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Senior Thesis Guide
Human Evolutionary Biology
2019-2020

Senior Thesis Tutor/Advisor: Dr. Katherine (Katie) Zink, Preceptor; kzink@oeb.harvard.edu
Dr. Zink runs the tutorials and meetings associated with HEB 99a and 99b. She is available to answer general thesis questions and to provide support to thesis writers (in addition to the individual research advisor).

HEB Advisors:
• Dr. Neil Roach, Concentration Advisor
• Dr. Daniel Green, Concentration Advisor

HEB Senior Thesis FAQs

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Q: What is a Senior Thesis?

A: A "thesis" is a proposition or assertion that is supported by logical arguments and factual evidence, or data. A Senior Thesis should represent an analysis of some phenomenon, typically supported by original data. What makes your essay a "thesis" is that you go beyond narrative and description to include original data, analysis, and argument. What makes it a Human Evolutionary Biology thesis is the centrality of problems and phenomena related to the concerns of our discipline: adaptation and natural selection.

The thesis involves, briefly:

1) working with your advisor to choose a research question, design and execute a research project that addresses that question through hypothesis testing;
2) registering for and taking two courses, HEB 99a and HEB 99b;
3) analyzing and thinking about your research results;
4) writing and submitting your work.

Your Senior Thesis is *not* expected to make a staggeringly original contribution to science or to report amazing "statistically significant" results that support your hypotheses (or to require that you lose sleep or find yourself without any social life because you are constantly in the lab).

The Senior Thesis is an exciting opportunity for you to work with a faculty member to carry out and write up original research that addresses a question in which you are very interested. As far as possible it should be enjoyable and not (too) all-consuming.

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Q: Why should I write a Senior Thesis?

A: While writing a thesis is *one* way to become eligible for honors, and the *only* way to become eligible for the *summa cum laude* level of honors, the best motivations are a love of research and/or a burning question. You should not consider a Senior Thesis if your primary motivations are not intellectually based, but are instead more practical—i.e., increasing your chances of getting into medical school or "beefing up" your resume. There are other ways to achieve those goals that might be more suitable for you, and you should discuss your options with an Office of Career Services or concentration advisor.

Students who write Senior Theses typically are motivated by a genuine intellectual curiosity for a particular area, and have a positive experience with research in the past. The process of the thesis is guaranteed to be *at times* arduous, stressful and challenging; but students describe the process as one of the most rewarding of their college careers. They report that that they get out of the thesis process what they put in, and in addition to learning valuable skills and becoming an expert in some area, they have an enormous sense of accomplishment and a new confidence in their own abilities.

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Q: Who is eligible to pursue a Senior Thesis?

A: Any HEB student is eligible—but you should seriously consider whether you want to devote the time and energy to the work (invariably more than an average course load), and whether you have a demonstrated interest in either research or a particular area of inquiry. Ideally, you'd have taken relevant courses, and/or had relevant work experience. There is no minimum GPA. Even if you know you won't get honors, you might want to research and write a thesis just for the experience.

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Q: What is the rough schedule for thesis work?

A: The schedule varies from student to student, but here are some guidelines that might help you plan. Be sure to schedule your thesis goals with your advisor, and make a calendar of deadlines. Aim to have your first chapter to your advisor by Thanksgiving, and data collected and analyzed, with a Materials and Methods draft completed by the end of the Fall semester of your Senior year. You should focus your Spring semester efforts on writing the body of the thesis, and make sure you can have it completed the Friday before Spring Break (in 2020, that will be Friday, March 13). Be sure to leave plenty of time for editing! Sloppy writing, typos and grammatical errors will shed an unwelcome light on your thesis.

What follows is the schedule that the majority of our students follow, but there is plenty of flexibility, depending on what you and your advisor work out. For instance, it's possible to spend the summer after Junior year doing something other than thesis-related work, if you're sufficiently prepared to begin research in your Senior Fall, and agree with your advisor that you can meet the deadlines above.

Junior fall—You will want to start thinking about thesis ideas your Junior year. Talk to friends, think about what you liked in your classes (or books you read), take time to look at the websites of faculty in HEB, look at research articles of some labs and professors that look interesting.

Junior Spring—Prepare for thesis research over the summer. One excellent way to do that is to take the HEB 91r independent research course with an HEB faculty member. If preparing for thesis research, this course could allow you to, for instance, design and carry out a pilot study, or even to read relevant papers and books, discuss them with your potential advisor, then carry out and write up an extensive literature review in the area in which you're interested. That paper could then serve as a basis for the introduction to your thesis.

Summer after Junior year—conduct thesis research, learn relevant statistical skills, become familiar with software packages (statistical and reference), write detailed outline for thesis, begin writing portions of thesis.

Senior Fall—Formally declare your intent to write a thesis and enroll in HEB 991a by submitting a Senior Honors Thesis enrollment form to an HEB advisor no later than the Course Registration Deadline. (This can be found on the HEB Honors Info page of the Life Sciences website.) Finish data collection, analyze data, submit first chapter draft by Thanksgiving, and submit a materials and methods chapter draft by the end of the semester.

Spring of Senior Year—Enroll in HEB 99b. Finish writing, and edit, edit, edit! We recommend leaving at least three weeks for revisions, printing, proofreading, copying, etc.

Due date: 1:00 p.m. on the day before Spring break -- Friday, March 13, 2020.

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Q: What are the basic requirements for a Senior Thesis in HEB?

A: Submit a Thesis intent form by the end of your junior year (or 6th semester).

Registering for and participating in HEB 99a and 99b.
Primarily these courses serve to allocate official course time for your senior thesis research and writing. In addition, you will be required to attend several thesis-related meetings, which are designed to provide you with logistical guidance and moral support as you go through the thesis process.

Original work. As the author, you need to do original work that makes a contribution to the field. All of the writing must be your own (of course you may get comments from others to help you improve the writing). This does not mean that *parts* of the thesis research can't be based on the work of others—on the contrary, all good research builds upon the work of others. But a major component of the research must be your own original work. Theses vary in the extent to which various parts rely on the work of others (e.g., ideas, broad hypotheses, data sets, analytical methods, experimental designs), but at a minimum, the main portion of the thesis should be based on your original thinking and work. The theses that receive the highest grades tend to be based on the most original and independent work on the students' parts, because this enables students to demonstrate their own abilities.

Length. We strongly encourage you to limit your thesis to 50 pages. Longer is not better; on the contrary, skill is required to explain complicated ideas in a clear and concise manner, and readers appreciate brevity when possible and more detailed writing when necessary and helpful. The thesis should only be as long as is necessary to complete limited goals, based on your experience, funding, and time constraints.

Topic. Theses in HEB need to concern some aspect of human evolutionary biology. This means that the focus of the thesis should be on some topic relating to how and why we are the way we are, using a biological, evolutionary perspective to answer these questions. Your questions may be about human culture, anatomy, behavior, psychology, disease, diet, or physiology. Your species on which you focus does not necessarily need to be *Homo sapiens*—it may be a non-human primate species, or other taxa that shed light on a question ultimately about humans.

Scope. Keep your hypotheses and research design as straightforward and uncomplicated as possible. It's easy to get excited about lots of questions, and tempting to try to incorporate as much as possible into your research design. Remember: keep it simple. Talk with your advisor about how you can complete an excellent thesis without taking on too much.

Courses. You must enroll in both HEB 99a and 99b in your Senior year Fall and Spring, respectively. Students enrolled in HEB 99 are required to attend several thesis-writer group meetings throughout the Senior Year. These meetings serve mainly to provide support and guidance to thesis writers.

Submit your thesis by 1:00 on the Friday before Spring Break (Friday, March 13, 2020).

Thesis Conference. After submitting your thesis, you will be scheduled to have a one hour thesis conference with your two evaluators (your advisor and one other HEB faculty member). In this conference, your evaluators will ask you questions specifically related to the content of your thesis, potentially including questions on background literature, research methodology, and interpretation of results. You will not be graded on your answers or performance during this conference. Rather, the conference is intended to provide the evaluators with additional context when evaluating your written thesis document.

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Q: What kinds of research projects are acceptable?

A: Most students collect and analyze original data as the basis for their thesis, but you may also choose to test a hypothesis using pre-existing data (published or unpublished). These options are described separately below.

Original data collection: Design and carry out a study to test a hypothesis, and collect and analyze the resulting data. The nature of your question will direct your study design, or, you may have certain methodological or time constraints that restrict the kinds of hypotheses you may test. You may want to conduct an experiment in one of the labs in Human Evolutionary Biology, conduct an observational study in the field or at Harvard, work in a psychology lab with human subjects, or you may work in a lab off-campus. Many students combine one or more of these options, for example collecting data from humans or non-human animals in the field then analyzing biological samples of various kinds in one of the HEB labs.

Using pre-existing data: Researchers frequently collect more data than they have the ability to analyze, and that doesn't mean that the data are not valuable or cannot provide insight into interesting questions! Many opportunities exist for students to work with such data sets in HEB or elsewhere, and this kind of thesis is an excellent opportunity to test a novel hypothesis with data in need of analysis. Our students have used pre-existing data sets to investigate areas such as the relationship between male aggression and female fertility in wild chimpanzees, or how diseases spread across primate groups. These types of theses offer both advantages and disadvantages that you should discuss with your advisor. Briefly, a benefit is that you need not take the time and effort to collect brand new data, and normally you will be able to take advantage of a rich data set collected by the lab of a senior member of the faculty. But a tradeoff is that you will be restricted in the questions you can answer, and you won't have the experience of designing and carrying out an experiment to collect your own, original data. This kind of thesis might be a great choice if (a) you are particularly interested in the work of a member of the faculty who happens to have such a data set; (b) you don't have the time to collect your own data; or (c) the kind of question you want to investigate is best suited to an existing data set. Regardless of your motivations, these kinds of theses tend to be valuable and rewarding experiences.

Literature based-research: There are two types of literature-based research projects that you could consider: a "meta-analysis," and a critical review of the literature. Both types involve using published research articles to test a hypothesis or investigate a question. A meta-analysis is a systematic, statistical review of the literature with a specific question in mind. These kinds of studies help to make sense out of a large body of literature on a topic, particularly when no clear consensus has evolved (usually the case when interesting scientific questions are involved!). In this kind of thesis, all the published studies in a particular timeframe relevant to your question would be objectively analyzed, and the results compiled and sorted in an original data set. This allows the objective analysis and synthesis of results from numerous studies, and may also shed light on how various outcomes are related to aspects of study design.

A critical review is more subjective than a meta-analysis. In this type of thesis, you would rely on relevant, published studies to lend new perspective to an old idea, or to reevaluate an existing hypothesis in light of new work. Summarizing literature is not enough! The standards for originality in this type of thesis are high—these can be particularly challenging because you would need to compare/analyze divergent findings, discussing the strengths and weaknesses of various studies and

conclusions, and arriving at some novel insight. This can be quite difficult for an undergraduate with relatively little research experience. This type of thesis would be rare.

You can learn more about your options by talking to one of the concentration advisors, a member of the HEB faculty whose work interests you, and by becoming familiar with different research methods used in published articles. There are likely other types of thesis research that would be acceptable—but what is described here are the major types available to you.

A list of recent thesis titles is available at the end of this document.

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Q: Do I need to be on campus to conduct thesis research?

A: No, but most students do conduct thesis research on or near campus. Some students carry out research away from campus, either overseas in the field (e.g., in Uganda studying chimpanzees), or at another lab. If you want to do research away from campus, or want to do it during the school year only, you should talk with your advisor about the possibilities.

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Q: How can I fund my thesis research?

A: Lots of funding opportunities exist for thesis research. Some of these have early deadlines, so the earlier you get thinking about funding, the better. These opportunities are listed, along with deadlines and links, in the Research section of the Life Sciences website, under "Research Opportunities and Funding."

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Q: How do I go about contacting a professor about thesis advising?

A: You can always schedule a meeting with a professor to talk about possibilities for thesis work. You don't have to have a very specific idea for a project, but you should have done some legwork and have some idea of the kinds of research the particular professor or lab conducts. It never hurts to read some recent papers that have come out of a lab and share your comments or questions with the professor. Excellent advice on finding research opportunities can be found in the Research section of the Life Sciences website. Your HEB concentration advisor is also a great resource for advice on finding research opportunities.

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Q: What can I expect from my thesis advisor? What are my responsibilities?

A: Your thesis advisor is there to advise and support you during the thesis process. You are ultimately responsible for the thesis, but you can expect your advisor to be a significant source of advice on ideas, research, data analysis, and writing. They should provide you with feedback on your writing—but remember, they are not your personal editors! In general, thesis meetings take place at least every two weeks, but this depends on your needs and progress, and your advisor's availability. You should discuss expectations (in terms of meeting frequency, deadlines, statistics help, feedback on writing) with your advisor early in the process, so you both know what to expect.

You are responsible for scheduling and attending meetings and meeting deadlines, but some advisors may prefer to take a more proactive role and send you reminders when deadlines are approaching. Thesis writers should be independent, self-motivated, highly disciplined and proactive. You will need to take the initiative to find a faculty advisor and a topic that intrigues you, and have the resilience to

persist through setbacks. While advisors are not responsible for your compliance and progress, they should provide support and encouragement when possible.

Thesis advisors should work more closely with you during the initial stages of planning the thesis research (ordinarily Junior spring), and should check in with you frequently as research is beginning. Advisors should provide frequent and detailed feedback to students about research and writing progress, inform students about the desired content and format of the thesis (e.g., chapters or headings, citation format, what should be included in methods or introduction), help students plan a calendar indicating when various chapters, analyses, etc. should be completed, and be available to read and comment on work as it progresses.

The Concentration Advisors will be available to provide you more general thesis advice, and to respond to any questions or concerns you have about thesis advising. They will work with both parties to ensure that the advisor/advisee relationship runs as smoothly as possible and that students receive the support they need.

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Q: What are the expectations for the format and style of the written thesis?

A: Talk with your Thesis Advisor for specific advice on how your thesis should be structured. Ordinarily, HEB theses include an abstract, introduction, methods and results section, discussion, and conclusion. You might want to examine published research articles that bear some relationship to the kind of research you want to do, to learn more about what various sections contain and how they are formatted. You could ask your advisor for good examples. Below is a summary of sections you might want to include, but again, talk with your advisor about his or her expectations.

The **abstract** is a summary of your thesis: the hypothesis, the methods you used to answer it, your findings, and conclusions. The **introduction** should state the problem, the general question and specific hypotheses being tested or investigated, and the manner in which you will test, analyze, and discuss the questions. The introduction may include the literature review, in which you provide the reader with the context for your research question—Why is your question important? What justifies your hypothesis? What's been done previously to address it? What's the consensus? What are the problems with the current state of the literature, and shortcomings of the methods that have been used previously to answer your question? What are the outstanding questions, and how will your research contribute? You will want to include a **Methods and Results section**, including a description of the statistical procedures you are using and an explanation of why you chose the particular methods you used. You will want a **discussion section** in addition to conclusions. In the discussion section, you should discuss whether your results provide support for your hypotheses. How do your findings impact current theory? What were the limitations of your study, and how might these limitations bear on your results? The **conclusion** should summarize the question, approach, main findings and interpretations, and outstanding questions. Don't forget the **acknowledgments section**! Most research projects are collaborative efforts, and rely on funding from outside sources. Be sure to thank the people and agencies who provided you with support.

Style. General Comments: You should address yourself to a well-informed reader. Avoid repetition, unnecessary detail, and irrelevance in both data and analysis. This is a crucial point: do not include any data or analyses that do not bear on your hypotheses, and be sure to thoroughly explain the relevance of all analyses to your hypotheses.

Use your own style—and use the thesis as an opportunity to develop it—but, in any case, write *clearly*. In the process of composing and preparing the thesis, do not neglect the details of good expository writing. The pleasure and the understanding of the reader (and perhaps your grade) can be undercut by inattentiveness to style, form, grammar, punctuation, spelling, and citations.

Page Formatting: Leave 1-inch margins at the top and bottom of the page and on the right. Be sure to leave a 2-inch margin on the left to allow for binding! All pages need to be double-spaced on one side of the page only.

Font: Use 12-point fonts, preferably Times.

Title Page: A sample title page is at the end of this document. Please follow this format in centering and spacing the appropriate text for your thesis.

References, Notes and Tables: Ask your advisor about preferred citation format—sooner rather than later! We recommend using a reference and bibliography software package, such as EndNote. This will greatly streamline the management and entry of your references, and will save you the hassle of having to re-format your bibliography every time you add or delete a reference. It will also allow you to automatically download references from online services, and automatically change the formatting of all your references, if necessary.

Charts, tables and figures should be placed within the text, at the appropriate place. The pages on which they appear should also be numbered or given some other systematic identification, and a list specifying page numbers or locations should be provided with the table of contents.

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Q: Where can I get help with writing?

A: Excellent references on style are W. Strunk and E. B. White, Elements of Style (http://www.bartleby.com/141/) and K. L. Turabian, A Manual for Writers of Term Papers, Theses and Dissertations (Chicago, 1973). You can also consult The Chicago Manual of Style (http://www.chicagomanualofstyle.org/home.html).

You should also consult previous theses for examples of structure and format. Some previously submitted HEB theses can be found in the Tozzer Library. Most recent theses are on the shelf outside of Daniel Green's office.

Finally, you are strongly encouraged to consult with counselors at the Writing Center (Room 019, Barker Center, 12 Quincy Street). The Writing Center offers individual conferences to plan and go over drafts of your thesis (http://writingcenter.fas.harvard.edu/pages/senior-thesis-tutoring). They also have a number of handouts on format, style, and other aspects of writing.

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Q: What's involved in submitting the thesis?

A: Theses must be bound, and submitted to Neil Roach on time. Late theses will be penalized one grade step per day, counting weekends. These penalties will be waived only in cases of serious extenuating circumstances. Students should contact the Director of Undergraduate Studies (Professor Daniel Lieberman) or a concentration advisor **immediately** in that event. Crashed computers, malfunctioning printers, and scheduling problems at the Science Center are *not* considered valid excuses.

Statement of Research: Along with your thesis, you are also required to submit a statement of research. This statement should name your advisor and the names of any collaborators. Please outline the role that each person played in helping you with your thesis. If you obtained data that were collected by someone else, please indicate this in your statement of research as well as in the written thesis itself. Your statement of research should also indicate how long you spent working on this project, including how many summers of full-time work went into this project, and if you were enrolled in courses like 91r.

Honor Code: All work associated with your thesis—from literature review, data collection and analysis to writing and presentation—should be governed by the principles of academic integrity expressed in the Harvard College Honor Code. You will need to sign an affirmation of the Honor Code when you submit your written thesis.

Copies/Binding: You must submit **4 copies** of the thesis, bound in clear clamp binders (e.g., this one from Staples, or similar: http://www.staples.com/Staples-Clamp-Binder-Clear/product_806968).

These copies will be distributed to your readers. One copy—destined to reside in the HEB Undergraduate Office—*must* be on high-quality acid-free paper; the other copies will be returned to you following submission of grades. *Please mark the archival copy clearly.*

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Q: Besides submitting the written document, what else do I have to do?

A: After turning in the written thesis, HEB thesis students have historically presented their work to the department in a symposium format, in addition to sitting for a thesis conference.

Presentations: Thesis writers will share their research and findings to the HEB department, including some faculty, undergraduate and graduate students. This symposium normally takes place at some point between Spring Break and Reading Period.

Thesis Conference: The thesis conference is a one hour meeting with your two evaluators, who will be your advisor and one other HEB faculty member. In this conference, your evaluators will ask you questions specifically related to the content of your thesis, potentially including questions on background literature, research methodology, and interpretation of results. You will not be graded on your answers or performance during this conference. Rather, the conference is intended to provide the evaluators with additional context when evaluating your written thesis document.

Q: How is the thesis evaluated?

A: The grade for the Fall semester thesis course, HEB 99a, reflects the quality of your work, your progress, and the effort you have put into your thesis up to that point. Your grade for HEB 99a is determined by your thesis advisor. Your HEB 99b grade for the Spring semester is determined by evaluation of your written thesis (with input from your thesis conference).

Notification of evaluations: Before graduation, you will be notified of your thesis grade, and will receive your written evaluations for the thesis and oral presentation/exam. We will also let you know the level of English departmental honors for which you were recommended. Details on departmental honors can be found in the HEB Honors Info section of the Life Sciences website.

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Please contact an HEB Concentration Advisor with any questions about the thesis process.

Most important: enjoy the process!

Thesis title page example:

Unpacking Punitive Judgments: Punishability, Severity, and Satisfaction

A thesis presented by
Your Name

to
the Department of Human Evolutionary Biology
in partial fulfillment of the requirements
for the degree with honors
of Bachelor of Arts

Harvard University
Cambridge, Massachusetts
March 2017

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