Some principles why even modern hearing aids still fail

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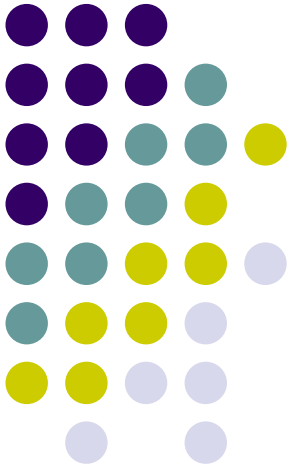
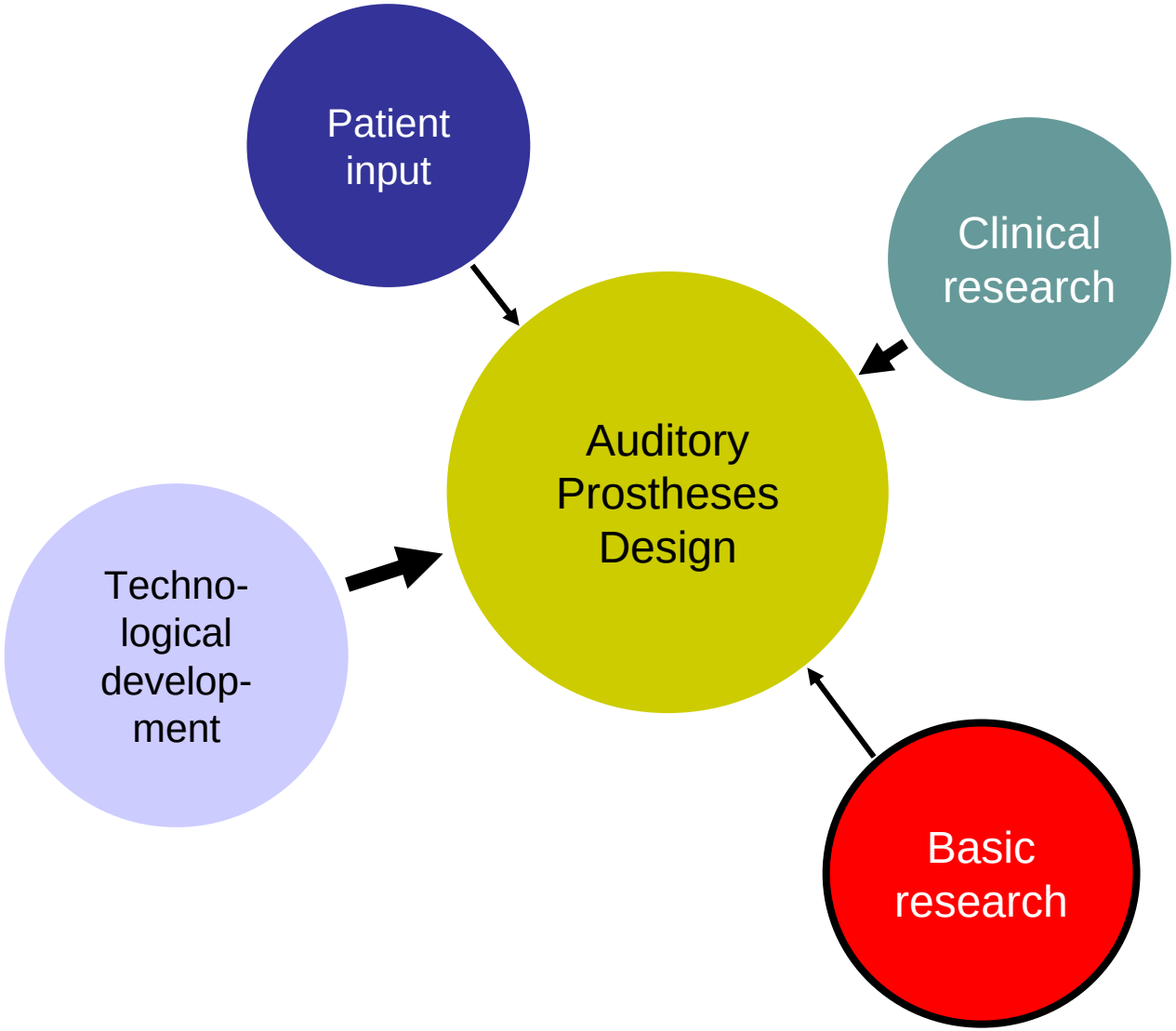
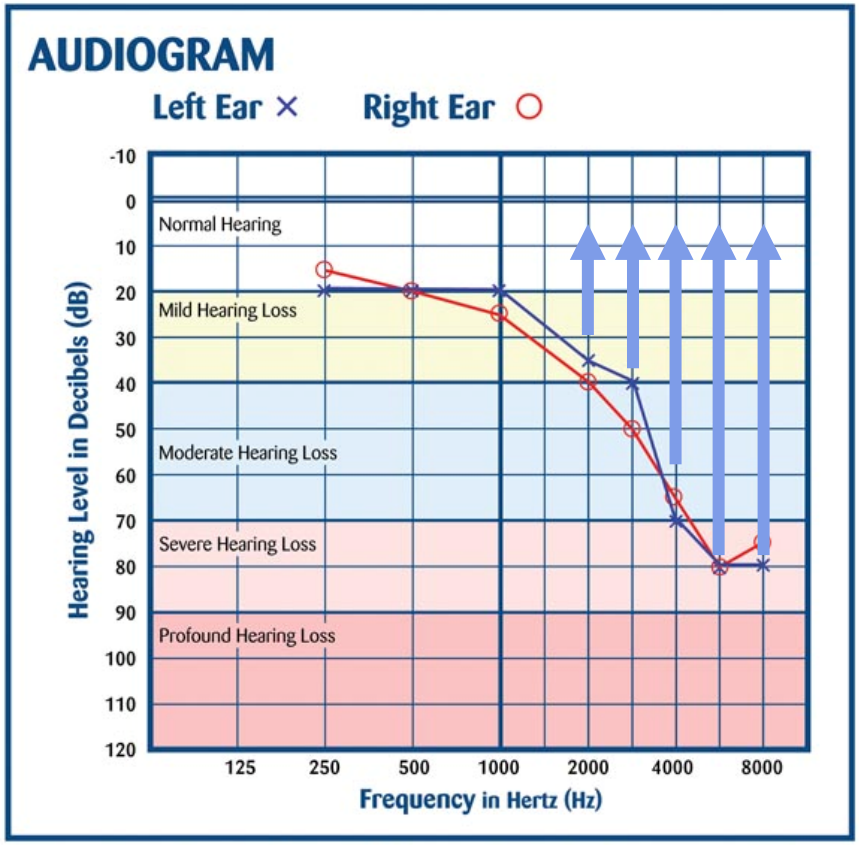


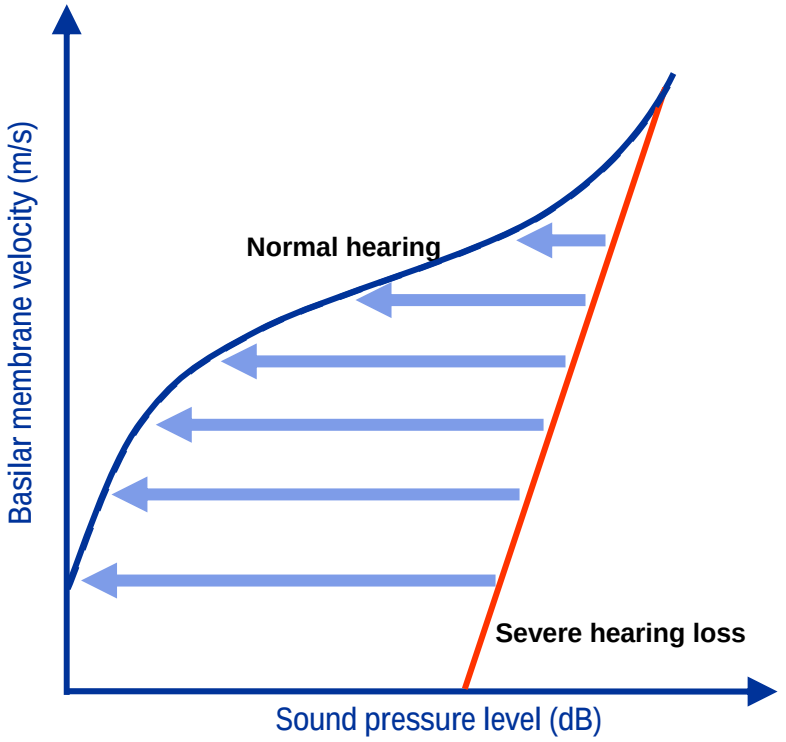
Aim


Patient input
Clinical research
Auditory Prostheses Design
Techno-logical develop-ment
Basic research

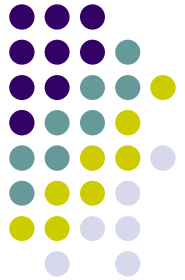
Hearing aids restore the dynamic range of hearing



* An example presbyacusis (sloping high-frequency hearing loss) synonymous with the ageing process.

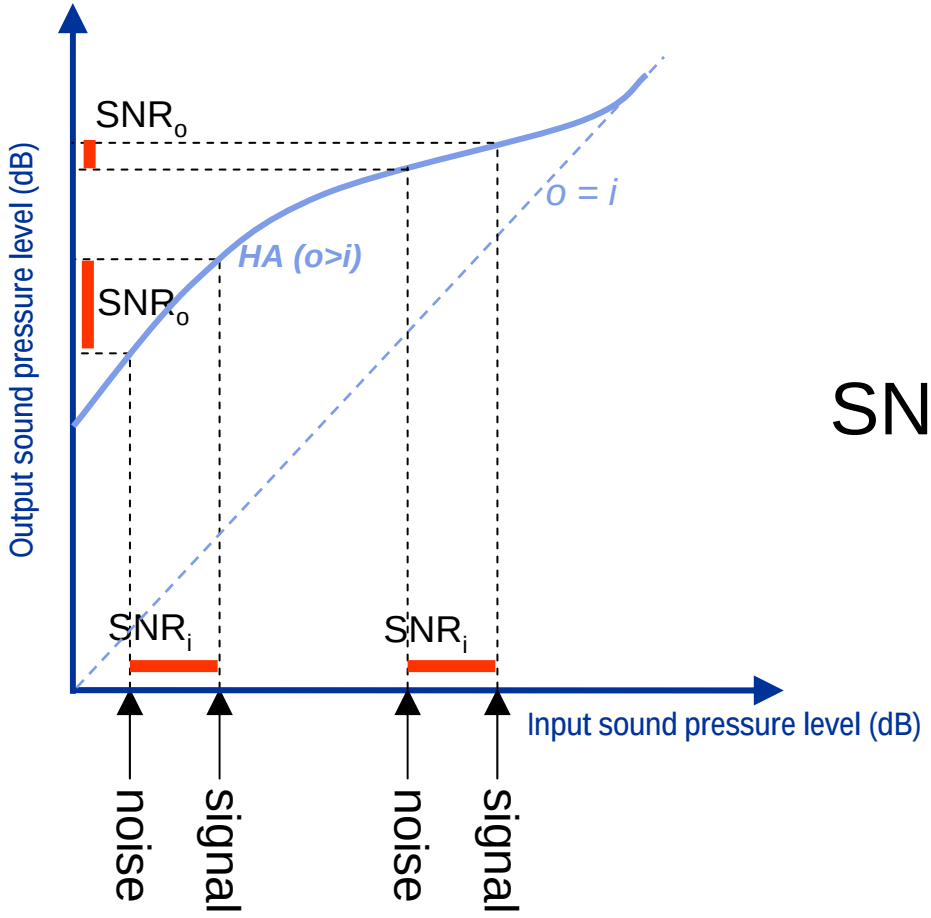


Why do they fail?



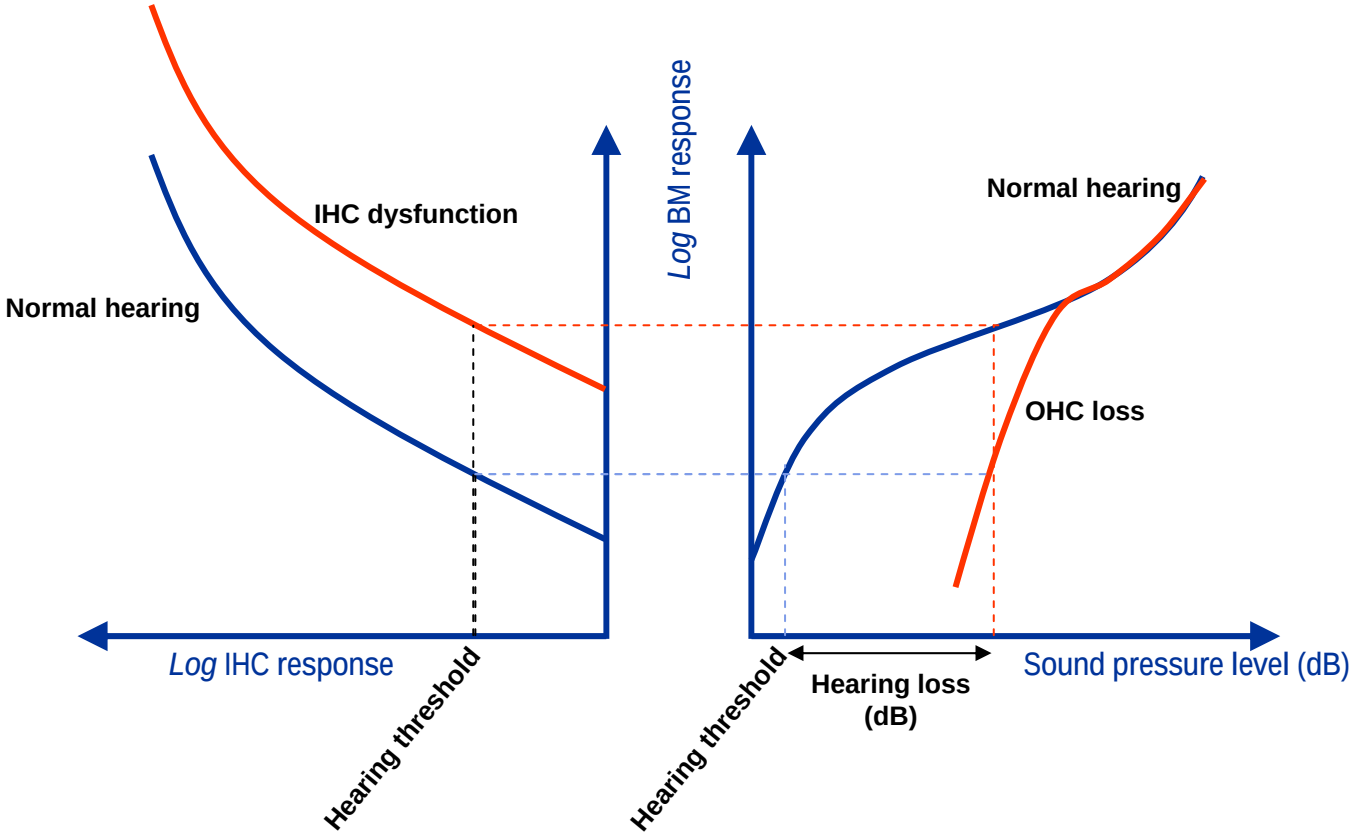
1. They amplify the signal and the noise, unless they make a priory assumptions about what the signal is.
2. The apply similar processing strategies regardless of the degree of residual compression.
3. The can change the frequency content of the signal but not how it is delivered in the cochlea.

They amplify the signal *and* the noise

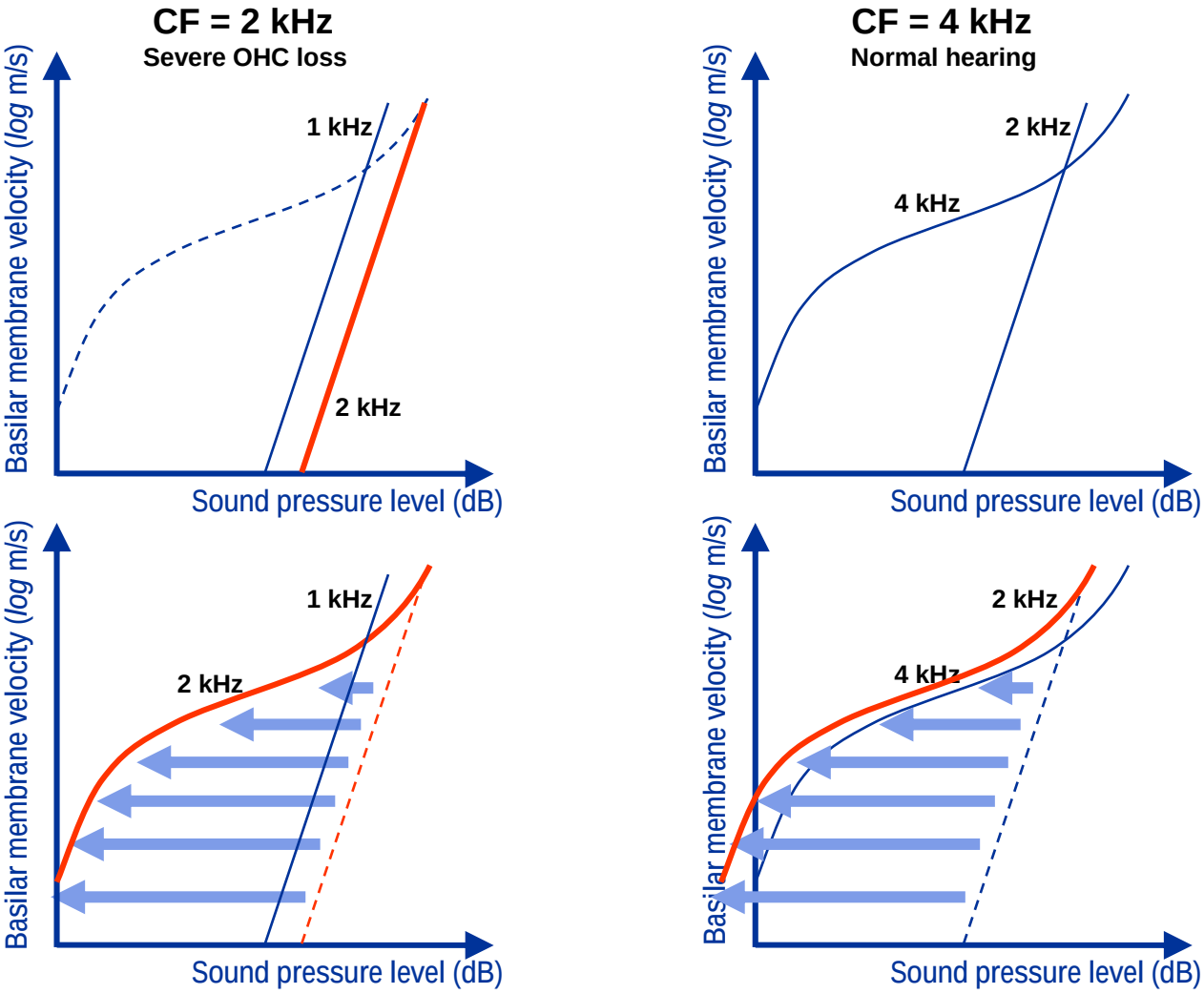


$$SNR_o \leq SNR_i$$

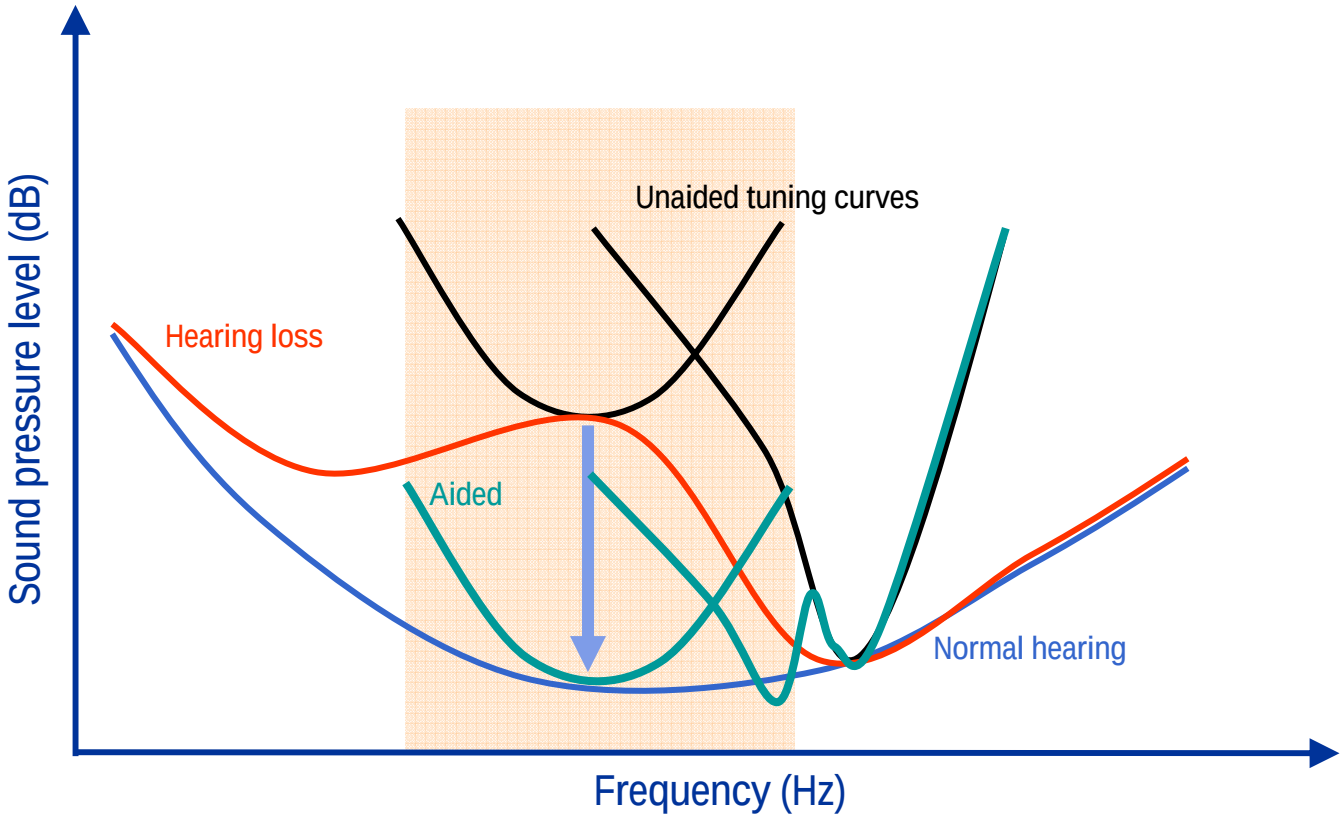
They disregard residual compression



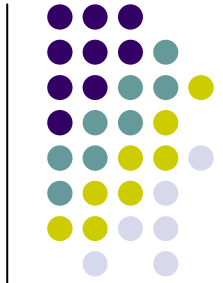
They can’t control how the signal is delivered in the cochlea



They can’t control how the signal is delivered in the cochlea



Complementary solutions

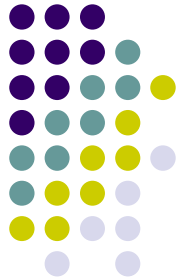


- Speech tracking and enhancement.
- Directional microphones.

Still have drawbacks

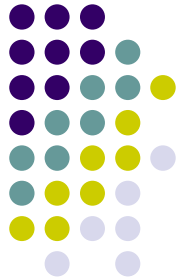
- Sometimes the desired signal is *not* speech.
- Even when it is, they amplify all speech.
- Requires knowing the position of the sound source and ‘staring’ at it.

Proposed approaches



1. Optimize functional diagnosis toward individualized fitting strategies (e.g.,measure residual compression).
2. Employ computational models of the human hearing to design new processing stragies.
3. Maximize information transmission without making a priori assumptions on what the signal is.

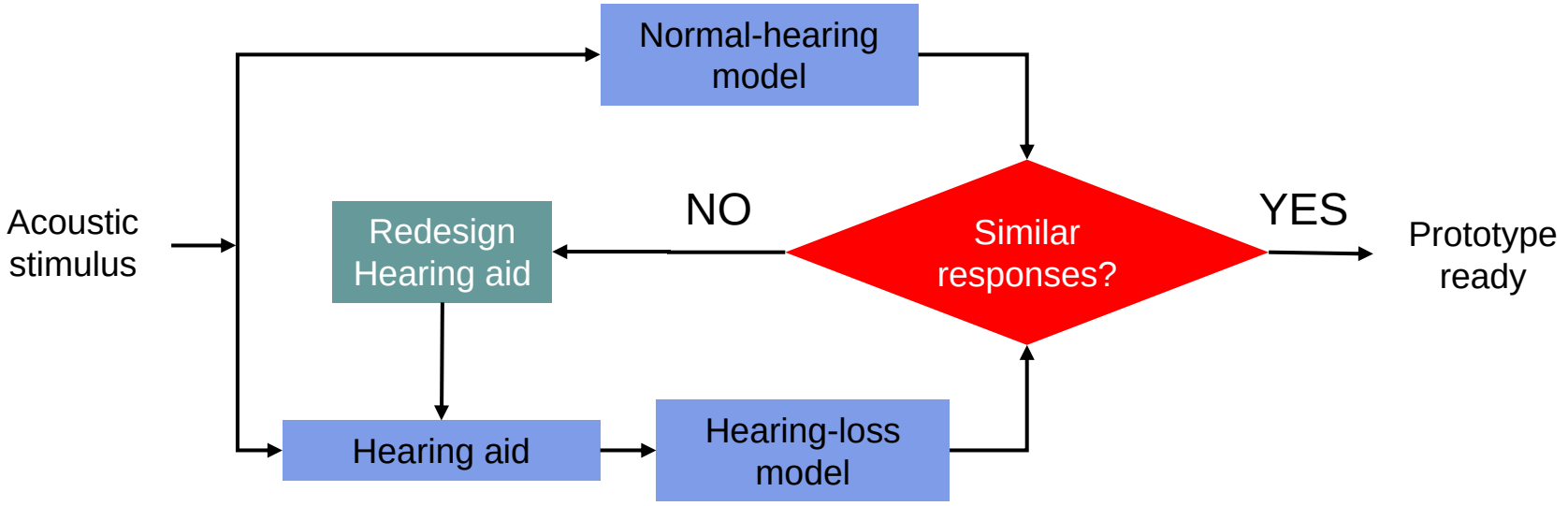
Individual functional diagnosis



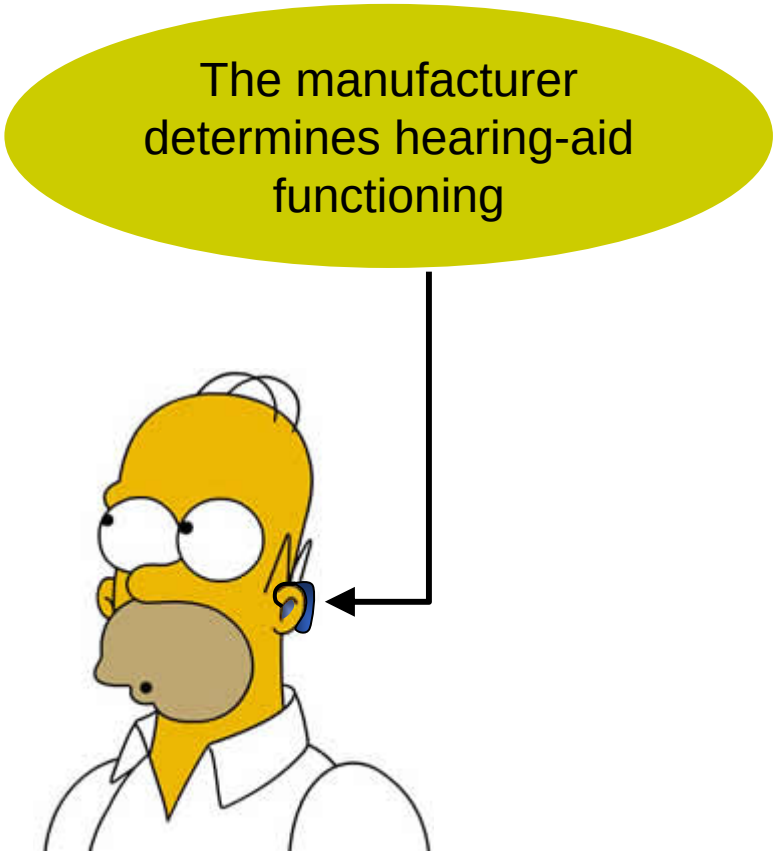
- Measure residual compression and take it into account when fitting hearing aids.
- Requires fast, reliable methods useful in a clinical context (even for kids and the elderly).

Use computational auditory models

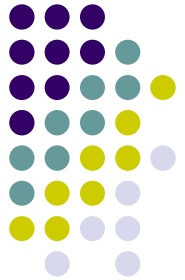
- Use computational models of human hearing to test new hearing-aid strategies:



Maximize information transmission without making *a priori* assumptions (still science fiction!)

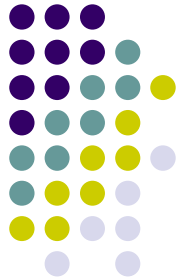


The latter requires



- Design new electrodes that can function in everyday life situations.
- Understanding brain evoked responses in selective attention conditions (e.g., cocktail party situations).
- Design processing strategies that “adapt” to these responses with the aim to maximize the desired response.
- It would be akin to mimicking the effect of the “efferent system”.

Conclusions



- There is big room for improvement!

Thank you!

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