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Vanderbilt Bill Wilkerson Center

“...since I lost most of my hearing..., I've had periodic bouts of tiredness that are deeper and of a different quality than I ever experienced before.”

— Copithorne, 2006 (Adult with hearing loss)



Understanding, Measuring, and Managing Listening-Related Fatigue in Adults and Children with Hearing Loss

Presented in partnership with Vanderbilt University

“My brain needs a rest from listening.”

- Child with hearing loss

Benjamin Hornsby, PhD

“I go to bed most nights with nothing left. It takes so much energy to participate in conversations all day, that I'm often asleep within minutes.”

— Adult w/ hearing loss
<http://hearingelmo.wordpress.com>



Ben Hornsby, PhD

Ben Hornsby is an Associate Professor in the Department of Hearing and Speech Sciences at the Vanderbilt Bill Wilkerson Center, Vanderbilt University School of Medicine. Dr. Hornsby's broad research interests include the causes, and impact, of the speech understanding difficulties that often accompany hearing loss. His current research focuses on relationships between hearing loss-related communication difficulties, mental effort, and fatigue.

Disclosures

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Learning Outcomes

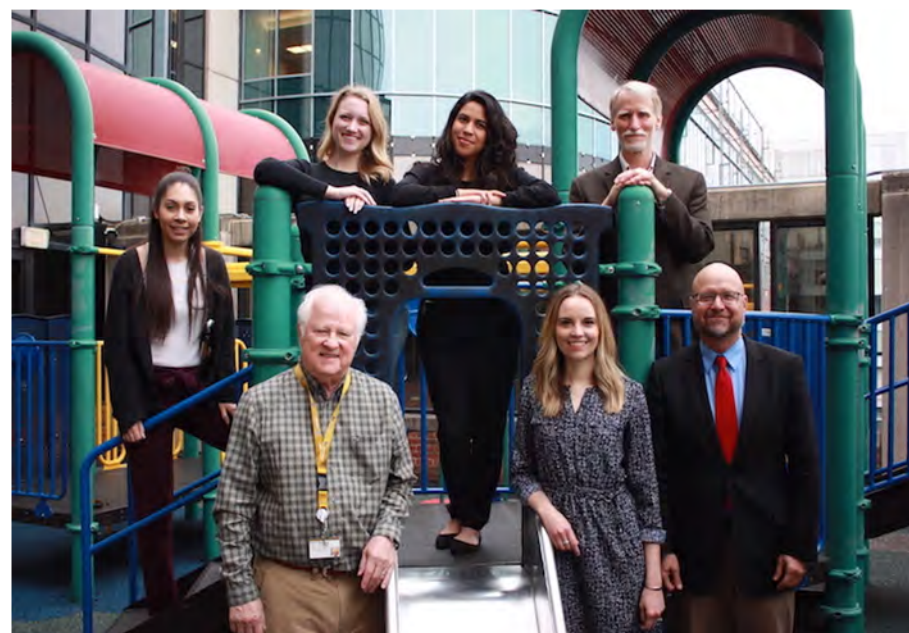
After this course, participants will be able to:

- Describe the construct of listening-related fatigue (LRF).
- Explain how to administer and score the Vanderbilt Fatigue Scales.
- Discuss possible interventions to reduce listening-related fatigue.

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Outline

- What is fatigue?
 - Why do we care?
- Why does hearing loss increase our risk for fatigue?
 - A model of LRF associated with hearing loss
 - Evidence of fatigue in adults and children with hearing loss
- An overview of the Vanderbilt Fatigue Scales (VFS's)
- Practical applications: Using the VFS's to assess listening-related fatigue
- Managing LRF in children and adults
- Questions/Discussion

What is fatigue?



- Definitions vary based, but fatigue and fatigue effects have been be defined, and measured various ways:
 - **Physiologically** (e.g., EEG, Pupillometry)
 - **Behaviorally** (i.e., changes in physical/cognitive ability over time)
- **Subjective fatigue**, a mood or feeling of tiredness, exhaustion or lack of energy, a reduced desire or motivation to continue a task
 - Quantified using surveys and questionnaires
 - Associated with the sustained application of *effort*
- **Listening-related fatigue** is simply a type of subjective fatigue associated with the continued application of *effort* during listening tasks.
 - Pichora-Fuller et al., 2016

See Hornsby, Naylor & Bess, 2016 for review

Who Has Fatigue?

- **Everybody!-**
 - Complaints of mild transient fatigue are common even in healthy populations, but...
- **Severe, recurrent fatigue-** is NOT common in healthy populations
 - But is common in people with various chronic health conditions like:
 - Cancer, HIV AIDs, Parkinson's, MS
 - and in people with Hearing Loss

Consequences of fatigue

- **Severe, recurrent fatigue has cognitive consequences—**
 - Inattention, lack of concentration, poor mental processing and decision-making skills
- **These issues affect adults—**
 - less productive and more prone to accidents
 - less active, more isolated, less able to monitor own self-care
- **And children—**
 - poorer school achievement, higher school absenteeism

Why do we get fatigued?

- A Motivation Control Theory of Cognitive Fatigue
 - Fatigue is an emotional response serving an ***adaptive, goal-directed function***
 - forces us to evaluate current goal-directed behaviors in terms of an effort/reward balance
- Fatigue is a “protective” mechanism to help us decide if the effort applied towards a goal is worth the reward.



Hockey, R. (2013). The Psychology of Fatigue: Work, Effort and Control: Cambridge

A motivation control theory of cognitive fatigue

- Factors driving fatigue development & severity:
 - Applied Effort: Mental or physical challenges
 - Conditions that require effortful control to attain/maintain performance
 - Especially if maintaining “acceptable” performance is difficult or not possible
 - Limited Control
 - Limited **ability** to modify the task or performance
 - Timed or scheduled tasks
 - Important conditions
 - Individuals with high motivation to do well &
 - Negative consequences for poor performance

Imagine a person with HL... What might this mean for them???



Hockey & Earle (2006); Boksem & Tops (2008); Ackerman (2011); Hockey (2013); Earle & Hockey (2015).

So, is fatigue a problem for people with hearing loss?

- If so, how do we measure it?
 - Other than via anecdotal reports...



“My brain needs a rest from listening.”
- Child with hearing loss

“I go to bed most nights with nothing left. It takes so much energy to participate in conversations all day, that I’m often asleep within minutes.”

– Adult w/ hearing loss <http://hearingelmo.wordpress.com>



“...since I lost most of my hearing..., I've had periodic bouts of tiredness that are deeper and of a different quality than I ever experienced before.”

– Copithorne, 2006 (Adult with hearing loss)

Quantifying Fatigue Subjectively

- *Many options but, until recently, none focused on hearing loss or listening-related fatigue*
 - *Profile of Mood States (POMS)*
 - *Fatigue Assessment Scale (FAS)*
 - *Multidimensional Fatigue Symptom Inventory (MFSI)*
 - *Pediatric Quality of Life-Multidimensional Fatigue Scale (Peds-QL MFS)*
- What do existing, *generic*, measures suggest about fatigue in people with hearing loss?



See Hornsby, Naylor and Bess, 2016 for review

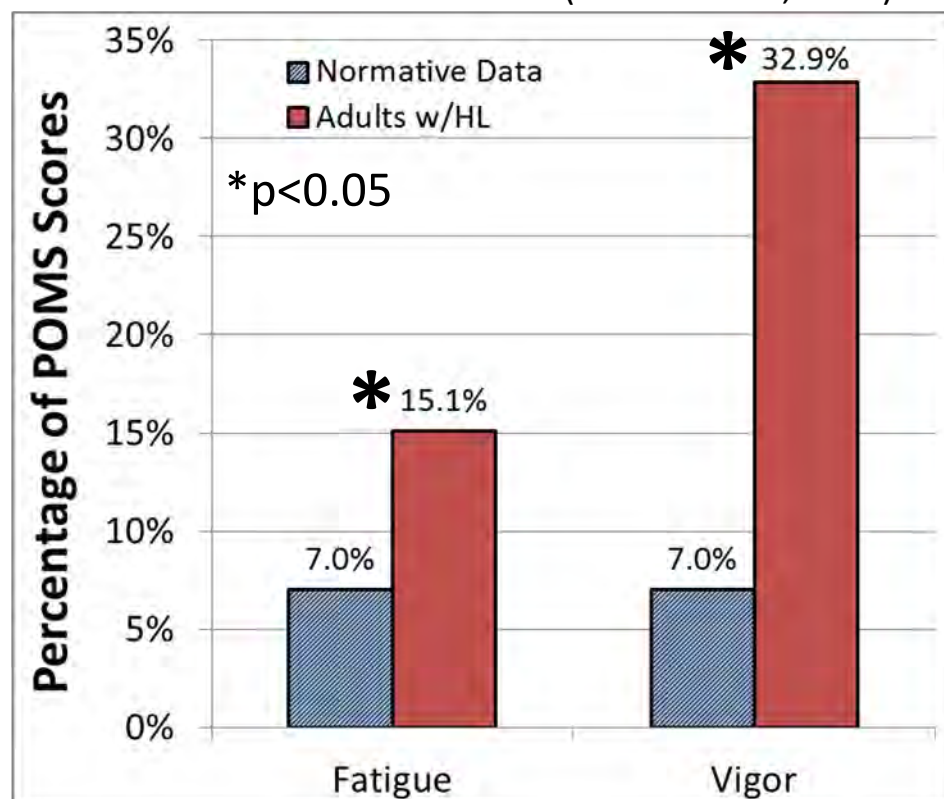
Quantifying Fatigue Subjectively

- Studies using *generic* fatigue measures often (not always) find increased fatigue in adults & children with hearing loss:
 - Adults
 - Hornsby & Kipp, 2016 (partially); Alhanbali et al., 2017
 - But see Dwyer et al., 2019 for contrasting finding
 - Children
 - Hornsby et al., 2014, 2017; Sindhar et al. 2021; Adams et al., 2023; Bakkum, et al., 2023



Adults with HL are at increased risk for severe fatigue and vigor deficits

POMS= Profile of Mood States (McNair et al., 1971)

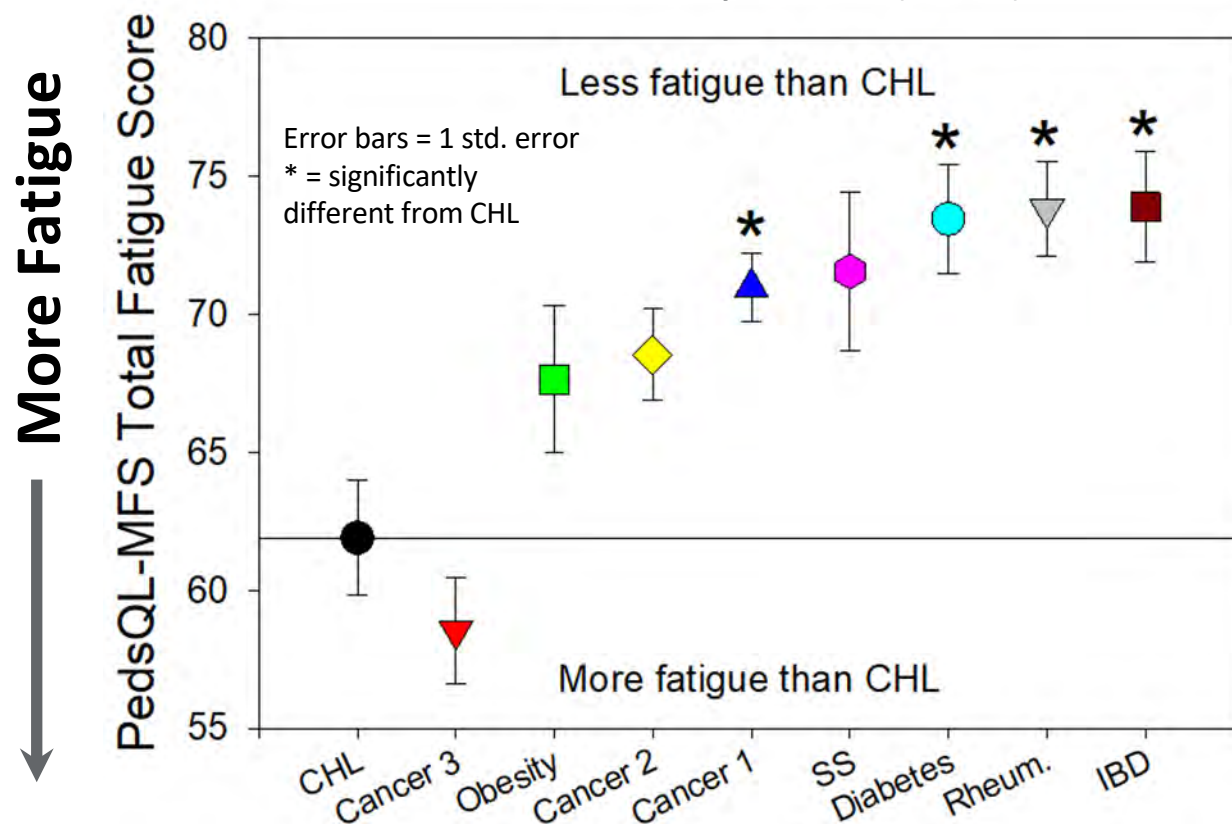


Hornsby, B. & Kipp, A. (2016)

- **More than twice** as likely to report severe fatigue and
- **More than 4 times** as likely to report severe vigor deficits!
- N= 116 HL group
 - Age: 55-94 years
- Severe = >1.5 st. dev. above normative means

Fatigue in Children with HL (CHL)

From Hornsby, et al., (2021).

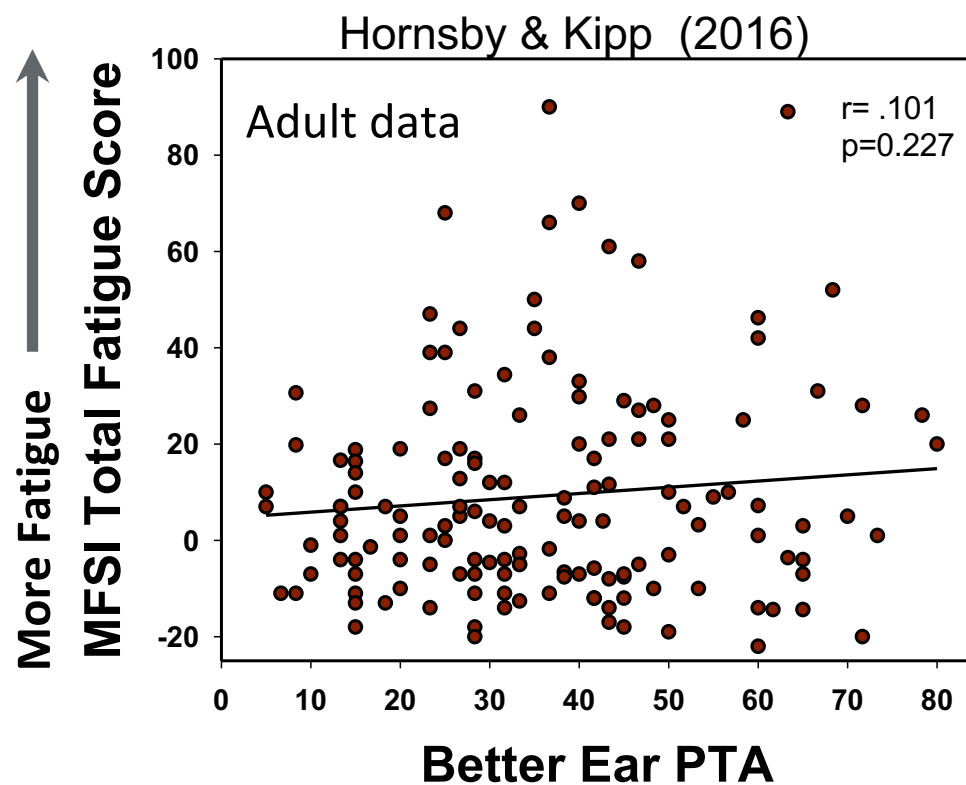


- *CHL report fatigue similar to, or greater than, that of many children with other chronic health conditions*

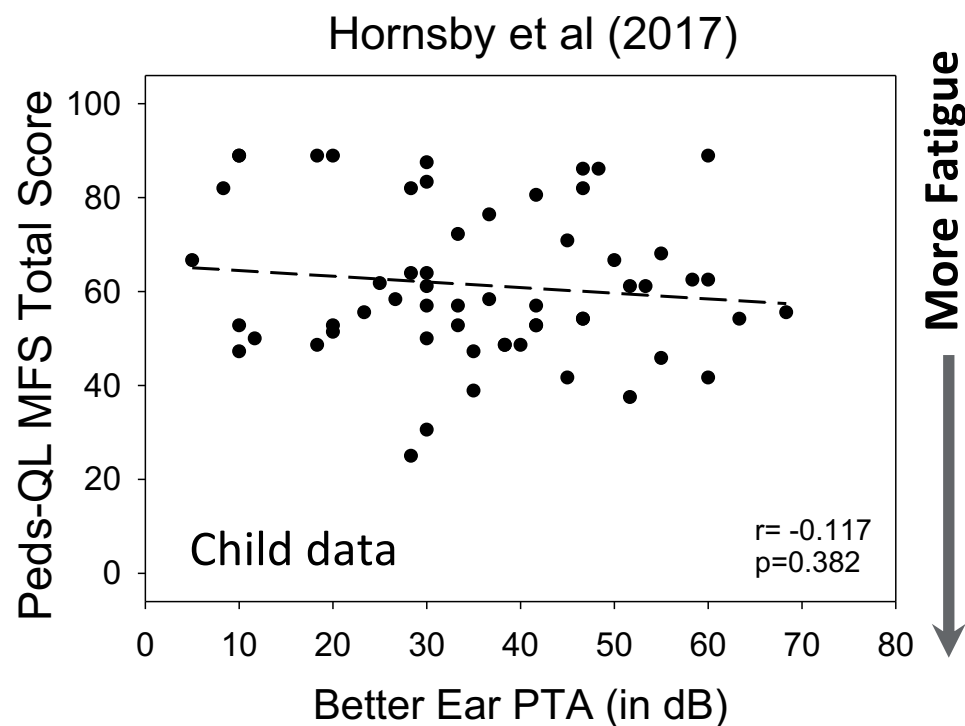
- CHL data (n=60) from Hornsby, et al., 2017
- 6-12 years olds w/ bilateral SNHL

Hornsby, et al., (2021). The Impact and Management of Listening-Related Fatigue in Children with Hearing Loss. *Otol Clin North Amer.* 54(6), 1231-1239
Hornsby, et al., (2017). Subjective fatigue in children with hearing loss assessed using self-and parent-proxy report. *AJA*, 26(3S), 393-407.

But... fatigue can affect people regardless of their degree of hearing loss



MFSI= Multidimensional fatigue symptom inventory- short form



Peds-QL MFS = Pediatric Quality of Life Multidimensional Fatigue Scale

Are Generic Fatigue Scales Optimal?

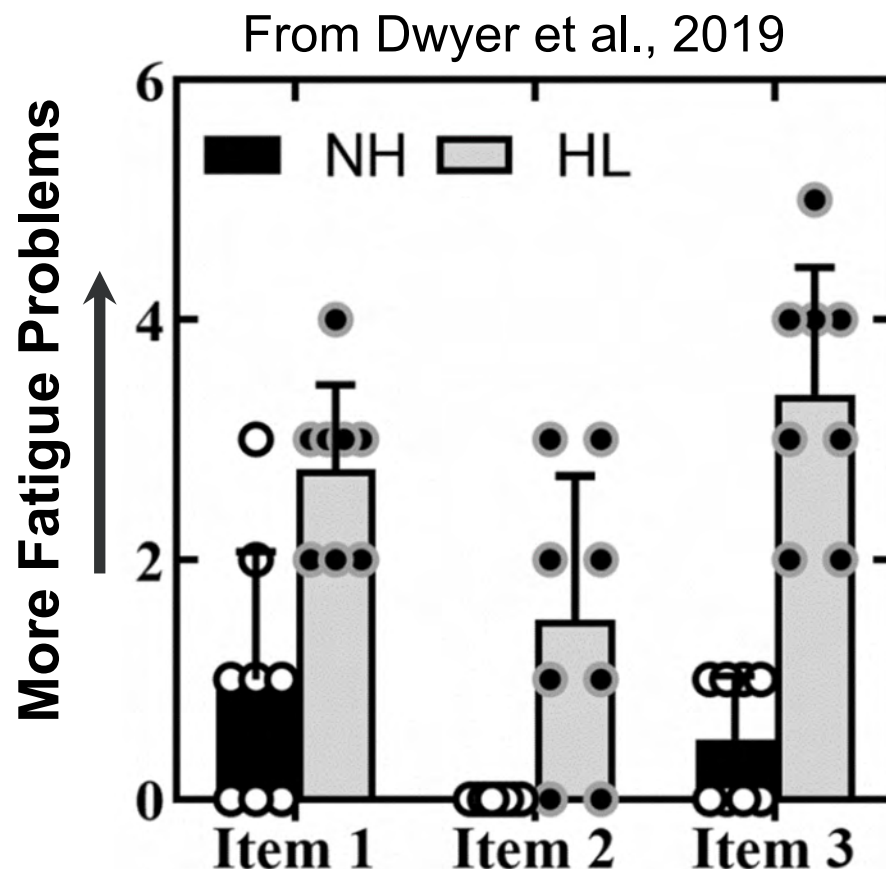
- Dwyer et al. (2019) used a generic (POMS) AND listening-specific measure to examine fatigue in young adults with severe-profound HL
 - 8 CI/HA users
 - 8 NH controls
- **No difference** in POMS fatigue or vigor ratings b/w groups
 - But...

POMS: Profile of Mood States, a generic fatigue/vigor measure

Dwyer et al., 2019

Scale sensitivity depends on the test

- Large differences when asked about “listening-related” fatigue
 - Item 1: Difficulty listening causes me to become physically or emotionally tired
 - Item 2: Fatigue and low energy due to difficulty listening are major problems in my life
 - Item 3: How often do you feel physically or emotionally tired due to difficulty listening?
- So, are generic measures optimal?



Generic fatigue scales may NOT be optimal for assessing LRF

- This motivated, in part, the development of the Vanderbilt Fatigue Scales
 - Scales designed specifically to measure LRF in adults and children
- Scales were designed with a focus on LRF associated with hearing loss
 - But may be useful for those with other auditory or communication difficulties
 - E.g., APD, second language learners, ADD, TBI, etc...

Vanderbilt Fatigue Scales (VFS): Overview

- Two versions for adults (for 18+ years)
 - ¹VFS-A-40: 40-item scale- appropriate for research purposes
 - Provides a Total score and assesses Physical, Cognitive, Social, & Emotional LRF domains
 - ²VFS-A-10: 10-item unidimensional scale- appropriate for research and clinical use
- ³VFS-Peds: Three pediatric versions (for 6-17 years)
 - VFS-C: 10-item Child Self-report Version (unidimensional)
 - VFS-T: 8-item Teacher-Proxy Version (unidimensional)
 - VFS-P: 12-item Parent-Proxy Version (multidimensional)
 - Assesses Mental and Physical fatigue domains
- All assess long-term listening-related fatigue (LRF)
 - i.e., fatigue experienced over a typical week

¹Hornsby, et al., (2021). Psychological Assessment, 33(8), 777–788.

²Hornsby, et al., (2023). Ear & Hearing 44(5), 1251-1261.

³Hornsby, et al., (2022). JSLHR, 65(6), 2343-2363.

Vanderbilt Fatigue Scales (VFS): Overview

- Response options for all scales use a 5-point Likert response format:
 - Frequency scale: All VFS's use this option
 - Never/Almost Never (0), Rarely (1), Sometimes (2), Often (3), Always/Almost Always (4)
 - Agreement scale: The VFS-A-40 has 9 items that use this option
 - Strongly Disagree (0), Disagree (1), Neutral (2), Agree (3), Strongly Agree (4)

Vanderbilt Fatigue Scales: Scoring Options

- **Summed scoring-** for clinical & research purposes
 - Max score varies with the number of scale items
 - VFS-A-40: 40 items; Max=160
 - VFS-A-10: 10 items; Max=40
 - VFS-C: 10 items; Max=40
 - VFS-T: 8 items; Max=32
 - VFS-P:
 - VFS-P_{Mental}: 8 items; Max=32
 - VFS-P_{Physical}: 5 items; Max=20
- VFS- Adults

VFS-Peds
- Cannot use summed scoring if any items are missing
- **Item Response Theory (IRT) scale scoring-** for research purposes
 - An item weighted standardized score (e.g., like Z-scores)
 - Scores range from ~-3 (very low fatigue) to +3 (very high fatigue) for all scales

Administering the VFSs

- All scales developed for English speakers who use listening and spoken language
- **Adults-**
 - Most adults can complete the VFS-A-10 on their own in ≤ 5 minutes
 - VFS-A-40 ~15 minutes
 - Can be administered online or in person

Administering the VFS-Peds

- **Children (VFS-C)-** for children aged 10-17
 - Can be administered online or in-person
 - Our clinical experience suggests best results when used with children aged 11 years and older
 - Read aloud to child or allow them to complete on their own
 - Ensure device use (if appropriate) & confirm comprehension
- **Teacher (VFS-T)-** for children aged 6-17
 - Should have direct knowledge of student's behavior in a variety of settings
 - Often general educator
 - SLPs, educational audiologists, and TODHHs can complete or distribute and add information to test batt
- **Parent (VFS-P)-** for children aged 6-17
 - Caregiver who spends the most time with the student outside of school hours

See VFS-Peds Users Guide for details:

<https://www.vumc.org/vfs/pediatric-scales-and-user-guide>

Vanderbilt Fatigue Scales

- The scales and user's manuals are freely available for clinical and research purposes,
 - Just google "Vanderbilt Fatigue Scales" or see:
 - <https://www.vumc.org/vfs>
- Spanish, Italian, Indian (Kannada), & Mandarin versions are also available
 - Brazilian, Dutch, Finnish, German, Hebrew, Swedish, and Turkish translations are ongoing

Using the VFSs

- As an **identification tool** to find those most at risk for significant problems who may warrant monitoring or intervention.
- As a **counseling tool** to educate adults, children, their parents, and professionals working with children
- As an **outcome measure** to assess the impact of an intervention to reduce listening-related fatigue

Using the VFSs

- As an **identification tool** to find those most at risk for significant problems who may warrant monitoring or intervention.
- What score “warrants monitoring or interventions”?
 - Ongoing work to develop useful metrics
- Interpreting VFS scores
 - Qualitatively, based on *frequency* of fatigue-related complaints
 - Experiencing fatigue “often” or “almost always/always” is problematic
 - Qualitatively, “interviewing” about the **functional impact** when fatigue-related issues occur “often” or “almost always/always”
 - Especially useful for children
 - Statistically,
 - Using standard deviation “cutoff scores” from a “standardization” sample

Interpreting VFS Scores: A Qualitative Approach

- Summed scores reflect the **frequency** of fatigue-related problems

VFS-A-10

- “Hypothetical” adult hearing aid user w/ severe HL
 - Summed score = 33
 - Scores $\geq 25/30$ suggest fatigue is **often** a problem
 - Scores $\leq 10/15$ suggest fatigue is **rarely** a problem
 - But...

		Never/ Almost Never	Rarely	Sometimes	Often	Almost Always/ Always
1.	I feel worn out from everyday listening.	0	1	2	3	4
2.	Struggling to listen and understand makes me feel tired.	0	1	2	3	4
3.	I get so exhausted from listening that I cannot do the things I enjoy.	0	1	2	3	4
4.	I schedule my day to avoid getting tired from listening.	0	1	2	3	4
5.	I get so tired from listening that I start to miss details in a conversation.	0	1	2	3	4
6.	I get so exhausted from listening that I go to bed early.	0	1	2	3	4
7.	I withdraw when I am unable to follow conversations in noisy places.	0	1	2	3	4
8.	Feeling tired from listening causes strain on my relationships.	0	1	2	3	4
9.	I feel emotionally drained when it is hard for me to listen and understand.	0	1	2	3	4
10.	It takes a lot of energy to listen and understand.	0	1	2	3	4

Total Summed
Score:

0 10 20 30 40

Interpreting VFS Scores: A Qualitative Approach

- But fatigue-related issues *could* be a problem in some situations

VFS-A-10

- A “hypothetical” adult w/ mild-moderate HL
 - Summed score = 14
 - But some fatigue-related issues occur “often” to “almost always”
- We suggest you review responses to each item
 - Especially for children

		Never/ Almost Never	Rarely	Sometimes	Often	Almost Always/ Always
1.	I feel worn out from everyday listening.	0	1	2	3	4
2.	Struggling to listen and understand makes me feel tired.	0	1	2	3	4
3.	I get so exhausted from listening that I cannot do the things I enjoy.	0	1	2	3	4
4.	I schedule my day to avoid getting tired from listening.	0	1	2	3	4
5.	I get so tired from listening that I start to miss details in a conversation.	0	1	2	3	4
6.	I get so exhausted from listening that I go to bed early.	0	1	2	3	4
7.	I withdraw when I am unable to follow conversations in noisy places.	0	1	2	3	4
8.	Feeling tired from listening causes strain on my relationships.	0	1	2	3	4
9.	I feel emotionally drained when it is hard for me to listen and understand.	0	1	2	3	4
10.	It takes a lot of energy to listen and understand.	0	1	2	3	4

Total Summed
Score: 0 10 20 30 40

A VFS-Peds “Interview”

VFS-C

- 13 year old girl w/bilateral HL
 - Summed score = 20
- Query the child: “You answered “Often” or “Almost Always” here. Tell me more about this.”
 - When does this happen?
 - What do you do when you feel tired or worn out from listening?

	NEVER	RARELY	SOMETIMES	OFTEN	ALMOST ALWAYS
I want to “zone out” in very noisy places.	☐	☐	☒	☐	☐
It is hard for me to concentrate when lots of people are talking.	☐	☐	☒	☐	☐
My brain gets tired after listening all day.	☐	☐	☒	☐	☐
I get worn out from listening at school.	☐	☒	☐	☐	☐
<u>Trying to listen at school stresses me out.</u>	☐	☐	☐	☐	☒
I use a lot of energy trying to listen in class.	☐	☐	☒	☐	☐
I want to go to sleep after a long day of listening.	☒	☐	☐	☐	☐
<u>I give up trying to listen when I get tired.</u>	☐	☐	☐	☐	☒
I get so tired from listening that I don’t want to do anything else.	☒	☐	☐	☐	☐
<u>I feel worn out when I have to listen carefully.</u>	☐	☐	☐	☒	☐

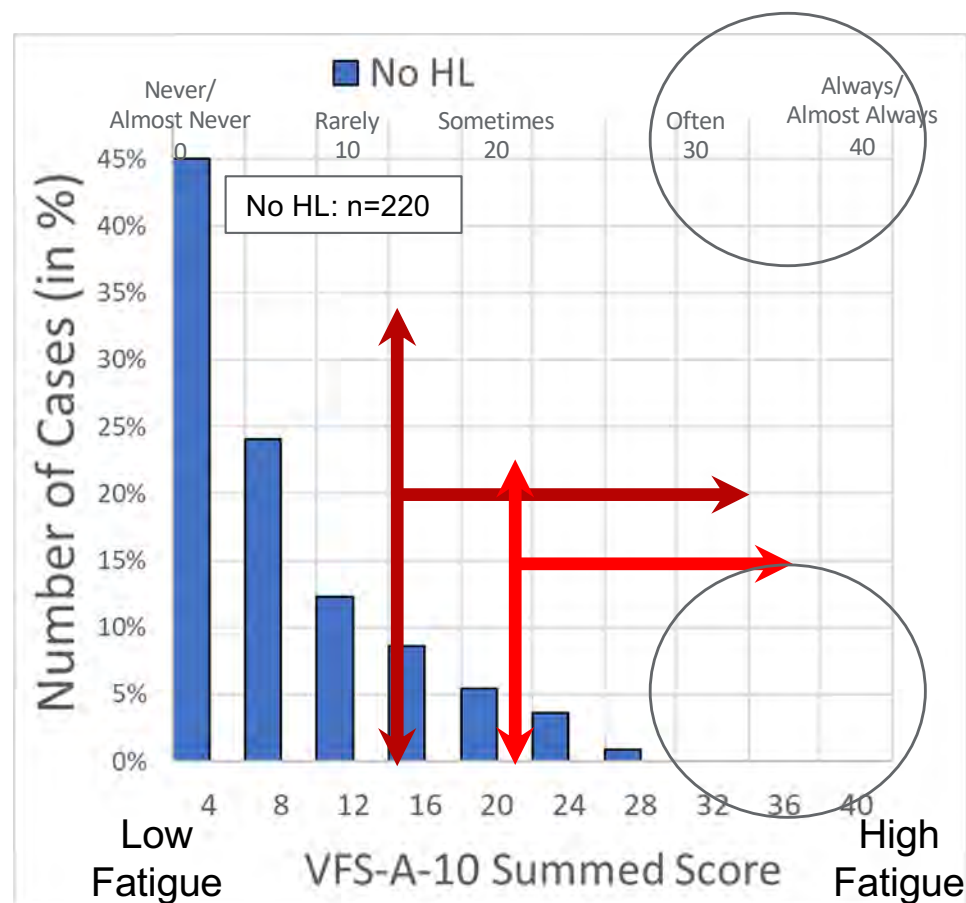
- The goal is to identify examples of the **functional impact** of the child’s fatigue (e.g., situations, experiences, etc...)
 - Can be used to advocate for and target specific interventions *regardless of the total summed score*
 - Can be very useful for team/IEP meetings

Interpreting VFS Scores: Statistically- Using cut-off scores based on “Norms”

- Scores $>$ than 1 or 2 standard deviations above the mean of a “normative” sample would be flagged for follow-up or potential intervention
- VFS cut-offs are based on the distribution of our “standardization” samples (No HL or other additional disabilities)
 - VFS-A-10: 220 Adults
 - VFS-C: 120 Children
 - VFS-P: 151 Parents
 - VFS-T: 68 Teachers
- This approach works well for adults....
 - But in isolation, it is not adequate, may miss children with significant problems
 - See VFS-Peds user manual for VFS-Peds details
 - <https://www.vumc.org/vfs/pediatric-scales-and-user-guide>
 - See Hornsby et al., 2023 for VFS-A-10 details

Using cut-off scores with adults

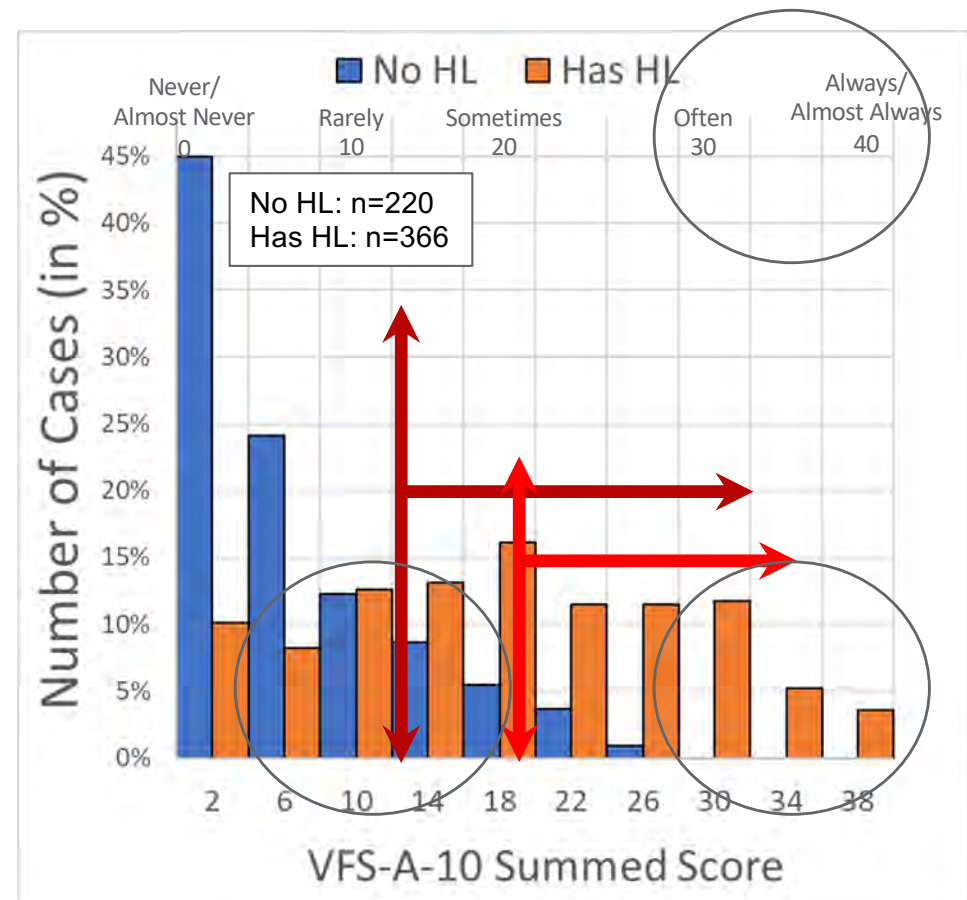
- Histogram of VFS-A-10 scores for adults with “*No self-reported HL*”
 - Note heavily skewed distribution
 - Median = 5
 - 1 SD cutoff = 13
 - 2 SD cutoff = 19
 - No scores >26
 - I.e., none with problems occurring “Often to Always/Almost Always”



Adapted from Hornsby et al., 2023

Using cut-off scores with adults

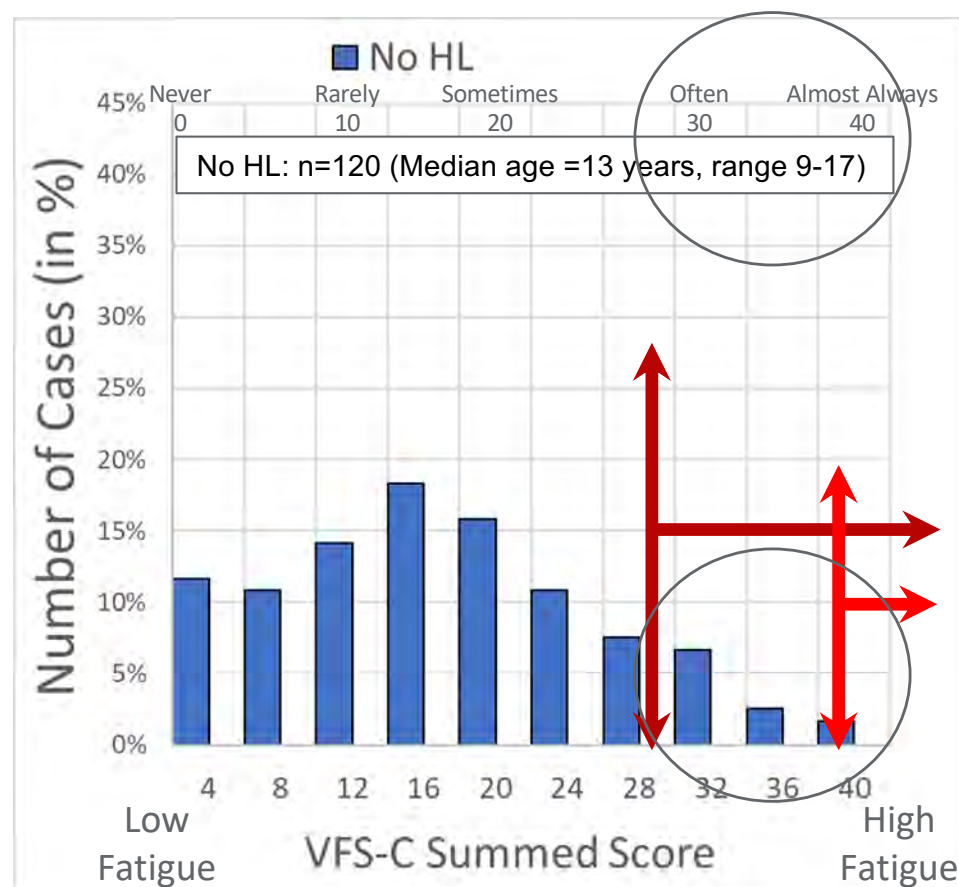
- Distribution for adults “with self-reported HL” is much broader & shifted higher
 - Some people w/HL report limited problems but...
 - Median = 18 (vs 5 of no HL)
 - ~68% of HL scores ≥ 13 (1 SD cutoff)
 - ~47% of HL scores ≥ 19 (2 SDs cutoff)
 - ~25% reporting LRF issues occur “often-Always/Almost Always”
- St. Dev. cutoffs provide an easy way to identify adults w/potential problems



Adapted from Hornsby et al., 2023

What about in children? (Child self-report data)

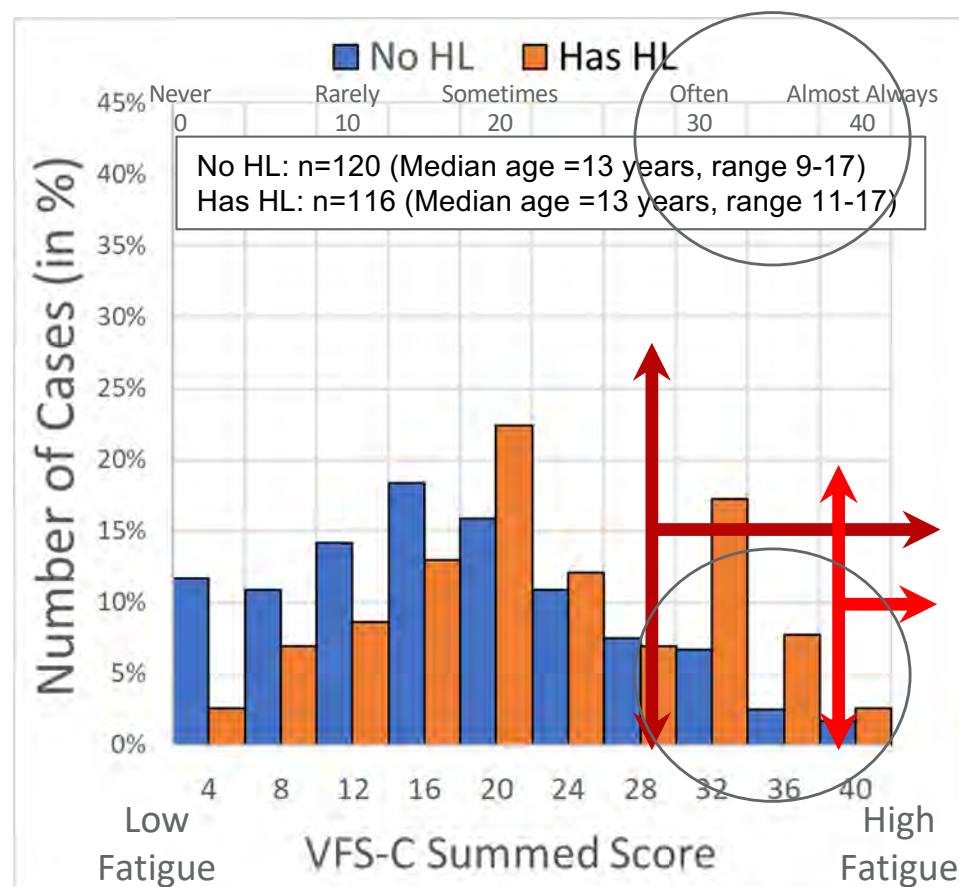
- Distribution of scores for “Typical” children (no HL & no additional disabilities) is relatively broad
 - Median = 15 (vs 5 for adults)
 - Results in relatively high 1 & 2 SD cutoffs
 - 1 SD cutoff = 27 (vs 13 for adults)
 - 2 SD cutoff = 37 (vs 19 for adults)
 - And ~12.5% of “typical” children report LRF issues occur “often-Always/Almost Always”!
 - vs 0% for adults



See Davis, et al., (2022). A User Guide to the Pediatric Versions of the Vanderbilt Fatigue Scale (VFS-Peds). Available at <https://www.vumc.org/vfs>.

What about in children? (Child self-report data)

- The distribution for CHL is shifted to the right but there is substantial overlap*
 - Median = 20 (vs 15 for no HL)
 - ~31% of CHL scores ≥ 27 (1 SD cutoff)
 - i.e., LRF issues are occurring “often-almost always”
 - Only ~1% of CHL scores ≥ 37 (2 SDs cutoff)
- Using st. dev. cutoffs (especially the 2 st. dev. cutoff) for CHL **may miss many children** experiencing frequent LRF problems



*Unpublished data from Hornsby et al., 2022 VFS-Peds development and validation data set

Interpreting VFS Scores: Statistically-Using cut-off scores based on “Norms”

- Cut-offs based on the distribution of normative sample scores
- These work well for adults....
 - But alone are not adequate for children as they may miss children with significant problems

Cut-Off	VFS-C	VFS-P	VFS-T	VFS-A-10
≥1 SD	≥27	Mental: ≥15 Physical: ≥13	≥23	≥13-18
≥2 SD				≥19

- Add follow-up interview questions about issues occurring “often-almost always”, especially for children
 - See VFS-Peds user manual for VFS-Peds details
 - <https://www.vumc.org/vfs/pediatric-scales-and-user-guide>
 - See Hornsby et al., 2023 for VFS-A-10 details

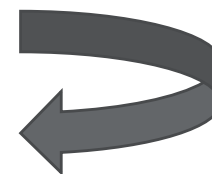
Using the VFSs

- As an **identification tool** to find those most at risk for significant problems who may warrant monitoring or intervention.
- As a **counseling tool** to educate adults, children, their parents, and professionals working with children
- As an **outcome measure** to assess the impact of an intervention to reduce listening-related fatigue
 - Evidence from the broader fatigue literature suggests interventions to reduce effort & increase control may be beneficial¹

¹Hockey, R. (2013). The psychology of fatigue: Work, effort and control. Cambridge University Press.

Managing Listening-Related Fatigue (LRF) in CHL

- Empirical work in CHL is lacking, but potential interventions (based largely on qualitative work and anecdotal reports) might include:
 - Set up the classroom to enhance listening/reduce listening effort
 - E.g., Preferential seating, access to visual cues, good acoustics
 - Consistent use of assistive devices (with caveat)
 - ***Provide a space for quiet breaks and/or schedule listening breaks into the day***
 - Educate the child (and parents/teachers) about LRF
- For details see the “Listening Fatigue Management Strategies” handout on our website:
 - <https://www.vumc.org/vfs/resources>



Managing Listening-Related Fatigue (LRF) in Adults

- Empirical work in adults is also limited, but as for children, potential interventions might include:
 - Listening breaks, education, and hearing assistive devices
 - Growing evidence supports (with caveats) the use of hearing aids & cochlear implants (CIs) to reduce long-term LRF
- For example, Holman et al. (2021) found that well-fit hearing aids reduced LRF (VFS-A-40) in a group of first-time hearing aid recipients with mild-moderate SNHL.

Effect of CI use on LRF- in adults

- Does CI use impact fatigue?
 - If so, what is the time course of the change?

Hornsby et al., in review

Effect of CI use on LRF- in adults

- Study involved two groups
 - Experimental group (N=48)
 - Newly implanted unilateral or simultaneous bilateral CI recipients (n=46/2)
 - Mean age ~63 years, sd ~13 years
 - Control group (N=96)
 - Experienced unilateral or bilateral CI users (n= 50/46)
 - Mean ~63 years, sd ~15 years
- Data collected via online surveys at up to 7 time points
 - Experimental group: Pre-CI, 0.5, 1, 2, 3, 6, & 12-months post-CI activation
 - Control group: Baseline and ~3 months later
- Measures included:
 - Demographic and Audiologic (clinical) data
 - Subjective ratings of fatigue (VFS-A-40), effort, hearing handicap & social isolation

Hornsby et al., in review

Does CI use impact fatigue?

- **Yes-**

- What is it's time course?

- Significant decrease at 2-weeks post-activation

- Continued improvement up to 3 months

- Stable after 3 months

- Equivalent to existing users

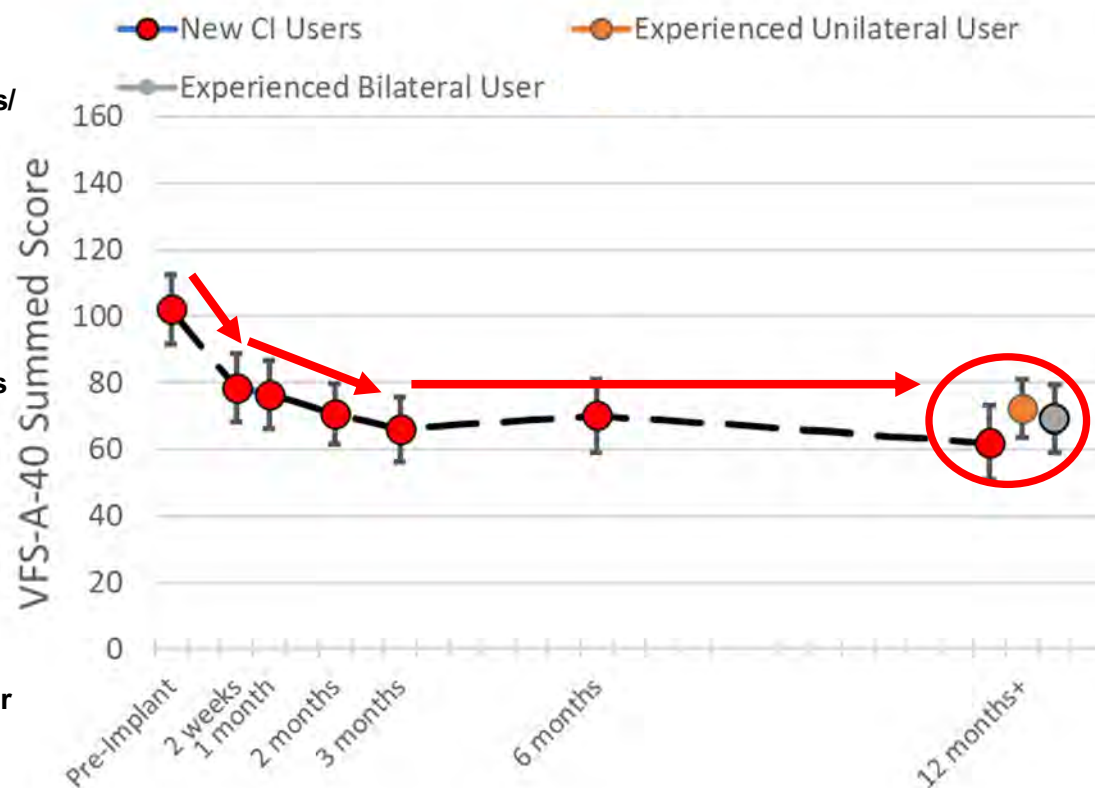
Almost Always/
Always

Often

Sometimes

Rarely

Never/
Almost Never



Hornsby et al., in review

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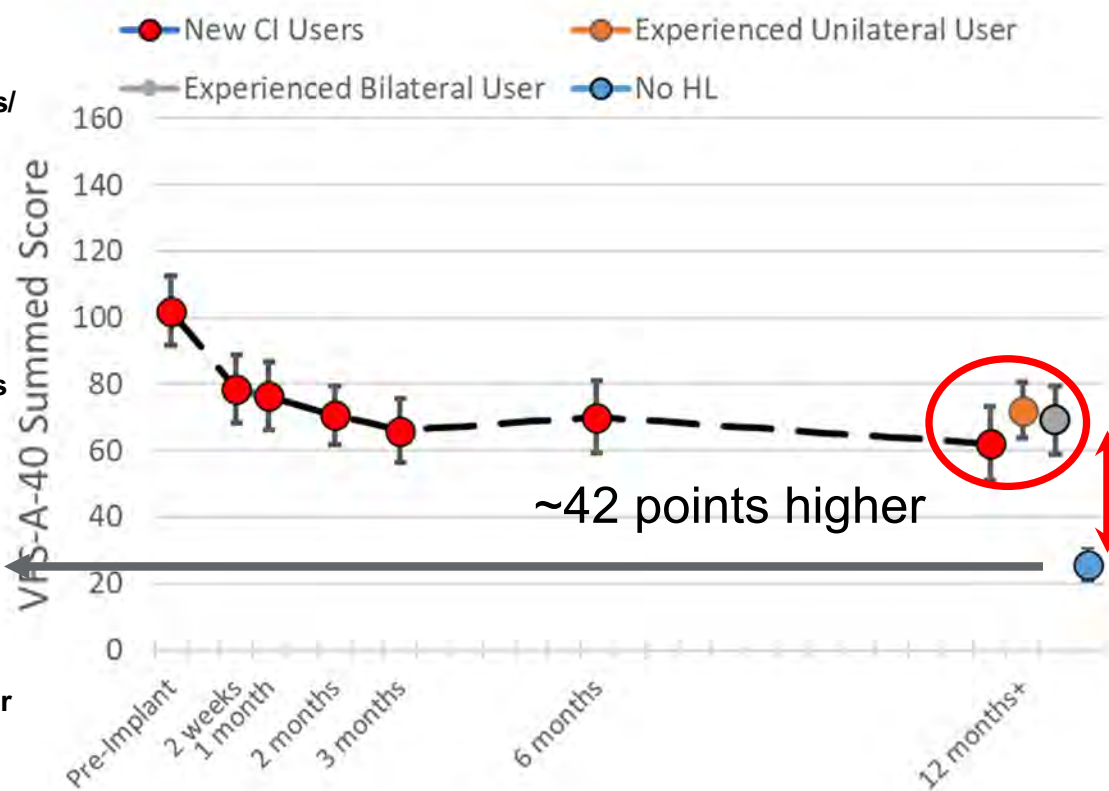
- Continued improvement up to 3 months

- Stable after 3 months

- Equivalent to existing users

- But still significantly higher than those with no HL

Almost Always/
Always
Often
Sometimes
Rarely
Never/
Almost Never

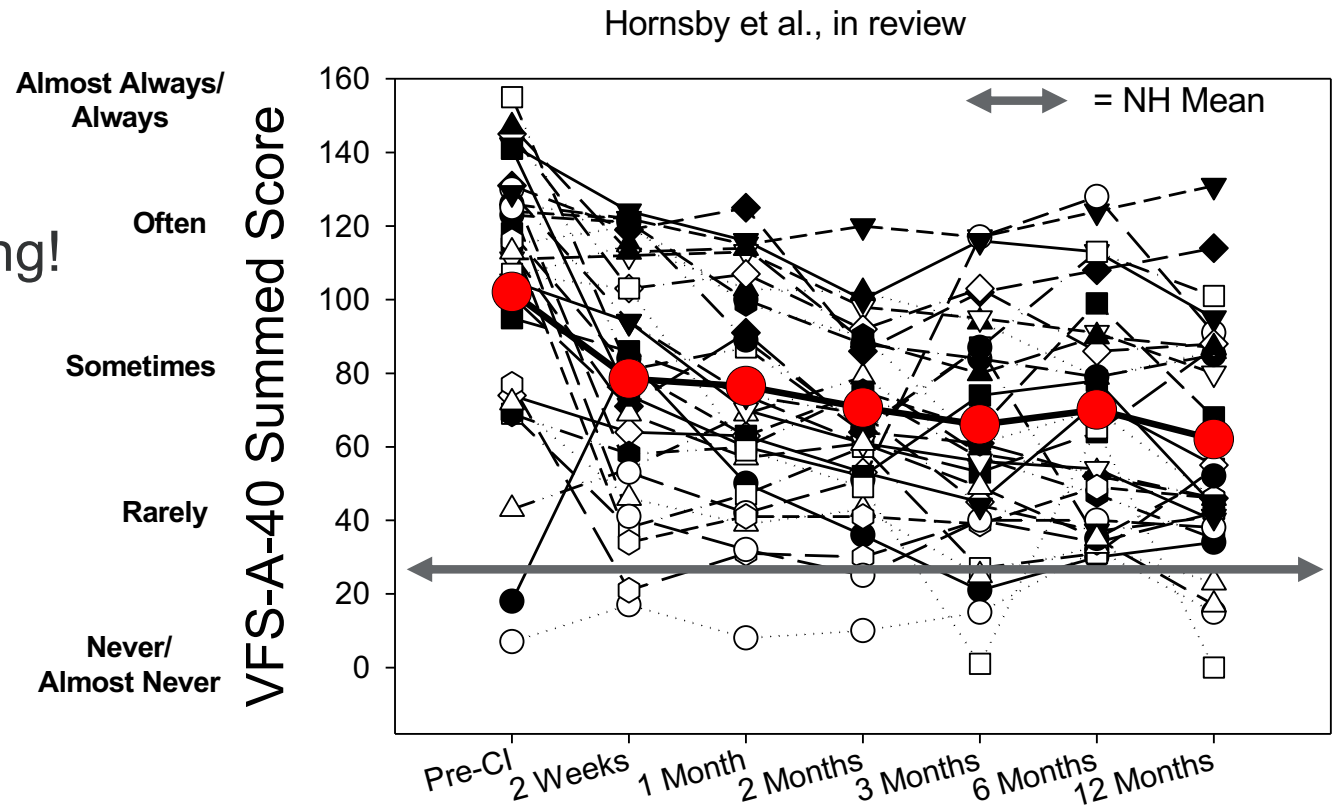


Hornsby et al., in review

Factors affecting *changes* in LRF?

- In new CI users the magnitude of change varied widely!

- Why?
 - Work is ongoing!



Using the VFS's –Your Next Steps

- **Evaluate**
 - Use the VFSs to identify those with recurrent LRF issues
 - With children use the VFS-Peds in conjunction with...
 - Interview
 - Classroom observations
 - Discussions with children/parents/teachers
 - Identify situational and individual characteristics that impact LRF to address in team meetings
- **Educate and advocate**
 - Explain LRF and its relation to hearing loss to adults, children, educators, & parents
- **Intervene**
 - No validated strategies for listening-related fatigue (yet)
 - Consider options based on the individuals needs and environment

Thanks for Listening!



Questions?

For more information
check out our website:
<https://www.vumc.org/vfs>

Or contact me directly
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