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

IHLC 2019
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

OAE: phase gradient of otoacoustic emissions

PSY: psychophysical detection of tones in notched-noise masker

\[ \text{cochlear frequency selectivity?} \]

Sumner et al (PNAS 2018)
Different means to measure tuning

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

Sumner et al (PNAS 2018)
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?
Research Paper

No otoacoustic evidence for a peripheral basis of absolute pitch

Larissa McKetton a, David Purcell b, Victoria Stone b, Jessica Grahn c, Christopher Bergevin d, *

a Biology, York University, Toronto, ON, Canada
b Communication Sciences and Disorders, University of Western Ontario, London, ON, Canada
c Psychology, University of Western Ontario, London, ON, Canada
d 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)

e.g., coherent reflection model

Zweig & Shera (1995)

Copernican Revolution....
Another fine mess...

review article

Simple mathematical models with very complicated dynamics
Robert M. May*

Logistic map

\[ X_{t+1} = a X_t (1 - X_t) \]

→ Even the simplest nonlinearities can greatly complicate matters!

→ period doubling cascade (i.e., chaos)