Measuring and Understanding Tinnitus - Including Patients Views on The Meaning of Life with Richard S. Tyler - 7 pm ET

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Measuring and Understanding Tinnitus-Including Patients Views on The Meaning of Life

Richard S. Tyler, Professor, Tinnitus Clinic Director, Department of Otolaryngology, The University of Iowa

Nov 19, 2020

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Canadian Academy of Audiology is a professional association dedicated to enhancing the role of audiologists as primary hearing health care providers through advocacy, education and research.

Andreas Seelisch - Host

Andreas Seelisch is the Director of Audiology at Hearing Solutions, the largest independently owned and operated hearing aid retailer in Ontario with 27 clinics. He graduated from Western University with a Masters in Communication Sciences and Disorders in 2008 and completed his thesis work at the National Centre for Audiology on the sound quality impact of frequency compression technology.

Speaker: Richard S. Tyler, Professor

Richard received a B.Sc. and a M.Sc. at the University of Western Ontario. He then received a Ph.D. in Psychoacoustics from the University of Iowa. He is currently a Professor in Otolaryngology at the University of Iowa. Richard has been a visiting scholar in China, South Africa, Australia, Sweden, Poland, Germany and France.

He was made an Honorary Professor at the University of Parma, Italy. His main areas of interest include tinnitus, hyperacusis and cochlear implants. He edited, Cochlear Implants: Audiological Foundations, the Tinnitus Handbook, Tinnitus Treatments, and A Consumer Handbook of Tinnitus.

Richard he was the first person to be trained as an Audiologist in Ontario!

Measuring Tinnitus
&
Reactions to Tinnitus,
&
Tinnitus Activities Treatment

Richard Tyler

University of Iowa

What tinnitus patients want?

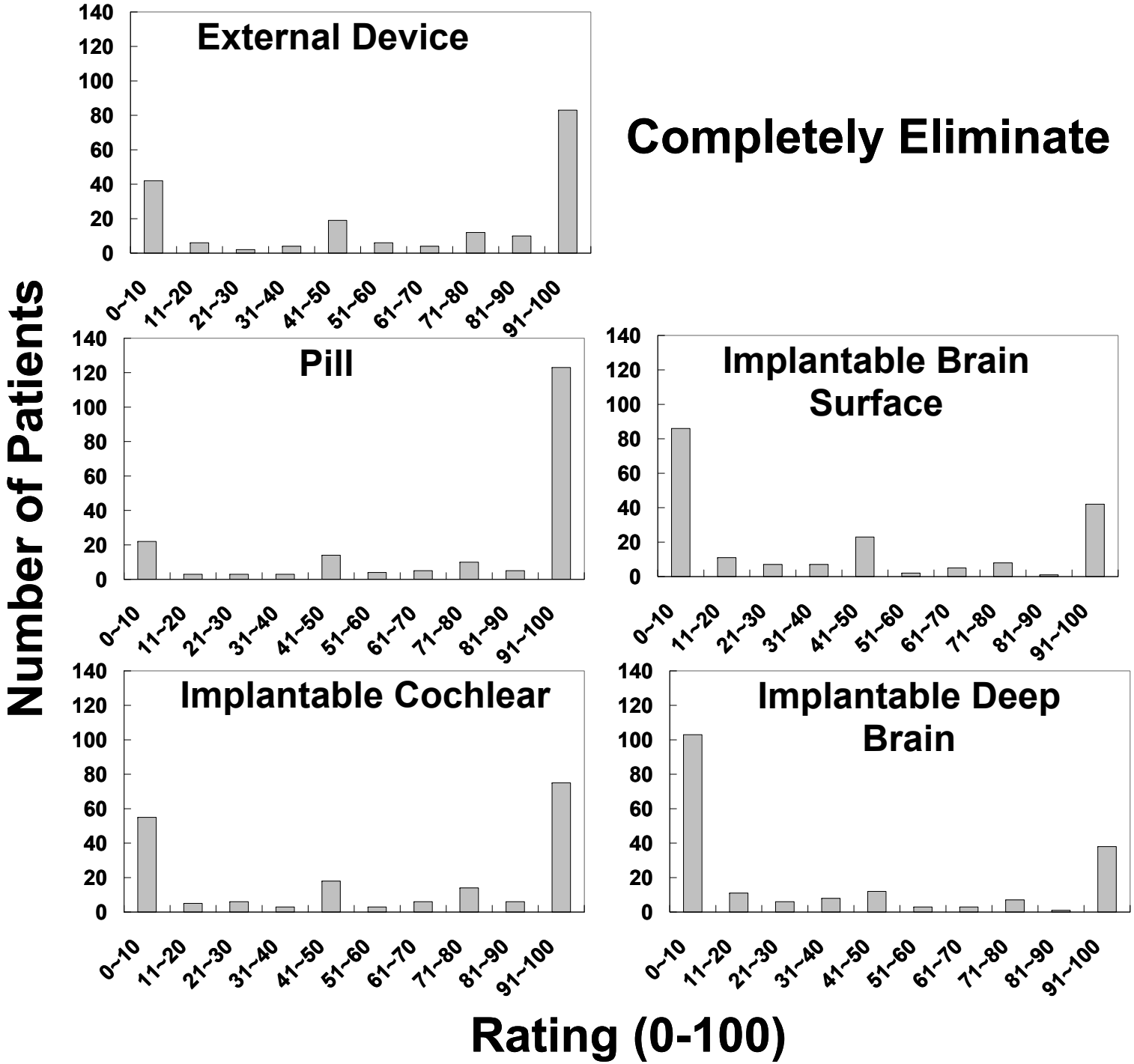
- How willing would you be to accept this treatment, if it were to **completely eliminate your tinnitus**?

- Respond from 0-100 %

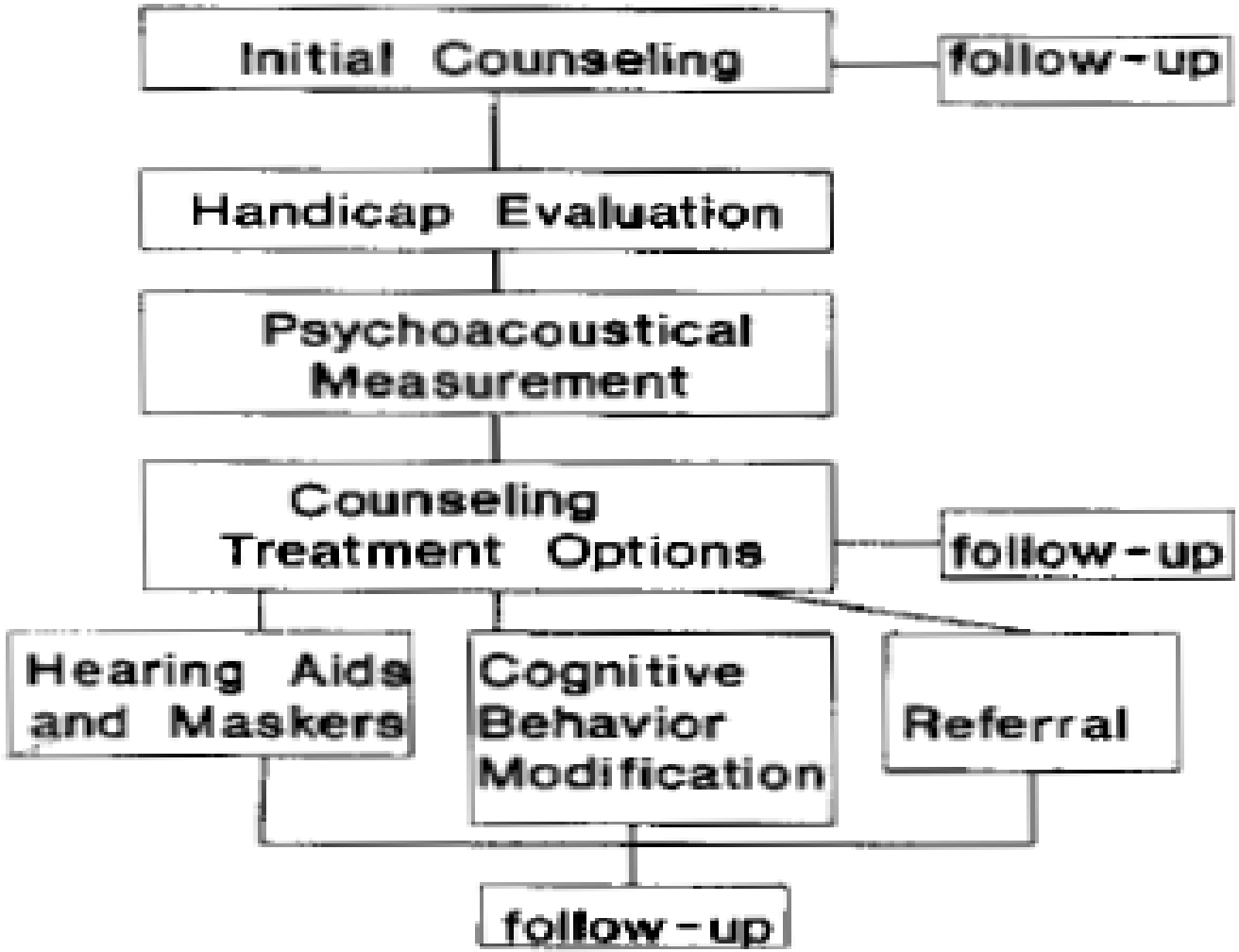
  0% - you would never consider it

  100% – you would absolutely try it.

  Tyler RS (2012) Patient Preferences and Willingness to Pay for Tinnitus Treatment J Am Acad Audiol 23, 115-125

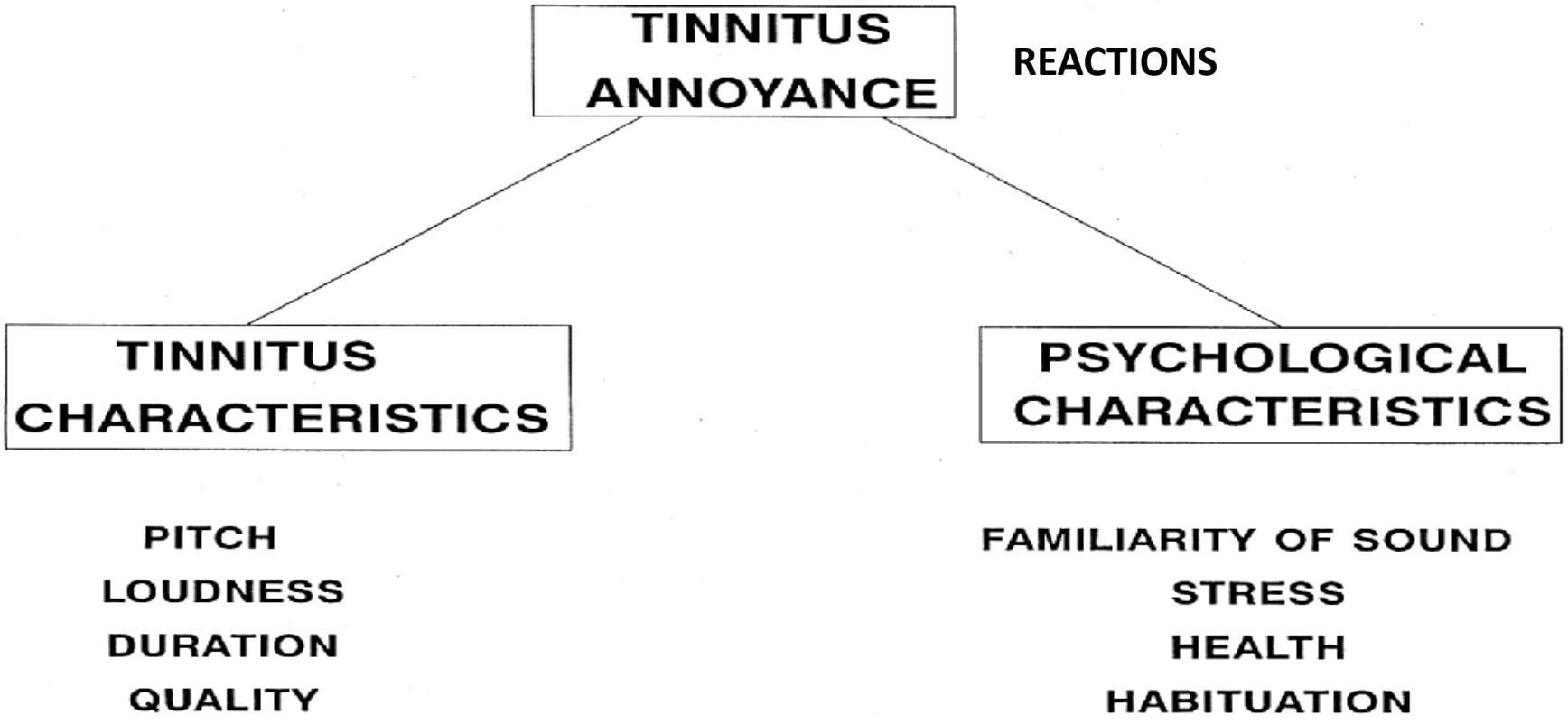

Completely Eliminate
External Device
Pill
Implantable Brain Surface
Implantable Cochlear
Implantable Deep Brain
Number of Patients
Rating (0-100)
0
20
40
60
80
100
120
140
0~10
11~20
21~30
31~40
41~50
51~60
61~70
71~80
81~90
91~100

Tinnitus Activities Treatment ; 1989



Tyler, R. S., Stouffer, J. L., & Schumm, R. (1989). Audiological rehabilitation of the tinnitus client. **Journal of the Academy of Rehabilitative Audiology**, **22**: 30-42.

The Psychological Model of Tinnitus



Dauman, R. and Tyler, R.S. (1992).

The Measurement of Tinnitus

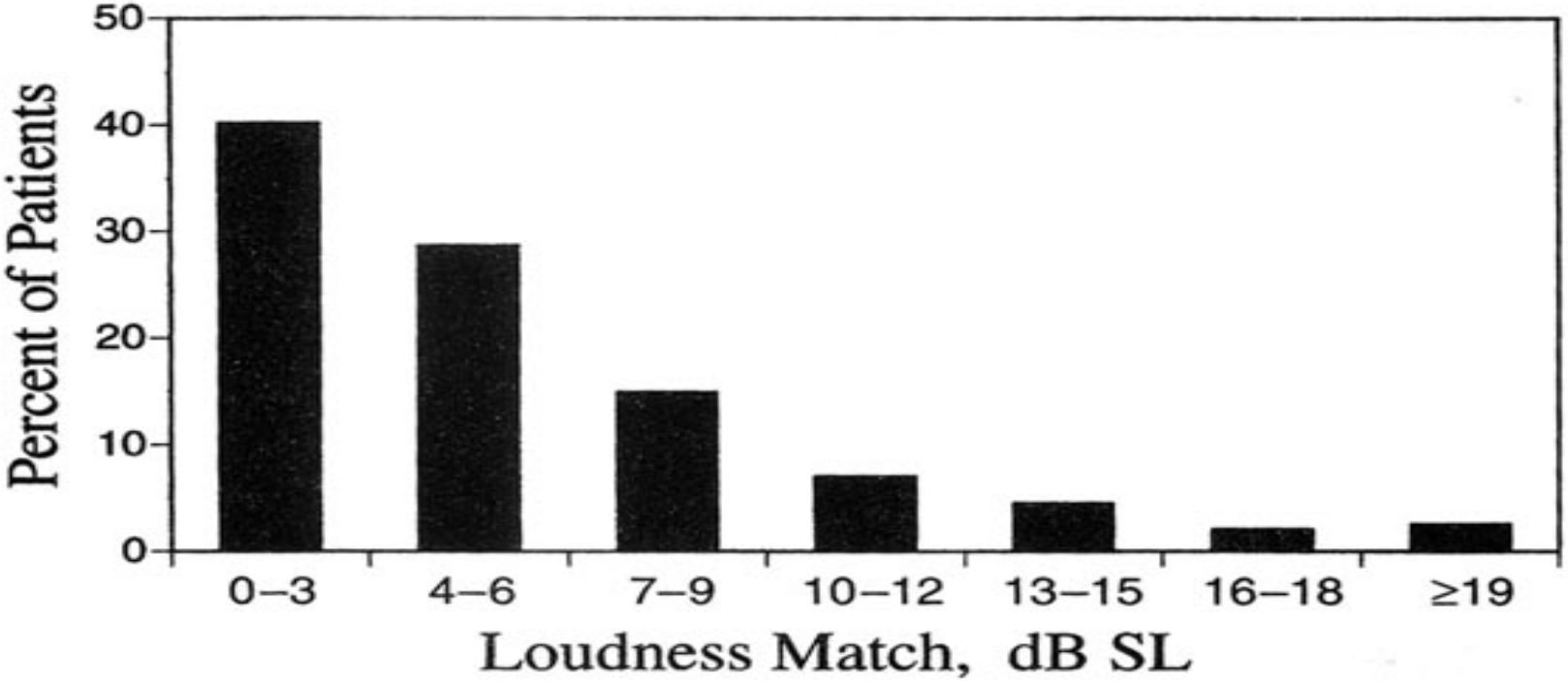
- Tinnitus
  - –Pitch, Loudness, Masking…
- Reaction to tinnitus
  - –Primary functions affected
    - Emotions, Hearing, Sleep, Concentration

Tinnitus Loudness

- To estimate the internal magnitude of the Tinnitus

1) Loudness matching
   - Match loudness of pulsed monaural tone to loudness of tinnitus
2) Loudness Magnitude Estimation
   - Estimate loudness of tinnitus (0-100 interval scale), with descriptive endpoints

Most matches are less than 10 dB sensation level

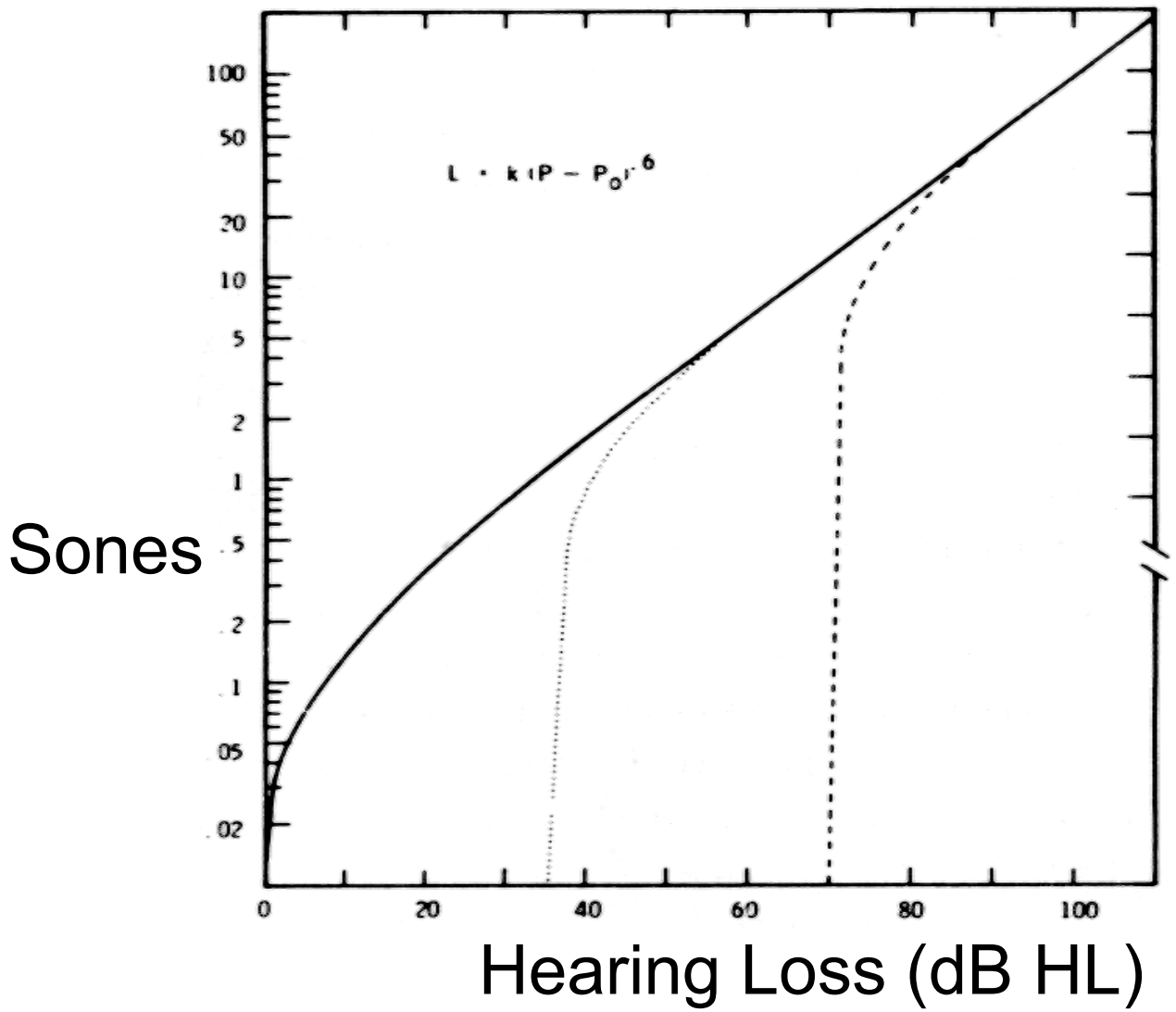


Vernon and Meikle, 2000

Loudness Matching

- Although the dB sensation level can be small,
- SENSATION LEVEL IS NOT LOUDNESS
- tinnitus patients almost always have hearing loss and loudness recruitment
- Therefore, loudness match a few dB SL can be loud

R. Tyler Copyright



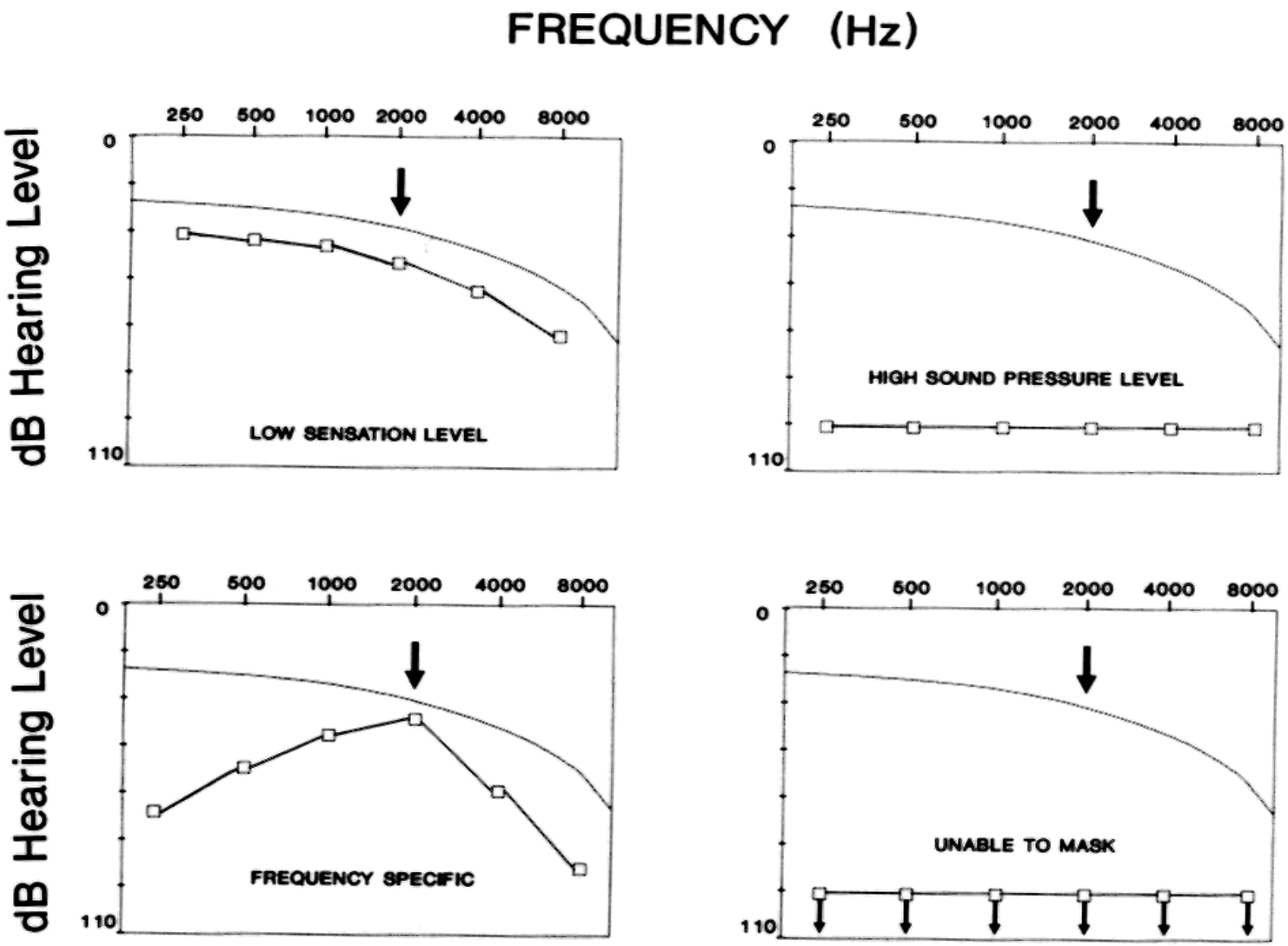
Tyler, R. S. & Conrad-Armes, D. (1983). The determination of tinnitus loudness considering the effects of recruitment. **J Speech and Hearing Research, 26**: 59-72.

Measurements important - **Subgrouping** –
Clinical trials are more likely to be successful if appropriate subgroups can be identified (Tyler, 1991)

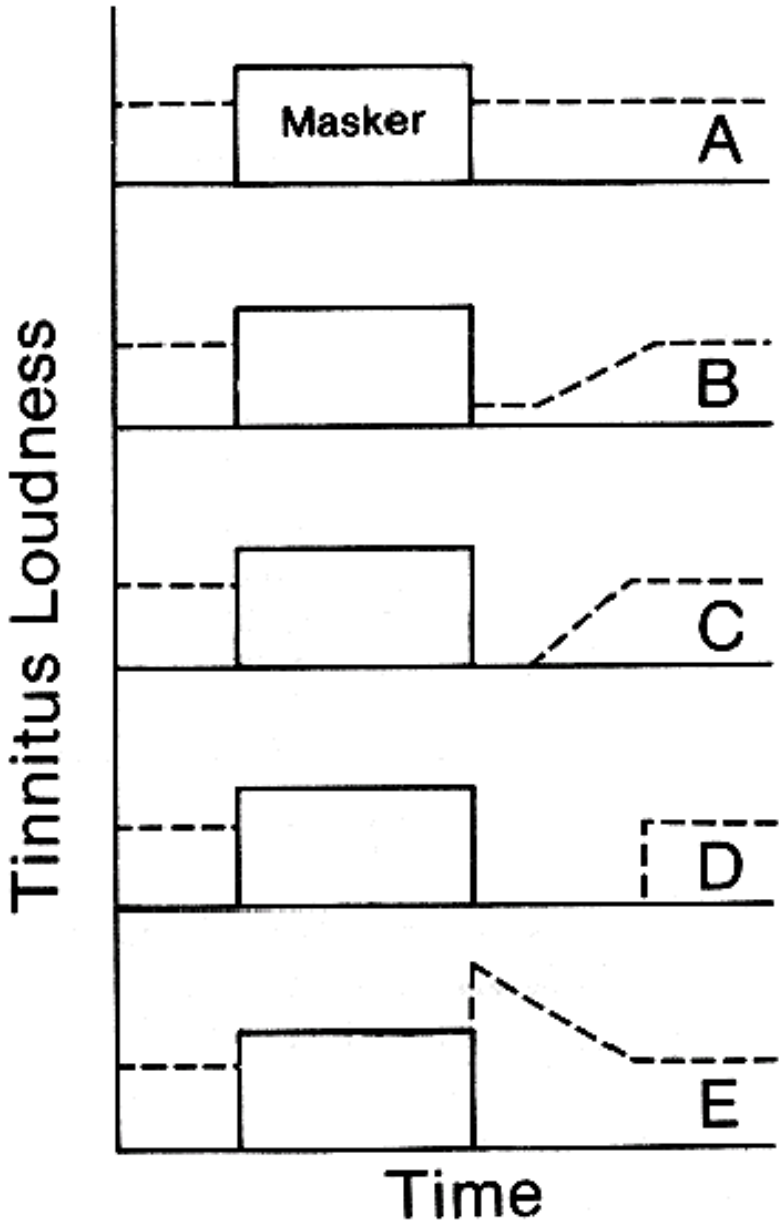
- Psychoacoustic measures
- Subjective reports
- Etiology
- Audiogram
- Imaging
- Tinnitus Primary Functions Questionnaire
- **Cluster analysis** ---- Tyler, et al. (2008). Identifying tinnitus subgroups with cluster analysis. Am J Audiol. 17(2):S176-84

- Cluster 1
  - Loud, persistent, **distressing**
  - Loudness hyperacusis
- Cluster 2
  - **Varies** in pitch & loudness
  - Tinnitus worse in noise
- Cluster 3
  - **Not distressed**
  - No loudness hyperacusis
  - Not influenced by touch
- Cluster 4
  - **Tinnitus worse in quiet & better in noise**
  - Soft loudness, not distressed

Tinnitus Masking with Pure Tones - **Psychoacoustic Tuning Curves**
Perhaps discover a source on the basilar membrane ?

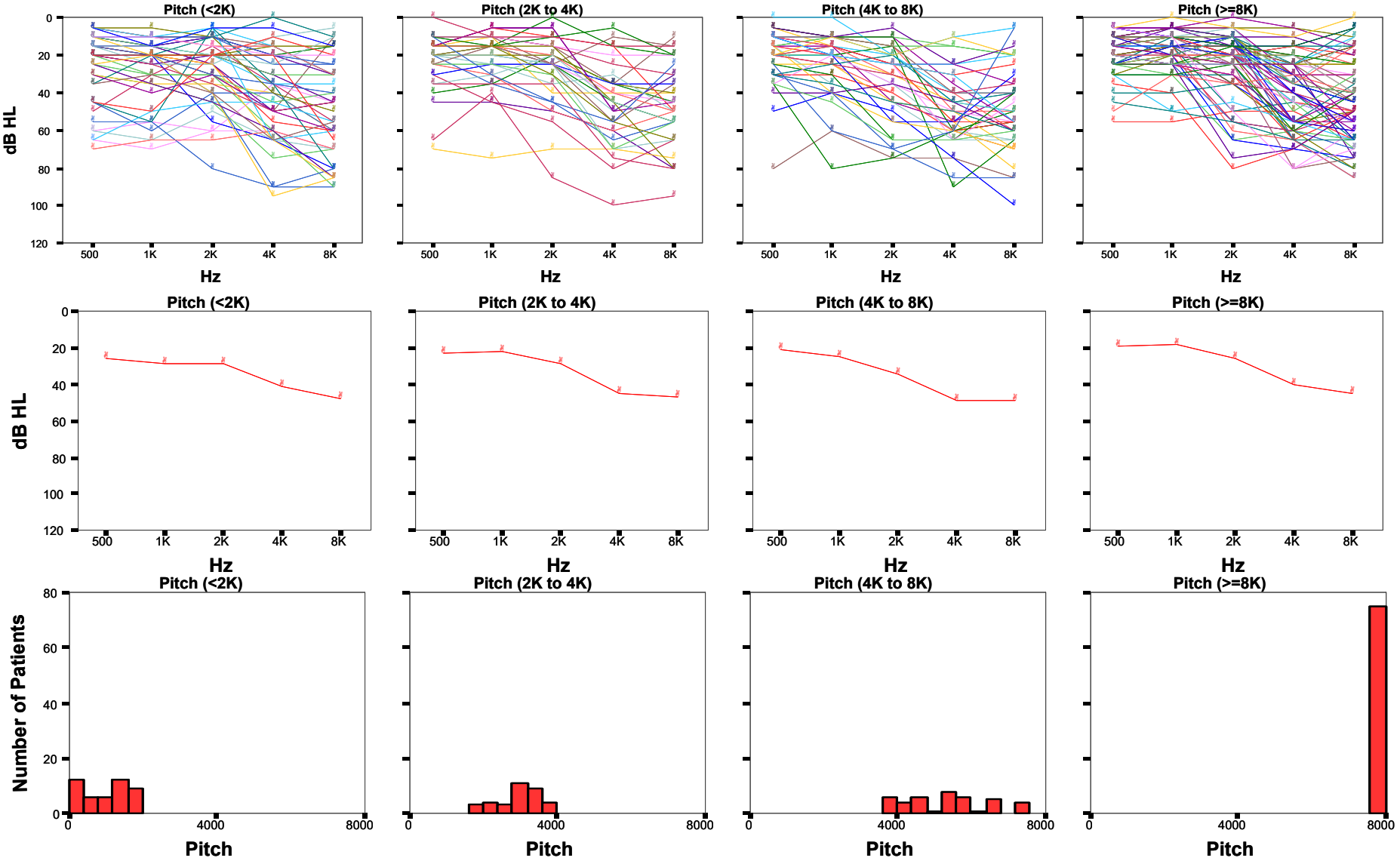


Tyler, 1984 Does tinnitus originate from hyperactive nerve fibers in the cochlea?
Journal of Laryngology and Otology (Suppl. 9): 38-44.

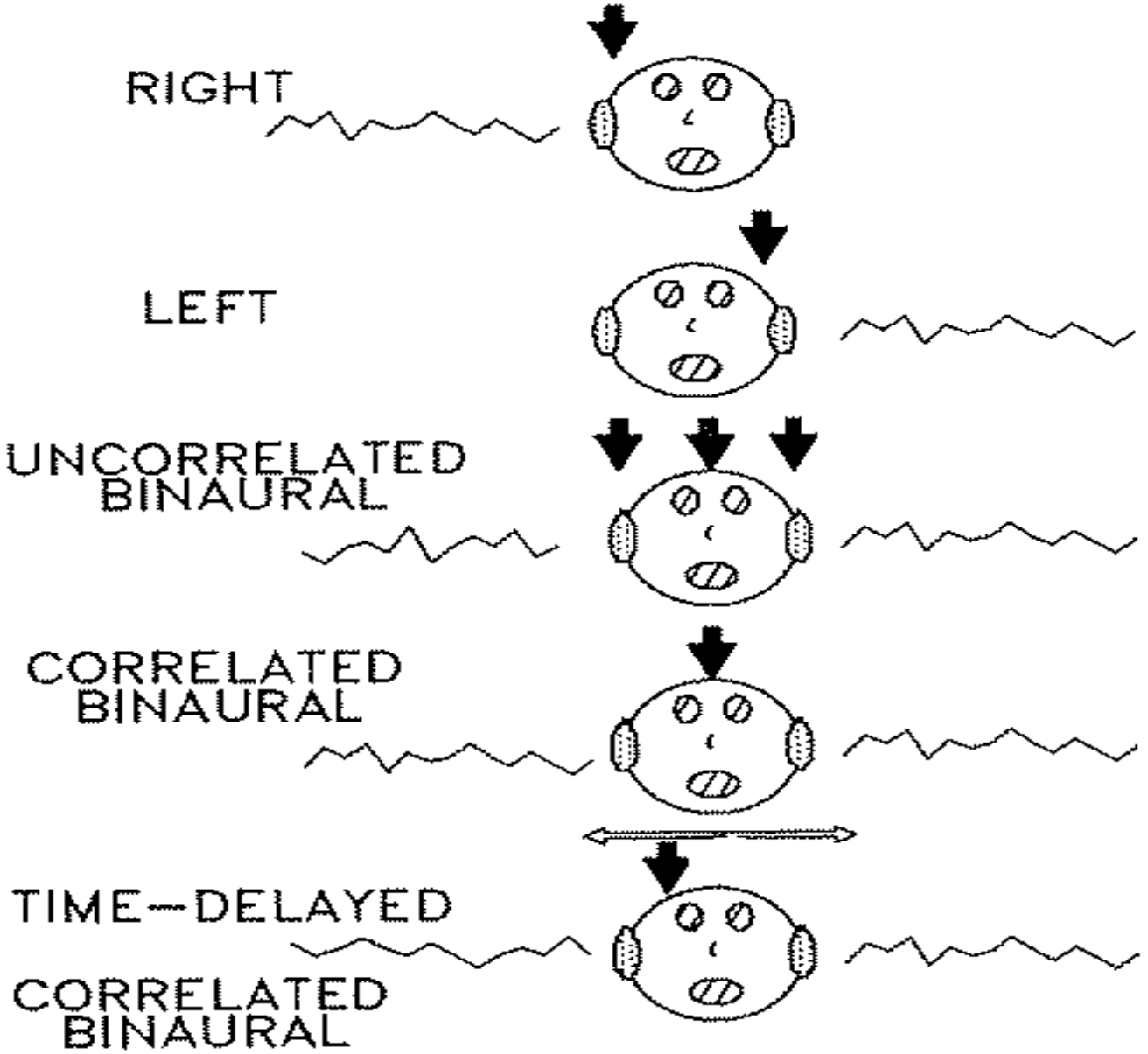


Post-Masking /
Residual Inhibition

- Pan, T., Tyler et al. (2009). The relationship between tinnitus **pitch and the audiogram**. Int J Audiol. 48 (4): 277-294. **195 tinnitus patients**



Binaural Masking



Measuring functions affected

- **Open-ended questionnaire (Tyler and Baker, 1983)**

- **Please list the difficulties you have as a result of your tinnitus**
- List them in order of importance
- Useful clinically to identify issues relevant from patient's perspective

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Tinnitus Functional Index

- Meikle et al. (2012)
- 25 questions
- Scored 0-10
- 8 factors
- Unfortunately includes 4 questions on Quality of Life

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Tinnitus Functional Index

- General question
  - Do you feel in control in regard to your tinnitus?
- Quality of Life
  - How much has your tinnitus interfered with
    - your enjoyment of social activities?
    - Your relationships with family, friends and other people?

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Institute of Medicine of the National Academies

- "problems occur with their **emotional health, hearing, sleep and concentration**."
- **Humes, Larry**; Jollenbeck & Durch (2006)
- "impact of tinnitus can be worse than the impact of hearing loss"

Tinnitus Primary Functions Questionnaire

- Four categories; Thoughts & Emotions, Hearing, Sleep, Concentration
- No secondary 'Quality of Life questions’
- High resolution (0-100) on @ question
- Can be scored only with subscales affected, increasing resolution

Copyright Tyler

Tinnitus Primary Functions Questionnaire

- 12 item version (does not take long)
- Validated with Sleep, Depression, Anxiety scales, Tinnitus Handicap Questionnaire
- Translated into several languages
- used worldwide
- **The Questionnaire Most likely to show an effect in clinical trials**
- (Tyler, Ji et al., 2014)

Tinnitus Primary Functions Questionnaire (TPFQ)

- I have difficulty focusing my attention on some important tasks because of tinnitus.
- My emotional peace is one of the worst effects of my tinnitus.
- In addition to my hearing loss, my tinnitus interferes with my understanding of speech.
- I lie awake at night because of my tinnitus

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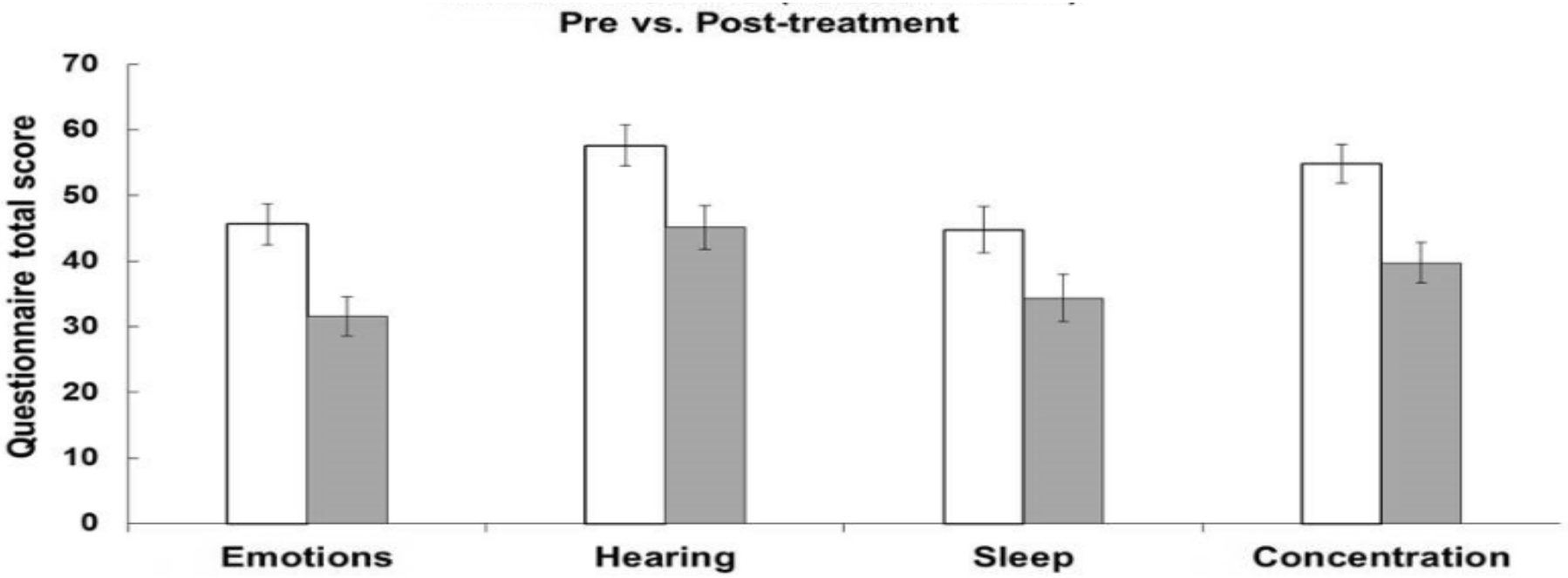


Clinical trial of Tinnitus Activities Treatment

Copyright Tyler

Tinnitus Activities Treatment

THE UNIVERSITY OF IOWA

Developed in 1980s

- Provided counseling on tinnitus and related problems,
- Suggested coping strategies
- Recommended partial masking for tinnitus

Influenced by work of Coles, 1987; Hallam, 1989; Henry & Wilson, 2001, 2002, Sweetow, 1984; among others

Patient reactions to tinnitus

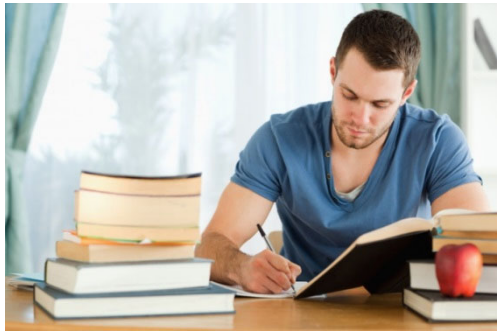
(Tyler & Baker, 1983)

Thoughts and emotions

Hearing difficulties

Sleep

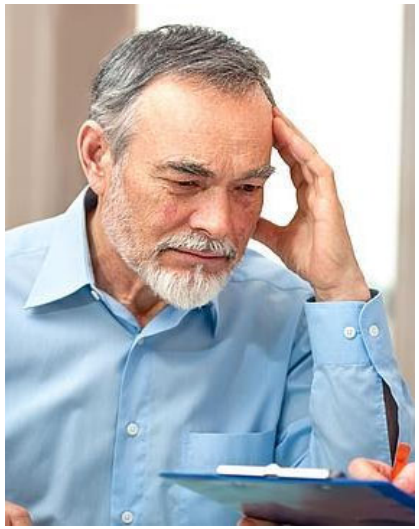
Concentration



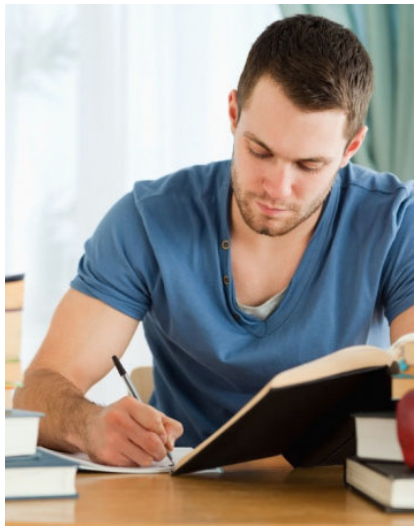
Part 1. Thoughts and Emotions

1. Hearing,
   hearing loss, and tinnitus
2. Attention, behavior, and
   emotions
3. Changing your reactions
   to tinnitus

Where do YOU want to start?

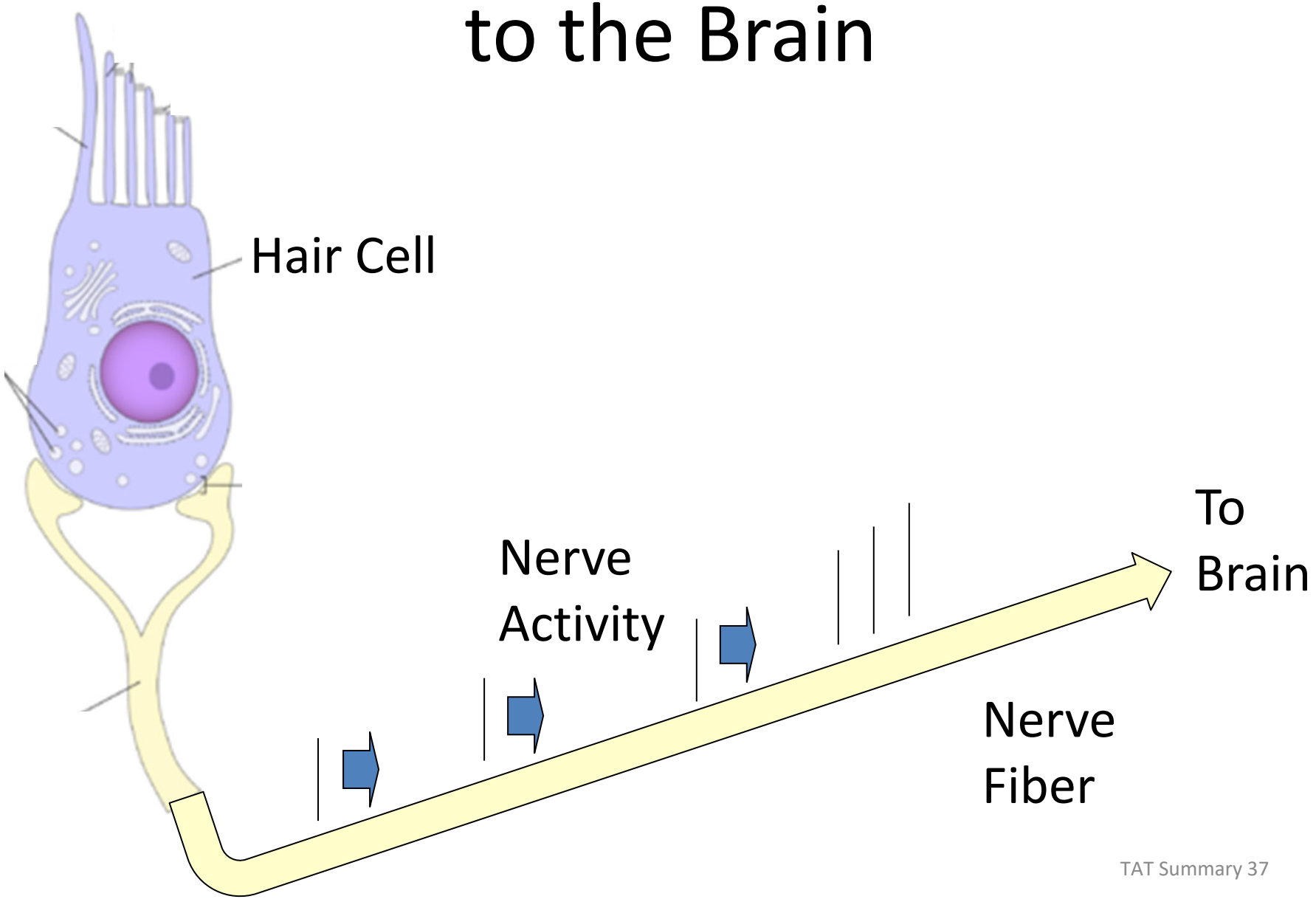
When your tinnitus began, what was your life like (home, work, etc.)?




How has tinnitus influenced your life?

How do YOU think we might be able to help?

Nerve Activity Carries Information to the Brain



Tinnitus is an Increase in Spontaneous Nerve Activity

Normal Hearing

Hear Silence

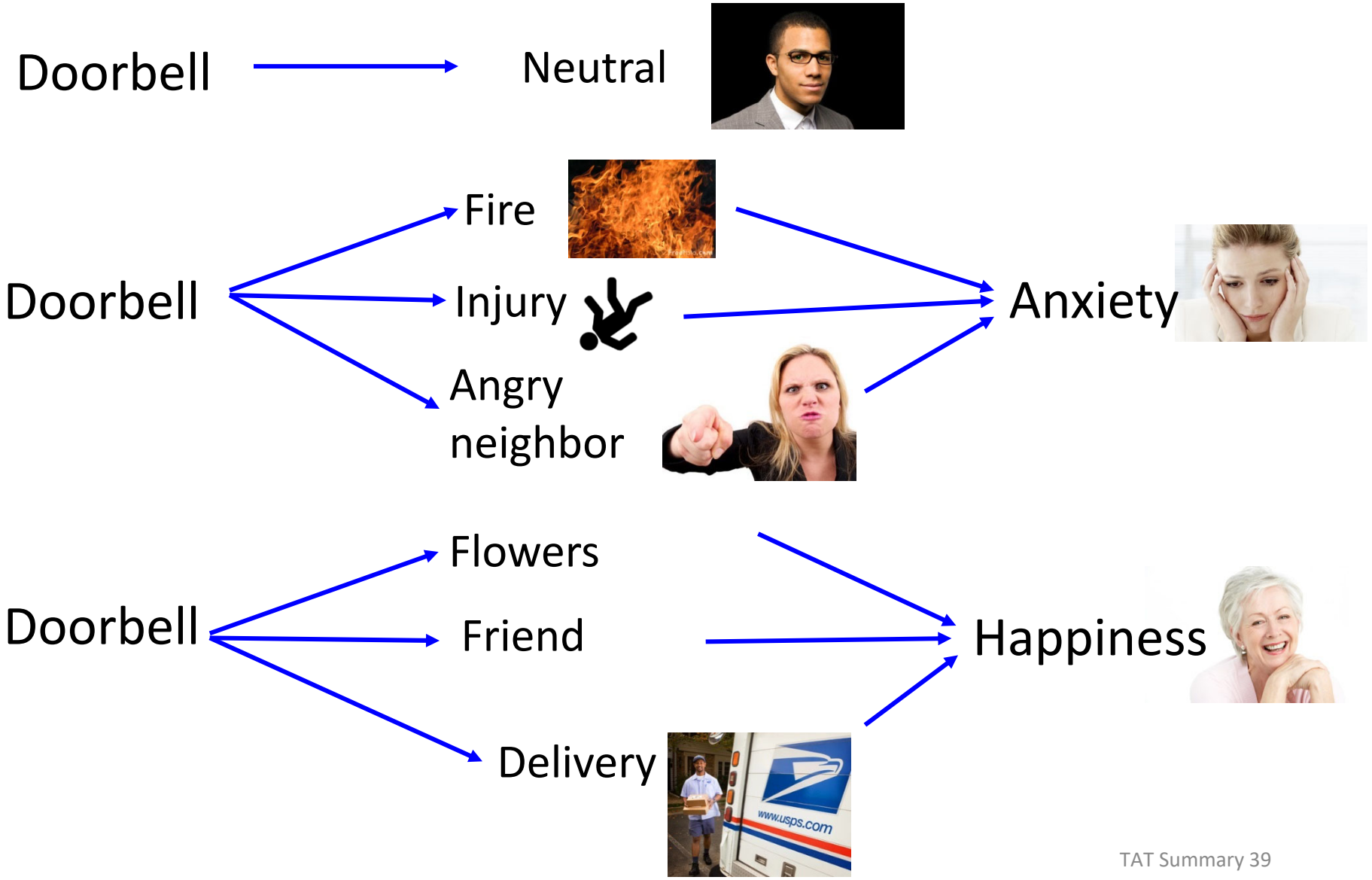
Hearing Loss (No Tinnitus)

Hear Silence

Tinnitus

Hear Sound

2. Our Thoughts and Emotions



Things That Capture Our Conscious Attention

Unusual

Important

Scary

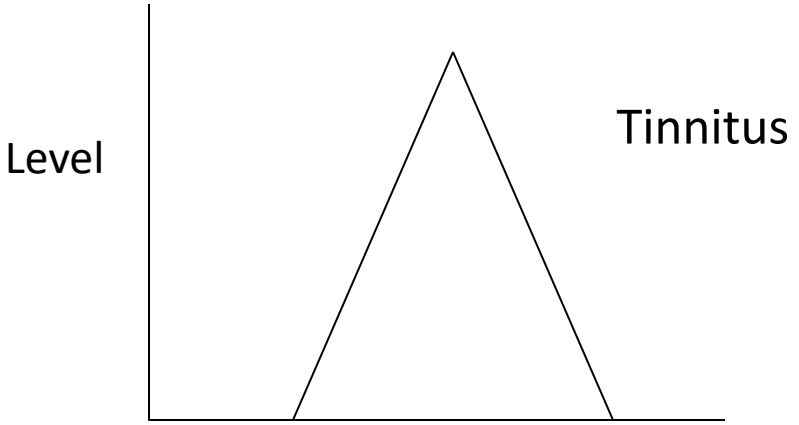
Unexpected

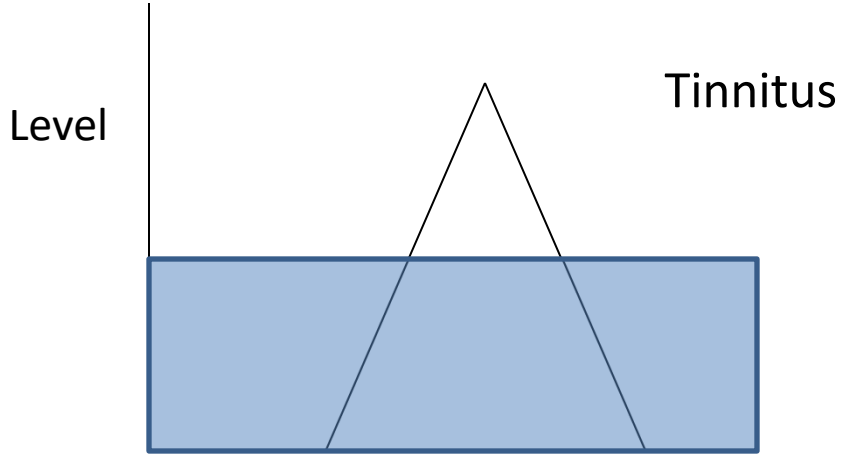
Tinnitus and Attention

If brain determines **tinnitus is not important,** the tinnitus can be ignored

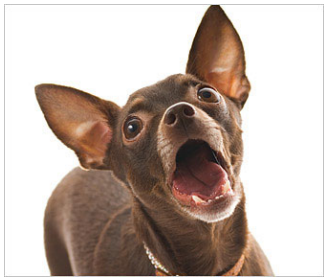
If brain determines **tinnitus is important,** we will pay attention to it

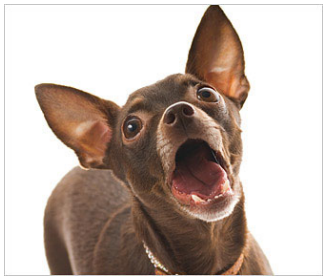
Decrease Prominence of Tinnitus

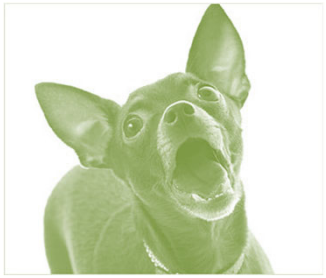




Background sound masks unwanted sounds







Part 2. Hearing and Communication

1. Hearing and communication difficulties
2. How tinnitus can affect hearing
3. How to improve your hearing

2. How Tinnitus Can Affect Hearing

- Tinnitus is not damaging your hearing
- Tinnitus can make it harder to hear sounds and distract one from listening
- Tinnitus can also mask some sounds

3. Use Amplification

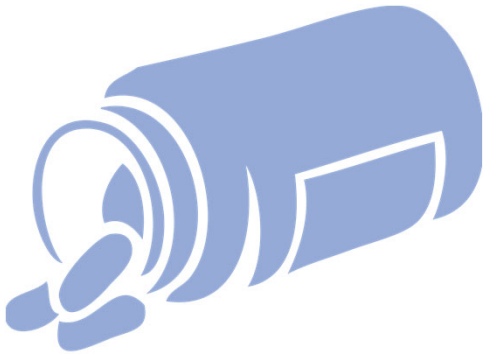
- Improve hearing and communication
- Reduce stress of effortful listening
- Hearing aids often help tinnitus:
  - Facilitates positive reactions to tinnitus
  - Helps to mask tinnitus sound

Part III.
Sleep

1. Normal sleep patterns
2. Tinnitus and sleep
3. Activities to facilitate sleep
4. Waking up at night

2. Things That Affect Sleep

- Stress and emotions
- Environmental factors
  - Noise
  - Light
  - Temperature
- Irregular work schedules
- Learned sleeplessness patterns
- Jet lag/time zone changes



Things That Affect Sleep, continued

- Physical conditions (sleep apnea, restless leg
- Medications
- Caffeine (coffee, tea, cola, chocolate)
- Nicotine (smoking)
- Alcohol (excessive)
- Tinnitus

3. Activities to Facilitate Sleep

- Avoid napping
- Get regular exercise
- Create a curfew separating day and night
- Avoid food, drink, stress or exercise right before bed
- Go to bed only when you are tired enough to sleep

Part 4. Concentration

1. Things that affect concentration
2. How tinnitus affects concentration
3. Strategies to improve concentration

2. How Tinnitus Affects Concentration

- When we focus attention to our tinnitus, it is harder to concentrate on other things
- Observe effects of tinnitus on concentration for simple and complex tasks
- Complex tasks are more demanding—tinnitus is less noticeable

3. Strategies to Improve Concentration

1. Interpret tinnitus as not important
2. Eliminate distractions
3. Stay focused
4. Adjust work habits
5. Decrease prominence of tinnitus
6. Take control of your attention

Take Control of Your Attention

- The focus of our attention is largely under voluntary control
- You can learn to control the focus of your attention under various conditions
- By bringing the focus of attention under control, tinnitus-related distress will be reduced at certain times

Summary of Tinnitus Activities Treatment

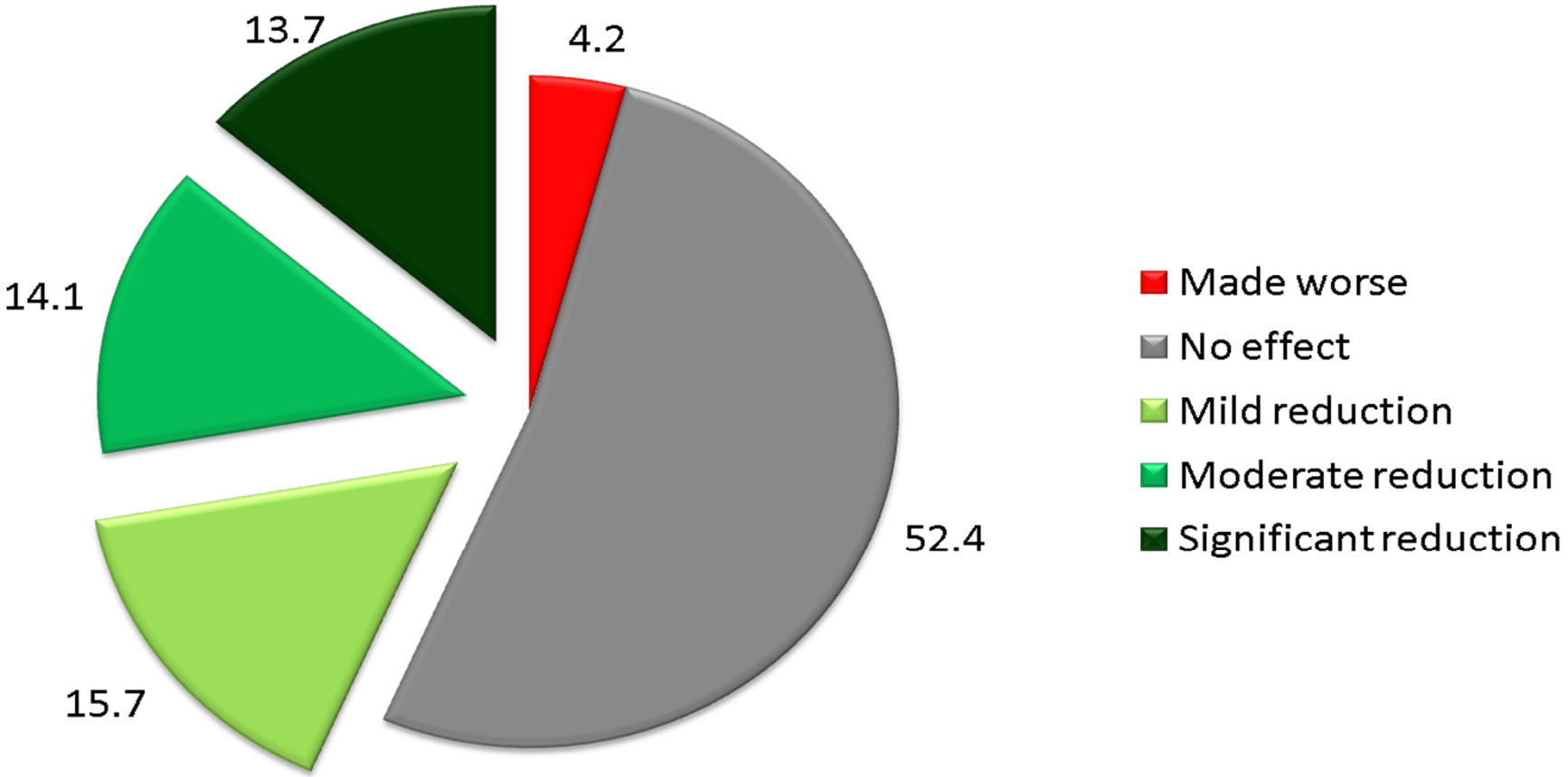
- Tinnitus Activities Treatment is available free!
- https://medicine.uiowa.edu/oto/research/tinnitus-and-hyperacusis

  – Tyler et al. (2014), Katz Handbook of Clinical Audiology.

HEARING AIDS FOR TINNITUS

Richard Tyler

Effectiveness of Hearing Aids mitigating tinnitus (n=1,314)



Kochkin, Tyler & Born (2011)

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Hearing Aids

help tinnitus because:

- Improve Communication
  - Therefore Reduce Stress
- Amplify Background Sound
  - external low-level sounds (distraction/partial masking)

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Hearing Aid fittings for partial masking

- Open ear molds to allow background sound
- no directional microphones
- Higher gain at low levels
- No noise reduction
- Extending Low & High Frequency Range

Sound Therapy Treatment

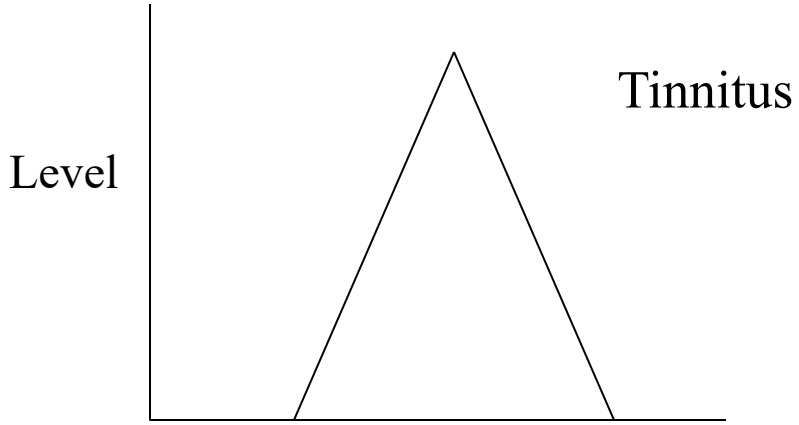
- Jack Vernon (1984)
  –wearable devices….Total masking;

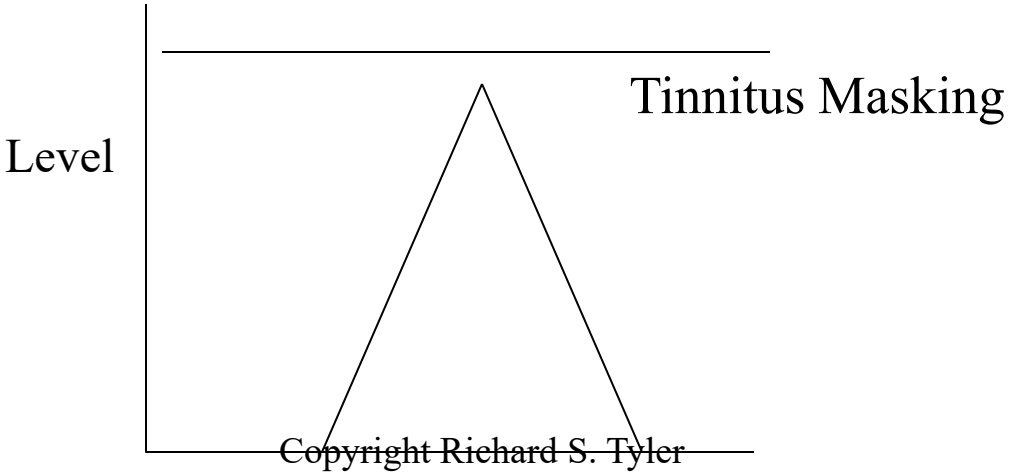
Level of the background sound

- Total masking
  - covers tinnitus completely
  - person hears a ‘masker’ instead of their tinnitus
  - Effective for some
- Partial masking
  - tinnitus and the acoustic sound can be heard
  - reduces the prominence and/or loudness

Copyright Richard S. Tyler

Complete/Total Masking





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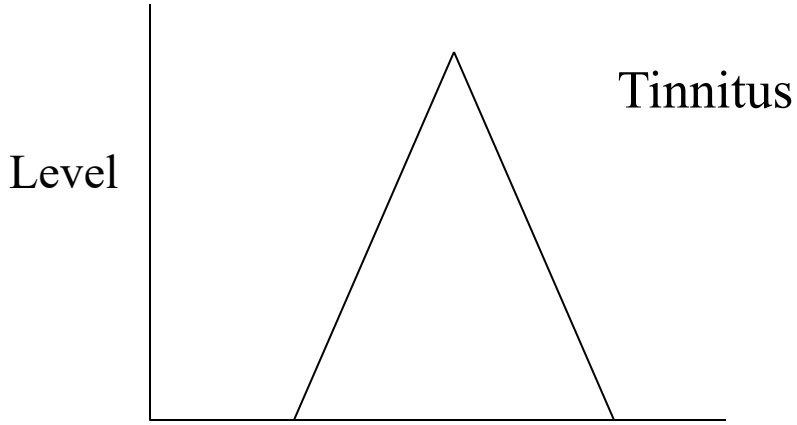
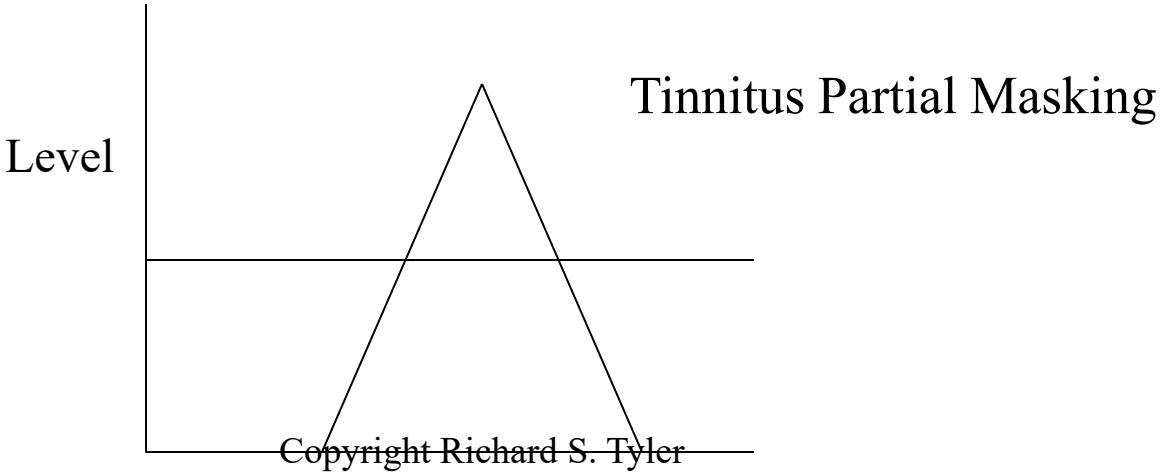
Partial Masking





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Tinnitus Retraining Therapy
"Mixing Point"

- Jastreboff (1995) "tinnitus sound and the external sound start to mix or blend together"
- Mixing point too loud for most patients
- Mixing point is not superior to total masking
- Tyler et al. (2012). Tinnitus Retraining Therapy: Mixing Point and Total Masking Are Equally Effective. **Ear Hear** 33(5):588–594

Sound Therapy Options

- Broadband noise
- Noise modifying spectrum
- Noise modifying envelope
- Combined tones, modulated tones
- Music, waterfall, raindrops……and on and on
- Spectrally adjusted sounds to account for the audiogram
- Notch noise or music around pitch match

- Tyler RS, Perreau A, Powers T, Watts A, Owen R, Ji H, Mancini PC. (2020) J Am Acad Audiol 31:6–16

- Tinnitus Sound Therapy Trial Shows Effectiveness for Those with Tinnitus.

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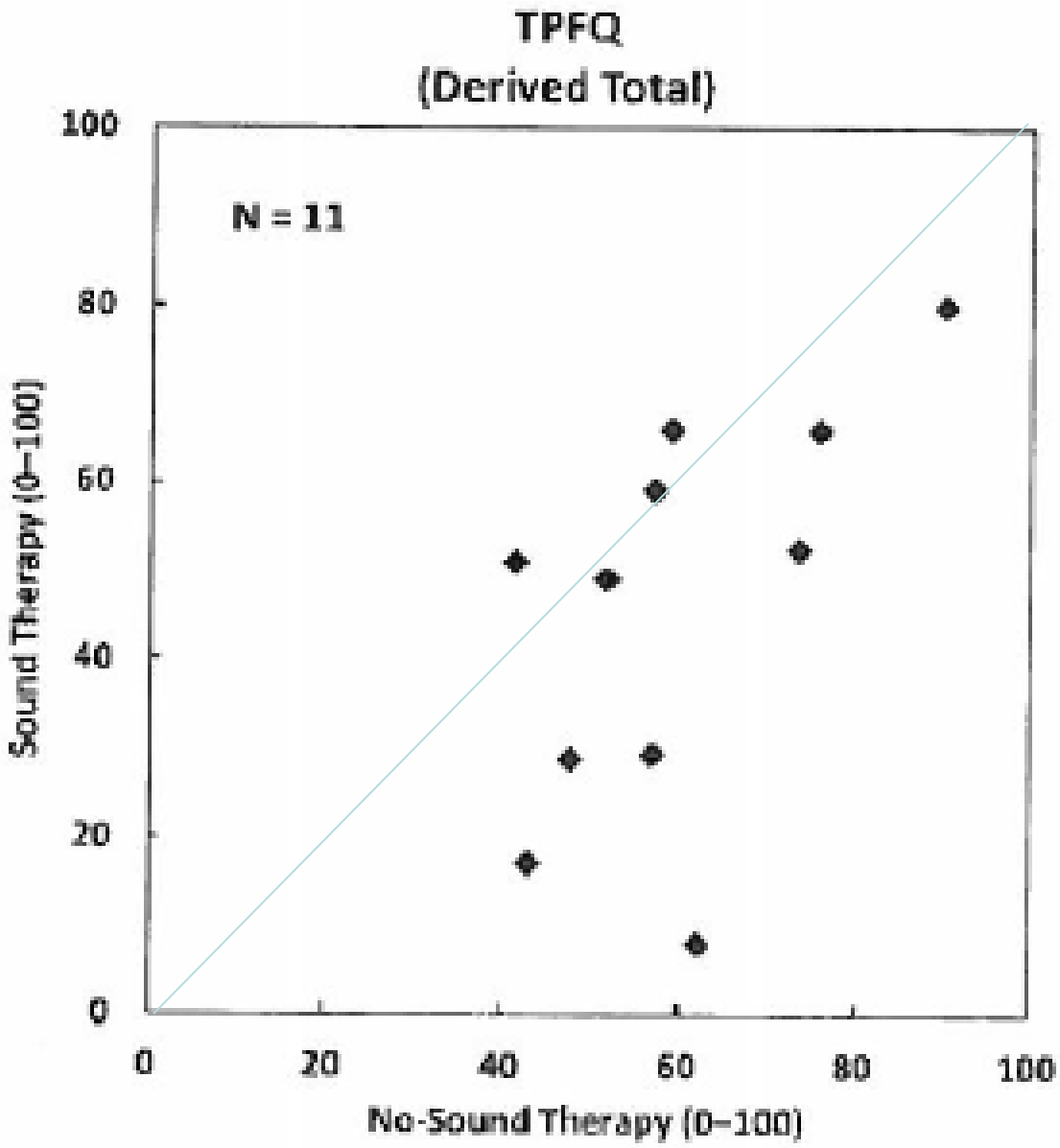


Figure 2. Derived total scores on TPFQ for the no-sound (x-axis) and sound therapy (y-axis) conditions.

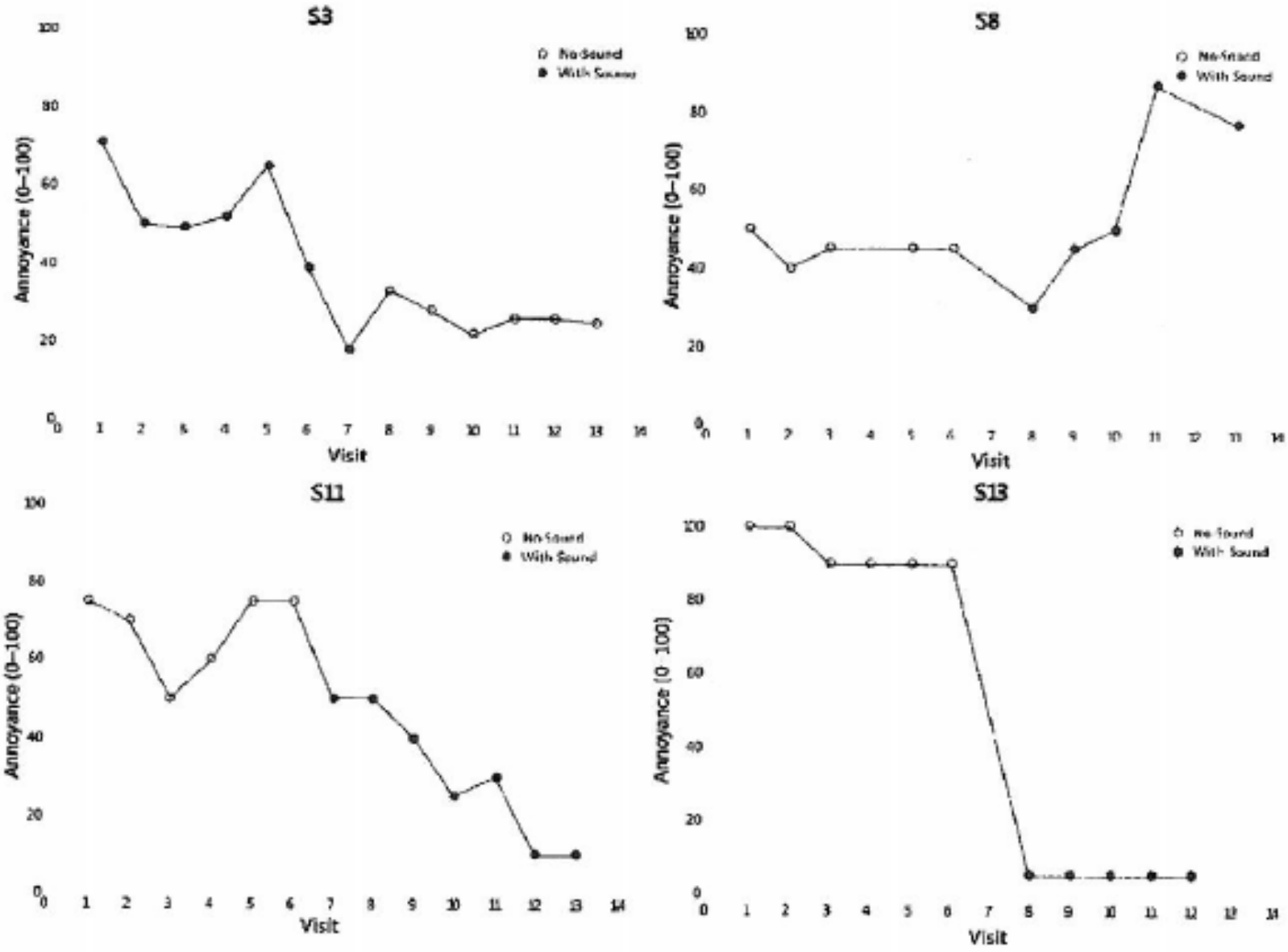
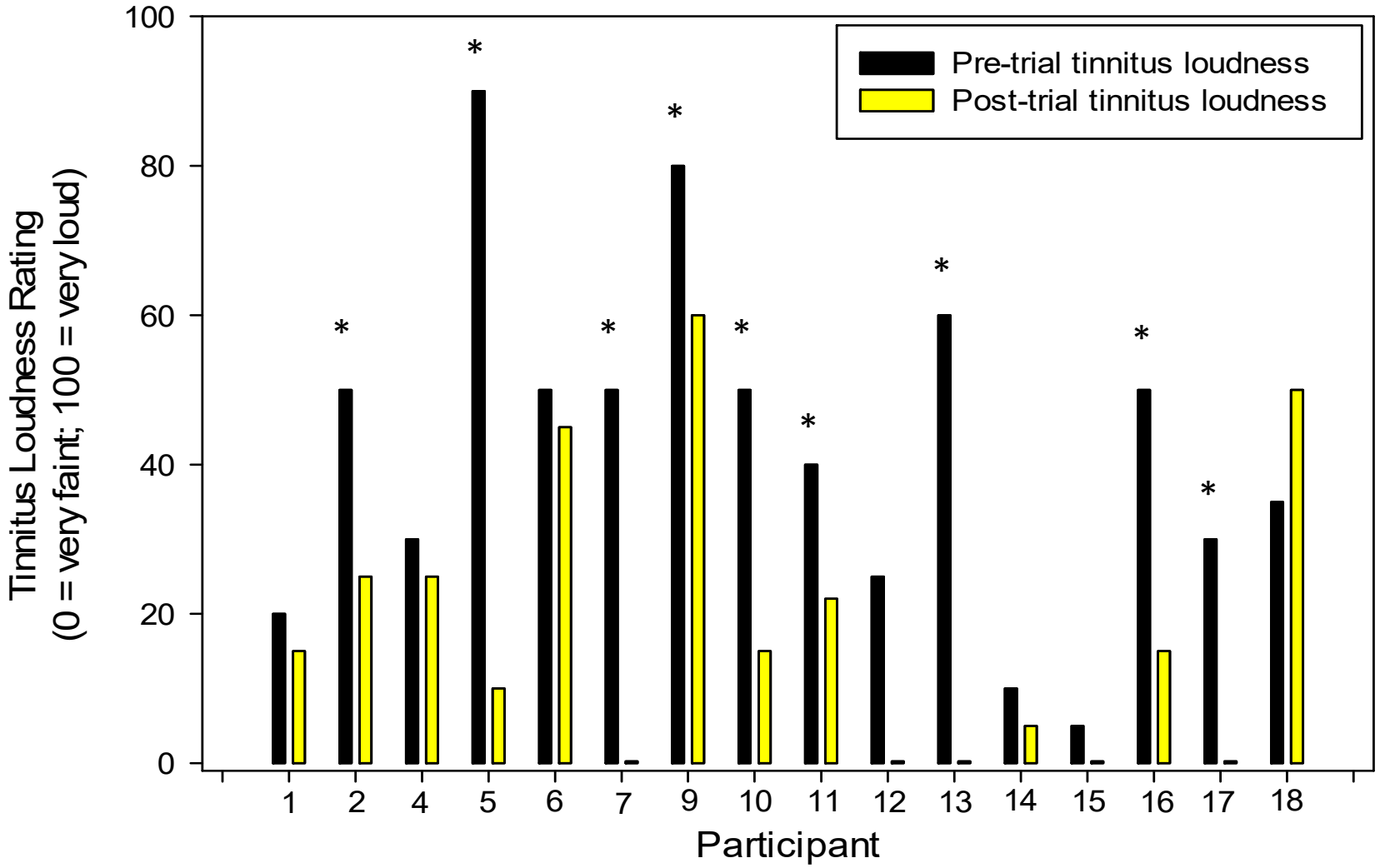


Figure 4. Individual differences on tinnitus annoyance ratings at the no-sound and sound therapy conditions.

Cochlear Implants – Sound Therapy App

- Tinnitus Relief™ App
- Streamed from an iPod to the CI Sound Processor using a Mini Mic 2+

CIs…. Clinic visit - Short-term effectiveness of Chosen Sound



Hyperacusis Activities Treatment

Richard Tyler, Ph.D., CCC-A
University of Iowa

Ann Perreau, Ph.D., CCC-A
Augustana College

Hyperacusis **Terminology**

- **Loudness Hyperacousis**
  - **Some moderately loud sounds are very loud**
- **Annoyance Hyperacousis**
  - **Some sounds are annoying (not always loud)**
- **Fear Hyperacousis**
  - **Patients are afraid of some sounds (not always loud)**
- **Pain Hyperacusis**
  - **Sounds evoke pain**

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Contest for Other Terms ???

- Hypersensitivity
- Phonophobia
- Decreased sound tolerance
- Misophonia (dislike of sounds)
- Select-sound sensitivity

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Less confusion if

- Choose simple terms with clear distinct definitions
- Avoid temptation for everyone to make up new terms
- Important for patients, audiologists, other health-care professions and general public to understand terms
- (Tyler, Pienkowski et al., 2014)

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Overview

- Introductions
- Discuss experiences with hyperacusis
- Explain hearing, hearing loss and hyperacusis
- Review treatments for hyperacusis

Progressive Muscle Relaxation- Practice Exercise

1. Start with your arms
2. Make a fist and tense your arms for 15 seconds
3. Release the tension
4. Breathe deeply and pay attention to the sensation of your arms relaxing

Visual Imagery - Practice Exercise

1. Close your eyes
2. Think of a relaxing scene (the beach)
3. Try to imagine the scene as clearly as you can
4. The smell of the water, warm sand on feet, sound of ocean
5. Allow yourself to relax as you imagine the location in your mind

Sound Therapy Treatments

1. Hazell & Sheldrake (1989, 1992)
   - Low-level continuous background sound on wearable devices- See also Formby and Gold (2002-2018)
2. Vernon & Press (1998)
   - Low-level background sound, controlled listening intervals, progressively increased duration & time
3. Tyler et al. (2000, 2009)
   - Tinnitus Hyperacusis Treatment – record/produce distressing sounds, controlled listening, systematic desensitization.

Hyperacusis Activities Treatment

- Record specific sounds
- play back at low levels in peaceful environment
- gradually increase levels and duration
- Gradually work into realistic situations
- (Successive Approximations)

- Tyler et al., (2000; 2009) (Katz Handbook)

Hearing Aids for Hyperacusis !!!

- **Closed earcanal** earmolds can reduce sound by ~ 30 dB
- Reduce maximum output of hearing aids so that high level sounds are peak-clipped or compressed
- Adjust gain so that low-level sounds are amplified, but not high-level sounds
- gradual transition (over months) to 'normal' settings
- Sammeth, C. Preeve & Brandy (2000). Hyperacusis: Case studies and evaluation of electronic loudness suppression devices as a treatment approach. Scand Audiology. 29, 28-36.

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current **Quality of Life** scales do not appreciate consequences of Hearing Loss and Tinnitus

We all define the meaning of our quality of life differently

We have different needs, different expectations

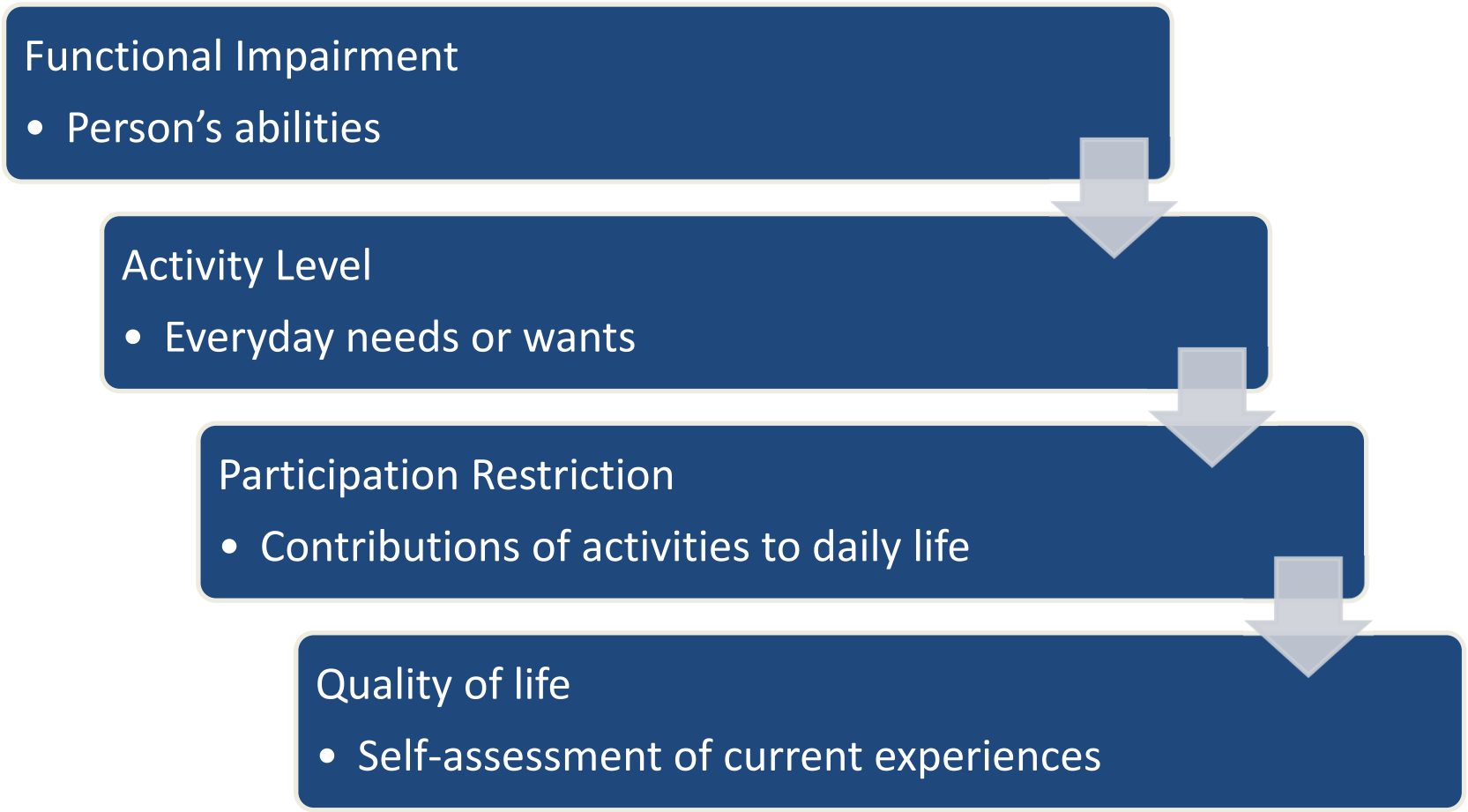
We have different experiences and interpretations

Therefore, is it straightforward to compare one's quality of life to another?

Background on measuring quality of life

- Quality of life scales are intended to measure an individual's feelings of their own health and well-being
- First scale developed in 1978 by John Flanagan, American psychologist
- Scales assess multiple aspects of quality of life:
  - Functional ability
  - Health status
  - Psychological well-being
  - Social networks and social support
  - Life satisfaction and morale

WHO International Classification of Functioning, Disability, and Health (2001)

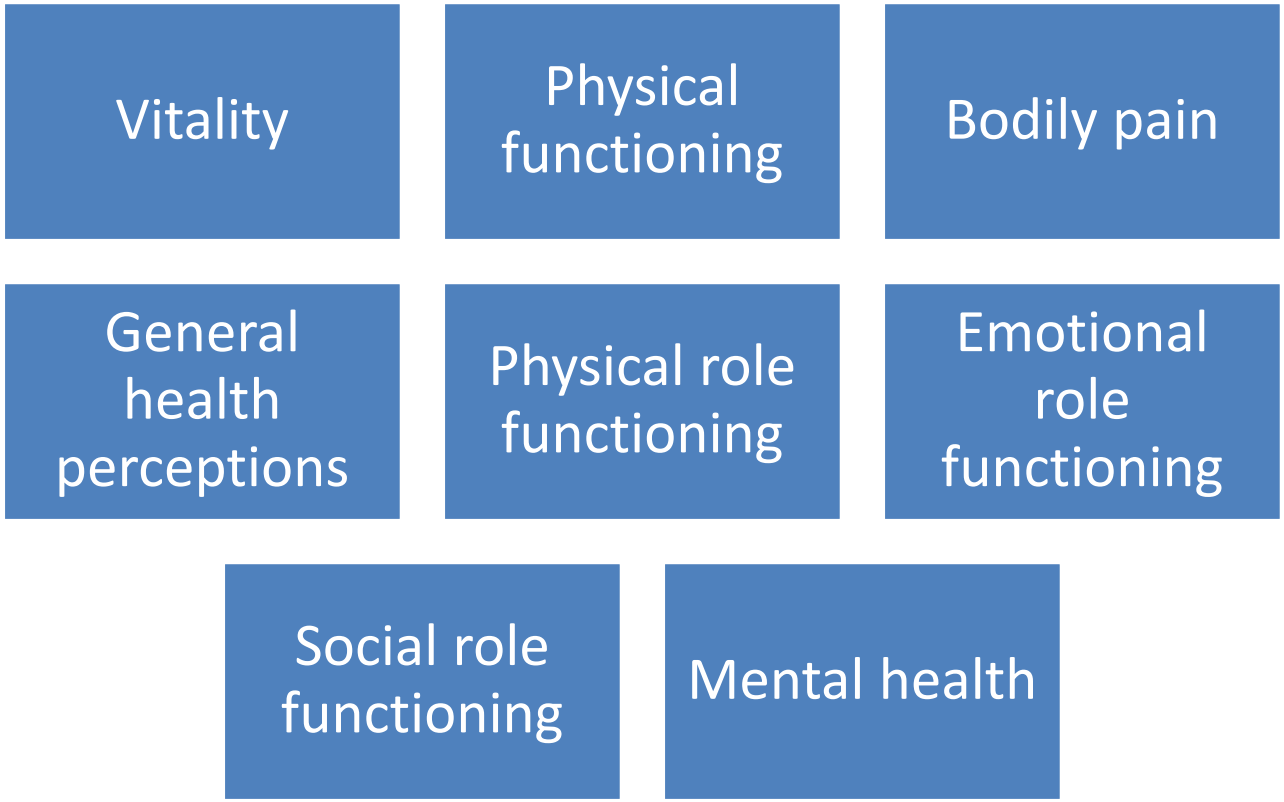


Widely-used quality of life scales:

1. Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36; Ware & Sherbourne, 1992)
   - Screening versions: SF-6D (Brazier et al., 2002) & EQ-5D (EuroQol Group, 1990)
2. World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0, 2010)

SF-36

- Designed for clinical practice and research, health policy evaluations, and general population surveys
- Applied to over 200 diseases, translated into many languages



SF-36 – Example items

Item	Response
1. In general, would you say your health is…	Excellent → Poor (5 point scale)
2. Compared to one year ago, how would you rate your health now?	Much better → Much worse (5 point scale)
3. Does your health limit you in any of these activities? Climbing stairs,walking more than a mile, bathing/dressing, etc.	Limited a lot → Limited not at all (3 pt scale)
4. During the past 4 weeks, have you had any problems with work or other daily activities due to physical or emotional problems? -Accomplished less than you would like	Yes/No
5. How much did pain interfere with your normal work or other daily activities?	Not at all → Extremely (5 point scale)

WHO-DAS 2.0 – Example items

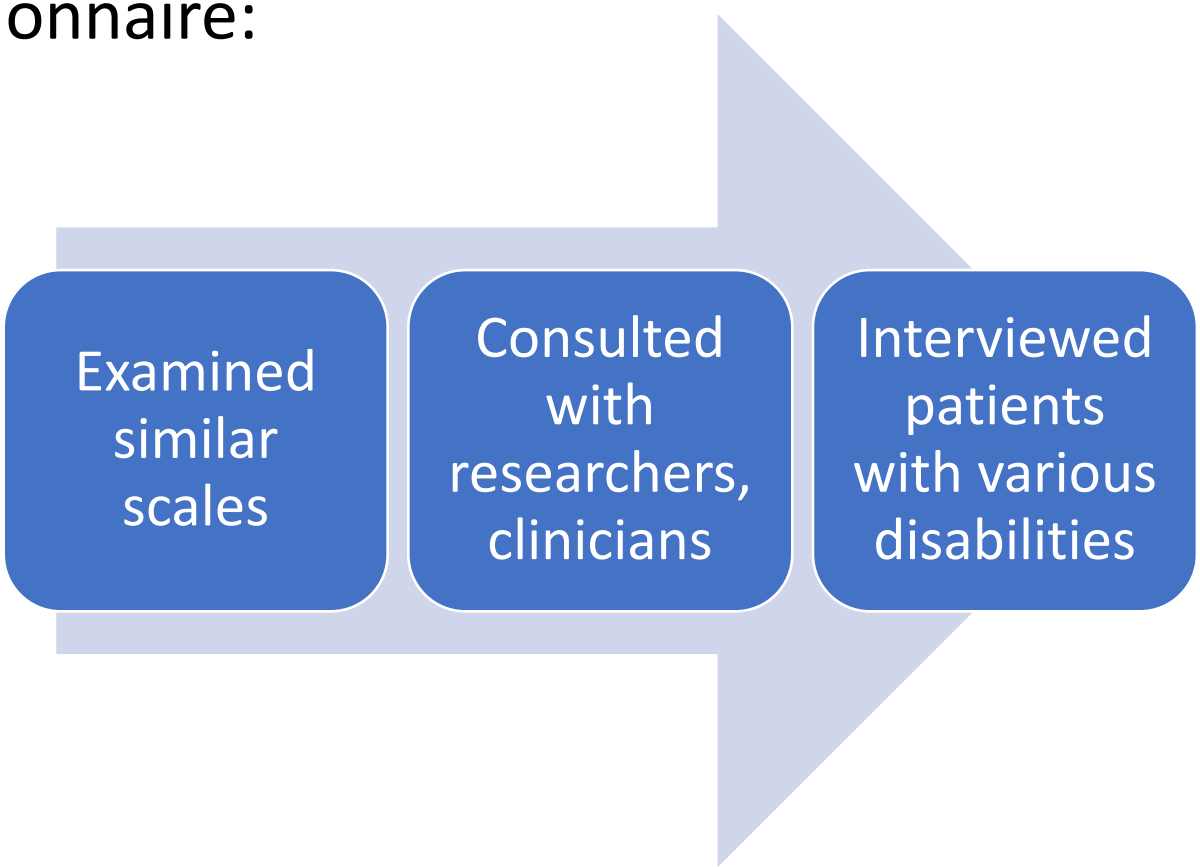
In past 30 days, how much difficulty do you have…	Response
1. Standing for long periods?	None → Extreme or cannot do (5 point scale)
2. Taking care of household responsibilities?	None → Extreme or cannot do (5 point scale)
3. Learning a new task?	None → Extreme or cannot do (5 point scale)
4. How much have you been emotionally affected by your health problems?	None → Extreme or cannot do (5 point scale)
5. Maintaining a friendship?	Not at all → Extremely (5 point scale)
6. How many days were these difficulties present?	Record # of days

Limitations of Current Quality of life scales

- Few scales include any questions about hearing or communication
  - WHO-DAS 2.0 includes communication – but 1 item on "generally understanding what people say"
- studies indicate - unlikely to detect a quality of life change due to hearing loss or communication impairment (Barton et al., 2005; Morgan et al., 2002)

Meaning of Life questionnaire (Tyler, Perreau et al., 2019)

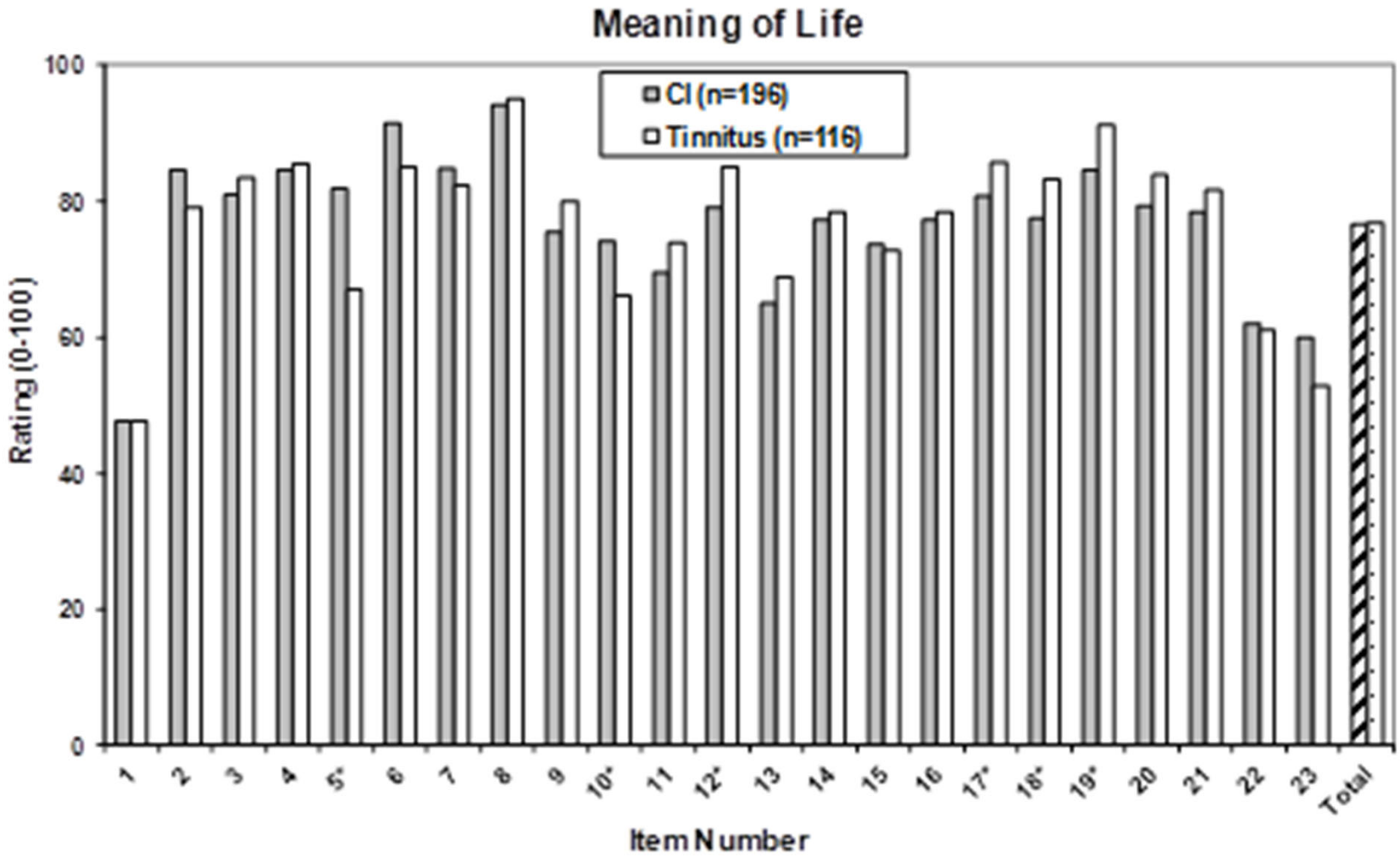
Step 1: Determining items and focus of questionnaire:



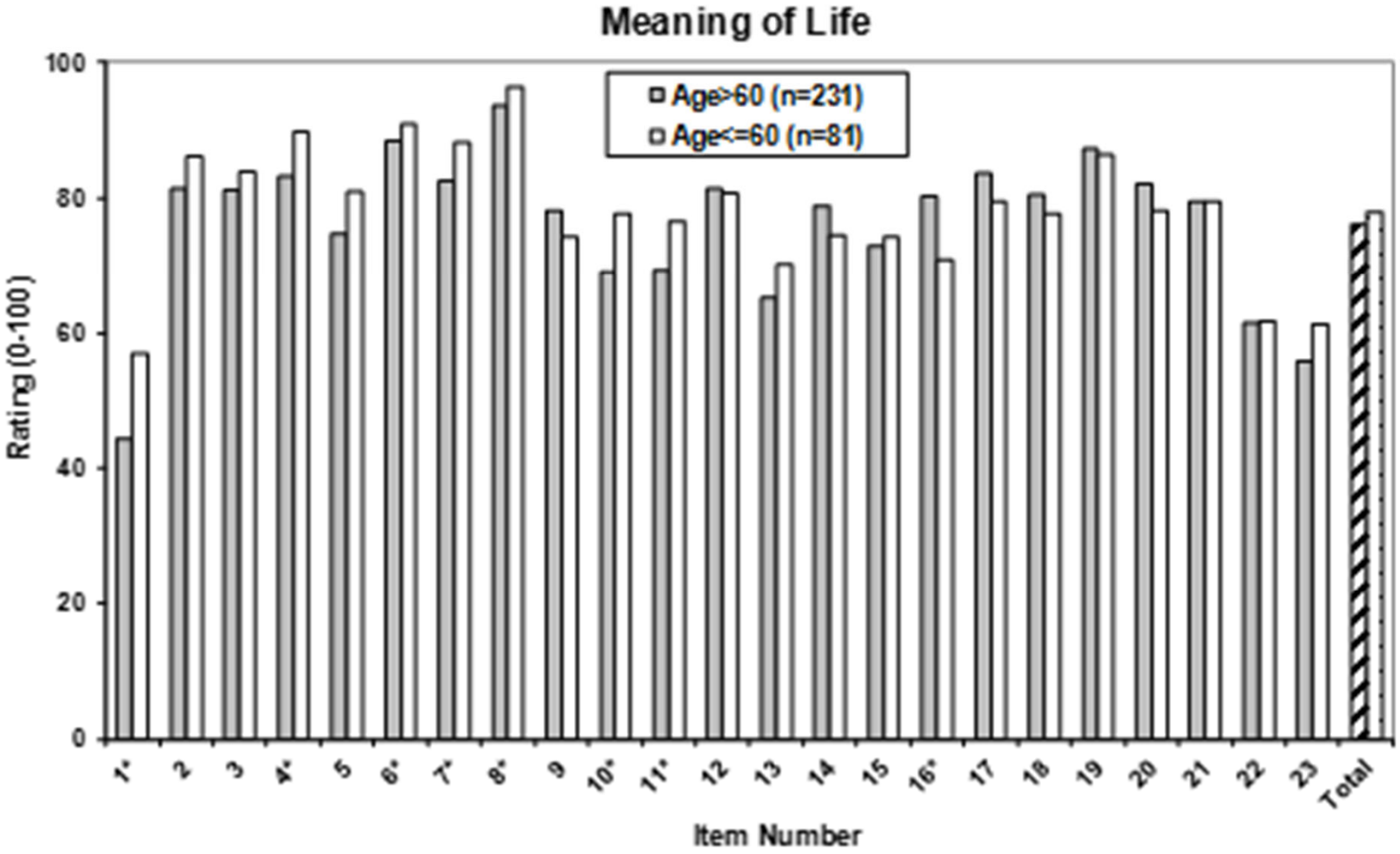
- Indicate your agreement with each statement on a scale from 0 (completely disagree) to 100 (completely agree).

1. I hear well in any situation.	13. I participate in several recreational activities.
2. I see well in any situation.	14. In general, I feel very relaxed.
3. I walk easily in any situation.	15. I am satisfied with my sex life.
4. I talk well and am easily understood.	16. I am satisfied with my financial situation.
5. I sleep well.	17. I feel good about my self image.
6. I manipulate things well with my hands.	18. I am very healthy.
7. I concentrate and focus well.	19. I have close friends or family that I can confide in.
8. I eat and drink with ease.	20. In general, I get all the pleasure I want out of life.
9. I have many friends that I socialize with.	21. I think the future looks very bright.
10. I always remember things.	22. I never feel depressed, sad or anxious.
11. I have many hobbies.	23. I never experience pain or discomfort.
12. I have emotional support from many others.	

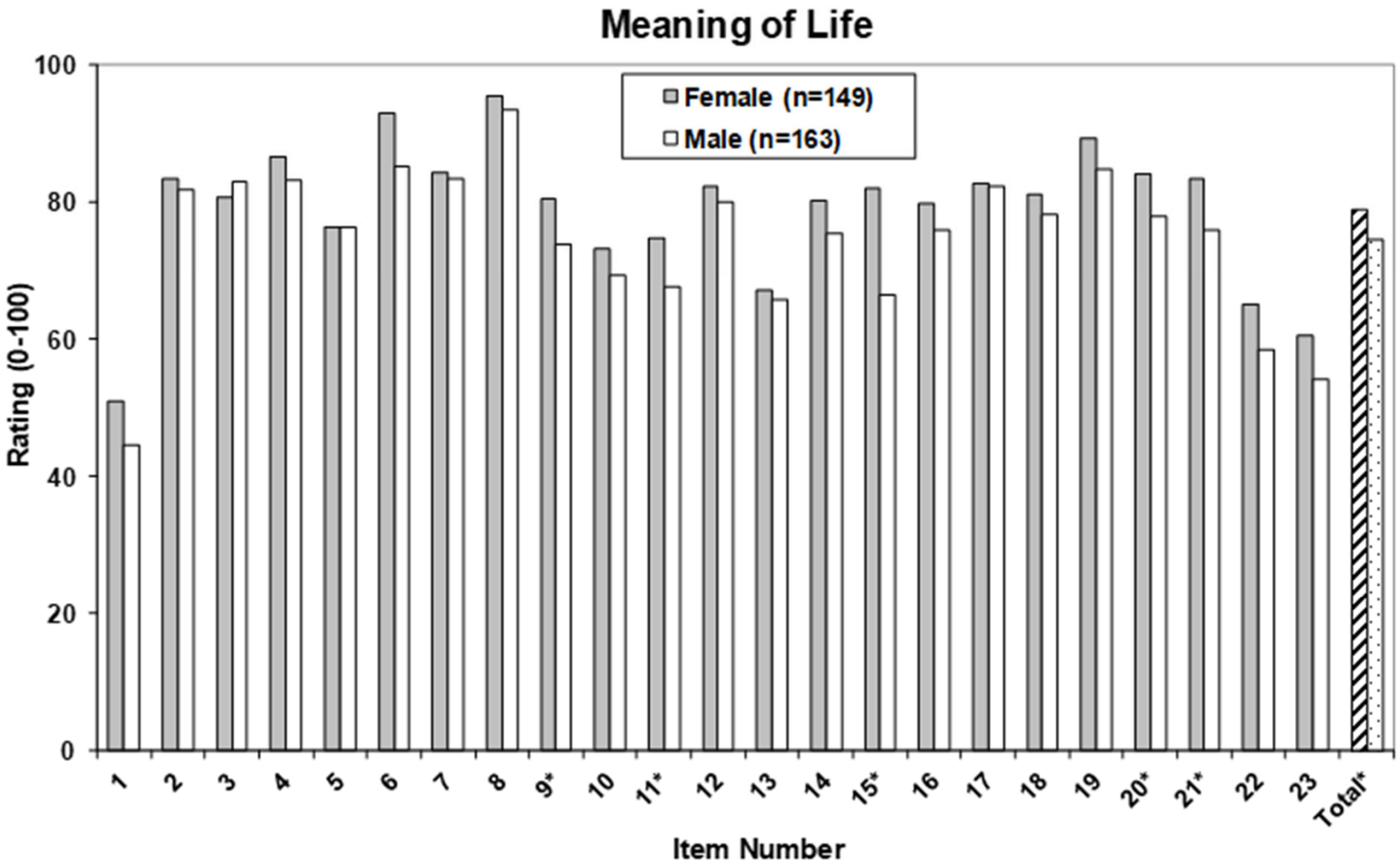
CI vs. Tinnitus groups



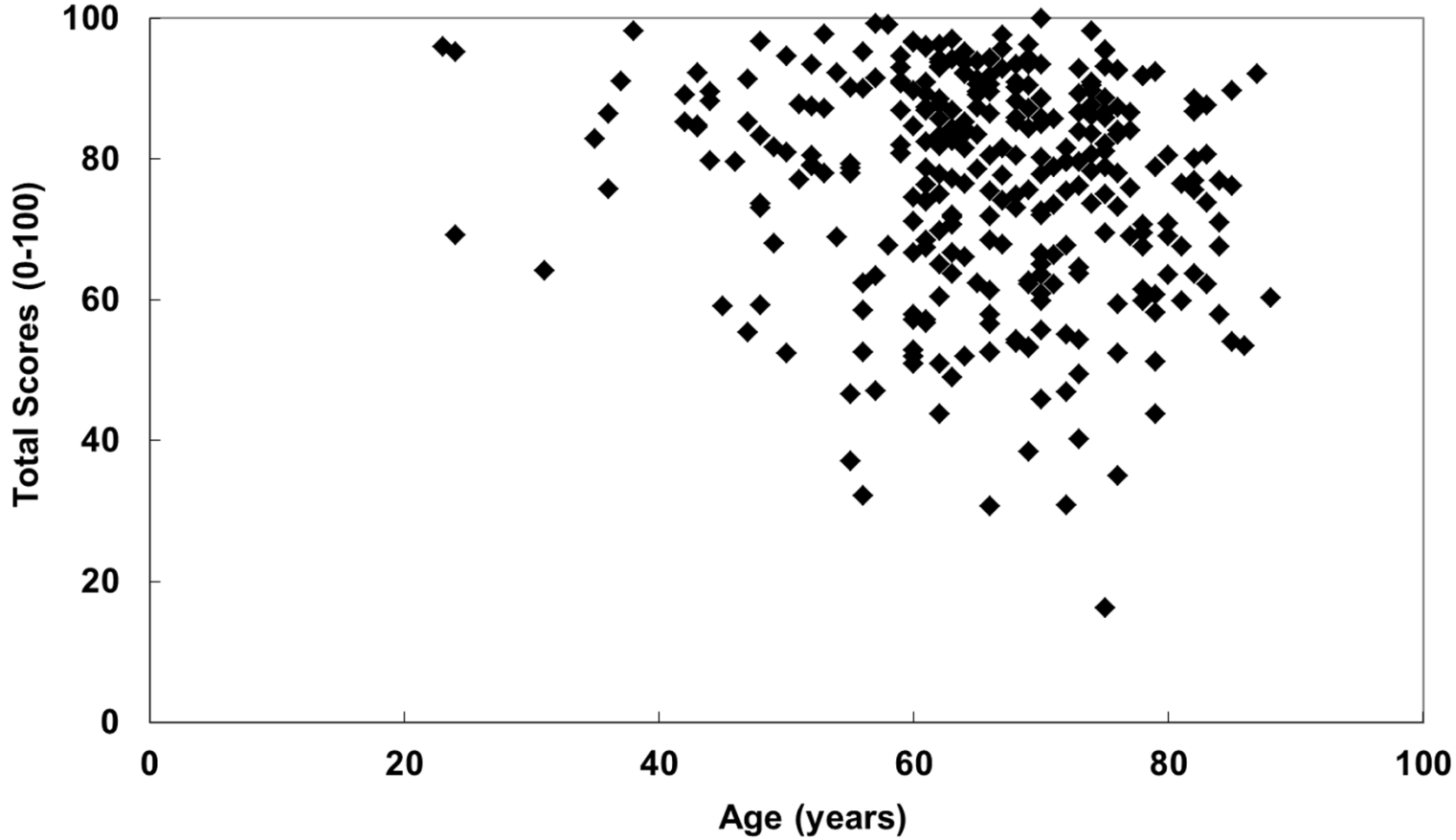
Results - Age differences



Results - Gender differences



Results –
Age vs. total score



Results

- exploratory factor analysis
- Four factors explained 61% of variance

1: Friendship and positive outlook (7 items)
2: Physical health (9 items)
3: Hearing and mental health (5 items)
4: Satisfaction in one's life (2 items)

Meaning of Life Questionnaire

(Tyler, Perreau, Mohr, Ji, & Mancini, 2019)

1. I hear well in any situation. (3)	13. I participate in several recreational activities. (1)
2. I see well in any situation. (2)	14. In general, I feel very relaxed. (3)
3. I walk easily in any situation. (2)	15. I am satisfied with my sex life. (4)
4. I talk well and am easily understood. (2)	16. I am satisfied with my financial situation. (4)
5. I sleep well. (3)	17. I feel good about my self image. (2)
6. I manipulate things well with my hands. (2)	18. I am very healthy. (2)
7. I concentrate and focus well. (2)	19. I have close friends or family that I can confide in. (1)
8. I eat and drink with ease. (2)	20. In general, I get all the pleasure I want out of life. (1)
9. I have many friends that I socialize with. (1)	21. I think the future looks very bright. (1)
10. I always remember things. (2)	22. I never feel depressed, sad or anxious. (3)
11. I have many hobbies. (1)	23. I never experience pain or discomfort. (3)
12. I have emotional support from many others. (1)	Key: 1=Friendship/Positive Outlook; 2=Physical Health; 3=Hearing and mental health; 4=Satisfaction

5. Overview of Meaning of Life questionnaire

- Hearing is an important factor in quality of life
- Hearing loss contributes to social isolation, loneliness, frustration and dependence on a caregiver
- Tinnitus results in significant sleep problems (Tyler & Baker, 1983; McKenna & Daniel, 2006)
- Age affects memory (Koivisto et al., 1995) and financial satisfaction
- Men and women regard satisfaction and happiness differently (Decety & Jackson, 2004; Rueckert & Naybar, 2008)

6. Conclusions and future directions

- Quality of life scales should be sufficiently broad to capture the impact of disability, but sensitive to consequences of a given disorder (e.g., hearing loss)
- We plan to include more diverse populations: musicians, persons with vision loss, among others
- Though the contingent nature of quality of life makes it difficult to assess with one questionnaire, we can appreciate its complexity and diversity

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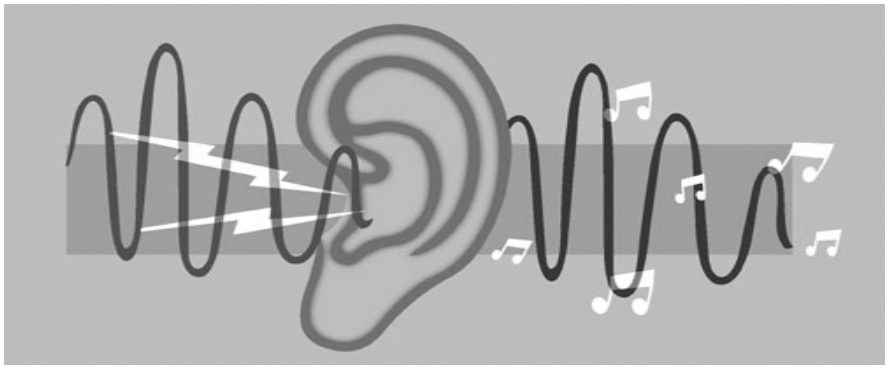

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Questions?

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