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.

Our 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, or sing a named pitch, without a reference. About .01% of the human population has AP, and it is generally thought of as a linguistic, labeling ability, as automatic and effortless in AP possessors as color naming is 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 (the resulting sound on their instrument), one might expect that this consistent motor-auditory mapping might generate another, less conscious form of absolute pitch in highly trained musicians. 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, more than a mapping between heard notes and pitch names. We will recruit several groups of expert musicians: pianists (since the piano has a continuous pitch-motor mapping), violinists (since the violin has a more discrete pitch-motor mapping), wind players, and vocalists. Our sample will include a mix of classical and jazz musicians. In our experiment, participants will hear a note (without a pitch label) and we will measure their ability to name, sing, and play that note on their instrument. We expect that highly-trained musicians can perform the third task above chance even when they don’t demonstrate traditional AP (as measured in the first two tasks).

Relatedly, we would like to test 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. Many years of associating a transposed, non-concert written pitch name with a certain note (e.g., hearing an actual concert Bb come from your instrument every time you play a C written on the staff) may shift these musicians’ AP representations over time. Thus, we would like to test whether non-C instrumentalists’ AP performance is biased toward their instrument’s particular mapping (e.g., people who play the trumpet, in Bb, might label pitches as one whole-step, or the distance between Bb and C, higher than they really are due to prolonged exposure to pitch labels a whole-step higher than the heard note). 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 own 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, from literature review and design, to the recruitment and testing of subjects, to 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 we will likely 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 programming and analysis. In the proposed project, he would have 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 would 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 would write the code to administer instructions, play different pitches, collect video data, organize the data using data structures, and analyze and visualize it. We would aim to finish tweaking the experimental design and collecting data by mid-July and would spend the final few weeks analyzing and visualizing the data and preparing it for presentations within Berkeley and possibly a conference abstract to submit to larger scientific meetings.

Jake would have access to multiple online resources (including widely-used tutorials, video demonstrations, and developer documentation) for programming in the MATLAB and Python languages and would have weekly meetings with me to discuss programming style and any challenges that arise. Of course, he would also have access to online resources for finding and downloading scientific journal articles, including the UC Berkeley library system and PubMed. Jake would also participate in my lab’s weekly group meetings and would 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).

50-60 subjects x $12/hour = $750

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