use of writing tools, but, ultimately, judgments should be made by you, not by software.

Most word-processing programs include a spell check function, which checks every word you have typed against a dictionary built into the program. Do not ignore it! Few people are infallible spellers or proofreaders and it is only rational to have oddities questioned. However, although the spellchecker is good at picking up typographical errors, it can't make decisions for you. Typical problems are proper names (people's names or place names), and words for which there are alternative spellings. In the case of proper names, the temptation is to tell the program to ignore its questionings, and go instead to the next area of doubt. This is a mistake: you should check any proper name yourself and, when you are satisfied that you have got it right, add it to the dictionary. Keep in mind that these are general-purpose tools, and will not always be perfect for specialized applications such as thesis writing.

On a related note, don't rely on the spellchecker to proofread for you; although it will pick up misspelled words, it won't distinguish between, for example, *there* and *their*, or *affect* and *effect*. Similarly, it won't tell you if you have left a word out. The second problem is words for which alternative spellings are permissible

(*-or* or *-our* and *-ize* or *-ise* are the most common). The most important requirement here is that you be consistent. Before you start, determine your preferred spellings for these words, and keep to them.

Grammar-checkers apply several kinds of checks to each sentence including:

- Does it contain a verb?
- Is it missing connecting words?
- Does the subject agree with the verb (plural subjects must not have singular verbs)?
- Is the verb in the passive voice (permissible, but should be used sparingly)?
- Are stock phrases being used (such as 'over and above'; 'in order to', 'part and parcel')?

You may think that your English is better than that of the grammar-checker—and some of the time you will be right—but my experience is that they are often useful, and it is essential to use a grammar-checker at least once before finalizing your thesis.

Some word processors have 'track changes' functions. These allow you to alter a document, see what you have done, and later decide whether to 'accept' or 'reject' your decisions. They can be used for collaborative work on documents with multiple authors. Take note of such functions and learn to use them, but not to excess. Often, students worry too much about every word they have typed to the detriment of their creative processes.

Thesis Templates

Lay out a consistent structure and style that encompasses the whole of the thesis.

A completed thesis should have a 'look and feel' that is consistent from beginning to end. This look encompasses the use of fonts, line spacing, text width, headings, table layouts, and so on. Templates are used to help create consistency. Online, there are many thesis templates available, as well as academic-paper templates and the like, for a range of word processors. You can search, for example, for 'APA style template' and hundreds of options will be returned, or you can create your own template based on departmental guidelines. Perhaps you can get a template from your supervisor or from a previous student.

But why use a template at all? First, templates help you to control formatting throughout the long document. In contrast to a 2000-word essay, it is extremely time-consuming to manually correct (or even just check) the style of every paragraph in a 20,000-word document. Second, the template helps you to easily produce a table of contents and lists of tables and figures, each of which may be required as part of the front matter of your thesis. Third, without use of a template, the behaviour of some word processors is unpredictable—moving a paragraph by cut-and-paste can change its appearance, for example, which is both frustrating and completely avoidable.

The main reason to use a template is that it helps you to see the entire thesis from the start and throughout the entire project. Many students devote too much

space to the background and literature review, and do not realize that they need to reserve some of the word count for other important components of the thesis. Using a template, you will be much more aware of how many words you can use for the review of literature, and how many are needed for the methodology section, and how many are then left for the results in the final discussion. Also, by using the template, you can anticipate where certain sections will have to go, and write ideas directly into the thesis at the moment of inspiration.

When I teach thesis writing, I use the metaphor of shopping in a supermarket as a way of encouraging students to map their overall argument through a template. A successful shopper, before entering the store, will have a broad idea of the purpose of the shopping and maybe even a few key recipes in mind. With that, the shopper knows what to buy to stay within the budget and time available. The unsuccessful shopper, on the other hand, will buy a random set of goods, and then be unable to create a balanced meal from what is available. For me, a template in academic writing helps by providing an overview of how an argument is developed; like a good recipe, it sets out the essential ingredients to guide you, and yet allows and welcomes the contribution of individual talent and tastes.

Remember that one of your goals throughout the entire process of producing a minor thesis is to become a member of the research community in your chosen academic field. Make an effort to produce a thesis that looks like the product of someone who belongs in that community; that is, follow the field's conventions, styles, and formatting. For me, one of the ways that students signal their intent to 'belong' is through the appropriate use of the standard styles of the discipline, including such things as how to format citations, create graphics, and set out tables. To examiners, first impressions count.

Present Well

The 'look' of your thesis helps signal your entry into the research community, so take the time to ensure that the thesis is presented in an appropriate form.

The fine details of the style of your thesis may not become settled until it is almost finished, and I strongly encourage that, in the early stages at least, your focus is on creation of content rather than on how it appears on the page. Nonetheless, right from the start you need to write within the constraints of a style—for example, ensure that all headings of the same kind, such as chapter titles, are displayed in the same way.

Which format do you adopt? I suggest that you use a thesis style that is already in use in your department, and it may well be that your department has specific requirements. You should also be aware of field-specific guidelines. The key is that you use a defined style from the start, so that you can easily change the appearance of the whole thesis if you want to do so. Pay particular attention to the way you cite references. Your professional handling of references is one way that examiners assess your readiness to enter the community of scholars. If you are sloppy, or your text and reference list are inconsistent, or you perhaps fail to cite a

work, you are signalling a lack of respect for colleagues. One way an examiner checks to see whether you know what you are talking about is to check the references as you cite them. Conversely, you shouldn't put entries in your list of references unless you have cited them. Read your own text as an examiner would, checking the list every time you come to a citation.

Pay attention to elements such as tables. Compare your tables to those in a journal in your discipline, for example. If you used the defaults in your word processor, it is likely that your tables won't look right, and in any case, your word processor may not have a default for table captions or other elements that you need.

Using a style means that, once you have established a pattern, you can easily stick to it and the reader will get the same message every time. For example, section headings, wherever they appear in your document, will always be in the same font and of the same size. They should always have the same space separation from preceding text, and always have the same space separating them from the following text. If you have two levels of headings (main headings and subheadings), they should be clearly distinct from each other.

A thesis consists of several different parts that need to be tied together with a set of conventions. Without a standard format across the entire document, the work will appear random and unprofessional. For example, you should put all chapter headings on a new page, using the same style—that is, the same font, justification, and paragraphing. You should give all major section headings a style that is different from that of the chapter headings. Captions to figures should all have the same style, but be different again from section headings and different from the main text. All new paragraphs should begin with the same indentation (except for the first paragraph after a heading, which may have no indent at all), and so on. All this will help your readers to navigate their way through your thesis. This styling is managed by templates, which govern the appearance and numbering of every element of a document. In my view, templates are the single most important feature of a word processor, and you *must* learn how to use them properly.

After creating a style and template, you can generate a thesis structure, with a few empty chapters and perhaps some subheadings and so on. You can then use the style to generate a table of contents, and begin to get a sense of how the final thesis will appear. As you proceed, you will use the table of contents, or other outline tools, to get a sense of the current structure of the thesis and where it may need revision—extra chapters, moving of material from one section to another, changing how headings relate to each other in the hierarchy, and so on.

Writing Style

Take the time to write well. Readers make negative judgments about the ability of authors whose writing is sloppy, incoherent, or difficult to follow.

There are many books that discuss writing style, and I suggest that you read some of them. Writing well is not about adhering to an arbitrary set of rules just

for the sake of it; it is about the messages you send to your readers. Writing that is full of mistakes says that the author is lazy or incompetent; such people don't do solid research. Writing that is impenetrably complex or knotted up says that the author is incapable of clear thinking. It is these kinds of messages that you are trying to avoid. Remind yourself that good researchers are busy; if you want other people to read and appreciate your work, you have to make it easy for them to do so.

Tone matters, too. Writing that is arrogant, defensive, too formal, or too informal does not create a positive impression. I appreciate a thesis that is written in a way that is easy to read, and where the concepts and arguments are presented in much the same words as would be used in a meeting with friends. You need to be precise, but neither patronizing nor pompous.

Storage and Backups

Be sure that you are systematic in your naming, storage, and backup of documents.

As you write your thesis, you will create draft after draft, and may have the work spread across many files. Some of these will contain the thesis itself, or fragments of it, but there will also be files containing data, images, and so on. Many students fail to anticipate how quickly these files will multiply, and how easy it is to lose track of where each part is kept. Once the files become disorganized, backup becomes more difficult, and without it there is a real chance of disaster. I've had more than one student who lost everything because all the work was kept on a laptop that crashed, despite being warned about the need to make copies of everything. It is crucial that you develop a system for how you name files, store them, and back them up—and stick to it.

Let's start with file naming. As I work, I make sure that I am using a directory (folder) that consists of the current or most up-to-date version of every file. I make sure that every file name is descriptive, and includes the date in some way. For example, Chapter 3 might be kept in 'chp_03_2014-02-11.docx', while a file of data harvested from the website <www.worldofwriting.com> might be in 'worldofwriting-partial-2014-02-25.csv'. Because this directory is going to get copied many times, I put large files that don't change much (such as collections of images) in a separate directory.

If a document is long, I break it into smaller files—maybe one per chapter. A common disaster is for a document to become corrupt in some way; having the chapters separate limits the possible scope of damage. For the same reason, I frequently save documents as I work, and don't let an hour pass without copying the document. I usually edit to a backup such as a USB key or a file server. At the start of each day, I make a copy of the whole directory, and put the date in the name of the copy. I can then continue to work in the 'master' directory.

The point here is that you should always have up-to-date backups, and be able to find previous versions easily. This also helps you monitor progress.

At the end of every writing session, I store and backup my work in three ways. First, I leave a copy on the local hard disk at the computer that I'm working on. Second, I send a copy to myself through one of my email accounts. Third, I place the file on a remote server. This may seem like a nuisance, but it ensures that my work is safe even if the computer crashes. The fact is that everyone who works at a computer will one day have the experience of losing work due to an electronic failure of one kind or another; if you have been careful in how you manage your files, the impact of the loss will be small.

Health and Wellbeing

Maintain your health by setting up an ergonomic workstation, and balancing study with exercise and relaxation.

Take your physical limits seriously. Working intensely on a single project for an extended period can be physically challenging. Set up your workstation properly: put the screen at a height where you don't strain your neck or eyes, and make sure that your arms and hands are relaxed at the keyboard and that you work the mouse appropriately. Footrests, back supports, and so on, are inexpensive; try them out if you find out that you are getting uncomfortable.

Don't plan to do all your work at the kitchen table—as you proceed towards the final write-up, you will spend long hours in front of the computer, and it is all too easy to injure yourself if the working conditions are uncomfortable.

At my workstation, I keep water handy, but I limit the coffee because I have found that it makes me irritable and dehydrated. Also, I don't eat at my workstation—when I'm at the computer, I work. Get up and walk around the room (or down the street) for a few minutes every hour. Be sure also to look away from the screen at regular intervals to give your eyes a rest.

I have found over the years that regular exercise helps me to work effectively. You need another activity to get you away from the computer and to stop you from thinking about work all the time. Sometimes I take a short walk, or even a bike ride. It may seem strange that, in this book on thesis writing, I am recommending that you stop work every now and again, but believe me: breaks make you more productive. After a few hours of writing, most people find that they slow down; I find that I 'run out of words'. After an exercise break, the words come again, sometimes more quickly than I can type them. And I feel much more rested after a walk than after a break on the couch—if you are getting tired, then by all means sleep, but get exercise too.

Also, it's important to spend time with friends. Again, it may seem strange to remind you of this, but I have found that being with friends generally adds

to my overall productivity and happiness. Of course you should return to your minor thesis feeling refreshed, not exhausted: you won't work well after a long night of partying. Stay on track, of course, but be sure to plan for time away from the thesis.

Chapter 3
The Structure of a Thesis

Although the focus and content of theses differ greatly, they all share a common recognizable, and appropriate, structure. Examiners expect a thesis writer to motivate the work, present background material, and conduct an investigation. Results must be well argued and displayed, and the thesis has to end with a sound conclusion. This standard structure works well for theses in the physical, biomedical, mathematical, and social sciences. Although theses that are produced in the humanities often differ from those in the sciences, they too follow structures that are both familiar and appropriate to their disciplines. In this chapter, we explain how a minor thesis is structured, and highlight how important it is to maintain a consistent narrative and style throughout your entire manuscript.

The 'Standard' Thesis Structure

Be familiar with the common parts of a thesis, and how they fit with each other.

The standard thesis structure has four parts: an *introduction*, the *background*, the *core* (for want of a better word), and a *synthesis*. Each of these parts has a distinct role.

- The *introduction* has the purpose of introducing the overall study and creating interest in the work. Simply, it explains what the thesis is about: the context and motivation of the problem, the aim and scope, a snapshot of the approach, and an overview of what lies ahead. In some disciplines, an introduction may include a brief example, key terms, or an overview of the findings. For a minor thesis, three to five pages is ample.
- A *background* section is needed to provide the examiner and other readers with sufficient knowledge to situate and understand your work. It contains a review of the literature that sets out the relevant history and context of the problem, current perspectives on the problem, central aspects of theory and practice,

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competing solutions, reflections on methodology, and the issues and debates that may arise in regard to other researchers' views.
- The *core* section consists of your own propositions or hypotheses, innovations, experimental designs, surveys, results, analysis, and so on. It contains your original contribution and often forms the bulk of a thesis.
- A *synthesis* draws together your contribution to the topic. It contains a discussion in which you critically examine your own results, and is where you produce conclusions. In the light of the background section, it is here that you make judgments as to what has been learnt in your work. A good synthesis responds directly to the aim of the work as stated in the introduction.

Ensure that each of these components is progressively developed as your writing proceeds. A strong thesis is the product of considered work, where there has been opportunity to debate, revise, and evaluate each chapter. An impressive thesis structure is the result of the tight integration of the four components, and it is most easily achieved if they are written to form a logically coherent, extended argument.

Of the four components, it is the structure of the core that varies most across the disciplines. Consider how work to do with languages could be structured. In one thesis, for example, the first sections of the core chapters may be descriptions of a survey tool, and an explanation of how it is linked to an investigation of language use in online communities; in another thesis, the core may consist of statistical analyses and presentation of the results. In another example thesis, the first core section might sketch how it is plausible that language-use learnt from web data can be used as a mechanism for automatic checking of grammar; the next section might propose an initial method for inferring some interesting forms of language-use and applying them to a new document. A common factor in core sections of theses is that they are narratives that lead the reader from a proposition to an outcome, linked by evidence and argument.

Your supervisor can provide you with theses from previous students. Read them, as they can be excellent guides to what you are trying to accomplish. With a past thesis in hand, see if the table of contents gives you a clear idea of the structure of the work as a whole. Then browse the introduction and conclusions, and look through the reference section. Next, read the introduction carefully and compare it to the conclusions to see if the work is linked in a coherent manner. Look especially for specific formatting and conventions: How are particular words spelled? What is the best way to display data? What is the typical length of a chapter? You may be impressed with the virtues of some theses, such as professional layouts, innovative displays of complex material in graphs or tables, or a strong integration of online materials. Stay alert for the points that impress you, and make a note to adapt them for your own work.

Creating a Non-standard Thesis Structure

Read and learn from other theses in your area to avoid having to invent structures for yourself, and to align with the approaches and expectations that are accepted by examiners in your discipline.

If you are writing a thesis that relies on a non-standard structure—or are writing a thesis where the approach and problem might, in traditional terms, be 'interdisciplinary'—don't make the mistake of trying to reinvent the form of the thesis from scratch. Take the time to find other theses that have pursued similar problems in a similar way; read these theses, and others, to help yourself decide how your work should be organized and presented. Make sure you are familiar with the methods of both qualitative and quantitative research; there are many excellent books on these topics, some written for specific disciplines but applicable to a broad audience, such as the books on statistical research methods for psychology. And it is essential that you establish a clear line of argument.

Perhaps surprisingly, you could base your early efforts on a standard structure. To do this, first write a draft of your introductory chapter—the problem statement, the aim and scope, and the steps you think you might take to achieve the aim. You may not feel confident about writing this introduction because you suspect that it will have to be modified later. Your suspicion is almost certainly correct, but that should not prevent you from writing a draft introduction. What you are trying to do is to get started. A rough structure may be a piece of flowing text, or a series of bullet points that capture essential content.

If you haven't done so already, find several theses in your broad area and have a careful look at their tables of contents. Some will be good, others poor. With the departmental assessment criteria in hand, take the time to analyze them, focusing on their structure. Take notes of what you liked and didn't like about various features. Think creatively about how you will avoid pitfalls and highlight strengths as you develop your own thesis.

Narrative

Use signposts and commentary to guide the reader through your thesis.

One way to think of the role of structure, and signposting, is as a guide that walks readers along a road from what they already know (past knowledge) to what they should know (a knowledge frontier).

When you write a thesis, it can be helpful to reflect on what you knew—and how you thought—when you began your work. In a way, this earlier 'you' is the person you are writing for. The story, or narrative, that takes the reader along the road should be as straightforward as you can make it. You may think that you need to tell everyone that you had to fumble, and explore, and make mistakes to get the results and produce a thesis. Move past such thinking, and view the purpose of your work as setting out a clear path, free of barriers, that helps the next person to come to the same point of view and the same knowledge without fumbling.

A key element to good writing is to clearly understand what the writing is meant to achieve. In my view, the twin concepts of narrative and audience—what are you trying to say, and who you are saying it to—are the most important concepts a writer can learn.

A clear narrative assists readers to develop their own understanding as they read the thesis; the structure is how the material is organized to create a narrative.

Different structures may be appropriate in different disciplines, notably the contrasts between the humanities and the sciences. For example, some theses might emphasize *quantitative* work, where the contribution rests on experimental tests of theories or innovations with measurable outcomes; others emphasize *qualitative* work, with discussion and argument based on documentary sources and other researchers' interpretations of records of events. Still others theses may explore the text of a major literary work, or seek to critique a political stance. Each of these, regardless of structure, needs to guide readers through a narrative.

Who reads minor theses? Who is your audience? Quite simply, most academic research is read by academics. Your examiners will probably be staff in your department or school, and, although you may have worked with them earlier as teachers or lecturers, they will examine your work in their roles as researchers. At this point, their goal is not to educate you, but rather to provide the department with a single score and brief summary report. When I examine theses, I set aside my pedagogical role. My job is not to give advice to improve the thesis—that was done by one of my colleagues, your supervisor—but to provide a score. I calibrate my score against the departmental minor thesis assessment guidelines, and then write up a brief explanation to defend my own assessment. I then prepare to discuss my score, and perhaps negotiate an adjustment, at a departmental meeting. In brief, your audience is a busy academic who, when reading your thesis, focuses on the role of an objective researcher with the aim of assigning a grade with respect to official criteria.

Initial Efforts

Decide where you are going to begin your writing; this is likely to be the literature review or part of the core.

Once you have sketched a structure, your next task is to decide which chapter or section you could tackle first, and start writing. Many students find it easiest to start with a factual or concrete chapter, rather than attempt to write material that requires careful argument or complex interpretations or judgments. In a technical area, for example, this chapter might be a description of an experimental design, or a presentation of a series of initial results.

Another model, which works well when you are able to develop a clear structure right from the start, involves writing fragments from around the thesis. For example, in a thesis on the changing vocabulary of social media postings, you can simultaneously be working on the parts of the background concerning language adaptability, documenting the experimental environment, explaining how 'real world' data is obtained from social media websites, and exploring ways of presenting your initial experimental results. This way, if one task is stalled—or is leading to excessive procrastination—you can switch to another and continue to be productive.

In the early stages of your first thesis, you are probably not quite ready to write a critical review of the literature. To get you started, though, I suggest that you

start to review key concepts and terms. From experience, 'the literature' is not a solid, monolithic entity, but rather a fluid conversation in a community of scholars. At times, that conversation gets noisy and heated, and definitions and concepts are robustly discussed. One task in entering this community, then, may be to determine which variation of a concept you would like to adopt for your own work. When you have read the literature and written about such issues, you will be far better informed about your project. Indeed, you may need to revise your aim, and perhaps trim the scope of your study. At this point you will certainly be in a much better position to, for example, devise questions for a survey, or to examine the nuances of a particular phenomenon. The writing will not be wasted, as much of it will end up in the final draft of your thesis.

Thinking your way into the project like this will help you to write a tentative structure for the first part of your thesis. There will probably be a big blank in the final chapter or two, but you at least have enough material to draw up a tentative table of contents.

In my experience, a strong obstacle for some students at this stage is fear of making a false start and thus wasting time. However, any productive work on a minor thesis is time well spent: it helps you come to grips with the literature, gain experience with tools, and learn to write as a researcher. Moreover, it can be difficult to establish a clear line of research without writing about it—for example, it may well be that the exercise of creating an initial thesis is how you learn that the topic needs to be changed.

Once you start the writing itself, allow the creative side of your brain to work through the argument for you. When you have finished writing for the day, sleep on it (the existence of this expression is evidence that our unconscious thought processes keep working even when all rational thinking has been switched off). Your first task the next day is to look at the chapter outline, then read the chapter as it stands.

Print your thesis out occasionally, so that you have a hard copy to make notes on; put it in a folder with printouts of any other chapters you have drafted. Every time you go to a meeting with your supervisor, take the folder with you. It is the latest draft of your thesis.

Beginning an Individual Chapter

To get started on a chapter, set out the signposts to begin a narrative for the reader.

Just as the entire thesis must be properly structured to ensure that the examiner is guided through the narrative, so must individual chapters. Why is each chapter there? What is its function in the thesis? You must make this absolutely clear. The best way to ensure clarity is to write a formal introduction to every chapter. Follow with the business of the chapter itself, then a formal conclusion. By a formal introduction, I mean a piece of text that is designed to explain the role the

chapter plays in the thesis. A typical such introduction is organized into three brief paragraphs:

- *First paragraph*. Create a link back to the earlier parts of the thesis, in particular the previous chapter, to make it obvious why the chapter is needed.
- *Second paragraph*. State the aim of the chapter, what the reader should learn from it and how it advances the overall goal.
- *Third paragraph*. Outline how you intend to achieve this aim. This paragraph may have the 'overview of contents' flavour that so many writers think constitutes an introduction, but it is only one part of the introduction. Without the other two parts, the reader struggles for a sense of direction. (Avoid presenting this as a table of contents, which is far from helpful. The reader needs to know not only what will be dealt with in the chapter, but also the logical connections between the various sections.)

After the introduction comes the main body of the chapter. Its contents and structure will depend on the kind of chapter you are writing and the kind of research you are reporting. Nevertheless, it needs to flow logically from the purpose of the chapter, as stated in its introduction, to its summary or conclusions. This typically involves three or four major sections. Having too many sections in a chapter makes the structure difficult for the reader to follow. If you find that you have created a lot of sections, then you need to step back and ask if the structure is still appropriate.

Study or Case Study?

Your research will focus on a phenomenon in its own right (a study) or be investigated as an example to see how principles work when they are applied (a case study).

The structure of a chapter, as well as guiding both writer and reader, reinforces the key aim of your work; it is a framework for the argument.

A problem can be investigated in its own right or be used as an example for a range of similar problems. To illustrate, consider an investigation of the ways that Indonesian television news broadcasts are understood by learners of the Indonesian language. In this investigation, there is a clear focus on Indonesia *as a study*. One implication of such a study, then, would be to develop better language teaching materials based on television programs for learners of Indonesian.

Alternatively, we might investigate the understanding of Indonesian television news by language learners *as a case study* to determine how advanced learners of any foreign language make sense of television programs. In this example, there are many types of television news programs across the world, and there are many millions of people who may learn a language from watching such programs. What factors, though, influence their comprehension of the news? Here, we are

investigating only those wanting to learn from Indonesian programs, but the implications of such a study are written so that they apply to the learning of any foreign language through television. The implications of the case study could be transferred to investigations of the understanding of television in China, Senegal, or Canada. The intent of the thesis was to come up with broadly applicable results, for which the Indonesian study served as an initial example.

As you can see, despite the similarity of the subjects in the two research projects, the structure of the thesis depends, in part, on your purpose and final goal. From the start, then, you need to be clear about whether you are investigating a phenomenon *in its own right* or as a *case study* from which you might later develop principles that apply to similar settings. The decision to pursue either a study or a case study design fundamentally affects the introduction and aim of your thesis, the focus of your literature review, and the areas of implications for your work.

Anouck (introduced in the Preface) was struck by the range and type of bilingual advertising in areas of Melbourne. In brief, as Melbourne has become increasingly multicultural over the last several decades, advertisers have done their best to promote their goods and services in a range of languages. In some suburbs of Melbourne, a great deal of the advertising signage is bilingual. Anouck was interested in how bilingual advertising was perceived by monolingual residents (in this case, those who spoke only English). What did they think of the signage in other languages on neighbourhood shopping streets?

At the start of our supervisory meetings, many of our discussions sought to determine whether Anouck was intending to write a study or a case study. We outlined the two structures and discussed them, first considering how the differences affected her intended work.

Comparison of a study and a case study

A study: The primary purpose is to examine a particular phenomenon or site of study, leading to the development of implications that relate directly to the specific concerns raised within that context.	**A case study:** The central purpose is to investigate a phenomenon or site of study as a single example of a broader set of related examples, leading to the development of broadly applicable findings that can be used across a range of similar contexts.
Title: Attitudes towards bilingual advertising signs on the streets of Melbourne.	**Title:** Perceptions of bilingual advertising: A case study of Melbourne street signs
Context of the study: As a result of globalization, bilingual advertising signage is increasing in Melbourne.	**Context of the study**: As a result of globalization, there is an increasing amount of bilingual advertising in major cities.
Motivation: Although Melbourne is known as a tolerant and multicultural city, little work to date has investigated how bilingual advertising signs are perceived in the city.	**Motivation:** Despite a rise of differing languages in urban spaces, little research to date has examined the role of bilingual advertising signage in relation to tolerant attitudes in global cities.

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Aim and scope: To examine the perception of bilingual advertising signs in Melbourne. Limit the scope of study to focus only on a specific area of the Melbourne, and survey (for example) only the monolingual English-speaking long-term residents of the area advertising in global cities.	**Aim and scope:** To examine the perception of bilingual advertising in global cities. Limit the initial scope to Melbourne, with a proviso that one area will be used to represent the entire city, and survey (for example) only the monolingual English-speaking long-term residents of the area.
Approach: Specify that one particular area of Melbourne is the focus of the in-depth investigation, and strive to determine and understand the unique characteristics of that area that may influence resident attitudes to bilingualism.	**Approach:** Select and justify Melbourne as an appropriate site of study; because it meets the definition of 'global city', the results of the study may be broadly applicable to similar global cities.

Be clear about which of the two approaches you are using. If you are undecided, your *background*, *core*, and *synthesis* sections will be confused and muddled. Why? If you are conducting a study, your review of the literature should focus on the specific phenomenon or site; in a case study, your review of literature would concern a much wider view of previous work. In a study, your core section shows evidence related to the specific phenomenon or site; in a case study, analysis exemplifies how general characteristics are present. Finally, the synthesis of a study relates only to the specific phenomenon or site; in a case study, the synthesis seeks to make broader claims to a wider set of related phenomena or sites.

Which one of the thesis designs should you use? For a minor thesis, I would advise you to conduct a study: by investigating a specific phenomenon or site, your work has defined limits and you are likely to complete it within the tight time and resource constraints. A case study, on the other hand, has the potential challenge of throwing up a wide range of sites, phenomena, and other possibilities that may take some effort to constrain, both conceptually and practically. Thus, a study is a more suitable approach for a minor thesis, and a case study is better suited to senior research degrees and projects. Of course, such choices can be highly discipline-specific.

Observation or Innovation?

A technical investigation can focus on observing and quantifying existing behaviour, or on demonstrating the properties of an innovation.

Many research topics concern the study of specific phenomena in one form or another: for example, the effectiveness of an innovative teaching approach; the extent of use of video games as recreation by the elderly; the invasion of unwanted plant species in farming districts; the performance of underwater microphones.

These topics can be seen as based on *observation*, in that they propose descriptions of observed phenomena and then proceed to evaluate whether the descriptions are valid. In such a topic, the description is, or forms part of, the hypothesis.

Other research topics concern construction or invention: a technique for inferring grammar, an energy accountancy method, a health message design, a new microphone technology. These topics can be seen as based on *innovation*, in that they involve creation of something new as well as evaluation of it. The description of the innovation may, in some cases, consume a substantial proportion of the thesis, and most of the core. There also needs to be a discussion of the properties that the innovation is expected to have (that is, what it is predicted to do) and of criteria that it is intended to meet. Together, these components form a hypothesis, but one that is very different in form from that in an observational thesis.

Other topics are neither one nor the other, such as a model that links weather conditions to likely road traffic. A model is by its nature descriptive (a form of structured observation), but may involve innovative mathematical constructs. Indeed, it is a simplification to regard any topic as purely observational or innovative—no topic is truly at these extremes—but, as a handy simplification, it helps us to understand how the purpose of an investigation influences the structure of a thesis.

Organization

Be conscious of your choices in structure, and, in particular, of the overall flow of the argument.

So where do these lines of discussion take you in terms of how to organize the central chapters of your thesis? As I noted earlier, practice varies a great deal between disciplines, and you need to read other theses in your area—and get advice from your supervisor—to establish how your thesis should be arranged. For some topics the core is quite brief, with a focus on statement of a hypothesis and an explanation of how data was collected in the process of evaluating the hypothesis. For other topics, the core extends over two or more extensive chapters, which will contain descriptions of an innovation, a discussion of what is involved in practical deployment of the innovation, explanation of criteria that the innovation needs to meet, and a description of the experiments that have been used to evaluate the innovation. The practice of your discipline is the best guide, and if you have sought out other theses, you will undoubtedly have found good examples to use as models.

While I cannot give you guidance that is specific to your discipline, I can give you advice on the criteria that the core part of the thesis needs to satisfy. The term is overused, but let me again say ‘narrative’. You are leading the reader through your thinking, and need to do so in a way that lets the reader see that your hypotheses and methods are reasonable and appropriate. You need to explain why your proposals are plausible, and, at least subtly, persuade the reader

of the strength of these compared to other perspectives or approaches. Each project will be different.

- For an observation-based thesis, this may flow directly from the background material; for an innovation-based thesis, this may involve building a case to support the claim that your new approach solves problems that previous approaches neglected.
- For a study, you need to persuade the reader that the subject is of sufficient interest; for a case study, you need to persuade the reader that the subject is representative of a broader population or phenomenon.
- A quantitative thesis may need sections, or a whole chapter, on experimental design and data collection.

A common feature, though, is that the reader has been made aware of which method you used and why you chose it. Before you describe the results obtained by using this method, you must first describe in detail the *way* that you applied the method, and *why*. Although projects may use quite different approaches, the issues to be dealt with are similar: clear identification of questions and hypotheses; explicit choice of method and tools; design of research instruments; and so on.

Plagiarism and Research Integrity

Your thesis must be your own. Other people's text and ideas cannot be incorporated unless they are fully and unambiguously acknowledged.

Plagiarism, or the unacknowledged use of material, is a fundamental issue of academic honesty. Suspected instances of plagiarism can provoke strong responses. An underlying cause is that the reputations of scholars are based on what they have produced and written; in the academic community that you are seeking to enter, the unacknowledged use of other scholars' words is perceived as a particularly threatening form of theft. Copying is a violation of community norms. Such actions have a particular significance in the context of a thesis because it is an initial point of entry into the academic community, and allegations of misconduct can severely damage a professional reputation.

Some students argue that 'just a little' copying is acceptable. But charges of plagiarism may be based on the unacknowledged use of much less than a section of a chapter; 100 or 200 words of direct copying would be regarded as a breach of ethical standards, and it would be sufficient to trigger some form of disciplinary proceedings. It does not matter whether the original material was in an academic paper or a web page; it is not the source of the work that is being considered, but whether it has been copied. Unless clearly attributed and put into quote marks, each and every word in your thesis should be your own.

Other forms of academic misconduct are, likewise, of concern. These include, but are not limited to, falsification or misuse of data, unethical practices, and

presenting as your own work any material that was produced in collaboration with others. Take the time to read about academic misconduct at your university; most institutions have guidelines and regulations on this topic. If you have any questions about what is and is not acceptable, talk to a senior academic that you trust, such as your supervisor or thesis coordinator.

In a related question, how much should you ask—or even pay for—someone to edit your own writing? The short answer is *nothing*: ideally, each word in your thesis should be yours alone. A university writing-support unit may provide assistance; in such sessions, support staff will ask you to reflect on what you have written, ask you if you can self-identity tangled prose and faulty grammar, and suggest some strategies and materials to help you to improve your work. The task of editing your work, fixing up faulty structure, and so on, is yours, not one for your supervisor or a consultant.

Chapter 4
A Strong Beginning: The Introduction

Your initial chapter is crucial: it must concisely situate your study, motivate and focus it, and provide an indication of your approach and where the work is going.

The initial chapter also has another purpose: to introduce *you* to the examiner. Imagine, for a moment, that your thesis is an interesting person you are meeting for the first time. Think of the questions that you might ask: Where are you from? What are you doing here? What kind of work do you do? What have you done so far? Where are you going? Take the time to write the introduction properly, and revise it on a regular basis as your research project develops. You want the examiner to think highly of you; the introduction is where all-important first impressions will be formed.

In this chapter, I identify the elements that the introduction should contain, but that doesn't mean that it should be a series of headings with a paragraph or two of text under each. A strong introduction is a single, flowing piece of text that talks to the reader in an engaging way; frequent headings can turn interesting text into a series of dull pronouncements.

Context of the Study

Introduce the reader to the area of work by explaining the context or environment in which the problem arises.

To establish a relationship with your examiner, and provide background to your problem, argument, and outcomes, you need to provide some context for your study. Contexts may, for example, be historical, geographical, situational, or theoretical (or perhaps a combination of such perspectives). Situate your thesis historically, by telling the examiner approximately how long the area of study has existed, or how the area arose; you can note the major studies that first recognized the issue at hand. If your study requires a sense of location, you can briefly introduce where the study is located geographically.

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An alternative to a geographical location is a situational location, such as the factors that give rise to the question. Mickey's situational context was search technology as it is applied to web data, and the fact that web search is intended for general-purpose use; the same search engines are used across the same set of web pages (the whole web, more or less), regardless of what kind of information is being searched for.

Introducing a theoretical framework is a more abstract undertaking. To make such an introduction engaging, imagine that you're trying to situate your study or approach in the larger landscape of the entire research field. Locate yourself in relation to some of the major thinkers in your field or among major current trends in your area.

By providing a context you are explaining the perspective from which you will approach the problem. If your interest is in household purchasing choices, for example, then this needs to be made clear; the problems that arise in this context will depend on whether your interest is in search technology, bilingualism, poverty, social strata, advertising, psychology, or some other field. All of these can be applied to purchasing choices, but in very different ways.

Motivation for the Study

State the reason for the study: What problem does it seek to address?

A defining element of a research project is that it should accomplish something. Readers of a minor thesis should have their understanding advanced in some interesting way. A key task of the introduction is explain what that advance was in a way that persuades the reader that the work was worth undertaking.

Brainstorming is important in developing a thesis. To give a project this sense of purpose, I suggest that you write out at least three reasons why your study is required. When I work with my students, I ask them to write down as many ideas as they can about their topic. I do this for two reasons: I get an idea of the areas they're interested in, and ensure that when they do select a topic it is the one that they truly want to do. As we begin to brainstorm, I ask a series of simple questions: Who might be affected by the work? What is affected by the work? Will it cause something to grow or to diminish? Who stands to lose or to benefit by any resulting changes to current beliefs or knowledge? What changes in practice might result? What assumptions must be made for the research outcomes to be applicable?

When advising Anouck on her study of bilingual advertising, we came up with several motivations for the work: the world is becoming more global, and variation in language use is part of globalization; earlier research on bilingual advertising has focused on magazines, not urban streets; the prominence of, and attitudes towards, increased bilingualism in the community; and so on. Mickey and I, likewise, found several motivations: search of fiction had almost no prior research; stylistic markers have been used for applications such as identifying the author of a work, but have not been used to link to readership; it would help test the generality of methods developed for analysis of blogs and newspaper articles; and others. For these students, clear ideas of what motivated both the interest in and the need for their work helped them to direct the rest of their projects.

Aim and Scope

With reference to the motivation, state in a single sentence the purpose of the study. Identify the anticipated limitations of the project in terms of factors such as location, framework, application, completeness, or participants.

The aim, or purpose, of a project has three characteristics: it responds directly to the motivation, it is singular—that is, it concerns a single goal and activity—and it suggests the project's title.

First, a well-stated aim should provide clear purpose and direction, and it can only do so if it responds directly to the motivation. Second, having a singular aim ensures that the thesis will be coherent. For me, it shows that the student is not over-promising and has a clear grasp of the project at hand. If your aim has multiple parts, then you run the risk of creating a monster stitched together from unrelated components. For example, Mickey wanted to develop statistical methods for categorizing pieces of fiction and then design search technology to use these statistical methods. Both of these are significant problems and it would not be possible to address them in a single minor thesis. To avoid the perception that you are over-promising, you can designate one as the primary aim, and present the other as a secondary aim if you believe that it will follow naturally and easily from the first. It would be better, though, to discard the secondary aim unless the primary aim is meaningless without it.

Third, if a thesis aim is such that it can be directly reflected in the title of the thesis, then a clear link is established between what is expected and what is delivered. The title is usually the first thing I read in a thesis and it sets the tone and raises expectations about the entire work. Having a mismatch between the title of the work and the purpose of a work is a waste of time for everyone involved. Establishing the scope of the thesis helps to manage examiner expectations, and to clarify what can be accomplished with limited resources and within the deadline.

I urge my students to identify three to five limits to their work. Your work, for example, can be constrained by the amount of time that is available, the complexity of the lab work or software development to be undertaken, the kinds of areas or applications to which the outcomes will be relevant, the amount and type of data that is available, or the location of the study. It can also be constrained by the theoretical framework, or by the target of the inquiry. Your supervisor can work with you to establish a scope to help ensure that you do not overestimate your abilities, and to confirm that the work can plausibly be completed on time with the available resources.

For a minor thesis student, setting a scope is much more than an idle exercise because it teaches the basic relationship between research effort and reward; the scope can be seen as a contract between you and your supervisor as you learn to establish boundaries. At times, when I am discussing with my students what was expected and what was delivered, I draw their attention to the scope we set at the beginning of the project before we discuss milestones and delays. In this way, the scope helps us to maintain an effective working relationship.

Research Questions

With reference to the problem and aims, state the emphases of the study in the form of questions, perhaps even just a single question.

You will have developed your questions early in the process of undertaking the project, and now you need to articulate them in a precise way. The questions are not the same as the aim; Mickey's aim was to develop methods for online search among pieces of fiction, while his questions concerned whether statistical properties of text could be linked to reader preferences. For Anouck, her aim was to examine bilingual signage in urban spaces, but her questions were focused on the role of attitudes among residents. A strong thesis will often rest on just a single question, but, to provide highly specific direction to the work, it may instead be appropriate to use two or three related questions that suggest a thread of activity.

Approach and Outcomes

Briefly provide an overview of the methodology of the project, how the outcomes were achieved, and what they were.

From the start, you need to know whether you are investigating a phenomenon in a specific context, or using the phenomenon as an example of more widespread issues and concerns; this is the 'study versus case study' question I discussed in Chap. 3. You also need to know if your work will be quantitative or qualitative; observational or inventive; based on existing tools or on tools developed for the project; and so on. I urge you to 'locate yourself' by mapping out the various characteristics of your approach. Anouck, for example, saw herself as a qualitative researcher conducting an observational study through the use of an established framework for linguistic and attitudinal analyses. By situating her study as such, and understanding her choices, she was less vulnerable to the temptation to make changes, or to endlessly reconsider choices, as I've seen some students do.

Critically, you need to know how the outcomes will be measured and assessed, and you need to know what constitutes a positive outcome. This issue, and questions such as whether it is a study or case study, determine what data you need and what activities you undertake.

Later, you will set out your approach, data, and so on, in the appropriate chapter of your thesis. At this point, you need to give the examiner a general overview, which would usually occupy no more than a page or so—but not all of the detail, or a lot of detail presented too compactly. The introduction is where the ideas are sketched out, and can be absorbed in an informal or intuitive way; the detail is filled in by the body of the thesis. An examiner who has read your introduction should be able to open the thesis at any point and quickly grasp the broad thrust of what is being discussed.

A thesis is not a story that unfolds slowly like a crime novel, designed to keep the reader in suspense; thus the results should not be kept as a surprise for the examiner, tucked into the last few pages, but should be clearly flagged in the opening chapter. I have examined several frustrating theses in which I could not identify what the student claimed to have accomplished! Make sure that the examiner understands, right from the start, the purpose of your thesis and where it is heading.

Overview

Provide a brief summary of what is to follow, chapter by chapter.

An overview can consist of about 8–10 sentences in a single paragraph, and is often used to wrap up the introduction. It is used to succinctly indicate to the examiner what lies ahead, in terms of the structure of the thesis. If you like, it is a sketch of the learning the examiner must go through in order to appreciate your project and its outcomes. It states what is explained where, and in what order, and it can be thought of as answering a series of questions. Where is background literature discussed, and from what areas? Where is the data introduced and explained? Where is the methodology, and on what principles does it rest? Where are the experiments, and how comprehensive are they? With this brief guide to the work in hand, the examiner can quickly proceed to the body of the thesis.

Chapter 5
Situating the Study: The Background

For research to be of value, it must in some way extend, refine, or rebut current knowledge. The background of your thesis is where you fully explain the context of your study, and establish the current state of understanding in the field. Your task in this part of your thesis is to explain the knowledge you are building on and the knowledge you will change, or to explain how your work relates to past studies, current debates, and gaps in the present body of knowledge. Our purpose in this chapter is to help you write this background.

Structure of the Background

Use your background to help the reader appreciate how your outcomes relate to current knowledge in the field.

Depending on the nature of your thesis, the background sections or chapters can take any of several different forms. But their function is always the same: to provide the context for your work and to explain your position in relation to the field. A useful perspective is to think of the background as educating the 'you' that you were at the start of the research project. Four common elements in the background are:

- *Establishment of a context* to locate a study in time, situation, application, or culture.
- *Identification of current theory, discoveries, innovations, and debates*, including an evaluation of those most useful and relevant to your topic, as well as identification of gaps or inconsistencies in the literature.
- *Outline of current practices and technologies in your field* that highlight, and perhaps synthesize, a selection of the appropriate methods and tools for gathering data and results for your study.
- *Preliminary investigations* undertaken by you or others that clarify research techniques, formulate questions and hypotheses, or focus the investigation.

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Considering the work of Anouck, to investigate the perception of bilingual advertising in an urban environment you would certainly need a descriptive section on the key characteristics of bilingual ads. You would also have a section that sets out current controversies that surround the bilingual advertising: Who is it really for? What is its underlying purpose? Why do businesses use it? Next, you would need to have a section that details ways in which previous studies on such advertising in urban environments have been conducted. If previous work is unsatisfactory in some way, for example, the questionnaires used are out of date or not applicable to your intended participant group, then you would need to conduct a preliminary study to clarify instruments and other aspects of methodology, including research questions.

Considering the work of Mickey, the research goal is reasonably straightforward, but a wide range of technologies are potentially applicable. You would need a section on the properties of text that are relevant to methods for statistical language processing, and an examination (perhaps based on preliminary experiments) of properties that are specific to online fiction. Much of the background would consist of review and in-principle assessment of approaches to automatic text processing; a key example might be the 'authorship identification' methods that are used to estimate who may have written an anonymous document. The background would conclude with a review of experimental methodologies applied in similar previous work.

The background section would be the basis for the design of your project, which can then be understood as naturally following on from prior work, and conducted using techniques that are backed with solid justification.

Literature

Existing knowledge is captured in academic publications, and you need to establish your own competence by demonstrating mastery of this prior work.

A great many kinds of activities go into creating a thesis. A critical one is the search for relevant literature. What constitutes 'relevant' varies between disciplines, but in general the bulk of the citations will be to academic literature, that is, to documents that are accepted by the community as reliable sources of knowledge. These are typically refereed, widely accessible, identifiable, and durable. A blog article found on the web fails most of these criteria, as does an email, even if from an eminent authority.

The type of research you do (case study or study, for example) affects which literature you will search for and eventually read. Anouck was unsure, when she started her study, how much scholarship was available concerning ways in which multiculturalism has influenced Melbourne. When students tell me that they are having difficulty finding previous work in an area, I say that it may not be possible to conduct a 'study', and we should now switch to a 'case study' and thus broaden their search terms. Anouck had to do this for her work and was able to find much more research about bilingual advertising in the geographical context of other places, such as Europe.

There are many sources of information besides the academic literature, including newspaper articles, corridor conversations, resources such as Wikipedia, and the web in general. In most cases it is appropriate to confirm such knowledge in an academic source, and it is the academic source that should be cited. To take a wider perspective, we read for many reasons, such as to establish that our work is novel and to identify new lines of questioning, and to set our work in an academic context. Such reading informs us, but is not necessarily a part of the final thesis. Reading can sometimes be footnoted rather than listed as a formal reference.

Never forget that reading is an ongoing commitment; you should be looking for and incorporating literature throughout your study, even when you are setting out results, discussing your findings, and writing conclusions. Some of this will be deep reading of key papers; some will be light reading across an area to get a sense of the current thinking. Some will be a return to search tools to see what new work is being published. Commit to a weekly routine of searching and reading, and stick to it. Be sure to accurately catalogue your references so that they are readily accessible. Many students use bibliography database software; if you are seeking a suitable tool, ask your supervisor or consult a librarian at your university.

In a common approach to thesis writing, students are asked to produce a 'literature review' chapter, thorough and polished, before they are permitted to proceed with their own work. The idea is that, informed by a literature review, students will be able to see where previous researchers have drawn unwarranted conclusions or disagreed with each other and would then be able to design incisive investigations to resolve these problems.

You certainly should read the literature before you leap into your research program, and should also attempt to write down your understanding of it. But until you have done some work of your own, or collected and analyzed some data, it is not possible to be 'critical' in the sense implied by 'a critical review of the literature'. It follows that you will not yet be able to design those incisive investigations that have so far eluded the other researchers in your area. You may be able to design a research program, but almost certainly, at this stage, it will be tentative.

Developing Critical Thinking

Throughout your thesis, seek to develop and demonstrate your critical thinking skills.

How do you convert your initial 'literature survey' into a critical review of existing theory that leads logically into the work that you design and undertake yourself? A review of current literature serves three purposes: it gives the background information required to establish the extent and significance of your research problem; it identifies and discusses attempts by others to solve similar problems; and it provides examples of methods they have used in attempts to get these solutions. Make sure you deal with all of these. It is likely (and expected) that you will have read much more widely in the topic area than you need for your review. Your initial journey through the literature will help you to gain a

better understanding of your central problem, but you do not need not to write about every paper in full. Keep in mind the aim and scope of your thesis: How does the existing literature relate to these?

As you read, write: the act of writing forces you to come to grips with ideas and focus your attention on the most significant arguments. Eventually, you will gain a sense of how previous research is leading you towards possible ways of dealing with your problem. As you develop a stronger sense of the field, strive to filter the good from the bad. What you are doing at this point is creating an internal set of criteria on which to accept or reject arguments; that is, through this process you are developing the skills of critical thinking. By now you will probably have written many fragments and mini-reviews, and it is time to write a serious first draft of your 'critical review of existing literature'. Before you hand this to your supervisor for feedback, it is a good idea to put it aside for a week or so and work on something else. Then come back to it and rework it into a second draft in which you try to articulate the criteria you have been developing, and demonstrate to readers just how sharp your criticisms are. Read, and think, like an examiner.

Effective critical thinking depends on effective reading. For me, the process of reading a piece of research literature falls into phases. The first phase, counter-intuitively, is fairly uncritical. I try to get a sense of what the researchers were trying to do and whether the problem is genuinely interesting, and then to understand how they undertook the work. Once I have a broad grasp of what a paper is about, I begin to look at issues such as whether the results really support the conclusions and whether the experiments seem robust. A big question is whether the work is significant; some papers are genuinely remarkable, but most are an incremental contribution and need to be analyzed from that perspective. In considering whether the work is reliable, it also helps to consider the reputation of the authors, which may seem unfair, but senior researchers are unlikely to knowingly put their names to poor work, while more junior researchers may be desperate for any kind of publication.

Some papers are plain wrong or misguided. The fact that they are published means that someone believed in them, and it is certainly the case that high-impact journals are more trustworthy than fringe publications, but you should always be sceptical. It is up to the author to convince you that the work is correct. At the same time, a paper can be a strong result even if it is beyond your comprehension.

Foundations

Give a brief, but precise, account of key work to date to establish the current state of knowledge and belief.

Following on from the general introduction to the context of the study, write an account of work to date that brings the examiner to the present day. In a sense, you're trying to answer the question: How did we get here? Again, when you

search the literature, you can cluster your work in this area in terms of particular developments, such as, historical, situational, technological, or political.

I recommend that you cite major, well-known studies and make the section reasonably concise. All too often, I have seen students write tens of pages on this foundational background material in the early stages of their thesis writing. I think they do this for two reasons. First, the students themselves must learn this background material in order to situate and develop their own thinking in the area. This is a necessary step, but much of this learning may not belong in the thesis, as it will be familiar to the examiner.

Second, I suspect that students write at length about foundations simply because it is 'safe'. In your consideration of foundational materials, you are unlikely to need to engage deeply in critical thinking, and the certainty of established material is easy to write about. Further, some aspects of undergraduate education encourage the summarization of background information, and the writing of summaries is familiar ground for students at the start of a minor thesis. When deciding what to omit, and what to include, I suggest four rules:

- If the reader does not need certain material in order to understand what will follow, then don't include it; although, for example, we need some computer science to understand how to process a document, much of the field is not relevant to the problem.
- Don't make extensive use of material that has been covered in your coursework; remember that your examiners are likely to have been your past instructors, and will not be impressed by rehashed work that they covered in your subjects.
- Avoid including material that interrupts the flow of logic in your argument; that is, be sure to be disciplined and not drift into unrelated areas.
- Include work that is fresh and genuinely useful to the development of your own argument; in a way, your cited authors are colleagues whom you call upon to animate debates, generate further interest, and produce evidence for your thesis.

Conceptual Framework

Provide a conceptual or theoretical framing for the study; place your work within a particular perspective on the phenomenon, problem, or concept that is being investigated.

Successful researchers work within a constrained framework. While fields of research can span an extensive body of interrelated knowledge, which may encompass many perspectives and approaches to a range of connected problems, you need to focus on the main elements in the area that are relevant to your topic. You need to read widely in the field, and then distill the material to a

limited set of concepts, to demonstrate both critical thinking (choices had to be made) and an awareness of the constraints of a minor thesis (it is a disciplined project).

Consider Anouck's approach in her study of bilingual advertising. First, she had to 'locate' her study along a continuum from primarily structural to primarily social views of language. Specifically, she had to determine if she wanted to view her data sample—in this case, photographs and videos of bilingual ads on a street in Melbourne—as either representative of various components of language (such as types of nouns, verbs, declarative forms, or questions) or as social activities (such as type of goods and services offered, or emotional and cultural appeals to consumers). Anouck, based on her background and experience, chose to pursue a more 'social' perspective; accordingly, she began to search the literature in sociolinguistics, consumer attitudes, and multicultural media.

You can use your justification of the framework to demonstrate critical thinking. Why, for example, did you choose to go with this particular set of characteristics rather than any other? The justification can be in terms of popularity, applicability, relevance, or perhaps the fact that the perspective has not been applied in other studies. The key is that you do not assume that there is only one way of viewing a problem or research question, but recognize that there is a range of perspectives, and defend the particular conceptualization that you have chosen to use.

Current Debates

Following from the motivation for the study, set out key areas of controversy that inform the development of current theory and perspectives.

Having selected and justified the use of a particular framework, you need to engage with other researchers who may or may not agree with the way a point or concept has been framed. If the matter is settled, we do not need research. If the matter is not settled, the concept has not been fully defined and thus research is required.

An academic debate may concern what a concept means, or what components should or should not be included in a conceptual definition. As Anouck read previous studies, for example, she presented a debate among scholars on what it meant to be 'bilingual': Did the concept exclude people who used more than two languages? What level of proficiency was sufficient in any of the languages to be considered 'bilingual'? Did a person's first language matter? As she explored the literature, she found that various scholars had proposed various ways of defining terms. It was Anouck's job to sift through the many proposals to determine which best fit her study, and to find studies that helped her to demonstrate her critical thinking to examiners.

Another common area of debate is methodologies, or procedures for data collection. In these discussions, academics consider what it means to 'generate knowledge', or what ways are acceptable to 'produce knowledge' within a particular field. Note that I've used the phrase 'a particular field', as what is reasonable for one area may not be accepted in another. For Anouck, she had to determine the extent to which researchers who study language would be comfortable adopting 'visual methodologies' such as streetscape photography. Mickey had to become familiar with standard experimental protocols for measuring the effectiveness of document categorization methods.

A third major area of debate concerns the interpretation of the facts and data that have been collected. Recall that an argument can, in part, be a link between some data or results and the implications of that data. A single research result can often be interpreted in multiple ways, and even in technical fields there can be debate over what the underlying cause of an observation might be. Later in your thesis, in your discussion section, you will be interpreting the outcomes of your project; here, you may need to note that there are debates over interpretation, and perhaps consciously take one side or another—but only with the support of reputable literature or clear reasoning, of course.

Open Issues

A discussion of the literature can be capped with discussion of issues that are currently unresolved.

As you come to understand the perspectives, debates, and areas of active investigation in your field, you will become aware of debates and issues that are currently unresolved. For some students, this may be the point at which a specific question is identified: there is a gap in the literature that can be filled by development of some specific knowledge. Such a question (or maybe a couple of related questions) may differ slightly from the aim of your study, but nonetheless should fall within the scope of your intended work. This is a good opportunity to return to your first chapter and make sure that what you have written there agrees with your understanding from the review of literature.

Examiners can be sensitive to instances in which significant papers are neglected or are discussed only in passing. Key literature should always be adequately discussed, but remember also to point out how these other studies have advanced the discipline. For example, Mickey sometimes had a tendency to place previous papers in one of two categories: a few papers were insightful, ground-breaking, and of critical importance; the rest, in his view, were more or less misguided, incomplete, confused, foolish, or wrong. He failed to see how some papers in his second category made useful contributions because he didn't appreciate that much research is incremental. The net effect was that his criticisms of previous work could seem inconsiderate and harsh, and that made his own work appear to lack balance.

Some students make the opposite mistake: they treat all previous literature as text that is 'correct' and cannot be questioned. Such students often do little more than list previous work without providing any insights or critical assessment. These are the students that, in my view, show the least promise as researchers, because they appear to be satisfied with an unimaginative restatement of previous claims, no matter how weak. They show little sign of imagination or critical reflection.

Keep in mind that you are engaging in a conversation with other academics. Engagement is the key concept: it is a spirit of 'give and take' that respects the value of multiple perspectives. It is easy to make the mistake of thinking that the function of the review is merely to report or describe previous studies in an effort to show that you have 'done your homework'. Rather, you should interweave various studies to build up the argument that the problem you are tackling is not yet solved and still raises interesting and unanswered questions.

Methods and Approaches

Describe the ways in which other researchers are undertaking investigations in your area.

Another section of the background is where you examine the approaches and techniques used by others in research in your topic area. From your previous reading, and from other learning opportunities such as attendance at research seminars, you will probably have become aware of the flaws in research design, research methods, and the reporting of results that can undermine an otherwise competent investigation.

It has been claimed that almost every paper that reports experiments or a quantitative investigation can be found to have a flaw in the research methods, so you need to find a balance between genuine fault finding on the one hand and gratuitous criticism on the other; but it is also the case that a surprising number of papers that present strong arguments and interesting ideas have poor research design. Once you get to know some of the common mistakes, stay alert to them as you review previous studies. Where appropriate, point out the limitations to those approaches. No method is perfect, but your review should lead to an understanding of which methods can be used to achieve solutions to your problem. You will need to draw on this in your next chapter, where you select appropriate methods for your own research program.

In some disciplines, a key purpose of this part of the literature review is to establish baselines. The aim of your work may be to improve on the state-of-the-art: a more sensitive search method, for example. The very presence of these comparative terms (improve, reduce) suggests that there is something you are comparing against. This is your baseline. You need to know what the current best competitor is, and later you will need to test whether your approach has

advantages. Perhaps obviously, there is little value in showing that your approach is better than something else that is already known to be poor—so you need to use your literature review to show that your chosen baseline really is the best that is currently available.

Chapter 6
Explaining the Investigation: Methods and Innovations

The core of your thesis is where you present the contribution developed in your project. Considered as a narrative, it should flow on from the background and literature review, and lead in a natural way to the results. However, the core is the component that differs the most from project to project, and from discipline to discipline. In some cases, it may consist of a description of how data was gathered and how that data relates to the research question. In other cases, it may consist of an explanation of an innovative new technology, followed by an in-principle discussion of why the technology should be expected to be successful, together with an explanation of how the technology can be evaluated. There are many further forms of the core of a thesis.

To get a sense of what you need to discuss in this part of your thesis, the best resource you have is the publications in your immediate field, and other minor theses that have been undertaken in your department. Ask yourself: What have other authors chosen to discuss between the background and the results? What are the corresponding elements of my project that need to be discussed? Here, I can only give general advice, but strongly encourage you to think very carefully about what should be included.

A mistake that some students make is to think of this part of the thesis as a kind of chronological record of the work they have done, rather like an undergraduate report on the sequence of steps performed in a lab experiment. These students haven't yet realised that their thesis is much the same as the research papers they are reading—an explanation and presentation of their work to other researchers who want to learn about their discoveries and insights. Students who have made the transition in their writing from undergraduate assignment to graduate investigation are on the way to becoming independent researchers.

P. Gruba, J. Zobel, *How To Write Your First Thesis*, DOI 10.1007/978-3-319-61854-8_6

Methods

Explain how, and on what basis, you conducted your *study*.

In many theses, the chapter I am discussing is titled 'Method' or 'Research Method'. You may also see 'Methodology' or 'Research Methodology'. But this chapter should include much more than the selection and description of your method. The methods we select are ways of testing hypotheses or answering questions or evaluating innovations. Therefore, if you call the chapter 'Research Method', you are in danger of forgetting to deal adequately with the hypotheses or questions; and if your thesis concerns an innovation, you need to describe it somewhere!

You have told your readers about your hypotheses or questions. Now you must tell them which method or methods you used to test the hypotheses or answer the questions, and why you chose them. You should first review the methods available to you, as I discussed in the context of your literature review, and then justify your reasons for selecting the methods you used. Students often forget this step altogether. You may have adopted a fairly standard method used by your predecessors for testing the type of hypothesis you have put forward, or a method suggested by colleagues or supervisors as suitable. In these cases you might not really be aware that you had selected a method, but nonetheless, a selection has taken place; one of the less obvious aspects of the progress of research is that, not only does knowledge advance, but so does method. There are continual refinements to the statistics that are used to assess the outcomes of experiments, for example, and debates over how best to gather feedback from people whose behaviour is being studied.

Alternatively, you might have put a lot of thought into the selection and justification of your method, but, by the time you came to report the results, you were so immersed in them that you forgot to say why you chose that particular method. But no examiner is going to be kind enough to write, 'Well, even though it is all very unclear, I am sure that the candidate had good reasons for selecting that particular method'. Examiners are specifically asked to check whether the methods you have adopted are appropriate. The method needs to be appropriate to your aim, scope, and available resources, and you are the one that has set those elements in your thesis. The main point here is to remind yourself that you need to review your self-imposed boundaries and to justify your assumptions.

It's worth noting that, in some disciplines, what I've loosely referred to here as 'the core' may be a complex bundle consisting of an innovation, discussion of anticipated properties of the innovation, and explanation of criteria that the innovation is intended to meet. 'The method' is the mechanism for evaluating whether the innovation successfully meets these criteria. The examiner needs to be persuaded of the rationale underlying all of these elements.

Be aware of the concept of *confound*. Lack of consideration of possible confounds—that is, other reasonable explanations for the same observations—is one of the most common weaknesses in theses. Your arguments can only be strong if you actively seek confounds, and show that they do not invalidate your results.

Research Methods

For a thesis, understand how your research design affects your overall argument.

There is a large literature on the topic of 'research methods', much of it specific to particular disciplines. This literature is largely concerned with the practice of research, or, in the terms I've used in this book, developing the research questions and hypotheses, and designing experiments, instruments, and processes for testing these hypotheses. There is also a substantial literature—reaching back many hundreds of years—on the nature of research methods and the philosophical attempt to link observations, experiments, and knowledge. Both of these perspectives on research are beyond the scope of this book.

However, the issues of research methods are intertwined with the development of your thesis. Your research should be shaped, right from the start, by your writing. Until you have made the attempt to capture your questions, methods, experimental design, and so on in a precise form, you are not ready to explain and argue for your research program. You need to be in the position of being able to say, as unambiguously as possible, that '*this* is what I am doing' and '*this* is how I am going to investigate it'. Only once you have a concrete 'this' can your supervisor debate it with you and help you to sharpen your arguments and your thinking.

Another way in which method and thesis are intertwined is a subtle point that many researchers overlook: the issue of measurement, or assessment. A researcher who uses thousands or more words of careful argument to explain a hypothesis and its importance, and thousands more explaining how it is to be evaluated, may nonetheless fail to justify the method being used to measure the outcomes.

Let me give an example. Suppose your project concerns how limitations in the keyboards of mobile devices such as smartphones affect the ways in which people report their experiences (enjoyment of a movie, opinion of a political figure, and so on). Effective communication is the result of several factors, including audience awareness, choice of words, background knowledge of the topic, and personal style. In your research, you have proposed a statistic for assessing whether messages from mobile devices are likely to be influential, and propose the use of message data to see if your statistic is in fact useful.

As a measure, you propose that messages can be regarded as influential if they are forwarded to others, that is, you deem your statistic to be a success if it can predict whether a message will become widely distributed. This measure sounds plausible, and is appealing because the idea of having consistently successful messages would be of interest in communication studies. But do you think that it is sufficient to simply use this measure without some rationale, or without some consideration of the alternatives? I hope that you agree with me that the answer is no! It certainly isn't good enough to use a measure on the grounds that it may have some impact. To see what I mean, consider some of the alternative measures (not all of which you will agree with, but I think you will agree that some kind of argument could be made for each of them): the status of the message sender; the impact in the wider media of the message; or the translation of the message into actions.

Something I've found intriguing is how easily, under prompting, some students find problems with the measures they have been using. It is as though they have never taken the time to think about whether their measures are defensible, plausible, or informative. Another failure of this kind occurs when students don't consider whether their measures relate to the questions they are asking. A common one in computer science is students who examine whether a proposed method of computation is efficient, but haven't examined whether it is correct!

These students haven't considered whether there are confounds that would undermine their methods, or they haven't considered whether they have made assumptions that other researchers would not see as justified. You need to write about the assumptions underlying your measures in order to tighten them into a form where they can be debated with others.

In Mickey's case, scholars in the area of document search have published many papers on the problem of measurement of document analysis techniques. No approach to measurement is suitable for all research questions, and Mickey's underlying data (the reader recommendations in particular) was not fully consistent with the kinds of data that had been used in previous similar experiments. Nonetheless, this literature meant that he could make an informed choice of measurement technique, and justify it by reference to experts in the field.

Another interaction between method and thesis writing is your need to be confident that the evidence you are gathering will, in fact, test your hypothesis. It may seem surprising, but I have often seen research projects in which this is not the case. It may be that a researcher goes looking for some particular data (such as numbers of people participating in a sport), but finds that it is inconsistent or unavailable, and instead decides to make use of other data (perhaps the numbers of people who attend sporting events) that seems as though it will be a good approximation; but the researcher has not realised that the connection to the original argument is lost. Or it may be that the project was inspired by the appearance of some particular data source (such as the discovery of historical records of language use among immigrants to Australia in the 1940s), but that the hypothesis that was to make use of this data had, through the course of discussion with the supervisor, shifted away from issues that the data could resolve.

Thus it is critical that you regularly assess the relevance of your data and method to the aims of the project. Be sure to compare the aims you have written down as part of your introduction with your method to ensure that they correspond.

Instrumentation Design and Use

If needed, design and evaluate your *instruments (survey, questionnaire, interviews, software, equipment, tools, and so on) or use existing instruments that are appropriate to your study. Justify the instruments to be used to gather data.*

For a minor thesis, I prefer that my students adopt existing instruments; given the tight time frame and focus of the study, I recommend making use of

established procedures, tools, questions, and so on. To do this well, however, demands more than simply deploying an instrument in your study. You must adapt it to fit your purposes, or at least demonstrate that it is suitable.

My suggestion is to search the literature well. By now, you have read many articles and sources; which ones used procedures that you yourself need? Revisit those, and see if they included detailed descriptions of their questions, test items, and the like. Write up the reason for choosing a particular one, as well as a brief reason for rejecting other possible options. Perhaps the instrument will need to be modified to fit your own study; if so, detail and justify such modifications. Throughout, note that you have an opportunity to demonstrate your methodological competence and critical-thinking skills, for example by arguing for principled adjustments to improve 'fitness for purpose'.

If your research has involved the development of tools such as software or lab instruments, you need to consider how an examiner will regard them as validated. You may need to report separate tests that demonstrate that this equipment is working, or include comparisons to other 'standard' equipment. The requirements are much the same as for data: you want the examiner to be satisfied that data has been gathered or generated in a way that is unbiased, accurate, representative, and so on, and you similarly want the examiner to be satisfied that you have used robust equipment.

Supporting Your Arguments

Throughout your writing, maintain a critical attitude to your claims, methods, and analysis of data.

The issues of measurement and relevance are aspects of the need for your conclusions to be built on a robust argument. You will use your data and method as part of the path from raw results and numbers to new knowledge; this knowledge is the primary purpose of your thesis. This path, or chain of reasoning, is the argument.

In the context of your method, the main thing is that you need to be confident, in at least a preliminary way, that the path exists. That is, you need to satisfy yourself that if you gather certain data, and it has certain properties, then you can use it to present an argument that gives a clear answer to your question. If you are not confident that you can answer the question, then you will not be able to build the argument on which your thesis will rest.

A perspective on a thesis is that the presentation of the argument is largely made in the results and analysis chapters, but its foundations are actually laid here, in the chapter on your investigation. At this point you need to have established for yourself what the lines of the argument are going to be and addressed any scepticism the examiners are likely to have, by examining and justifying your assumptions.

A last but significant note on this point is that, ultimately, the argument and your assumptions are subjective. Your final line of defence, in choice of assumptions,

method, and so on, is that they are *reasonable* and *consistent*. The final product of your effort is an objective thesis, but it would be dishonest to disguise the fact that some elements are essentially choices, whether they arise from constraints (only certain data was available, resources were limited) or from explicit decisions (such as approaching the problem from a particular perspective). At the same time, you need to be confident that the reasonableness of these choices is obvious to others. If you and your examiners cannot agree on the basis of your research, they are unlikely to respect your outcomes.

Chapter 7
Presenting the Outcome: The Results

If you have been undertaking quantitative work—bench experiments, surveys, measurements, and so on—you need to report the outcomes of your investigations. At this stage of the research, you will have analyzed and interpreted your results, and now you need to use them to present an argument to the reader. If your work is more qualitative (observing and interviewing people who work in a school, for example), you still need to present what you have found, and it may well be in the form of a 'results' chapter. In either quantitative or qualitative work, such a chapter provides a basis for the analysis or discussion that completes the body of your thesis.

Many students perceive their project as, primarily, the activities of gathering, analysing, and interpreting data. From this perspective, the other stuff—such as writing, reading the research literature, and constructing and presenting clear arguments—is a kind of dressing up that follows the real work. There is a grain of truth to this perspective, particularly for a typical quantitative project, in that it is the gathering and handling of the data that leads to answers, and is the investigative part of the work. However, this perspective also completely misses the key element of academic research: it needs to be robust, and robustly communicated, if it is to be of any value to others. A discovery without communication and persuasion is worthless.

The need for robustness is particularly true of the results. A typical examiner will have seen many examples of poor work, and will read every thesis with some scepticism as to the reliability and value of the outcomes. A thorough presentation of the data and results is essential if your work is to be taken seriously. Generally, about half of the thesis can be viewed as a sequence of three components: first, how the data was gathered and what it is intended to represent; second, what the gathered data looks like; third, how it should be interpreted. How to present 'what the gathered data looks like' is the subject of this chapter.

Before I move on, let me clarify the terminology. Discussion of how to present results is clouded by inconsistencies in the way experiments and their outcomes are described. In many fields of research, for example, 'data' is the outcome of the recording of measurements. The data could have been recorded by you as the

P. Gruba, J. Zobel, *How To Write Your First Thesis*, DOI 10.1007/978-3-319-61854-8_7

researcher using the instruments you devised to test your hypotheses, or recorded by some other researcher and then made available. Or it could have been recorded for some other purpose, such as the temperatures recorded at a meteorological station, or the share prices recorded at a stock exchange. But data can also be the subject of an experiment. A researcher investigating a weather model could use temperature measurements as an input, and the recorded values—'data' in the above definition—could be the input to the model, which also produces 'data' as output. Here I use 'data' to describe experimental results, or measurements, and 'outcomes' or 'results' to describe what the researcher found by interpreting these measurements.

Data Preparation

Describe the ways in which the data was prepared and transformed in the process of readying it for analysis.

There is no such thing as a perfect data set. So, when I see data that is reported in a way that makes it seem ideal, I am suspicious. In real research, participants don't respond fully to surveys, answers in interviews are partial or vague, equipment fails or introduces error, data sources are inconsistent, and so on.

Also, data is not usually analyzed in its raw form. For example, data collected in an interview must be transcribed so that it appears in a written form; how detailed the print transcription is will depend on your research question. Other data, too, needs to be transformed: observations, for example, must be collated and categorized; quantitative results may need to be checked for accuracy and completeness; outliers from experiments need to be individually investigated; and so on.

The point is that data preparation is an essential part of your methodology and often takes time. Students may underestimate the time that it takes to prepare the data for analysis. As a rule of thumb, for example, 1 minute of a spoken interview may take 5 minutes to transcribe: therefore, 1 hour of an interview will take 5 hours to transcribe. As another example, data from different sources may need to be manipulated to allow it be analyzed with a single procedure, and it may be that some of it will need to be manually discarded to remove anomalies such as incomplete records. Students need to take the time to both process the data and explain how it was handled; if some outliers are removed, for example, it needs to be clear that there is an objective reason for doing so.

Data Analysis Procedure

Describe, and justify, the procedures for data analysis.

To impress examiners, the results of your thesis must be clear, verifiable, and well presented. Clarity is achieved by being confident of what to report, and what

to leave out. Strive to be concise, and avoid the common tendency to report too much; I think students do so because they feel that 'it might be important' in their overall analysis, and feel that the more they report, the more it shows how hard they have worked. Or, perhaps, they feel that their hard work is being thrown away if some results are set aside and haven't understood that the primary reason for having results is to confirm the answer, not necessarily to fill up the thesis. If you report results that are 'almost significant', doubt about their true significance raises questions about your data collection procedures or perhaps the choice of analytical procedures. Further, it shows poor critical thinking because decisions on what to include, and what to leave out, are not justified.

To verify analysis is to be able to assure that the accuracy can be checked. At times, if an analytical procedure is not well described or set out, it is very difficult to understand what was done to what, and under what conditions. You must describe your analytical procedures in such a way that another researcher can follow them. If the procedures are widely used in your field, verifiability will not be a challenge: if, however, you are trying a new procedure or introducing it from another domain, you must be sure that you can explain it to your readers.

Quantitative or Qualitative Analysis?

The approach you take to presentation and interpretation of your data depends on whether the research approach is quantitative or qualitative.

A common categorization of research is that it is either quantitative or qualitative, or perhaps more accurately, whether it is closer to one or another of these extremes. At times, the same set of data can be examined either way; in a minor thesis, it is good advice to take the approach that is most prevalent in your literature review or the one that is suggested by your methodology.

The experiences of Anouck are a good example. After a review of the literature, the development of a survey, and university human research ethics clearance, she collected data on the streets of Melbourne. She took hundreds of photographs of bilingual advertising signs and shopfronts, and also interviewed people on the street with her survey. When I met Anouck after her data collection sessions, we discussed analysis of her data from both a quantitative perspective, such as mapping of locations, counting the number of elements in the signs, and summarizing survey responses; and a qualitative perspective, such as thematic categorization of the language content in the signs and survey responses, or examining common design features of the signs.

Because Anouck had decided early on that she was going to take a 'social' view of language in use, I advised her to pursue a qualitative analysis of her data. Nonetheless, I thought it would be wise to provide some descriptive statistics ahead of the more substantial work concerning thematic categorization. To me, the descriptive statistics would acknowledge that quantitative work is valued in our field, while a more complex analysis was not justified at this time. Anouck

hesitated: Didn't she have to demonstrate that she knew and understood a wide range of analytical techniques and approaches?

My advice to Anouck—to incorporate some descriptive statistics but make the bulk of her analysis qualitative—was based on three points. First, it would take time for Anouck to find, review, and write up the studies that she would need to be able to show that she understood appropriate statistical procedures. Second, such statistics are not widely used in studies of bilingual advertising, and there would be few relevant examples in the literature that she could adopt. Third, I did not have sufficient background to be able to advise her to the level needed to impress examiners in my department. The solution we proposed was that she outline the use of additional statistical procedures as one of her suggestions for further research.

Mickey's project, in contrast, was highly quantitative. His research was based on many thousands of stories, and on thousands of users who had collectively made nearly a hundred thousand recommendations. To this data (or subsets of it), he had applied a range of computational techniques, producing sets of raw results to which he had applied pairwise comparisons. At one stage, we were concerned that as much as two months might be required just for the computations, which would have been a serious threat to on-time completion; fortunately, we were able to identify much faster alternatives.

Mickey's challenges in processing and presenting this data were many. For example, given the sheer number of individual tests, we needed to take particular care to ensure that there were no bugs and the tests were all valid. Some of the outcomes were very supportive of his question; so much so, in fact, that we had to investigate these in a qualitative way, to check the possibility that the underlying data was faulty. (It turned out that some users had copied the entirety of other users' recommendations, creating false reinforcement.) Some of the outcomes seemed incoherent; again, the data had to be investigated.

Once he had explored the outcomes thoroughly enough to be satisfied that the effects he was seeing were valid, he then had to make informed, representative choices of illustrative examples of the results to present in his thesis. He had to be careful to ensure that the examiner did not jump to the conclusion that these examples were chosen in a biased way; at the same time, only a very few examples, and a range of summary statistics and outcomes of statistical tests, could plausibly be included.

From Data to Results

Data is meaningless without interpretation. Results are obtained by showing how the data relates to the original question via an argument.

You have a hypothesis; you have been busily gathering data and drawing inferences, and, informally at least, linking the data to your original goal. Now you have to take this activity and use it to persuade the reader to agree with your thinking. The process starts with your data.

A first step is to decide, through critical thinking, what is 'in' and what is 'out'. You need to have criteria about what data to include and what data is out of scope, or a justification for your choice of particular data sources. Such criteria can come from a single authoritative published source, or from synthesis of several sources. The next step is to systematically organize the data. I cannot emphasize this enough. You need to create spreadsheets in which the data is laid out in a regular way, or build files in which material has been categorized by key criteria, or draw pictures showing how the data items relate to each other, or something else; but whatever you do, get the data under control. When a student walks into my office clutching a big pile of printouts, or shows me a folder full of files on the computer with no idea of what the file names mean or what is in them, or has lost track of which version of the data is correct, or which graph is current, I know the student is in trouble. A casual approach to managing your data may not seem to create issues early on, but leave things too long and the complexities will begin to compound and get out of control. Keep in mind, too, that having well-organized data helps protect you from possible accusations of falsification of results and gives you confidence in the outcomes.

Materials that are in a mess suggest that the thinking is in a mess. This is a good point for self-reflection: if you find that your arrangement of the materials has become chaotic, then maybe your grasp is chaotic too. Take yourself back to first principles, ask basic questions about the data and what it is supposed to represent, think about how you would like to see it organized—and then make it happen. Remember that a core skill of research is careful thinking. Take heed of signs that suggest you can improve, and act on them. Readers won't trust your results unless they understand that your data is fair, unbiased, and representative. A clear presentation of how the data was chosen, what its properties are, and so on, is essential to establishing trust with the reader, and, just as importantly, satisfying yourself that your data is complete and correct.

Presentation

You need to explain the data to your reader; this may be more difficult than you expect. It is summaries and interpretations of the data, not raw numbers, transcriptions, or photographs, that are likely to be of the most value.

In the previous chapters of your thesis you described the design of your work, explaining how it tested your hypotheses or answered your research questions. You now have to present the results you obtained in this work.

This presentation should not be haphazard. The presentation should *educate* the reader. You may believe that your task is to include every single data point or case that you recorded in your work—but doing so is almost certainly a mistake. You have used this data to draw conclusions as objectively as you can; now the task is to use representative examples drawn from the data, and example analyses of the data, to persuade the reader of the validity of these conclusions.

In any case, even when the data is limited, it is surprisingly difficult to capture it all within the confines of a thesis. Even a brief explanation of a single interview subject might take a page or two; an explanation of how a procedure is applied in one instance in a case study may take pages. Anouck had hundreds of photographs; Mickey's raw results had millions of individual data points, and hundreds of secondary products could be built on these, such as tables and graphs showing the relative effectiveness of the different document analysis methods. Inclusion of all the data is unlikely to be feasible.

And what would be the point of simply dumping the data into the thesis? It is unlikely to be meaningful to the reader. Here are the things the reader needs to know:

- How the data was gathered—where it was sourced from, what aspects of it were measured, what it consists of, what the guidelines were, what permissions were required, what restrictions apply, and so on.
- How the data might be obtained by a reader—whether directly from you, or from an external source; or how similar data might be created.
- What the results look like—by example; or by graph, to show, say, the distribution of values; or by table of typical instances. For example, a common strategy is to list out the categories into which the data can be placed, and give an example of an item in each category.
- Summaries of the complete set of results, in as rich a way as possible.
- Notes of issues such as known gaps or incompleteness in the results, or where the data may be uncertain or unreliable.
- Analyses of the results, using discussion, argument, statistical tools, and so on, as appropriate to the work.
- Interpretation of the analyses, completing a transformation from data to information to knowledge (more on this later).

Inclusion of the raw data is not in this list. Note, by the way, that many disciplines, and most institutions, have research guidelines for how data is managed, retained, and described. Make sure you are familiar with these guidelines as you work through your data presentation.

Somewhere you may want to discuss the data you didn't gather, but would have liked to, and other issues of that kind. My advice is that this is a good thing to do. No piece of research is really complete, and the reader will appreciate your views on where the work could be extended. For the examiner, such discussion shows that you are thoughtful enough to be aware of the shortcomings of your study. Remember that the examiner may well notice them without your help—and acknowledgement of shortcomings is not a sign of weakness.

Reflect on whether another researcher trying to reproduce your work would succeed in doing so—or whether you would succeed in doing so. One of the classic fallacies of science is that, if you repeat an experiment with small variations until it succeeds, and then stop, it may seem as though the desired outcome is achieved. However, if there is any kind of uncertainty in the experiment, it is possible that the positive outcome occurred by chance. If this success is all that is reported, the reader gets a highly distorted view of the true results.

Analysis

Analysis of data is how it is examined for properties of interest, which can then be related to the question. Analysis is closely linked to presentation, because good presentation is required for understanding.

Two key concepts in every aspect of managing data and presenting results are *variables* (or parameters) and *category*. These concepts reflect how we understand data. Assigning instances to categories lets you discuss and analyze data in a consolidated way. Variables determine the behaviour of the data, and we have understood what is going on when we can accurately predict how variables and data values interact. These concepts underpin how you proceed with data analysis, and also underpin how you proceed to teach the reader about the data.

And it is not only the reader who is learning. Your presentation of results is part of your process of interpreting them—writing the results chapter is part of a cycle of understanding, not an end point. Your aim is to educate others, and self-learning is likely to be part of the process, even at this late stage of thesis writing.

I've noted that it isn't valuable to include raw data, and nor is it persuasive to just include one or two brief examples, but don't go to the opposite extreme. In one thesis I examined, the candidate had discovered the power of a graph-drawing facility. His results chapter contained over a hundred graphs plotted by trawling through all of his data sets and plotting every variable against every other possible variable. His readers were given so much information, at such a low level, that they were totally overwhelmed, and learnt nothing about the system under examination.

From my discussion of earlier chapters, you can see how important it is that you state the purpose of the chapter in its introduction, and that you write a summary in which you describe how that purpose has been fulfilled. This rule is as important for the results chapter as for any other. At the end of the chapter, you should share with your readers your understanding of what is now known, but was unknown when the chapter began.

Reasoning from Data

A strong result rests on an interpretation of data that yields new knowledge.

The aim is to use your data to make a case for the proposition being explored in your thesis. Consider the dictum: 'data is not information, information is not knowledge, and knowledge is not wisdom'. As soon as you use data to examine a question—to make a link between a proposition and some observations—it becomes *information* (what the data tells us). For example, temperature measurements collected by the weather bureau become information when used in conjunction with records of plant growth to test the hypothesis that plants grow faster at higher temperatures. Similarly, the data collected using your research instruments becomes information when you use it to test the hypotheses that led to the design of the instruments.

Information becomes *knowledge* when you use an argument to draw conclusions from it: plants do grow more vigorously at higher temperatures, for example. Here, the argument is an explanation of how the information demonstrates the conclusions, and will probably need to explain why other plausible interpretations of the information are likely to be incorrect (you need to eliminate confounds). The argument will also need to explore the subtleties of the data—to demonstrate that the number of measurements is sufficient for statistical significance, for example.

Knowledge makes a contribution when it is integrated into a way of looking at things. It is the implications that you draw from your results that are useful to others: new insights, new theory, new frameworks. Your results chapter is a keystone of the hypothesis-evidence-argument-theory (HEAT) structure of much research, which can be sketched as:

- development of a question or initial hypothesis, which is used to shape the gathering of some observations
- formation of a definite question
- building of tools and use of them to gather measurements to be used as evidence
- construction of an argument that uses the evidence to give a case for or against the hypothesis
- conclusion by developing a contribution to a theory, understanding, or framework.

(As an aside, too many students—and some supervisors!—confuse theories and hypotheses. Theories are the building blocks of research. They represent our best understanding to date: the theory of relativity, the theory of evolution, and so on. They are the concepts in which we have the greatest confidence. A hypothesis is an unconfirmed supposition. Another, arguably worse, confusion is between theory and speculation; some people think they are theorizing when they propose new untested ideas, but from a more formal perspective they may be doing little more than guessing. While such sloppiness is fine in conversation, it has no place in a research thesis.)

The HEAT analysis of the research process points towards what you should include in the results chapter and what you should leave out. Raw measurements do not convey knowledge unless you explain or display them in a suitable way, and should be left out or possibly just relegated to appendices. Results that are displayed in the form of tables or figures that enable you and the reader to make sense of the outcomes become information, and should be included.

Illustrations

In many theses, effective illustrations are crucial to support the explanations and interpretation. Poor illustrations will undermine the value of your work.

A typical results chapter consists of argument and narrative supported by illustrations, such as graphs, diagrams, photographs, and tables. But why are you using them? A typical answer to this question is: ‘I include a figure when it expresses a

point more clearly than does the written word'. On this principle, illustrations are likely to play a role in many parts of your thesis; I discuss them here because the results chapter is one place where they are not just helpful, but essential.

However, the use of illustrations to make a point is, I believe, only part of the reason they are of value. If you wish to get the best out of your illustrations, you need to put yourself in the position of your readers. Do they read the written text until they get to the sentence, 'Figure 6 shows that an increase in the migrant population is correlated with an increased use of bilingual advertising', and then dutifully find Figure 6 to check that this is indeed so? Probably not. My experience is that, long before readers begin to work through your results chapter, they will have opened the thesis and skimmed through it, 'reading' the diagrams and looking at the graphs and tables. It is this, rather than the careful reading that comes later on, that allows the examiner to form an initial understanding of your results.

After other preliminaries, such as identifying the aim of the research and reading the conclusions, the real reading begins. The written text develops ideas in the way that the writer intended, and readers will no doubt follow this development. But at the same time they will be generating their own interpretations and impressions. They will compare material in one chapter with diagrams or text in another in ways that the writer had not anticipated. They might refer to and puzzle over Fig. 6 long before they read the text that discusses it. They might return to it again when something written in Chapter 3 triggers another train of thought. Such exploratory reading is an essential part of thorough understanding of complex work.

Readers can use complementary channels of communication simultaneously, including both words and images. They do not use one at a time, switching from one to the other; rather, they can use them at the same time, perhaps giving more attention to one than to others at any given moment. This leads to some guidelines about visual material:

- The reader should not have to read the text that refers to the illustration to understand what the illustration is meant to demonstrate. Although an illustration should always be referenced by the written text, it should make sense by itself. In the caption, you should explain the context and how the illustration should be interpreted, and draw attention to features you wish the reader to note, even if you have discussed these in some detail in the text.
- Don't cram in too much detail. When I ask students for their view on the functions of tables, for example, they often reply that it is to record data such as experimental readings in a systematic way. This being so, a table might have to contain large amounts of data, perhaps extending over several pages. In my view such data should not go in the main text, but rather in an appendix—or be omitted altogether. A table in the main text must be a complementary channel of communication, and illustrative rather than exhaustive; that's why they're called illustrations.
- Reserve the use of illustrations for things that are important. The reader will focus on them and assume that they are the most significant part of your work;

use of illustrations for minor outcomes can skew the reader's understanding of your argument.

- Put material in a table only when the pattern obtained by arranging things in rows and columns tells the reader something in ways that are better than or different from a written description. If the data in your table seems to you to demonstrate some trend or correlation, you should consider displaying the trend by means of a graph.
- A diagram should be a net benefit to understanding. If the work of explaining a diagram that illustrates, for example, text analysis mechanisms is more work than simply explaining the mechanism, then the diagram is an unhelpful burden and should be discarded. (It can be helpful, though, to develop such diagrams for your own benefit, as they can clarify your understanding and help you to focus on what you are trying to say.) However, never overlook the possibility that a pertinent diagram can greatly improve your presentation.

There are three kinds of figures: diagrams, graphs, and images such as photographs. This book is not the place to give detailed advice on preparation of such materials, but you should be aware of some general principles.

Some authors like to describe aspects of their work as line diagrams made up of boxes, circles, arrows, labels, and so on. Such diagrams can be a powerful way of explaining relationships, but they are inevitably simplifications of complex situations, and may become so simple that they are misleading. A diagram may be a useful way of illustrating the mechanics of speech, for example, but that doesn't mean that a diagram is the right way to show the connection between the historical factors that lead to productive bilingualism.

In Anouck's study of bilingual advertising in urban spaces, she had taken many photographs of signs and shopfronts. Which ones should be included, if any? I suggested that one representative photograph be placed in her methodology section (to give an indication of the streetscape, and to illustrate her data collection), and that perhaps two or three more be put in her results section to show which features she was particularly concerned with in her analysis. The other photographs, I suggested, should be filed away, with the understanding that they could be accessed if requested by an examiner.

Graphs are used to demonstrate trends or correlations, so you need to think carefully about what you are trying to demonstrate.

Usually you will be either confirming an established model or developing a new one, and you should have this in mind when plotting your graph.

With the ready availability of rich tools for creating graphs, such as three-dimensional and coloured plots, the challenge for the author is to repeatedly ask the questions: Is this element necessary? And is it tasteful? The more detail there is, the less likely that it will be correctly understood. My advice is to test your graphs (and other diagrams too, of course) on other students and friends, and listen to what they have to say. If they don't understand what is going on, simplification may be required.

In Mickey's case, there is a long history of research on categorization of documents, with results displayed using a range of established visual presentation techniques. On the one hand, he had to be careful to stay within these conventions, to ensure that his results could be easily understood. On the other hand, this history meant that he had strong examples to use as models when developing graphs, so he did not have to put too much effort into deciding whether a style of presentation would be effective.

Some theses in lab disciplines used to include photographs of equipment such as assemblies for preparation of chemicals; maybe they still do. I am not persuaded that such photographs are more useful than a diagram, and while I've seen a good number of cases where the photograph was included but seemed unnecessary, I can't recall a case where I thought more photographs were required. However, sometimes it is clear that images are necessary—of healthy and unhealthy cells, for example, or of screenshots that demonstrate a software interface.

Some students appear to be comfortable with including truly appalling illustrations in their work. Unfamiliarity with tools is certainly part of this problem, as is the 'but I am not an artist' excuse. Perhaps they say to themselves that artwork is out of their expertise, and use this as a reason to quickly sketch something without even seeking advice. Unhelpfully, the tools for drawing figures and graphs with which most students are familiar are designed for very general applications; they are used by school children even before they can read and write. That is not to say that these tools aren't useful—but their default settings are certainly not intended for pictures that are to be included in research publications.

There are many specific things that I find jarring. This list is far from exhaustive:

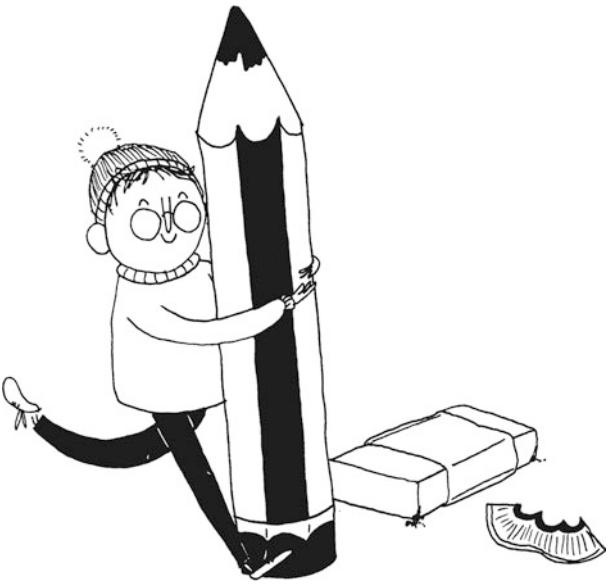
- Lack of principles. Does a box represent an individual, or a collection, or an action? What is the difference between a black arrow and a coloured fat arrow? Do the colours have any significance? Why so many fonts and font sizes? Why are they so different from each other, and so much bigger or smaller than the regular text?
- Congestion. Lines that cross each other unnecessarily; arrows that end in space, or just inside the thing being pointed at; lines that might be pathways, but might be part of a boundary; things under other things.
- Clip art. Are comical sketches (drawn by someone else, and often not very good) really what you want as the most visible feature in your thesis?
- Badly rendered photographs.
- Graphs with grid lines and unnecessary boundaries, poorly captioned legends, and too many lines. Missing data, out-of-proportion marks and line widths, poor use of space, and inappropriate sizing can all make a graph impossible to read, or worse, impossible to take seriously.

There are many good software tools for presentation, some of them free, in addition to those that are included in the common word-processing packages. Take the time to ask around and evaluate the options; you may be surprised at how much difference there is between them.

Many of the principles noted above for figures are just as applicable to tables. They should be self-contained, with detailed captions; they should not be amateurish. Choices need to be made about what grid lines to include or omit, how to align data in columns, what is important, and so on. Complex tables can present particular difficulties, when for example the data is multi-factorial but needs to be represented on a two-dimensional piece of paper.

I've found that a great way to find examples of good tables is to leaf through a first-rate journal. These journals use professional typesetters to arrange tables, and have deep experience in which table elements are clarifying and which are unhelpful. This is again a case where the defaults in word-processing software are poor—indeed, I would say they are dreadful. Find good examples from your discipline, and imitate them.

A final thought on this topic is that many of the problems I see in figures and tables are, I suspect, due to the fact that authors don't anticipate how much work they are going to be. Given that the illustrations will be a conspicuous element in your thesis, expect them to require real effort to get right.



Chapter 8
Wrapping it up: Discussion and Conclusion

In your background and literature review, contribution, and results, you have assembled the pieces of your project as a structured explanation of your work. You now need to explain the contribution of the project: how it adds to or alters existing knowledge. The discussion section is where you explain the value of your work, the significance of your discoveries and outcomes, their limitations, and their implications for the wider field in terms of both theory and practice. This is followed by a brief conclusion. The way this chapter is structured and presented is another component of a minor thesis that varies from discipline to discipline, but there are significant common elements.

Summary of Key Findings

Briefly summarize your overall *outcomes, and how they were achieved.*

It is helpful for the examiner if the final chapter begins with a brief summary of the overall project: it is a reminder of what you have set out to accomplish, but also it shows that you understand the project well enough to explain it concisely. For a minor thesis, two or three paragraphs are sufficient.

To get started, re-read your introduction with a focus on the motivation for the study and its aim and scope. Now rewrite these in a few sentences, keeping in mind that the reader has now been educated by you in your topic, and so can be spoken to in a more informed way. Next, go to your review of literature and write about the main ideas and trends that you found and then summarize the key results in a few sentences. You are now prepared, as is the reader, to consider your work in the context of the field.

Discussion of Results

In light of the knowledge in your field, and with your research questions in mind, discuss how the outcomes of your thesis contribute to current understanding.

P. Gruba, J. Zobel, *How To Write Your First Thesis*, DOI 10.1007/978-3-319-61854-8_8

The difference between a report or essay and a thesis is that the latter is characterized as a sustained argument that helps to build or inform current knowledge. When writing a first thesis, many of my students have felt intimidated, as they believed that they were not yet ready to make a contribution to the field. I tell them, and many find this surprising, that around half of all published research is done by students; though most of them are Ph.D. candidates, it is nonetheless the case that students doing minor theses often produce publishable work.

One way that I use to get students to begin to write their contribution is to have them imagine that they are in a conversation with some of the main researchers that they have reviewed in the literature. Suppose, for a moment, that you are in a meeting with other researchers in your specific area of study. What would you say to them? Now, with experience, would you agree or disagree with some of the results that they themselves have found? (In an engaging presentation, one of my students found pictures of prominent researchers and pretended to converse with them as she set out her work.) So, to get started, reread your own review of literature and then begin to draft the conversation in writing.

An effective way to open your discussion is to list points of agreement with previous work. For example, you may have found that your results largely support a particular hypothesis or way of doing things. Your contribution here is that you are strengthening our confidence in what others have found. As you continue, consider the points in the literature that you disagree with as a result of your own work. By 'disagree', I mean that you should highlight gaps or errors in our understanding. Your work, perhaps, helps to fill some of these gaps in ways that may be novel, innovative, or even surprising to others in the field. Indeed, this is your contribution, and you should show that you are proud of it.

Your research questions should be prominent throughout your discussion. Some students use the research question as a heading and then respond to it directly. Other students restate the research question in a paragraph, for example, and then refer to it as they continue to discuss results. Whichever approach you choose, be sure that you respond in a substantial way to your research questions as you assemble your final discussion. Again, this part of your thesis is where you are making a contribution, as you converse with other scholars in your field.

Implications

To further illustrate the contributions of your thesis, explain their potential broader influence.

Examiners expect that you consider ways in which your work can have an impact or be influential. You do not have the time or resources to establish this broader influence in a systematic way, but possible implications of your work can be discussed. An obvious implication is that the results might suggest new questions. For example, if fiction can be successfully categorised by use of statistical methods, what does this

imply for search methods? What does it imply for other texts, such as newspaper articles? If fiction cannot be usefully processed in this way, what mechanisms might be explored in subsequent work, and why might they succeed where statistics has failed? What might the causes of failure be? And so on.

Once students have thought about the scholarly implications of their work—or how their results may influence research—I like to encourage them to consider how their work could be applied to the 'wider world'. It has been suggested that there are five key areas for consideration.

Pedagogy

How might the results of your thesis influence teaching and learning? If your work relates in some way to the way people teach and learn about your field, consider its pedagogical implications. Your results may influence the way that an entire teaching program (or curriculum) is understood, such as the ways in which new material or technologies are integrated into classrooms. Assessment and evaluation practices, too, may benefit from the application of your results.

Policy

In what ways do the results of your thesis influence areas of policy for institutions, businesses, organizations, or governments? Policies are developed through complex, and often political, processes with a range of stakeholders. If appropriate, consider how the outcomes of your own study may influence such processes and resource allocations as relevant to your domain of study. In this area, your work would help to set the priorities for policy leaders and other influential people.

Professional Development

How do the results of your thesis inform the way that professionals in your field are trained? Think about people who are already working in the field, and how they maintain their understanding of current and innovative practices in their area. You may want to suggest specific areas of professional development that can benefit from your work, or how aspects of your findings could be taught to current professionals.

Practice and Methodology

How might the way that you conducted your study affect future data collection, research designs, or analytical procedures? If your study has involved innovative

methods or instruments to gather data, write about the ways in which your innovation could be applied to future studies. For example, it may be that your approach to data collection yielded richer results, was more efficient, or otherwise provided insights that had not been previously considered. Also, if your project was an interdisciplinary study, and combined practices from different areas, highlight how such combinations have led to greater understanding.

Products

How could the results of the study influence the way products such as materials, software, and instrumentation are designed and built? During your minor thesis, you may have developed a product such as a new material, innovative software or algorithms, a piece of machinery, or a tool. Consider the implications of this creation: How has your design improved on its predecessors? Who might adopt it? What other tools might be improved or adapted to make use of your development? In what ways is it more efficient, more reliable, or less expensive to produce and maintain? You may not know the answer to such questions, but simply raising them, in particular contexts, will demonstrate your appreciation for the implications of your work.

The implications of your thesis will not touch on all of these five areas; indeed, I encourage students to highlight one or two of them. The main part of writing about the implications of your work is to move 'theory into practice', to show that your work has relevance in the world beyond research.

Limitations of the Study and Critical Reflection

If the study were to be repeated, what would you do differently? What are some of the ways in which the project may be limited?

Often, criteria for examination include an awareness of the limitations of the project. You should reflect on areas of your minor thesis that could have led to better outcomes if you had, for example, more resources, a greater range of data collection procedures, or a larger sample size. You should also reflect on your scope, and in particular on what lies outside it. Where might Anouck's results on bilingualism be of low relevance? In what circumstances could Mickey's method be unreliable, or inapplicable?

Maintain a sense of confidence and maturity as you write about the limitations of your study. This is not meant to be an occasion for exposing failings or presenting your shortcomings, but is simply an opportunity to show that you understand your work—which includes knowing what it did not achieve. Your examiners will be well aware that any project has limitations, mistakes, and errors of judgment,

and an acknowledgement of such limitations shows a reflective, insightful mind. It also helps guide others to not repeat your mistakes.

To spark your thinking in this area, revisit the 'aim and scope' section of your introduction so that you yourself understand how you set the initial boundaries of your own work. If you have worked well within those boundaries, then discuss some of the shortcomings. However, do not take responsibility for shortcomings that were beyond your initial boundaries or scope. Again, reflect on the scope you developed early in your project, and perhaps revise it before submission.

Agenda for Further Research

Suggest ways to extend the current project and thus contribute to further research.

To set an agenda is to nominate priorities for work with an awareness of limited time and resources. It helps to define what is important and valued and what is not.

To help my students explore further questions, I ask them to imagine that they are in front of an interview panel for a research position in the field. They would face questions such as, 'Having completed a thesis, how would that work continue to be developed?' or 'If we did hire you, how would you direct your research? What larger outcomes would you seek to achieve?'

Agendas can be set wide or narrow, from abstract to practical, and can be global or local. The tone to set in this section, I think, is one that can be best described as 'pragmatic idealism'. That is, it is important to remain positive and visionary, but not to be so farfetched in your thinking as to stretch credibility. One aspect of agenda-setting is to think of ways in which your work may benefit from collaboration with other fields, or be interdisciplinary, in ways that may be innovative and exciting. This is the classic 'thinking outside the box' way of setting an agenda.

Another way to begin to set an agenda is to outline, or sketch, a series of projects that would result in a particular goal. To be able to achieve a final goal, some particular subgoals must first be completed; identify these subgoals and explain how they would cumulatively lead to significant advances in the field.

Conclusion

Write a brief conclusion to your entire thesis by restating the motivation for the study, its aim and scope, central results, and key contributions.

Conclusions should be complete and concise. For a minor thesis, I suggest that the conclusion consist of no more than three or four paragraphs. First, re-read

your introduction and re-state the main points. Next, re-read the literature review and nominate a few key ideas that led to research questions. Re-state the research questions as appropriate, and then give a brief summary of data collection and key results; I encourage students to make a simple definite statement that is a defensible claim about their outcomes. Finally, summarize the contributions in terms of both outcomes and implications, and then end with a recap of suggestions for further research. In your final few sentences, avoid a tendency to be grandiose or make statements that are not supported by the evidence and arguments in the thesis; your style should be mature and confident, but not excessively flowery.

It is essential to forge the links between the introduction and the conclusion, and between the discussion and the conclusion. As this is the final conclusion, it follows that the discussion does not need a separate conclusion of its own. (For this reason, I find it clearer to have end-of-chapter summaries throughout the thesis, except in this final chapter in which there is a conclusion to the entire work.)

You should now have a deep sense of satisfaction about the whole minor thesis! Any residual doubts may indicate that something is wrong earlier in the document, and you should try to find out what it is. Some diagnostics are as follows.

- *Draw your conclusion solely from the discussion*. I have already hinted at this. If the discussion chapter is where you draw together everything you have done in your whole research project (not just your own experiments or surveys, but also your reviews and analyses of the work of others), then this must be the basis for your conclusion. If you find yourself wishing to include themes or outcomes that you have not worked over in the discussion, you have either omitted something important from the discussion or, more likely, you are still hankering after more than one aim.
- *There should be only minimal discussion in the conclusion*. If you find yourself wanting to engage in further discussion, or are still quoting from the literature, you should have incorporated this material in your discussion. The final conclusion is a good place to tightly link together the themes that have emerged in your thesis, but a detailed analysis should take place elsewhere.
- *The conclusion should respond to the aim stated in the first chapter*. If you take your problem statement and the aim from your introduction, and follow these with your conclusions, the result should be a mini-document that reads logically. When looking at the first draft of a thesis from one of my own students, or examining a thesis from some other student, I always put it to this test. It often reveals that the writer omitted to state the aim, and it is only when I read the conclusions at the end that I can start to deduce what the unstated aim must have been.

- *Summaries are not conclusions*. Summaries are a brief account of what you found out; conclusions are a statement of the significance of what you found out. If you are merely summarizing the argument developed in your discussion chapter, you will feel quite unhappy with your conclusion. There will be no sense of closure. Also, you will almost certainly have failed to respond to the aim of the whole project. (Sometimes this happens when the aim is too modest, or even woolly. For example, when researchers say that their aim is to investigate the properties of a system, they may end up with a list of properties, that is, a summary. This is not research.)
- *Conclusions should be crisp and concise*. The conclusion section may be only a page or so, but brevity can help create a sense of closure.

Appendices

Appendices are the logical place to keep material that supports the main argument, but is needed only for reference.

Appendices do not participate in the main thread of argument, but their purpose is to support the overall thesis in one way or another. They might establish the context of an item in the main text, or give the derivation of an equation. They are often used as a repository for raw or transcribed data. They might give a sample of a completed questionnaire; in this case the main text would describe how the researcher constructed and administered the questionnaire, and would summarize the results obtained. In some cases, a human research ethics clearance or a permission form to gather data might be included in an appendix.

As appendices are there to support material in the main text, you should insert a reference to them at the appropriate point. It is pointless to include appendices that you don't refer to in the text. (You may think that this is too obvious to mention, but I have often seen stand-alone appendices.) Give the appendix an appropriate title—not just 'Appendix 3', but 'Appendix 3: Derivation of the Logistic Equation'—and briefly explain its purpose.

Some students include an appendix without justification. I wonder if this is 'shopping cart' reasoning: the student wants to have one of everything in the thesis: one table of contents, one introduction, one elaborate figure, one appendix, and so on. If it is clear that you have material that the examiner is likely to require, and it is clear that this material does not belong in the main body of the thesis, then put it in an appendix. Otherwise, leave it out.

Chapter 9
Before You Submit

You have just typed the final sentence of your conclusion. Finished at last? Wrong—you still have a great deal of work to do. You have two major tasks ahead: you must revise your first draft in response to the criticisms of your supervisor and friends, and, when you have done that, you must check the details of the whole work.

What you have done is to finish a complete first draft: a collection of chapters written according to the structure you devised. Now you need to focus on 'structural editing'. At this point, it may appear to you (and your supervisor) that each chapter is coherent, but you have to consider whether the entire thesis, as an extended argument, is coherent and consistent. You also need to check whether your argument systematically progresses from the aim to the conclusion; whether your aim itself has drifted during the course of the research; whether there is extraneous material that you should transfer to appendices, or delete; and whether important insights have emerged to which you gave little or no prominence in your original structure, but which are now demanding more attention. When you have fixed all of these points, the structural editing is complete.

As you work through the second draft, you will also need to work on sentence-level editing with a focus on details. There are many aspects to check: spelling, punctuation, captions to figures and tables, references, and consistency in everything including notation, nomenclature, format, reference style, and writing style. Although these tasks are not always intellectually demanding, you have to do them properly, and they take time. And they *are* important. What may seem to you to be minor errors in your text can send the reader a strong subconscious message that, fundamentally, you don't care about the work and it has been done in a sloppy way. Such messages are damaging to your final grade and professional reputation.

This chapter is based on material originally written by David Evans.

P. Gruba, J. Zobel, *How To Write Your First Thesis*, DOI 10.1007/978-3-319-61854-8_9

From First to Second Draft

After completion of a first full draft, a surprising amount of work remains, including the task of getting good feedback from your supervisor.

Some students, when they have typed that last full stop in their final chapter, print out a clean copy of the entire thesis and give the whole thing to their supervisor to read. Although this gives students a strong sense of completion, and of self-congratulation for all of their hard work, there are many reasons why this is not a good idea. First, the supervisor should have been giving feedback chapter by chapter, and may already have expressed satisfaction with some chapters while asking for extensive revision of others. If a supervisor thinks a chapter is done, there may be no need to ask that the material be read again. Second, you should submit work for review only after *you* have reviewed it. If you can see that further revision is necessary, why waste your supervisor's time doing work that you can do yourself? If a chapter is in good shape, you are likely to receive thoughtful feedback, rather than comments that do no more than point out that the work is still full of problems.

Handing over a thesis chapter by chapter means that you can continue to work while waiting for feedback. A supervisor who is given a complete final draft of a thesis may not return the manuscript for weeks, and such delay is likely to be frustrating for you.

What I do with the first draft is parallel to what I expect examiners of a thesis to do: I assess it. The only difference is that, because I am your supervisor, I am now familiar with the trajectory of your argument and approach, and I guard against reading things into the draft that you have not actually explained. When you are reading your own work, a common problem is that you see things that are not really there. For that reason, you should put your thesis aside for a few days before you read it as a whole.

When making a detailed review of a thesis, I prefer to work on a printed copy. Despite decades of experience of writing documents on screen, I find that a complex document cannot be read thoroughly in electronic form. As word-processing software improves, the advantages of hard copy are reduced, but it is still easier to thoroughly read and annotate a large document on a printout than on a screen.

On the topic of supervisor feedback, form your own judgments about its reliability. Some supervisors are extremely careful and give specific advice on what to fix and how to do it. Others tend to give generic advice that can lead an incautious student to make a mass of unnecessary changes. A colleague of mine was tormented by his supervisor's habit of asking for a change on one draft, then, on the next, asking for it to be changed back. The problem was that the supervisor sometimes didn't take the time to read the work properly, and thus didn't appreciate why things had been presented in a certain way. Be sceptical and think for yourself about everything, and do not blindly follow what may be wrong information or bad advice—especially when you *know* it is wrong.

Sometimes, specific advice is not appropriate; if I see some sentence or argument I don't understand, but where I suspect the student hasn't really thought about what they are trying to say, I may simply annotate it with a comment such

as, 'Are you sure you know what this means?' I expect my students to understand that fixing it means that, first of all, they need to try and analyze, then rectify, the problem for themselves—but I also expect them to check with me before doing anything drastic. If the problem is subtle or complex, I'll also include an explanation of the issues I've found, because, while I do want my students to develop their critical-thinking skills, I don't want them to waste their time.

In the early stages of working together, Mickey wasn't good at handling feedback from me. He was not an experienced writer and, although he produced text quickly, it was often full of minor mistakes. Worse, it tended to be disorganized, with bundles of unrelated thoughts gathered into the same paragraph, or the same topic discussed in multiple places. Indeed, this was something like his style in conversation! I did not see this way of generating text as a problem, but what was a problem was that the resulting 'brain dump' was unreadable. In one instance, I gave him detailed, constructive feedback in terms of grammar, word choices, organization, flow of ideas, and comments on missing or unnecessary text, which we reviewed together in a meeting. I later found out that he had felt that my extensive comments—there was a *lot* of ink on his draft—were a way of telling him that the manuscript was rubbish. Eventually, he understood that my intent was to help, not hinder. If you are in doubt, talk to your supervisor about how to handle extensive comments. It takes practice.

Structural Editing

When I receive an entire draft thesis to read, I first look at the overall structure. I skim the table of contents, for example, to check that it corresponds with the chapter titles and main section headings in the text. It should tell me straight away whether there are any major structural problems. If it is not informative enough, I go to the beginning of each chapter and read the introductions in order. At this stage, I am looking for logical links between each chapter, and then to see how they come together as an overall argument.

After skimming the chapters, I then re-read the introductory chapter *as if I were a reader seeing it for the first time*. Thinking as an examiner, I ask myself: Is this telling me (the uninformed reader) why the work is being done? Is it clear what the aim of the work is? Is there an adequate sketch of how the writer intends to achieve this aim? Is the scope of the thesis clearly delineated? Again, if any of these points are inadequately covered, I note the problems in the margin. Then I go straight to the conclusion, and ask myself whether it responds to the stated aim. Additionally, I look over the reference section to see if major works are absent, and to get an overall feel for the extent of literature that has been covered.

The Main Text

Next, I read the whole draft from beginning to end, noting spelling, grammar, and typographical errors as I go, and also noting things such as obscurities, poor style,

and places where the argument seems to have logic gaps. At the end of each chapter I write a few lines about how the chapter shaped up in the context of everything that preceded it. The summary of the chapter is particularly important here. One of my most common comments on summaries is that the author has written a list of the chapter contents, rather than giving me, the reader, a sense of how the chapter has advanced my comprehension of the argument.

A related check at this stage is to see whether the text has *flow* and *motivation*. When I am reading, for example, an explanation of graphic design, I want to know why it is there—how does it relate to the overall topic of bilingual advertising? When I am reading a description of experimental apparatus, I want to know why that apparatus was required, and what kinds of tests it is going to be used for. The old adage is 'tell the reader what you are going to say; then say it; then tell the reader that you have said it'. Sometimes this is described as 'make sure that everything has a top and a tail'. At a coarse level, this is how a chapter is organized—the introduction and summary provide motivation and context for the chapter's contents. The same principle should be applied at a more fine-grained level, so that the reader is never left wondering, for example, how a particular section or paragraph is relevant to the rest of the thesis. While top-and-tailing can easily be overdone, it is a critical tool for helping to ensure that the thesis has narrative flow.

By the time I have reached the end of the thesis, a sense of the integrity (or lack of it) of the whole document has usually built up. If there is a problem, it may be obvious. If it is not obvious, I repeat the first step—the examination of structure—but now with an understanding of how the argument has developed, or has failed to develop. There may be major gaps in the argument; there may be material present that is not part of the argument and should be relegated to the appendices; there may be repetitions that should be eliminated or consolidated; there may be material that would have been better located elsewhere in the document; there may be conclusions emerging strongly at the end that the student should have emphasized more, or had failed to argue for in the discussion, and so on. Before handing it back to my student, I write comments on these larger problems.

Thus the student now has two sets of feedback: detailed comments in the text on points of grammar and expression; and general comments about the structure of the argument. We discuss the latter, and the student gets to work on the second draft. As the student produces revisions of various parts aimed at solving particular problems, we review them. I usually find that a complete re-reading of the second draft is not necessary until after the more detailed part of the finishing process: revision.

Revising

Take the process of rewriting, and rethinking, seriously. Problems should be identified and fixed, even if they are found at a very late stage in the writing process.

As I recommended earlier, there is much to be gained in writing the background before or during the time when you are carrying out your own research.

However, when you have finished the research it is time to rewrite the background. You are now much clearer about several things than you were when you first wrote it:

- You understand the links between your work and the work of others.
- You now know what assumptions you made, perhaps unconsciously, about your study area. These can now be made explicit.
- You are aware of the issues surrounding the application of current methods in your field, and have explicitly pointed out their limitations.
- You may have realized, perhaps with the help of feedback from your supervisor, that you were making unwarranted assumptions about other people's knowledge of the background to your project.
- In your efforts to understand and interpret the results of your work, you will have reached a new level of understanding of the work of others—this is what is meant by a 'critical' understanding.
- You may have commenced your work without having developed a final version of your research questions. Check your wording again—and revise accordingly.

Such issues provide insights into how you should revise the background chapters:

- Ensure that the ways you are going to use words and ideas are carefully defined. Where these are fundamental to your work, the development of these ideas in the literature, or even the history of ideas, must be discussed.
- Any formal literature review that you do at an early stage should not appear in the final thesis in that form. What you should have, rather, is a structured account of the literature. You will be able to impose a structure on it, because by now you have largely finished your own work. Additionally, ensure that the structure provides a firm basis for your discussion chapter.
- Your thesis will include an appropriate formulation of your research questions or hypotheses. You have to work back to where these questions or hypotheses came from, and ensure that your background chapters prepared the way for them.
- You have to be ready to cut material out of background chapters if it is not used elsewhere in the thesis. The background chapters are not an end in themselves. They are merely the context for your project. Adopt a critical attitude, and aim for concise writing. If you have material that is not being used as either background to your work or context for the discussion of your results, delete it.

Finally, be alert to getting ahead of yourself. You may have inadvertently put work that is appropriate to one section in another, or forgotten to introduce a concept that you later discuss in depth, or begun to report outcomes without realizing it. Again, with a critical attitude, move or delete material from chapters when it interrupts the logic of your overall argument.

Checking the Details

The final step is to polish the text, and to check for any minor errors.

Although the second draft is now essentially complete, you still have some detailed, rather tedious work to do. Don't skip it—tedious or not, it is essential. The items that you need to check are listed below. You may even want to photocopy this checklist and tick the boxes when you have completed each task. If you have used your word-processing software effectively, though, some of these will already have been done.

Your thesis may include text that you already regard as 'finished', such as material drawn from reports that were written during your project; some departments, for example, ask all thesis students to write a separate literature review as an intermediate goal. You may be surprised to find how much change can be required when such text is integrated into a thesis. Make sure that all of your text is checked to the same level of detail.

Preliminary Pages

The first few pages, before the start of Chapter 1, set the context of the thesis. These initial pages will include some or all of the following items, generally in the order given below:

Title Page

- Check that it contains title, author, place, month, and year, the degree for which the thesis is submitted, and any task-specific requirements.
- Check that the title of the thesis accords with your aim. Two risks may arise here: (a) You may be tempted to use an eye-catching title that could disorient the examiners. This might make you feel pleased with yourself, but it is better to make sure that your thesis passes! (b) The work is difficult to search for future researchers because the title contains obscure, or perhaps very common, terms.
- Check whether you are still using the title that you nominated at the start of your project. Your initial aim will almost certainly have changed over the course of the work, and you may need to realign the title accordingly.

Abstract

Include a brief synopsis of your work in a single paragraph that includes: (a) the context and motivation of the problem, (b) the statement of the problem; (c) an overview of methods and key results; and (d) significant outcomes and implications.

Table of Contents

- List all chapter headings and headings of main sections within chapters. (Many students also list subsection headings. I suggest that you don't; they clutter up the table of contents and weaken it as an explanation of the structure of your thesis.)

- List all end matter (References, Appendices, and so on).
- Check the styles for table of contents entries, and change them if necessary to make a neater, more informative table of contents. It's a good idea to look over several completed theses to see how other students have done this. Select for yourself what works well, and avoid what doesn't work.
- It is optional to include lists of figures and tables; these are not essential, but are valuable in a thesis with a lot of technical material.

Preface and Acknowledgements

- A preface provides information about the preparation of the thesis that you feel is necessary, for example to explain how you came to embark on the project. Prefaces are seldom necessary for minor theses.

- Acknowledgements recognize help received in the execution of the research, including funding and scholarships, and in the preparation of the thesis.

Declaration

- Most universities require certification that the work in the thesis is your original work, and has not been used for the award of any other degree.
- If you have published work from your thesis before the final submission, you must list complete references to such articles. You need to do this to avoid possible accusations of 'self-plagiarism' or submission of work that is not entirely original, and you will need to clearly identify the extent to which the papers are your own work as distinct from that of your co-authors.

The Main Text

If you have been following the methods I advocated in the preceding chapters, everything in this checklist should already have been done. But do check. If you have just picked this book up and have not been following my suggestions, use this checklist, and if necessary go back and read the relevant chapter.

Aim and Scope

- Can the aim be located in the table of contents?
- Is the reason for doing the work outlined?
- Does the aim follow clearly from this problem statement or rationale?
- Are constraints stated that limit the scope of the investigation?
- Is the aim followed by a brief outline of the way you intend to go about achieving it? (This refers not only to the experiments, surveys or investigations that you will design yourself, but to the whole of the project, including reviews of theory and so on.)
- Do the conclusions you draw in the last chapter relate clearly to your aim?

Background

- Do the introductions to chapters and sections clearly state their purpose?
- Is there any material in the background chapters that does not contribute directly to the later development of the report or thesis? (If there is such material, it should be relegated to the appendices, or omitted altogether.)
- Do the background chapters justify the formulation of the hypotheses or research questions?
- If you are using a case-study approach, does the reason for selecting the case study, and a description of it, appear among the background chapters? (It should not, as it is part of your research method, and such material should not be described until you have selected your method.)
- Similarly, have you explained your contribution in the background? (You should not, as such material belongs later in the thesis.)

Design of Your Own Work

- Do your hypotheses or research questions arise logically from your reviews of theory or practice, or from your preliminary surveys or experiments?
- Do you discuss the possible methods for enabling you to test your hypotheses or answer your questions?
- Do you explicitly select a particular method or methods, and justify your selection through your review of other possible methods?
- Do you explicitly design experiments or other research programs to implement the selected method or methods?
- Are tests for your hypotheses, or ways of investigating your questions, unequivocally built into your research programs?
- Have you justified the selection of your data and method in terms of its representativeness or typicality, or other appropriate criteria?
- If you have decided on a case-study approach, have you justified this decision adequately?

- Unless offset by a colon and designated as such, does the name of the case study appear in the title or aim of your thesis? (It should not. If it does, you still have not sorted out the difference between a study of something in its own right, and the use of a case study to investigate a broader phenomenon.)

Results

- Are the results of your experiments or surveys or other own work clearly presented and explained?
- Are displays, such as graphs, table and figures, uniform in style and numbered?
- Are the major trends or findings outlined? (You should not be discussing the implications of them while you are reporting them. For a short paper this might be appropriate, but for a thesis keep them separate.)

Discussion

- Do you discuss your own findings in light of your overall purpose, the literature, and key findings, and then suggest implications for practice and an agenda for further research?
- Does the discussion permit you come to a final conclusion?

Conclusion

- Is your conclusion justified by the preceding discussion?
- Are you forming new points for discussion while drawing a conclusion? (You should not be.)
- Does your conclusion respond to your aim, as set out in your first chapter?

Format

Presentation varies widely from discipline to discipline, and you may have read several sources that use a range of formats. With your supervisor, discuss a standard format and style for your area, and then find a guidebook to help you to present your work consistently. Many formatting conventions can be managed by an effective use of a template, as discussed in Chap. 2.

Figures and Tables

Check all figures and tables. All must have a caption that consists of a title (which will appear in the lists in the preliminary pages) and explanatory material that draws attention to or explains certain features. If the work has been adopted from a published source, you must provide an appropriate citation. You may have all the figures, including graphs, diagrams, plates, photographs, and maps, together in one list, and then all the tables in another; this would give you a 'Table of Figures' and a 'Table of Tables'. When evaluating a table or figure, ask:

- Does it add to your ability to give a piece of information, demonstrate a trend or communicate an idea?
- Do important points emerge clearly?
- Does it, together with its caption, make sense by itself, or do readers have to read the text to make sense of it? (They should not have to.)
- Do you draw attention to important points in the caption?
- Is there a reference to the figure in the text *before* the figure itself?
- Have you acknowledged the source or the information on which it is based?
- Have you identified examples of 'good' figures in other people's work, and applied the lessons to your own work?

Any Graph (or Chart)

- Does it have both axes clearly labelled?
- Is the text legible?
- Are lines and other features appropriately labelled?
- Have you sought out and followed guidelines on design and preparation of visual materials?

Any Table

- Have you arranged it in some way that makes it more than a collection of data? Would the reader see patterns or trends? (There is no justification for having tables otherwise.)
- Is it vertically and horizontally consistent?
- Are there unnecessary lines?
- Are all rows and columns labelled?
- Have you considered relegating the data contained in it to an appendix, and plotting the main trends as a graph?

Notes and References

If you have used the numbered notes system of references, use your word processor to automatically number or renumber notes. It will enable you to collect your notes at the foot of each page or at the end of each chapter or at the end of the main body of text (but collected separately for each chapter), before your 'References'. Give your list a heading 'Notes', as a section-style heading if at the end of each chapter, or a chapter-style heading if at the end of the text.

However, be sure to check some things:

- Re-read the notes to make sure that you have not accidentally deleted any, and that you wish to keep the ones you have.
- Check whether you need to revise any notes in the light of revisions to the text.

Whichever reference system you use, include a full list of cited sources. The list should be in alphabetical order of authors' surnames, and should contain sufficient detail to enable the reader to find the material. Check your list, particularly if you are using bibliography management software or other automatic tools:

- Is your reference list in alphabetical order?
- Do the entries conform to an established style? Use the preferred style for your discipline and be consistent.
- Do all the references cited in the thesis appear in the reference list?

Title this section ‘References’ in the style of a chapter heading. (To clarify: a list of references contains only cited material, whereas a bibliography may contain other material of interest. For a thesis, ‘References’ is preferable.)

Appendices

The purpose of appendices is to include, for the examiner, any material that may be relevant to the overall research project (such as ethics clearances, data samples, or transcripts) but does not directly contribute to the flow and logic of an extended argument.

You need to justify why such material is needed by an examiner, and only include it if it is indeed required.

- Is there a preamble that explains briefly what its function is and what it is all about?
- Does the preamble refer to part of the main text? If it doesn’t, find the part of the text that it supports and make reference to it. If the appendix contains material that is unnecessary, or provides little support for your argument, delete it.

Glossary

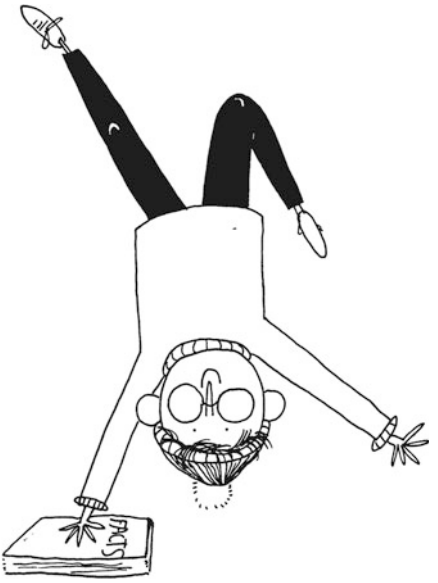
If you include a glossary, consult your discipline’s style guidelines to identify where best to include it in your minor thesis.

And Don’t Forget …

Your thesis needs to consist of your work, not that of other people. All text that is drawn from sources written by other people must be in quotes and fully acknowledged with citations. Inclusion of anything that is copied, paraphrased, or edited from the text of others without clear acknowledgement is plagiarism, and will lead to serious consequences. Further, it is not acceptable to include excessive volumes of text from other publications, even with acknowledgement.

If you have access to a tool for checking whether your text is original, use it. If you have text that is drawn from anything that you have co-authored with other people, make sure that they understand that it is being used in your thesis; you may be expected to include a signed release form from all of these authors, so you must check any requirements. Only include figures and tables if you have permission to do so; if you are not the author of a figure, you must ask the authors and

publisher if you can use it. If you are including material from papers you have written, it should be material you were responsible for; if one of your co-authors wrote a section without significant input from you, then it should not become part of your thesis.



Afterword

If we were asked to provide a single piece of advice to students writing their first thesis, it would be this: make a substantial time commitment to the project right from the start. No matter how far away that submission deadline may seem, you will have to learn many new skills before you finish, and you must work independently and do a great deal of reading and writing, as well as analysing, revising, reworking, and editing. Just about every thesis student regrets delays and procrastination.

To be successful, start writing early, take a professional approach to your project, and actively seek to keep your overall argument on track. We recommend that you don't choose a topic (or supervisor) that is not a good fit; work to a realistic, detailed schedule that breaks the project down into small components; don't get distracted by short-term deadlines such as assignments; and don't forget that completing even a minor thesis—a step that allows you to join a community of scholars—can be truly challenging.

Students who have done well in their coursework generally do well in their minor theses, provided that they put in sufficient effort. But there are exceptions, and it would be a mistake to assume that, because you have been an outstanding undergraduate student or have done well in your graduate coursework, a minor thesis will be straightforward. The skills of coursework are different from those of a minor thesis, and it is critical to recognize that you are taking on a new kind of challenge—and so you need to be aware of the possibility of unexpected setbacks.

At the start of this book we introduced you to two minor thesis students. Both Anouck and Mickey were slower to start than we would have liked, but managed to catch up in the middle of their projects. Anouck in particular initially struggled with the discipline of meeting milestones, but over the duration of the project she developed a more mature approach to her commitments. Mickey consistently worked hard, but also had to mature, in his case to become less sensitive when, for example, he had misunderstood a task or needed to redraft some weak text. They both finished well. Anouck went on to a PhD, while Mickey found a job at a search engine company.

P. Gruba, J. Zobel, *How To Write Your First Thesis*, DOI 10.1007/978-3-319-61854-8

As a final note, for many students, success in a minor thesis is transformative. It gives them the confidence to take on more ambitious goals, whether outside university or in further study such as a PhD. Approach the thesis with an open, enquiring mind; under take it with diligence; and thus complete what is often a deeply satisfying experience. It is a pathway to joining a community of scholars and to broad recognition for your intellectual accomplishments. Make the most of the opportunity, make use of all the resources available to you, and look forward to the completion of a rewarding achievement.

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