



# CALIFORNIA STATE SCIENCE FAIR 2006 PROJECT SUMMARY

<b>Name(s)</b> <b>Patrick M. Sullivan</b>	<b>Project Number</b> <b>J0331</b>
<b>Project Title</b> <b>Do Facial Expressions Affect Intonation in Singing?</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The goal of this study was to find out how facial expressions, specifically the raising or lowering of eyebrows, affect an individual's ability to sing pitches accurately. The hypothesis was: If young singers raise their eyebrows while singing an ascending phrase in an upper register, then their intonation will be more accurate than when their eyebrows are in neutral or lowered (scrunched) positions.</p> <p><b>Methods/Materials</b> Informed consent was obtained for a study population of experienced choral singers. Subjects of both sexes, aged 7-14 years, were played a key reference and an ascending musical phrase on a piano. They sang the phrase with eyebrows in a neutral position, then raised, and finally scrunched. The test was repeated three times. A laptop computer, using Raven Lite 1.0, acquired the sounds and produced spectrograms by which pitch frequencies could be measured in Hz. Multiple readings of the final and target pitch, E5, were made and compared to the piano reference.</p> <p><b>Results</b> The statistical mean frequency (in Hz) for the target E5 pitch was calculated for all phrases sung with neutral eyebrows and then converted to an intervallic measurement in cents. Compared to the piano, the E5 sung with neutral eyebrows was 2.6 cents higher. Doing the same for raised eyebrow test samples, the E5 was 2.6 cents lower. These were both under the "Just Noticeable Difference" threshold of 5 cents. Phrases sung with scrunched eyebrows produced E5 pitches averaging 18.6 cents lower than the target.</p> <p><b>Conclusions/Discussion</b> The hypothesis, that the target pitch ending the phrases sung with raised eyebrows would be more accurate in reference to the piano than those sung with either neutral or scrunched eyebrows, was only partially accepted. Raising the eyebrows while singing produced pitches which were more accurate than when scrunching them down, but of the same relative accuracy as when left in a neutral position. However, scrunched eyebrows clearly affected intonation and produced E5 pitches averaging a musically significant 18.6 cents lower than the target. The hypothesis was based on a presumption of a physiological interaction between eyebrow positions and vocal tract shape. With this group of singers, the interaction appears to occur only when they lower their eyebrows. The results might be different with singers who are not so well-trained. The experiment should be repeated with study populations of varying abilities.</p>	
<b>Summary Statement</b> This project investigates whether the raising or lowering of eyebrows affects an individual's ability to sing in tune.	
<b>Help Received</b> Mother took me to the UCLA Music Library, helped type the report, and glue the display board; Dr. F. Clark, Music Director, Georgia Institute of Technology, consulted on research plan; School Principal arranged for use of choir room.	