

M.Sc. in Cognitive Psychology and Cognitive Neuroscience

Guidelines for writing a Master Thesis at the Department for General Psychology and Cognitive Neuroscience (Prof. Schweinberger)

I. Master Thesis

I.1. Aims

According to the catalogue of modules for this master, the master thesis (module MPSY 400) covers 30 ECTS credit points, equivalent to a workload of 900 hours, or the full-term equivalent of one full semester. This means that your supervisor(s) know that they have a responsibility to suggest a topic and type of research that can be realistically completed within 6 months (of full-time equivalent work) – even when students typically begin their work towards the master thesis considerably before the final semester, and also may not work a full 100% on the master thesis in their final semester. As to the content of the work, the module catalogue specifies: “*By evaluating literature and applying empirical methods, students develop a psychological thesis according to their specialization. During the master colloquium students present the topic of their thesis.*” As to learning and qualification goals, the module catalogue specifies: “*The students show that they are able to work on a psychological thesis according to psychological standards. Furthermore, they show that they know how to use psychological methods and how to present a scientific matter in a written way properly.*”

By necessity, these are fairly generic descriptions. These present guidelines are therefore meant to give you a better idea for what is expected when you conduct a master thesis at the Department for General Psychology and Cognitive Neuroscience. If you are not planning to pursue a career in science, this may be the biggest and best research project you conduct in your lifetime. It can be a great aspiration to strive for a master thesis of a quality which (with appropriate editing and shortening) could potentially enable the work to be included in a paper submitted for publication to a scientific journal. Of course, this is not the normal case, but be assured that we do have

quite a few examples for master theses which eventually became part of paper publications. Some of these had remarkable scientific impact, and many of these may have been important for shaping plans of our master students for their successful professional career (examples include Hauthal et al., 2012; Humble et al., 2019; Itz et al., 2014; Ritter et al., 2020; Skuk et al., 2020; Stahl et al., 2008).

1.2. Types of Theses

For many years, this department (like the institute) has been supervising empirical theses only, and these often entail collection of data in our research labs. However, under pandemic conditions we have become more flexible (in line with the recommendations by the DGPs in their letter from March 23, 2020). We consider that empirical research often has to be completed under great time pressure, particularly when the research is used for qualification work. At present, master theses therefore can include types of research that include experimental research in the lab, but also online experimental data collection, test development/validation, meta-analyses and systematic reviews, or novel data analyses from existing data sets. In all cases, we strive for flexibility, while ensuring that the quality of academic education is ensured. Your supervisor will advise you on authoritative “best practice” recommendations for the type of research you choose for your master thesis, which would be beyond this guideline.

1.3. Planning the Research

When you plan your research, try to work on your introduction early. Wrap up the state of research in your field of interest, highlight open questions, and develop a study question. Whenever possible, embed your research in current psychological theories or models. Develop a few central hypotheses from previous findings in the literature. Note that this department is in strong support of the “Open Science Principles” (Open Science Collaboration, 2015), which aim at making research more transparent, replicable, and accessible. It is a good idea to become familiar with Open Science Principles, and to visit the platform <https://osf.io/>. In fact, it is likely that your supervisor will

encourage you to use the platform as you develop your study. One of the powerful features it provides is the option to pre-register your hypotheses when your study is fully designed – but, critically, before you have collected your first data. Even with complex study designs and data sets, this can allow you to document how your research has developed in a hypothesis-driven manner (as opposed to a purely data-driven approach to looking at your results).

Ethics. Before you start data collection, it is your responsibility to make sure that your research is in accordance with the guidelines for research of the German Society for Psychology. Remember that this is what you should declare explicitly in your thesis (§7 Abs. 3, Berufsethische Richtlinien, Deutsche Gesellschaft für Psychologie, DGPs, also refer to <https://www.dgps.de/index.php?id=85#c2001839>). Because these are adapted from the Ethical Principles of Psychologists and Code of Conduct of the American Psychological Association, you may additionally refer to these (published in *American Psychologist*, 2002, 57, 1060–1073. Refer to standards 3.10 and 8.01 to 8.15 there). Check with your supervisor whether or not it will be necessary to submit a proposal to an Ethics Board before you start. Finally, if the research in your thesis was reviewed by an Ethics Board (for instance, in the context of a funded project of your supervisor), you should add that information to the methods section of your thesis, together with the reference number of approval.

1.3.1 Sample Planning and Power Analysis

Another issue that we take very seriously is the adequate planning of your sample size for your research, with respect to statistical power. Frankly, it can be a waste of time to conduct studies that do not have sufficient power to detect an effect of interest - some researchers even consider underpowered studies to be unethical for that reason. Perhaps less well-known is the fact that studies can also be overpowered – the danger here is to find and report effects that are statistically significant under the classical “null hypothesis significance testing” (NHST) approach, but that they explain such tiny proportions of variability that they are of little or no practical relevance (Cumming, 2014). In addition, overpowered studies can waste resources

(e.g., excessive course credits as a limited departmental resource, in addition to time and effort). In most cases, you can use excellent free software such as R (R Core Team, 2020) or GPower 3 (Faul et al., 2007) to calculate the statistical power of your study plan. We know that power analysis can be challenging: although most researchers would agree that it is a good idea to plan a study such that you have a power of at least .80 to detect an effect of a certain size with an alpha level of .05, there are at least two issues that deserve consideration. First, if your study tries to replicate an effect already reported in the literature, you can use that effect size (hopefully reported explicitly in that paper) as a basis for your power calculation. Alternatively, you may calculate, and report, power for small, medium-sized, and large effect sizes for the critical effect you are after. A good authoritative reference on effect size estimates is Fritz, Morris, and Richler (2012). In any case, you should note that we typically expect you to report an a-priori power analysis in your methods section.

1.3.2 Practical tips

Once you have planned, designed, programmed, and set up your study, it is essential to collect a few datasets from pilot participants, and to check that your data structure is meaningful, complete and suitable for statistical analysis. Better be safe than sorry: Of course you can do stats on data from two or three participants – this will not be very meaningful in terms of an interpretation of findings, but it will allow you to check whether your data structure and analysis routines work, or whether there are still residual errors that are better corrected *before* you collect your final dataset. But once you and your supervisor are happy for you to start data collection, it is also a good idea to write the methods section of your thesis at this point in time. This is because you now have all the information necessary for describing the methods (except for the sample) – and more, you have just compiled that information. It will be much easier for you to document all the aspects of the study (including, say, a perfect description of the luminance or size of the stimuli, the distance of a chin rest to the presentation monitor, or the filter settings of the EEG amplifier) at this point in time, and it is much harder to reconstruct this information a few months down the line when you would need

it for your thesis. Always write your method section with the aim in mind that it should enable other researchers to understand your study to a level of detail that would allow them to replicate your work. You can use appendices in your thesis, or supplementary materials in your OSF project, to document material (for instance, a list of all your stimuli) that would distract from reading the essential information in your methods section.

I.4. Data analysis and presentation of results

Plan enough time for analysing your data. Try to understand your data. Look at data from individual participants to get an impression for individual differences. This will also help you to identify potential artifacts (particularly important for, but by no means restricted to, EEG data), and to discuss with your supervisor ways to deal with these where necessary. To keep your analyses transparent and replicable for others, use scripts whenever possible, comment your work in these scripts. Discuss with your supervisor if the use of version control software is advantageous for your project. When you report your data, consider reporting effect sizes, and confidence intervals around effect sizes (cf. Fritz et al., 2012). Forest Plots (Cumming, 2014) are now also popular for good reasons, particularly when results from meta-analyses or systematic reviews are to be presented. For visualizing data from neuroscience, a good guideline paper is available (Allen et al., 2012).

II.1. Write-up

While there are countless possibilities for flaws in theses, excellent theses share a substantial number of features, despite differences in topics. Writing styles can differ, but many experienced scientists report that it helps them to write the abstract early on. The abstract is your blueprint for the whole thesis. It forces you to prioritize, and to highlight a small number of results that you consider the most important. Even when you modify your abstract multiple times as the thesis develops, this is the norm, and not a problem. Regardless of your writing style and preference, do consider that the abstract deserves perfection – for a scientific paper, the abstract is THE most important text which determines the likelihood that others will be interested to read on, and

whether you can bring the message of your research across. When writing, always try to take the perspective of your target readership.

The best and most authoritative document to consult in all questions of manuscript preparation is the Publication Manual of the American Psychological Association, in its current edition. The current 7th edition (APA, 2020) came out in 2020 and can be expected to be the standard for the next decade or so. It is available in paperback for cheap money – well worth the investment – but is of course also available at the library (ThULB). You should consult it whenever you have a question – in most cases you will find a clear answer that promotes your own excellence in writing your thesis. Excellence in writing is critical for success, not just in your thesis, but also in many other professional backgrounds in psychology. The APA publication manual will help you to present your story in a clear, concise, and consistent manner. Use it as a reference for how to present and format tables and figures, for using bias-free language, for using verb tenses, or for using units of measurement (to give just a few examples), in order to bring work into pristine shape. Also see <https://apastyle.apa.org/products/publication-manual-7th-edition/>.

As a practical recommendation, consider using a reference managing program (such as endnote, citavi, zotero, mendeley, reference manager or others), some of which should be available to you for free via the university. This will help you to keep your citations and reference list updated as you write your document. It is also important to keep in mind that, in the context of increased sensitivity to possible plagiarism, you can avoid unwelcome consequences if you make sure that you mention and cite all the sources you used for your thesis correctly.

II.2. Research Seminars (Forschungskolloquium)

It is recommended that M.Sc. students visit the Research Seminars of the Department for General Psychology (currently weekly on Tuesdays, 14-16 c.t. during Term Time). Depending on the topic of your thesis, alternative meetings could include the Autism Research Seminars (currently approximately monthly on Fridays, 9-11 c.t.), or the Voice Research Unit Seminars (currently approximately monthly on Fridays, 12-14 c.t.). After you collected and analyzed your data, it can make sense to present your study in

one of these groups in order to obtain valuable feedback and discuss your findings with experts, before you submit your thesis.

II.3. Finishing up and submitting your thesis

Once your thesis has advanced to a stage in which you believe it could be nearly ready for submission, do leave sufficient time and energy to achieve a high level of perfection. Note that your supervisor(s) will typically offer to give you *one* round of feedback on an almost final draft of your thesis or on individual chapters. Because your supervisor(s) are typically very busy and work towards multiple deadlines of their own, you should inform them about when to expect your draft, and you will need to give them sufficient time (perhaps two weeks, and more outside term time). This will allow them to give you feedback, and it will also allow you to incorporate any suggestions and necessary changes before you actually submit. Once you are ready, you should submit your thesis via the official channels to the examination office of the Institute of Psychology. In addition, we ask you to submit a pdf file to your supervisors / examiners. Note that this can make them more flexible in evaluating your thesis in good time, independent of the location of the paper document. Again, take the perspective of the recipient (e.g., a file name “master thesis.pdf” might seem unique to you, but your examiner as a recipient might find a file name “master thesis <year> <forename> <surname>.pdf” to be much more appropriate).

The master thesis often is the last work you submit in order to obtain your master degree. We know that there are occasions in which it can be important to have early documentation that the M.Sc. has been obtained. This can be the case when you have a current job offer for a post that requires an M.Sc. grade for the purpose of employment. Most employers accept a preliminary certificate from our Institute’s examination office, confirming that all works towards the M.Sc. were completed and will definitely be accepted with a grading of “adequate” (ausreichend) or better. Consider that examiners should submit their report no later than six weeks after they received the thesis from the examination office. Please let us know if (and only if) you urgently need such a certificate before the reports with your final grade can be submitted.

A final remark here: Note that documenting resources and cleaning up files is an essential part of research that has been performed and analysed by using computers and servers of the department. This means that all documents should be stored systematically in the respective directories of the server, and any paper files should be brought into pristine shape. If you leave the team after completion of your thesis, you should organize a handover meeting with your supervisor. Once this is completed, you should clear up all redundant or unused documents from local computers to avoid misallocation later. A separate document is available that gives guidance on documenting resources (e.g., data raw files, experimental stimuli, experiment code, declarations of consent, inventories, analysis code, etc.). Note that due to the nature of the peer-review process in scientific journals, publication can take significant effort and time (several years are no exception, and re-analyses of data, or running additional experiments according to reviewer suggestions also are no exception), meaning that publication typically is an option only when the data are still accessible by yourself, by your supervisor, or other collaborators. Note also that most journals now encourage or require datasets to be made publicly available, such that it is essential to ensure that all variables are well-documented and self-explanatory.

II.4. Length

There are no absolute lower or upper word limits for your master thesis. We recommend, however that your M.Sc. thesis ranges between about 12,500 and 25,000 words (without appendixes), which is equivalent to approximately 30-60 manuscript pages. If you believe you have strong reasons to deviate from these recommendations, you should discuss the issue with your supervisor(s). Please do consider that original research papers published in scientific journals often range between about 3,000 and 10,000 words, even for papers with multiple experiments.

III. Criteria for Evaluation

Our department uses a list of criteria when reviewing master theses and strives to make these transparent. However, note that the criteria for evaluating the quality of your master thesis will obviously depend to some extent on the type of study you conducted – not all criteria will be applicable for each and every study. Note that because your master thesis typically addresses a new field of current science, not every aspect of your work can be classified into right or wrong, and examiners may make discretionary decisions that reflect their best judgement regarding the merits of your thesis. Even experienced examiners may differ in their grading. In Jena, the procedure is to average grades across examiners as long as the differences remain within limits (here, within one full grade). If differences in grades exceed one full grade, however, further consideration is given to the final grade, and where discrepancies remain, further examiners may be subsequently involved by the examination office in order to resolve these.¹ Please expect that your examiners will make their best efforts to provide you with a competent, critical, fair, and unbiased evaluation of your work. Below we have compiled, for your convenience, a list of criteria according to which examiners in our department are encouraged to evaluate your thesis.

¹ These procedures can be regarded as a strength rather than a weakness of the evaluation process. In this context, you may want to note that it is well-known that the scientific peer review process even for quality journals certainly is not fully objective. For decades, scientists have undertaken continuous efforts to either improve the process or replace it entirely. Today, peer-review still exists, explicitly with a degree of discretionary decision, which may well be impossible – and potentially undesirable – to eliminate. For the interested reader, a few entries for discussion include Della Sala & Grafman (2002), Harnad (2002), and Lee et al. (2013).

Type of study

Experimental work
 Test Development/Validation
 Meta-Analysis
 Systematic Review
 Data analysis (existing data set)

Grading *

1 = very good 5 = not sufficient

* Criteria that are not applicable should not be graded (n/a). Where grading each subsection appears too detailed, grading may be made separately for each main section only. Note also that weighting of sections can depend on the nature of your study and is the examiner's judgement. The following list may or may not apply to your specific thesis, but it can give you an idea about the aspects of your work you should attend to when writing your thesis.

0. Abstract**1. Aims, introduction, theoretical and empirical state of knowledge**

- 1.1 Scholarly and Comprehensible Development of Rationale
- 1.2 Justification of Aims of Work
- 1.3 Development of the central theme („leitmotif“)
- 1.4 Explanation of theory, models, and constructs
- 1.5 Wrap-up of state of research and directly relevant studies
- 1.6 Fit and breadth of scientific reading/cited references
- 1.7 Exposure of Hypotheses/Study Questions

2. Methods

- 2.1 Adequacy of Sample / Power Analysis
- 2.2 Description of Sample
- 2.3 Description of Materials/Stimuli
- 2.4 Description of how concepts were operationalized
- 2.5 Study design/plan
- 2.6 Ethics compliance statement

3. Results

- 3.1 Structure and systematic report
- 3.2 Accuracy of report
- 3.3 Justification of statistical procedures
- 3.4 Adequacy of statistical procedures
- 3.5 Communication and Visualization of Results
- 3.6 Documentation, Replicability, Appendices

4. Discussion

- 4.1 Short and accessible exposure of main results
- 4.2 Integrating own results into published findings
- 4.3 Critical reflection of own work
- 4.4 Adequacy of conclusions
(theoretical and applied implications, future perspectives)

5. General aspects of presentation

- 5.1 Composition and structure
- 5.2 Clarity of written expression
- 5.3 Accessibility (Tables, Figures, Images)
- 5.4 Formatting of Tables and Figures using APA-Standards
- 5.5 Citations in text and reference list

** The following marks can be given: 1,0 / 1,3 / 1,7 / 2,0 / 2,3 / 2,7 / 3,0 / 3,3 / 3,7 / 4,0 / 5,0.

IV. Brief check List (chronological)

- Allow yourself 6 months full-time, or more when part-time
- Develop a plan and schedule (with your supervisor)
- Develop central hypotheses
- *Pre-register hypotheses on a platform that is appropriate to your study, such as <https://aspredicted.org/>, or <https://osf.io/>
- Design your study (with your supervisor)
- Adhere to ethical guidelines
- *Determine required sample size with power analysis
- Collect and analyze pilot data *prior* to your study
- Report effect sizes and visualize your data according to current standards in research
- Consult APA-Guidelines for manuscript preparation
- Get feedback from your supervisor (on your first draft) and other experts (e.g., via research seminars)
- Keep word limits: 12,500 and 25,000 words (without appendixes), or ~ 30-60 pages
- For research conducted in the department: ensure all materials, data, scripts and final analyses are stored in a format accessible to your supervisor and (potentially) other collaborators (e.g. on the departmental server and/or on OSF).

*if applicable, depending on your type of study and after discussing with your supervisor

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