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Perfect pitch study offers window into influences of nature and nurture

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Practice, practice, practice might get you to Carnegie Hall, but for aspiring musicians, there's new evidence that genes may influence one's ability to get there, as well.

Perfect pitch, also known as absolute pitch, is the rare ability to recognize and name musical notes without any reference pitch for comparison, detecting, for instance, A before middle C. The rarity of the aptitude contrasts with the common ability to immediately recognize and name colors, distinguishing pink from red or azure from blue.

In the July 2 online posting of "American Journal of Human Genetics," UCSF scientists report that they identified a particular region of genes on human chromosome eight that is linked to perfect pitch, at least in people of European ancestry. The next step, they say, is to identify a specific gene.

The finding, part of a larger examination of families of various ancestries - Europeans, Ashkenazi Jews, Indians and East Asians - is the first significant genetic evidence of a role of genes in perfect pitch. It is likely, the researchers say, that multiple genes are involved in all cases of perfect pitch and that different genes could be associated with different ethnic backgrounds.

Regardless, the finding is an important advance, they say, in their effort to move in on the relative roles of early musical training and genetic inheritance on perfect pitch. More broadly, says senior author Jane

Gitschier, PhD, UCSF professor of medicine, pediatrics and genetics, and herself a singer, it is an advance in the team's effort to explore the relative contributions of environmental factors and genes on learning and other behaviors.

"Perfect pitch is a window into the way in which multiple genes and environmental factors influence cognitive or behavioral traits," she says. The team has learned over the last decade that both factors contribute to perfect pitch. "What's exciting now," she says, "is that we now have made the first foray into teasing out the genes that may be involved."

In the current study, the team drew on data acquired from the lab's web-based survey, established in 2003, which gathers information about participants' musical training history and tests their pitch-naming abilities. Tens of thousands of people have participated in the study to date, which they generally learn about through word of mouth or by surfing the web. Participants listen to an auditory frequency and then click on a keyboard to identify the note.

A 2007 analysis of data from the survey indicated that, across the population, the ability to identify notes does not range evenly across a continuum, as one might expect for most aptitudes. Instead, individuals tended to cluster at both ends of the spectrum. Many people showed little aptitude for identifying notes and another group exhibited perfect pitch, or something close to it, suggesting the possibility of a genetic component.

In the current study, lead author Elizabeth Theusch, a graduate student in the Gitschier lab, identified a collection of families in which at least two people (mostly siblings) had perfect pitch as determined by the web-based test. Seventy three of the families chose to participate in her investigation. They included 45 families of European ancestry, 19 of East Asian ancestry, eight of Ashkenazi Jew ancestry and one of Indian

ancestry. She provided the study subjects with a mail-back kit to obtain DNA from saliva, or a mobile phlebotomy service was dispatched to collect blood.

She then looked for bits of DNA shared by family members with perfect pitch, and found evidence that the genetic variations contributing to the acquisition of perfect pitch might be different in different populations. The chromosomal region that stood out as statistically significant was identified in families of European ancestry. Further studies will be needed to validate the findings and to further home in on the specific gene or gene-controlling DNA responsible, she says.

In addition to continuing to identify and collect data on families with multiple cases of perfect pitch, the researchers plan to analyze candidate genes for variations that might be associated with perfect pitch in participants of European ancestry. For comparison, they also will recruit and study individuals of European ancestry without perfect pitch but with equivalent early musical training.

The ongoing effort is supported in part by a grant by the NAMM Foundation, which was established by the international music products industry association with the aim of promoting "active participation in music making across the lifespan," in part by supporting scientific research.

Any insight gained about the apparent developmental window for learning a skill such as this is likely to be of broad interest among scientists, the researchers say.

"Interestingly," they write in their paper, "one study [by another research team] showed that infants preferentially use absolute pitch cues over relative pitch cues in certain situations, suggesting that all people might be born with absolute pitch, but that a majority lose their absolute pitch

abilities with age. Thus, an attractive hypothesis is that genetic factors might extend this neurodevelopmental window to a duration sufficient to intersect with the onset of musical training."

The study marks significant progress in a project that began more than a decade ago. Gitschier launched the ongoing effort in collaboration with former UCSF faculty member Nelson Freimer, PhD, now at UCLA.

Source: University of California - San Francisco