1. Research Opportunity Description. (Please limit your response to 500-1000 words, 1-2 pages, single spaced, 12-point font.)

Please provide a description of the research opportunity in which you propose to mentor an undergraduate, if selected for funding. Describe the relation to your own research interests. Indicate what kinds of research activities the undergraduate will be expected or encouraged to undertake. If the research opportunity is part of a larger project, describe how the undergraduate's contribution will be defined in relation to the larger project. If the research opportunity involves primarily independent work, give some examples of the research resources to which the undergraduate will have access. If appropriate, comment on the kind of research presentation the undergraduate might be able to produce after a summer of mentored research.

This research project will explore possible variants of absolute pitch in different populations of musicians. Traditionally, absolute pitch (AP) is defined as the ability to instantly name a given pitch (e.g., “C”), or sing a named pitch, without a reference. About .01% of the human population has AP, and it is generally believed to be as a linguistic labeling ability, which is as automatic and effortless in AP possessors as color naming is in the general population. AP is not more common among musicials than in the general population. However, given that musicians accumulate a tremendous amount of experience associating a particular motor output (usually, a particular configuration of finger positions) with a heard pitch, highly-trained musicians may have a consistent motor-auditory mapping, which is a less conscious form of absolute pitch. For example, a jazz saxophone player improvising a melody based on what the pianist just played has to instantly translate recently-heard pitches into motor sequences. This important musical skill would seem to require a strong auditory-motor mapping, between heard notes and finger movements, rather than a mapping between heard notes and pitch names.

The project will involve several groups of expert musicians, including pianists, who play an instrument with discrete pitches, and violinists, who play an instrument with a continuum of pitch possibilities. Participants will hear a note played without given the name, and will be asked to name, sing, and play that note on their instrument. Highly-trained musicians may perform the motor task above chance even when they don’t demonstrate traditional AP (as measured with the naming and singing tasks).

Additional subjects, who play wind instruments, will be recruited to examine the impact of experience playing a transposing instrument—an instrument, such as the Bb clarinet or F horn, whose music is notated at a pitch different from the pitch that sounds, or “concert pitch”—on absolute pitch. These musicians have years of associating a transposed pitch name with a certain note. For example, the musician would associate a concert Bb (B flat) with a C written on the staff. This may shift these musicians’ AP representations over time. Thus, including these musicians in the study will reveal whether non-C instrumentalists’ AP performance is biased toward their instrument’s particular name-to-pitch mapping. As long as these shifted representations are consistent within an individual, they would indicate that AP is shaped by experience with a particular musical environment, rather than being a linguistic skill acquired within the first few years of life, the “critical period” for language.

My dissertation project focuses on multisensory integration, or how the brain combines different cues from multiple sensory modalities, like sight and hearing, to form a unified, coherent perceptual interpretation of the world. One of my experiments investigates the impact of recent auditory experience on perceptual selection, the process by which the brain interprets an ambiguous stimulus (such as the Necker cube or other bistable visual images) at any given moment. In another set of experiments, I am studying the human auditory system’s use of summary statistics (such as the average pitch of a sentence or melody) to efficiently process complex sounds. Thus, this project on auditory-motor mapping as a form of absolute pitch is closely tied to my other dissertation work.

The undergraduate student (Jake Sheynin) will be involved in all stages of the project, including literature review and experimental design, recruitment and testing of subjects, and data analysis and dissemination of the work (through presentation at conferences and writing the manuscript). Jake will have the opportunity to present the results of this research at a lab meeting, at the Berkeley Interdisciplinary Research Conference (where he presented another project he was involved in earlier this year), at the California Cognitive Science Conference, and very possibly at a meeting of the Society for Neuroscience, Society for Music Perception and Cognition, and/or the Acoustical Society of America meeting, if the work is accepted there.

Throughout the project, Jake will have access to any background articles relating to the project through UC Berkeley’s subscriptions to various scientific journals as well as online programming tutorials and feedback from myself and other lab members in MATLAB programming, which he will use to present sounds and collect, organize, and analyze data.

Research Mentoring Statement (Please limit your response to 500-1000 words, 1-2 pages, single spaced, 12-point font.)

For the research opportunity described, please indicate your plan for mentoring the undergraduate. As part of that plan, provide a timeline of the interaction you propose for you and the undergraduate you will be mentoring. If there are any special considerations you think would benefit an undergraduate in the proposed research, such as specific orientations to research materials or techniques, mention them, and indicate whether you know of resources available that might be used by the undergraduate to receive this support (for example, library workshops on using article databases; online tutorials in specific research methods; etc.).

Jake Sheynin, the undergraduate student with whom I will be conducting this work, has been a dedicated and productive research assistant in my lab for over a year. Thus far, he has primarily been responsible for data collection (i.e., testing human participants on a variety of experimental tasks) and some small programming and analysis tasks. In the proposed project, he will have a more independence and involvement in the experiments from the initial design onward. In fact, Jake has already been involved in the development of the project proposal, and we have read and discussed some relevant background literature together.

To get a head start on the project so that we can begin collecting data at the beginning of summer 2014, Jake and I will submit a protocol to the Committee for Protection of Human Subjects (the Institutional Review Board for UC Berkeley) sometime in mid-spring 2014. Jake has already completed the necessary training and is certified to collect data from human subjects.

During the first few weeks of the summer 2014 fellowship (by mid-June), we will recruit participants from UC Berkeley’s Department of Music and the San Francisco Conservatory of Music. To gain experience designing and programming behavioral experiments, Jake will write the code to administer instructions, play different pitches, collect video data, organize the data using data structures, and analyze and visualize it. I will oversee his work to ensure that he is completing these tasks correctly, and provide any support he needs to do so. We aim to finish tweaking the experimental design and collecting data by mid-July and will spend the final few weeks analyzing and visualizing the data and preparing it for presentations within Berkeley and larger scientific meetings.

Jake will have access to multiple online resources (including widely-used tutorials, video demonstrations, and developer documentation) for programming in the MATLAB and Python languages and will have weekly meetings with me to discuss programming style and any challenges that arise. Of course, he will also have access to online resources for finding and downloading scientific journal articles, including the UC Berkeley library system and PubMed. Jake will also participate in my advisor’s (Dr. Michael Silver) weekly group meetings and will be asked to give a presentation on our project at some point during the summer.

3. Research Budget and Budget Justification (Please limit your response to 500-1000 words, 1-2 pages, single spaced, 12-point font.)

Each selected project is eligible for up to $1,500 in funding for research expenses. Please provide a brief budget justification and summary of the proposed use of this research funding. Eligible categories of expenses include research travel (including travel to archives, libraries, or conferences after the summer for either the graduate student or the undergraduate, or both); expendable supplies; and equipment (for example, instruments needed for the undergraduate to participate in research).

60 subjects x $12/hour = $750

Conference travel to the Society for Music Perception Conference or Acoustical Society Meeting in October 2014 in Indianapolis = $750

[Might want to price out airfare, hotel, and registration]

Flight = $350

Hotel = $80 \* 4 nights = $320

Registration = ???

Food $20 \* 4 days = $80

Total =