

# Towards clinical evaluation of frequency selectivity using stimulus frequency otoacoustic emissions

Christopher Bergevin

Dept. of Physics & Astronomy, York University, Toronto, Ontario, Canada

David Purcell

Communications & Sciences and Disorders, Western University, London, Ontario, Canada



## Sensitivity vs Selectivity

Note: Selectivity = *tuning*

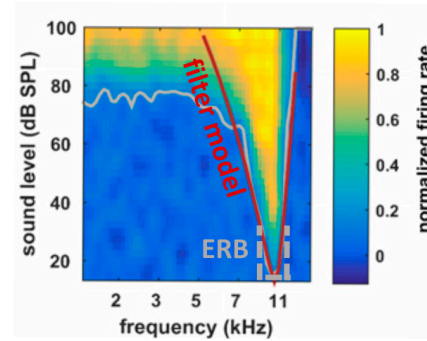


Audiometers measure sensitivity, not selectivity

# Different means to measure tuning



Chris Sumner & Alan Palmer  
(Nottingham)

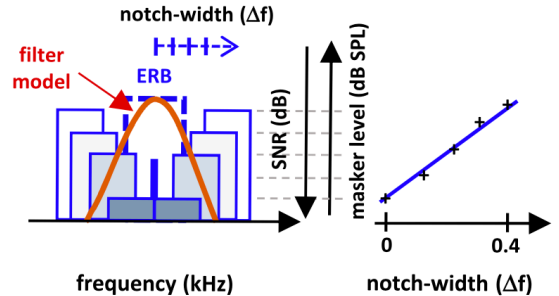
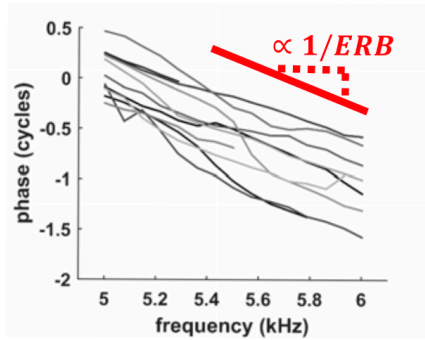


ANF: threshold tuning of auditory nerve fibers

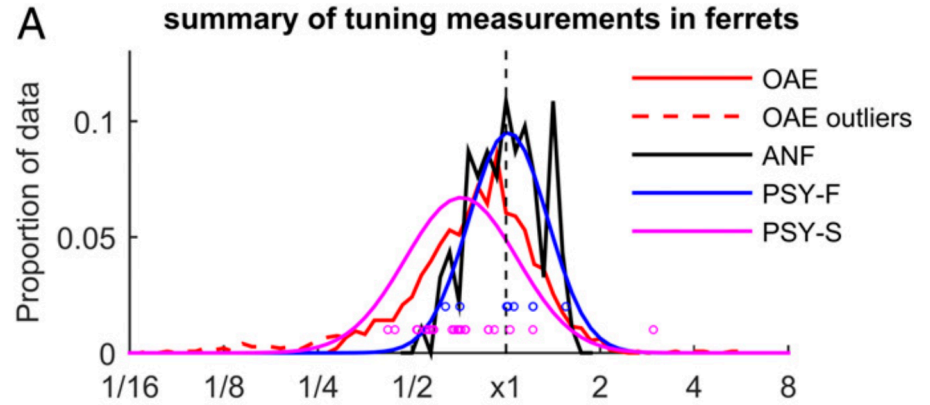
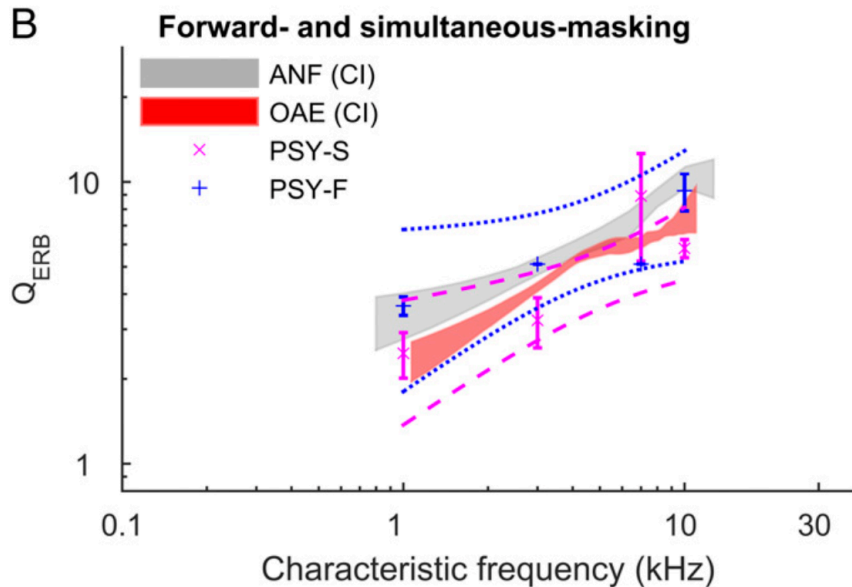
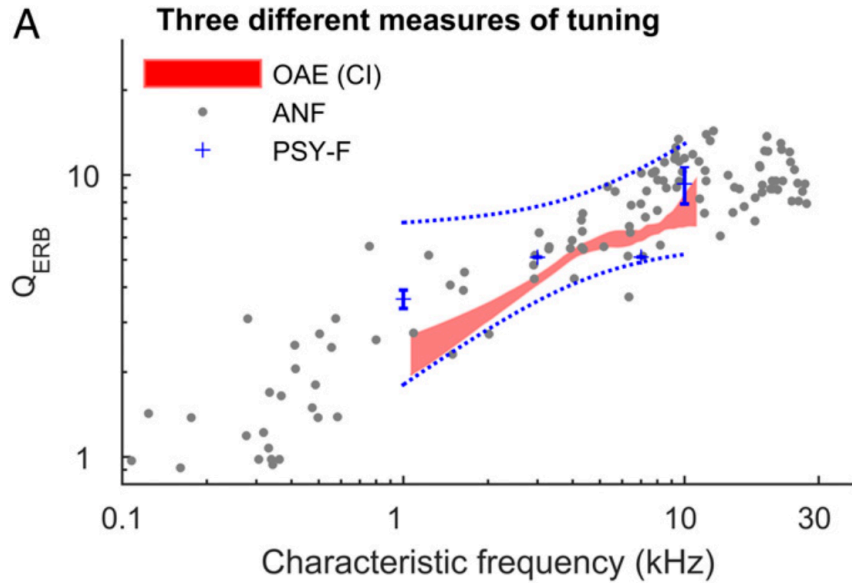
=  
cochlear frequency selectivity?

OAE: phase gradient of otoacoustic emissions

PSY: psychophysical detection of tones in notched-noise masker



# Different means to measure tuning



(2018 argument)

Combining OAE, ANF, and PSY tuning measures in ferret confirms *sharper tuning in humans*



## SFOAEs of clinical use to quantify tuning?

- Can SFOAEs be used to rapidly/objectively *estimate tuning in individuals* (w/ normal-hearing)?
- If so, to what extent can these methods be extended to *measure tuning in hearing-impaired* individuals?





Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

# Hearing Research

journal homepage: [www.elsevier.com/locate/heares](http://www.elsevier.com/locate/heares)



## Research Paper

# No otoacoustic evidence for a peripheral basis of absolute pitch

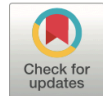
Larissa McKetton <sup>a</sup>, David Purcell <sup>b</sup>, Victoria Stone <sup>b</sup>, Jessica Grahn <sup>c</sup>,  
Christopher Bergevin <sup>d,\*</sup>

<sup>a</sup> *Biology, York University, Toronto, ON, Canada*

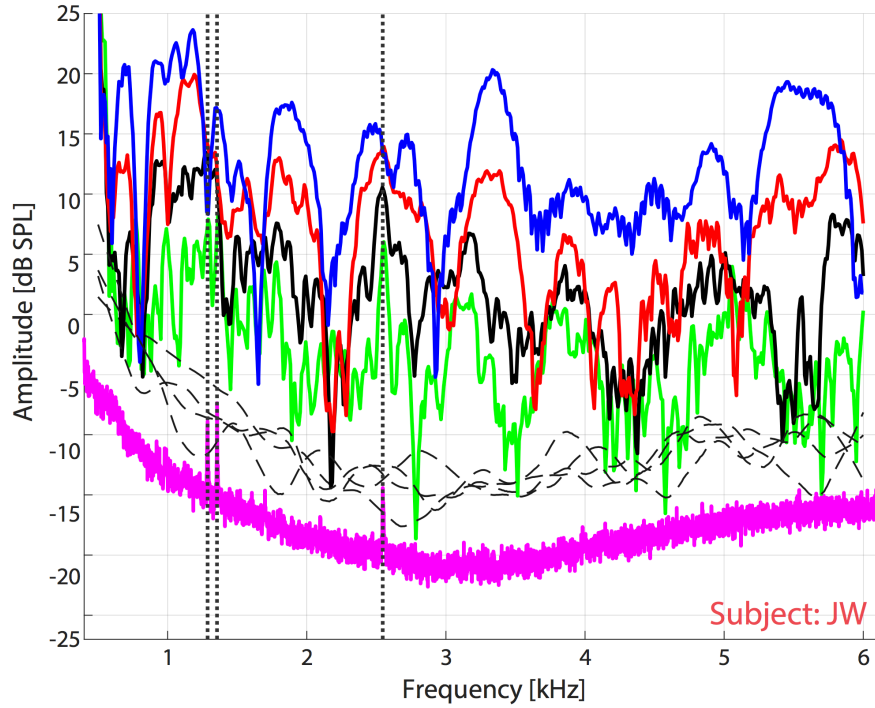
<sup>b</sup> *Communication Sciences and Disorders, University of Western Ontario, London, ON, Canada*

<sup>c</sup> *Psychology, University of Western Ontario, London, ON, Canada*

<sup>d</sup> *Physics & Astronomy, York University, Toronto, ON, Canada*

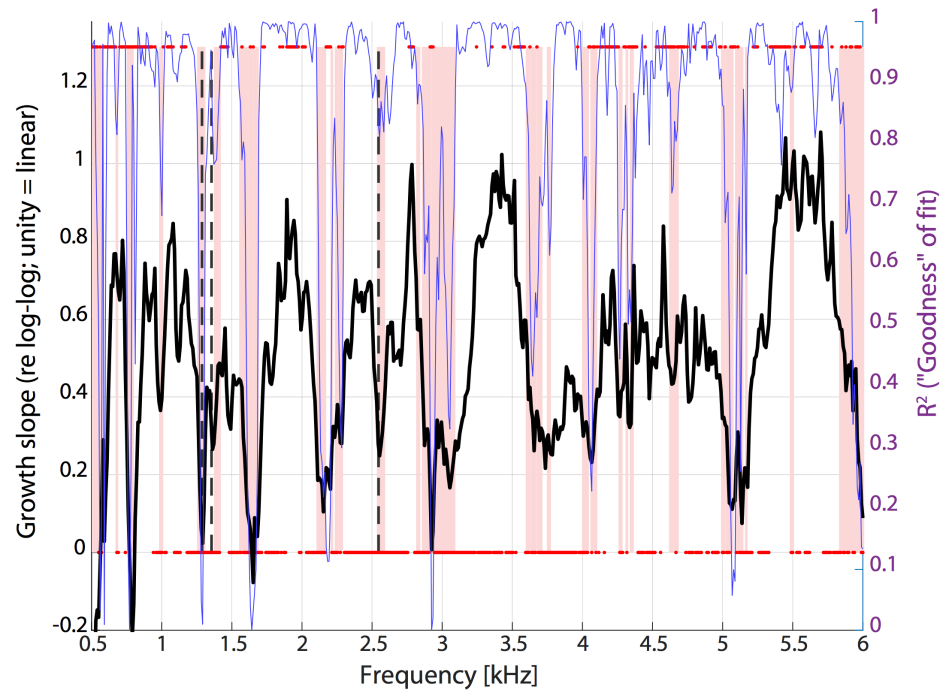


# Better characterization of SFOAEs

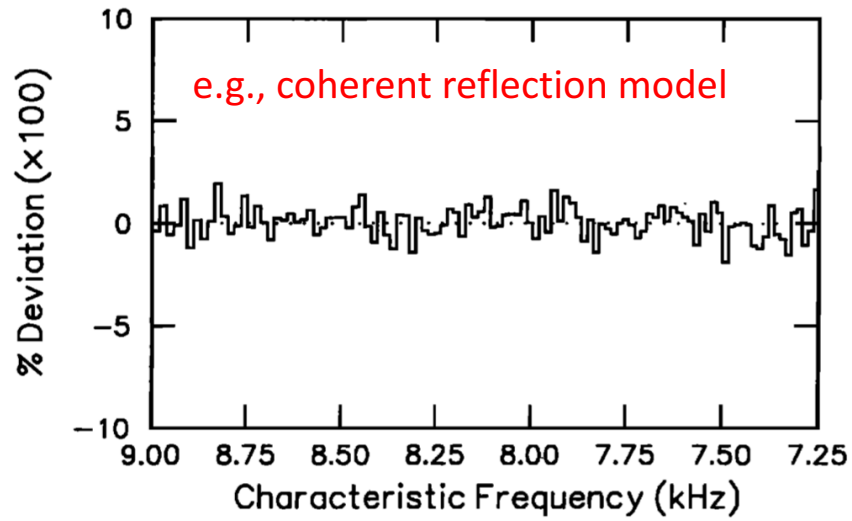
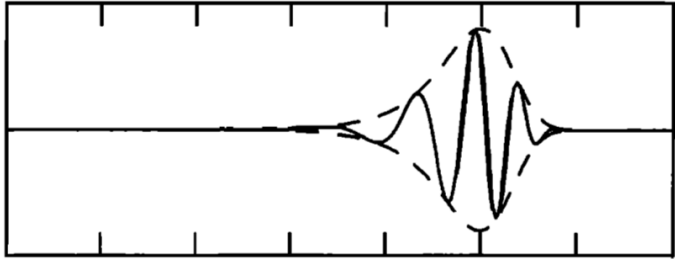


Present goal — Better characterize SFOAE (& SOAEs) in normal-hearing adults

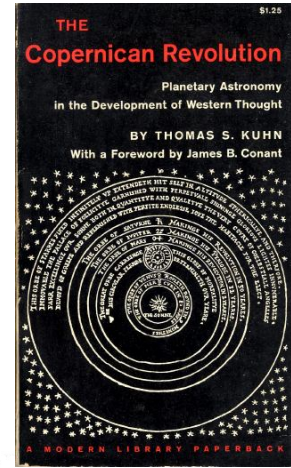
→ Highly nonlinear behavior....



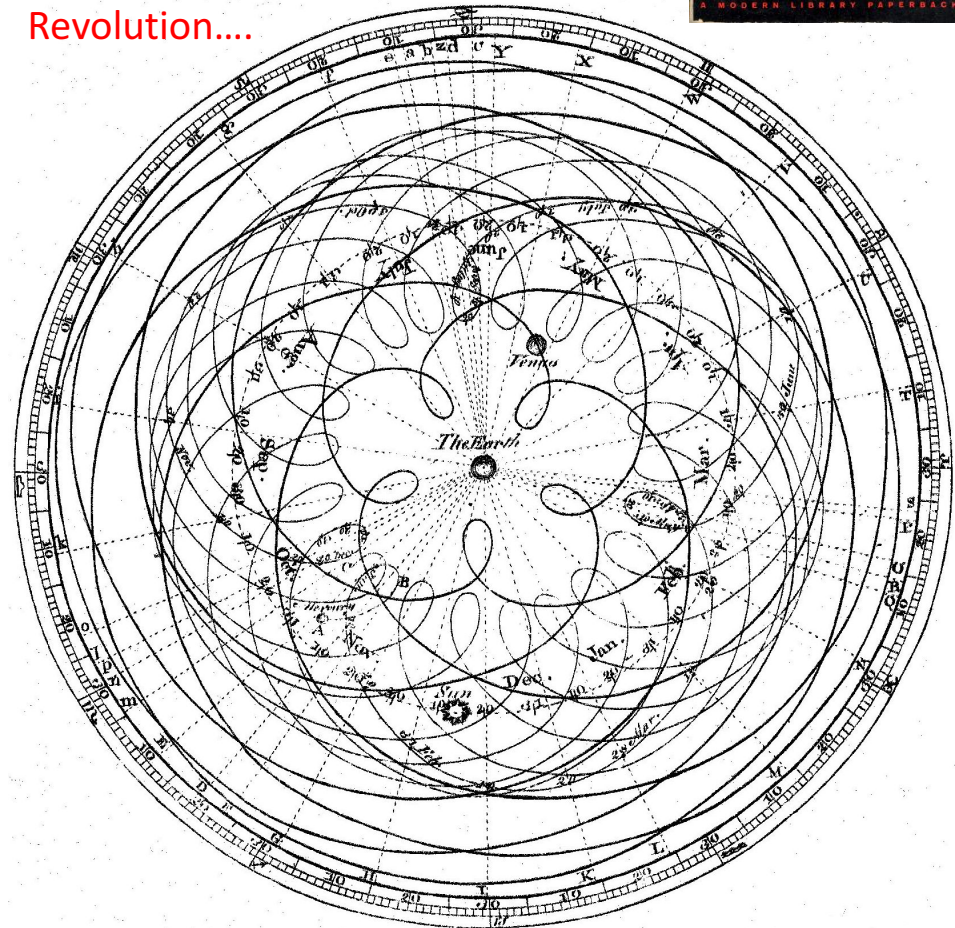
# Constraining cochlear models...



Zweig & Shera (1995)



## Copernican Revolution...





---

# review article

---

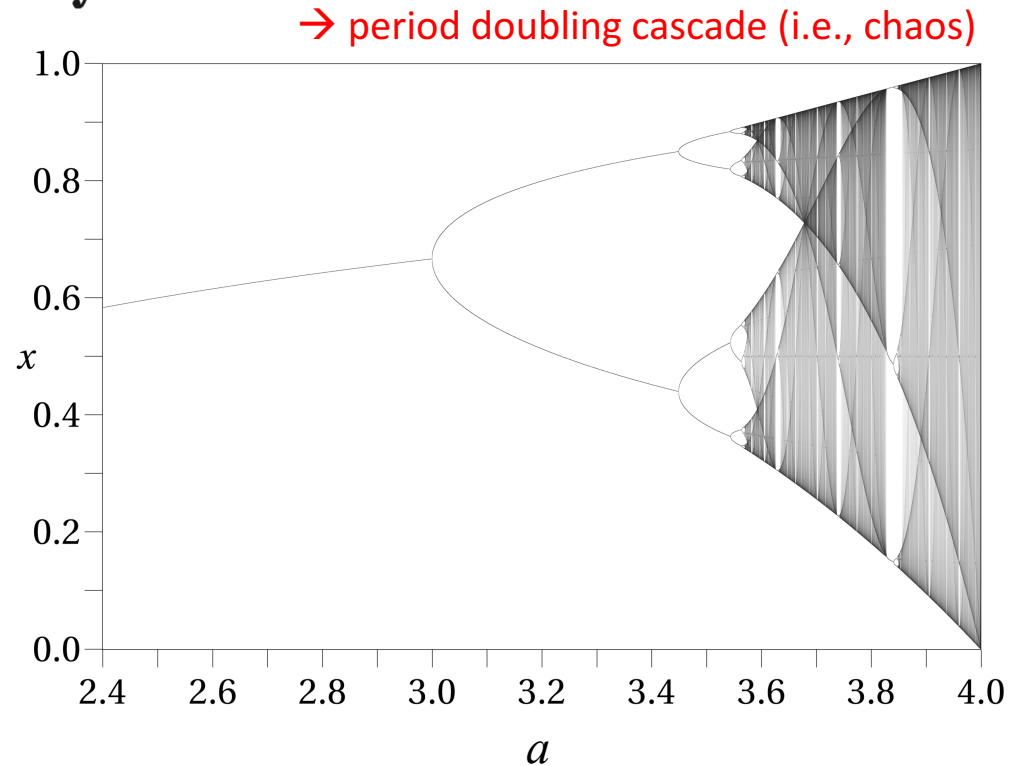
## Simple mathematical models with very complicated dynamics

Robert M. May\*

Logistic map

$$X_{t+1} = aX_t(1 - X_t)$$

→ Even the simplest nonlinearities can greatly complicate matters!





# BIOPHYSICS @ YORK



*redefine* **THE POSSIBLE.**