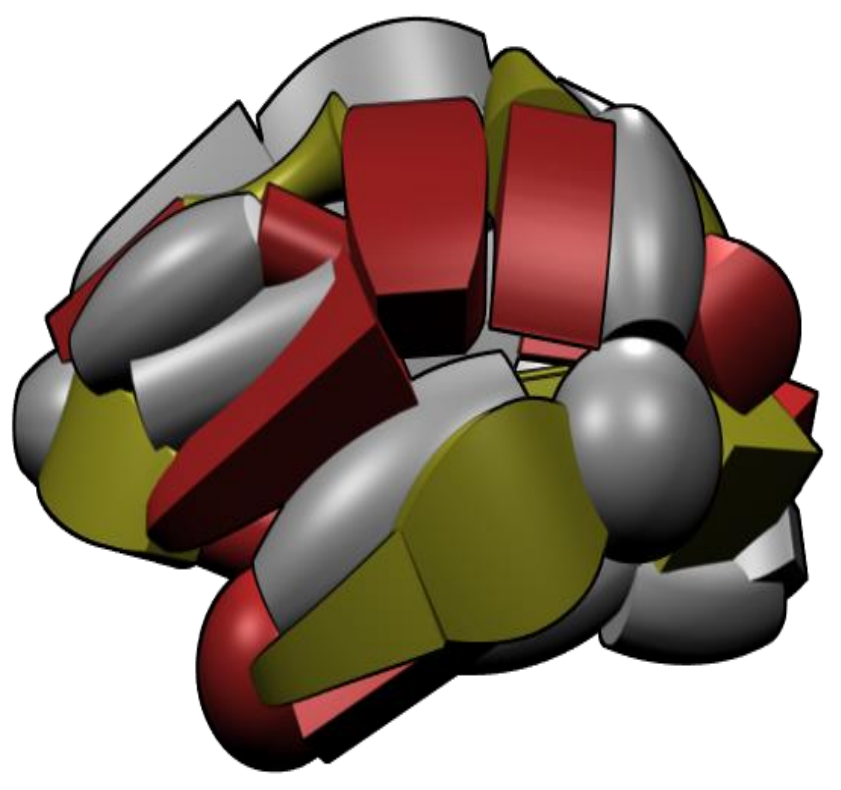




# An Estimate of the Incidence of Developmental Phonagnosia



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## Deficits of Person Individuation:

**Prosopagnosia:** The inability to recognize familiar faces, generally congenitally (“developmental”), rarely by lesion (“acquired”). Population incidence estimated to be 2.5% (“Have We Met?”, 2006)

**Phonagnosia:** The inability to recognize familiar voices. Only three cases of Developmental Phonagnosia have been reported in the literature (Garrido et al, 2009; Biederman et al, 2013).

**What is the incidence of phonagnosia in the population as assessed by a web-based survey?**

## Methods: Survey Components and Subject Criteria

**Recognition Task (See Screen shot on right):** 50 trials of 1, 2, or 4 celebrity target speaking voices. Celebrities were paired against nonfamous voice foils, matched for age, sex, and accent, with no identifying semantic information spoken.

**Familiarity Pretest:** Subjects indicated which of 100 target celebrities’ speaking voices were unfamiliar to them. Unfamiliar targets were not scored in the next task.

**Imagination Task:** Subjects then self-rated imagination abilities (see below)  
A total pool (n=977) was trimmed to 201 subjects based on:

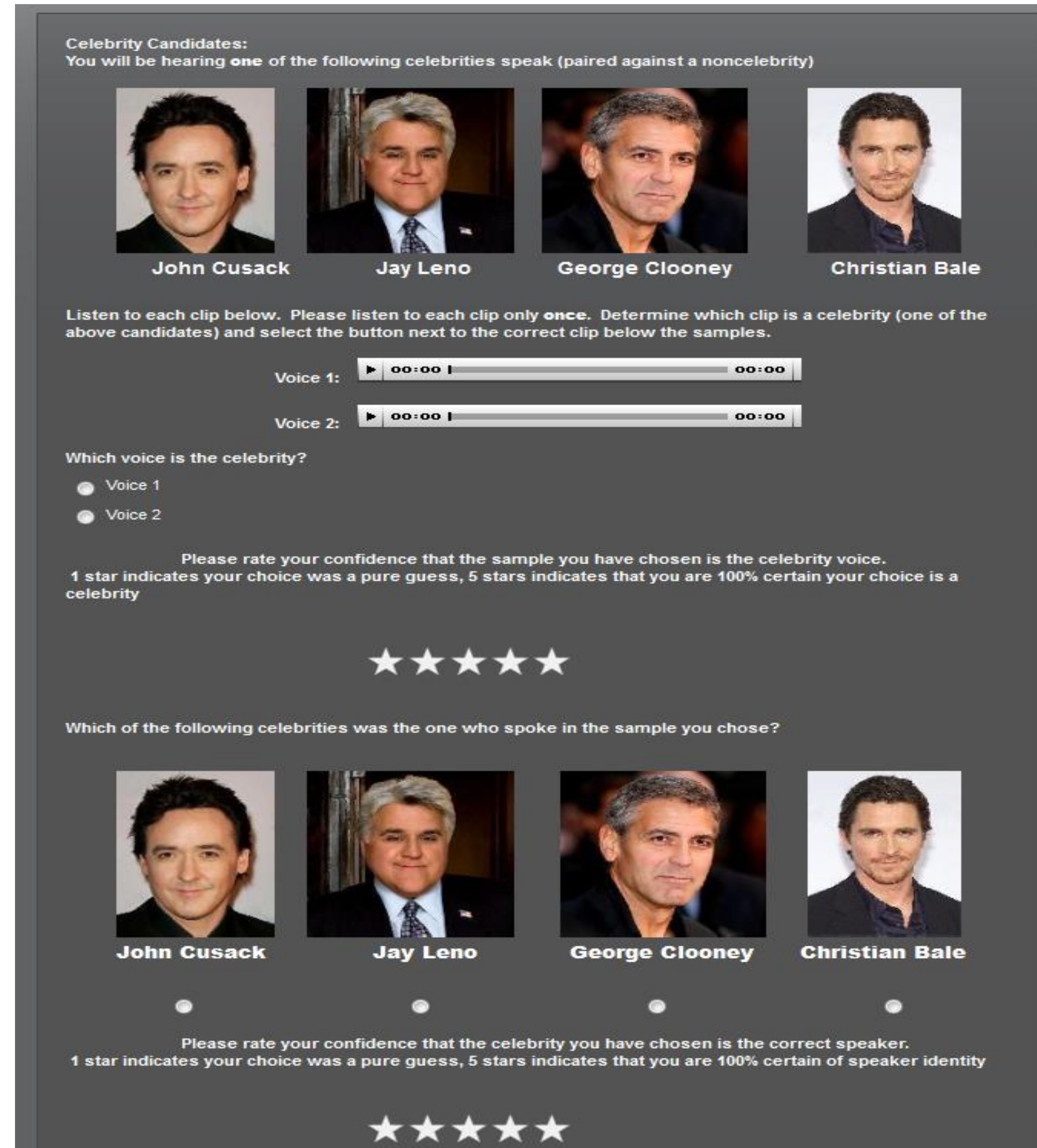
1. English speaking abilities,
2. Cheat-detection measures, and
3. high familiarity with the target celebrities (>80% from the pretest)

## Methods: Imagination Scale

Following the Recognition Test, subjects generated five celebrities not on the test, and judged 1 to 5 the extent to which they could imagine their voices.

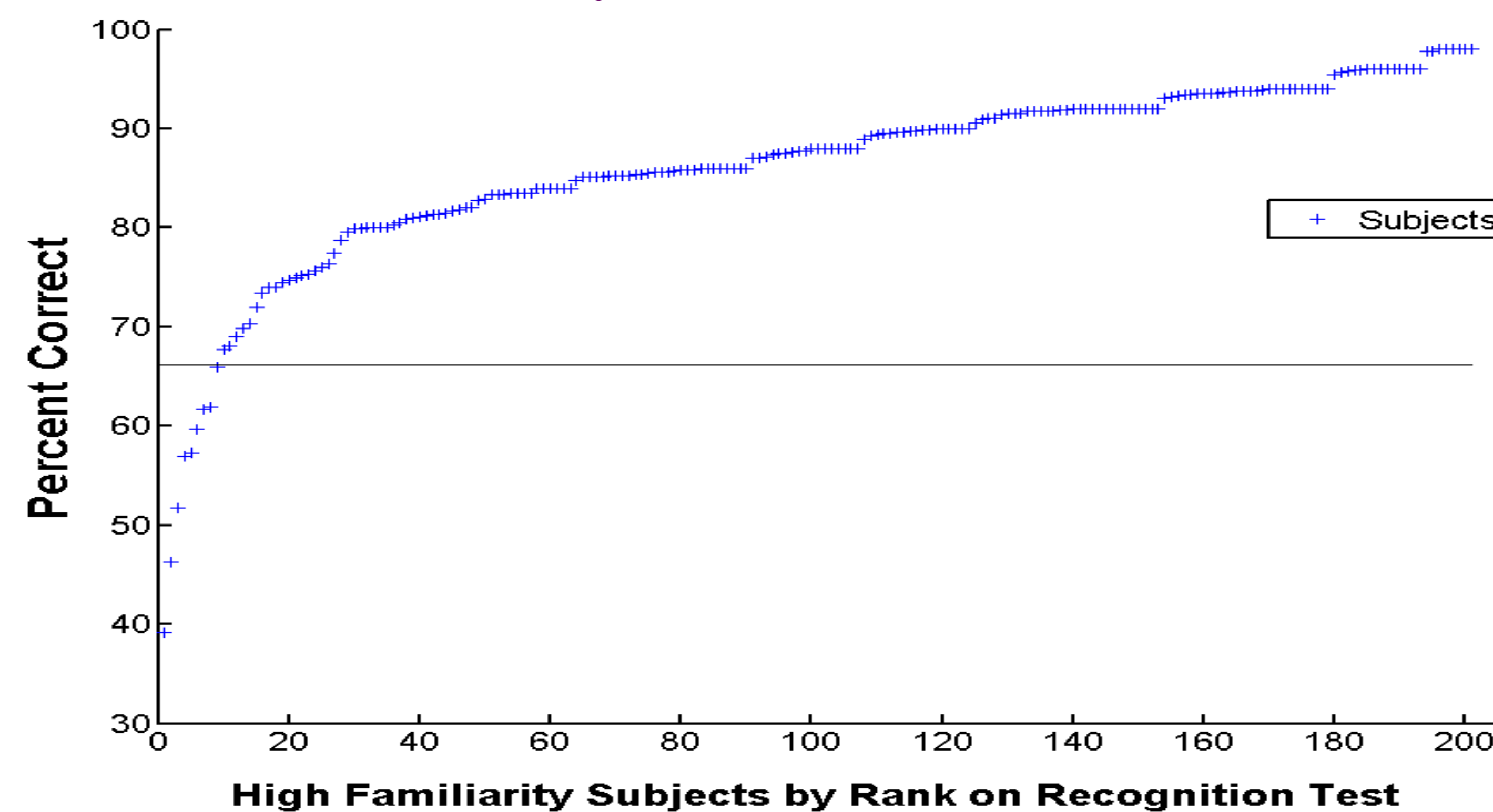
- [1] No auditory imagery at all, you only know that you are thinking of the person’s voice
- [2] Vague and dim
- [3] Moderately clear and vivid
- [4] Clear and reasonably vivid
- [5] Perfectly clear and as vivid as normal hearing

## Experiment: Celebrity Voice Recognition Test



**Sample screen shot of a four-choice trial (above).** Subjects listened to the clips by pushing the “play” buttons, then selected the bubble for Voice 1 or Voice 2 to choose which voice was one of the celebrities. The specific identity of that choice was chosen with the bubble options under the headshots. Confidence ratings for both the voice and identity choices were made with the five star scale.

## Results: Recognition Outliers Among Subjects with Familiarity Scores > 80%



**Above:** Distribution of high-familiarity subjects; 201 subjects were familiar with at least 80% of the celebrities. Each point is a single subject’s performance, ordered by recognition score. The horizontal line denotes two standard deviations below the mean; the 9 subjects below it (4.5% of the total sample) are significant outliers and therefore potential phonagnosics.

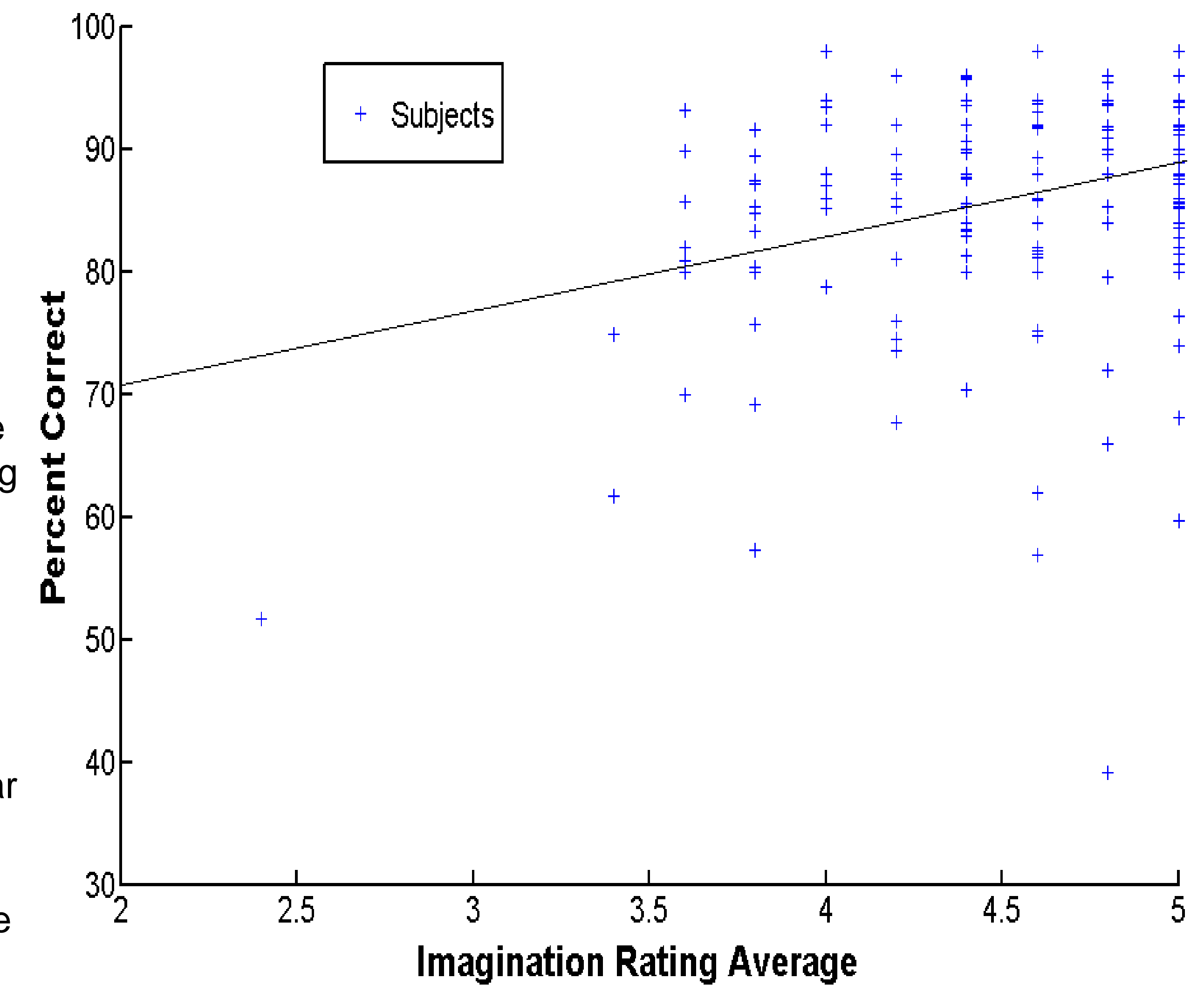
## Familiarity vs Recognition:



**Left:** Even though trials in which the subjects were not familiar with the target were not scored, the higher the proportion of the celebrity targets that were familiar to a subject, the higher their accuracy on the voice recognition test,  $r(771) = .36$ ,  $p < .001$ .

**Right:** Self ratings of imagination abilities were reliably correlated,  $r(186) = .30$ ,  $p < .001$ , with performance on the recognition task. Three of the nine recognition outliers, composing 1.5% of the sample on the recognition task were also poor at imagining voices, making them particularly strong candidates of developmental phonagnosia. The three developmental phonagnosics thus far reported in the literature all reported an inability to imagine familiar voices.

## Recognition Ability vs. Imagination Ability



## Conclusions:

- \* This is the largest known behavioral survey of voice recognition abilities
- \* Given the criteria of a) low (2 S.D. below the mean) recognition score and b) an inability to imagine familiar voices, we estimate that 1.5% of the population may have developmental phonagnosia
- \* The inability to recognize familiar voices is associated with the inability to imagine familiar voices. This seems to be a characteristic of developmental phonagnosia that is shared with the inability for face recognition and imagination manifested in developmental prosopagnosia.
- \* Both phonagnosics and prosopagnosics show no deficit in discriminating voices or faces, respectively, nor do they show a deficit in recognizing faces and voices respectively. Their deficit may thus stem from reduced white matter connections from posterior areas where voice prosody and face representations are computed to an otherwise intact person identity node in vmPFC.

References:  
Biederman, I., Xu, X., Herald, S. B., Shilowich, B. E., Amir, O., & Allen, N. E. (2013). Developmental Phonagnosia implicates a neural correlate for perceiving speaker identity. Paper presented at the Annual Meeting of the Society for Neuroscience, San Diego, November.  
Garrido, L., Eisner, F., McGettigan, C., Stewart, L., Sauter, D., Hanley, J. R., Schweinberger, S., Warren, J., Duchaine, B. (2009). Developmental phonagnosia: A selective deficit of vocal identity recognition. *Neuropsychologia*, 47, 123–131.  
“Have We Met?” (2006, June) *Science Magazine*. Retrieved from <http://news.sciencemag.org>  
Supported by the Dornsife Foundation. “Geon-Brain” logo of the Image Understanding Lab (top right) is the work of Mark Lescroart.

