Personal Relevant Background

I was drawn to psychology by an interest in human cognitive development, and I have been actively involved in psychological research for the past four years. Over the last four years my research interests have evolved to be more focused on statistics and methodology, with the goal of improving research quality and scientific inference. My current interests are the development of Bayesian statistical methods, implementation and dissemination of publication bias mitigation techniques, improving scientific replicability, and investigating statistical cognition. These interests fit into the *quantitative psychology* discipline, where statistical tools are developed with the goal of applying them to psychological problems.

My research experience began in 2011 during my sophomore year of college at the █████ ██████████ University in the cognitive neuroscience lab of Dr. ████████████, studying the cognitive foundations of attention. Under the mentorship of Dr. █████████ I designed and implemented an experiment investigating the extent to which people allocate attention to particular visual objects versus visuo-spatial locations. In 2012 I was awarded the ██████ █████Undergraduate Research Fellowship for this project, which is considered ███████████ █████ University's most prestigious undergraduate research award and a clear indication of **intellectual merit**. As a member of the █████████ Society I was awarded $5,000 of research support, enabling me to travel to the Vision Sciences Society's 2013 conference to present a poster of my work to peers in my field. Additionally, I presented this work at the ████████████████ University's "Undergraduate Research Days 2013," where my poster was awarded third place for the Social Science division. Dr. ██████████'s lab is currently collecting follow-up data to be included when we write up the research for publication.

In the summer of 2012, between my junior and senior year, I spent three months as a ██████████████████████ Research Fellow at the University of ██████████. Receiving this competitive Fellowship award of $3,600 made it possible to spend a summer in ██████████, ██████████ doing research in visual perception. Under the joint mentorship of Dr. █████ █████ and Dr. ████████████, I conducted a visual perceptual learning experiment examining post-stroke vision recovery in stroke patients and control subjects. We brought in patients to the lab who had suffered stroke damage to their visual cortex, and used perceptual training 3 times per week to expand their visual field.

It is important to me that what I end up studying has the potential to have real-world impact. At the University of██████████ I experienced the impact of psychological science with one patient who had lost most of his left visual field. The patient remarked that he was amazed at the effectiveness of our training, noting that he no longer had to turn his head completely to the side just to check the clock on the left side of his desk. My work on this project had the **broader impact** of contributing to the rapidly advancing field of stroke recovery therapy, and we saw real benefits for patients that improved their quality of life. I intend for my graduate work in quantitative psychology to have similar real-world benefits.

Quantitative psychology and statistics

After graduating in 2013 I began working in developmental psychology labs, where I acquired an interest in statistics and quantitative psychology. Developmental psychology has many challenges that need advanced statistical methods to overcome. Working in Dr. ██████████ ██████'s lab as a lab manager, I discovered the challenge that developmental psychologists face in collecting adequately sized data samples; small samples are ubiquitous in the de-

velopmental psychology literature. This is not for lack of education about the pitfalls of small samples, but simply due to the nature of the populations being sampled. By learning new statistical techniques we were able to overcome these limitations, and I saw how much impact quantitative psychologists can have on the entire field of psychology.

Dr. ████████ and I were researching how children of ages 3 to 5 learned to imitate others in order to solve tricky puzzles. We were lucky to have the support of the ████████████ ████████████████████████, which allowed us to collect our data on their premises. Even with the ████████'s support, we were barely able to collect 20 children in each age group for our study. I began studying statistics to try to find a way to overcome our small sample limitations, and this is when I found the literature on Bayesian statistics. With classical statistics small sample size is a big problem, because one needs many subjects to have any chance at detecting subtle (small) effects. One **benefit of Bayesian statistics** over classical statistics in situations with small sample sizes is that we can bring in prior information about the research field, which allows us to increase the information value of our statistical procedure. To clarify this point, classical statistics incorporates prior information by formalizing it in the *statistical* model (likelihood function). The Bayesian solution is to formalize the prior information as a distribution over the parameter space (prior distribution), making a strong commitment to a *theoretical* model. By making a stronger commitment to theory, a Bayesian analysis can find support with a smaller sample size because it is taking a risk; it is also easier to find evidence against the theory with a smaller sample size because it makes pointed predictions. In other words, the Bayesian approach rewards researchers who make accurate predictions by permitting smaller sample sizes. Using Bayesian analytic tools, we were able to efficiently collect our data and find support for our theory in a way that would be nearly impossible using classical statistics.

My experience teaching myself Bayesian statistics in Dr. ████████'s lab was so profound that it completely shifted my research interest from cognitive psychology to quantitative psychology. As I learned more about Bayesian statistics, I progressively felt more certain that I had found my niche. Over the next year I was reading at a pace of nearly an article per day learning everything I could about Bayes. I have gone on to teach myself the necessary calculus to read advanced statistics papers. I also taught myself how to program in the statistical language R, in order to implement the methods I was learning about. My intrinsic interest in the topic of statistics, combined with my willingness and ability to teach myself complex mathematics and statistics techniques, is a clear indication that **I am ready to start on a PhD**.

Science communication

After a year of self-education, I thought that everyone should have the chance to learn about this type of statistics. Taking a cursory look at the statistics education for psychology departments across the US it is clear that almost no Bayesian education is provided anywhere. I decided I should start a blog, where I would cover the statistics I was learning. It started as a way for me to consolidate what I was learning into a concrete form, but it has grown over time to be a forum for me to educate my peers about statistical issues using simple demonstrations and without the complicated mathematics. I am committed to writing tutorials about methods that psychologists can actually *use*. While my interests are heavily technical, my ultimate goal is giving psychologists tools that they can use to overcome the

challenges of their research.

My first blog posts were rather banal, covering topics like the following: What is a *p*-value? What is a confidence interval? The blog only had a few interested readers. It was not until I felt I had a much better grasp on Bayesian statistics that I was ready to create Bayes tutorials, in the series ██████████████████, and the blog readership grew exponentially. These were designed to educate psychologists on the fundamental concepts underlying Bayesian inference, and they have been extensively read and shared. **The educational pieces I have written have had a broad impact, with over twenty thousand readers this year from 115 countries all over the world.** In addition to the wide readership, many professors have informed me that they are using my teaching tools in their classrooms. I will also be giving an invited talk at the Psycholinguistics department of the University of ████████ (Germany) in November 2015, titled, "███████████████████████████████ ███████████." This will serve as their students' first contact with Bayesian inference, and hopefully not their last.

I have forged many valuable professional connections through this blog, including my prospective PhD adviser, Dr. ████████████████████. We have taken one of my posts, in which I performed a Bayesian re-analysis of ██████████████████████████ which had over 6,000 unique readers, and submitted a modified version to ██████████ ████████████████, where it is currently under review. We have also committed to developing new and easy-to-use Bayesian methods for psychologists (see project proposal).

Another valuable professional connection I have developed is Dr. ████████████████, a quantitative psychologist and methodologist with whom I am currently working as a visiting student on many projects. We have conducted a survey of students and researchers, asking how much evidence they would need to make various decisions. Harold Jeffreys, the inventor of the Bayesian significance test, proposed certain evidential cutoffs that one can use to denote weak, moderate, or strong evidence, and we expected his proposed values to roughly correspond to our survey results. We have survey data suggesting that in some cases they do, but that the correspondence varies with the amount of statistical education of the respondent.

Future goals

My plan for the future is to obtain a master's degree in Psychology and in Statistics, and finally a PhD in Psychology. When I have completed my PhD I will apply for postdocs with Bayesian quantitative psychologists and methodologists to further my statistical training, as well as gain experience applying the methods I have learned to varied behavioral research problems. After a postdoc I will pursue faculty positions at research universities to begin implementation of my own research program, continuing development and dissemination of new Bayesian methods. I am aware that this is a highly competitive time for faculty positions, but according to the recent APA taskforce, quantitatively focused applicants have higher success rates overall.

My ultimate goal is to work from within psychology to improve the field. The recent results from the Reproducibility Project have made it clear that psychology is in a time of flux and needs quantitatively focused leaders. Researchers are now aware that their methods need to improve, and **I have the technical aptitude, dedication, and communication skills to help guide the psychology community into a future of stronger methodological and statistical rigor.**