Vanderbilt Bill Wilkerson Center

Subjective Fatigue in Children with Hearing Loss:

Is it a problem and how do you measure it?

Benjamin W. Y. Hornsby

Modern Developments in Audiology (MDA)

Nashville, TN

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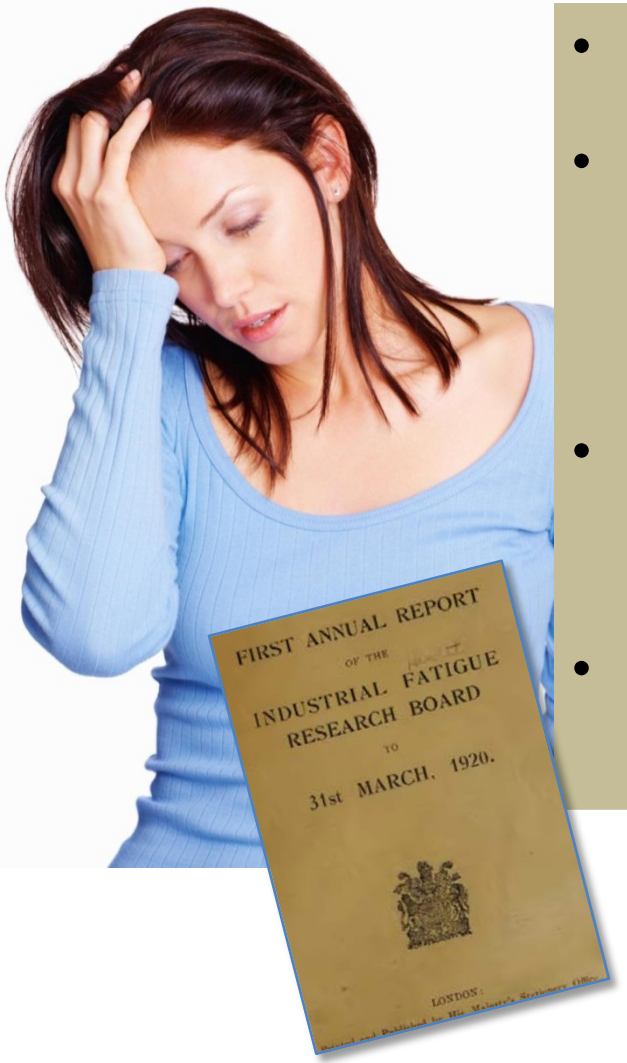
What is fatigue?

See Hornsby, Naylor & Bess, 2016 for review



- No universally accepted definition exists
- **Subjective fatigue** is an ongoing "state", a mood or feeling of tiredness, exhaustion or lack of energy, a reduced desire or motivation to continue a task
- **Behavioral (Cognitive) fatigue** is an outcome, a decrement in performance
  - Physical or mental performance
- **Physiologic measures** can be used as indirect markers of subjective and behavioral fatigue

"[I recommend] that the term fatigue be absolutely banished from precise scientific discussion".

----Muscio (1921)

Who Has Fatigue?

Everybody!-

Complaints of **mild transient** fatigue are common even in healthy populations

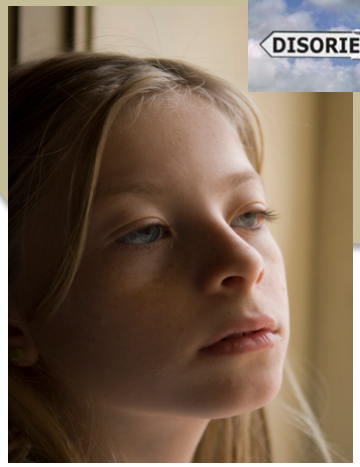
Severe, recurrent fatigue- is not common in healthy populations

-Common in many chronic health conditions

-Cancer, HIV AIDs, Parkinson's, MS

-Almost no work on hearing loss and fatigue--

Consequences of severe, recurrent fatigue



Adults—

- Inattention, lack of concentration, poor mental processing and decision-making skills
- less productive and more prone to accidents
- less active, more isolated, less able to monitor own self-care

Children w/ Chronic Illnesses—

- inattention, concentration, distractibility
- poorer school achievement, higher absenteeism

Amato, et al. 2001; van der Linden et al. 2003; DeLuca, 2005; Eddy and Cruz, 2007; Ricci et al. 2007

Quantifying fatigue and its effects

A variety of approaches have been used:

Subjectively—

- Using questionnaires and survey instruments

Behaviorally— as a performance decrement

- A decline in (cognitive) task performance due to sustained (mental) demands

Physiologically—

- Physiologic changes or biomarkers associated with mental fatigue

Quantifying fatigue and its effects

A variety of approaches have been used:

Subjectively—

- Using questionnaires and survey instruments

Behavior— a performance decrement

- A decline nitive) task performance due to sustain (me) demands

Physiolo lly-

- Physiolo nges or biomarkers associated with mental gue

Quantifying Fatigue Subjectively

- Subjective measures include surveys, rating scales and questionnaires that ask about mood or feelings
- Fatigue scales may be
  - Multidimensional
    - E.g., Physical, mental, emotional, vigor, sleep/rest
  - Or Uni-dimensional
    - A “General” composite measure of fatigue

See e.g., Dittner et al., 2004 for review

Quantifying Fatigue Subjectively

- Subjective measures include surveys, rating scales and questionnaires that ask about mood or feelings

- *While many options are available, none are specific to hearing loss or focus on listening-related fatigue*

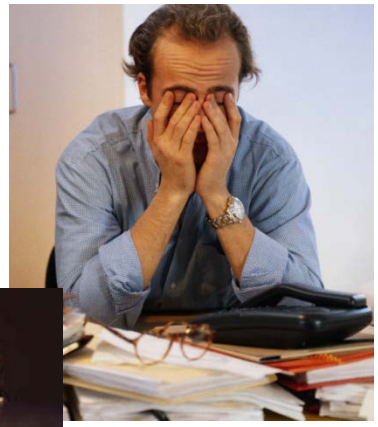
See e.g., Dittner et al., 2004 for review

Is fatigue a problem for people with hearing loss?

"..... I can attest to the **FATIGUE** caused by prolonged intensive listening in noise through hearing aids.....".

Mark Ross, 2006, 2012
Pediatric Audiologist

Hearing Loss, Listening Effort and Fatigue



- "…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
- But why is fatigue a problem?
  - Active listening can be hard work!
  - "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."
    - Blog post http://hearingelmo.wordpress.com
- But….

Fatigue- more than just high effort

High effort/difficulty ≠ always lead to fatigue

Fatigue- more than just high effort

- Risk for fatigue increases in:
  - Mentally/physically challenging conditions
    - Requires effortful control to attain/maintain performance
    - Maintaining “acceptable” performance is difficult or not possible
  - Low control conditions
    - Timed or scheduled tasks with limited flexibility
    - Limited **ability** to modify the task characteristics
  - Important conditions
    - High motivation to succeed, along with
    - Negative consequences for poor performance

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

Is fatigue a problem for people with hearing loss?

"..... I can attest to the FATIGUE caused by prolonged intensive listening in noise through hearing aids.....".

Mark Ross, 2006, 2012
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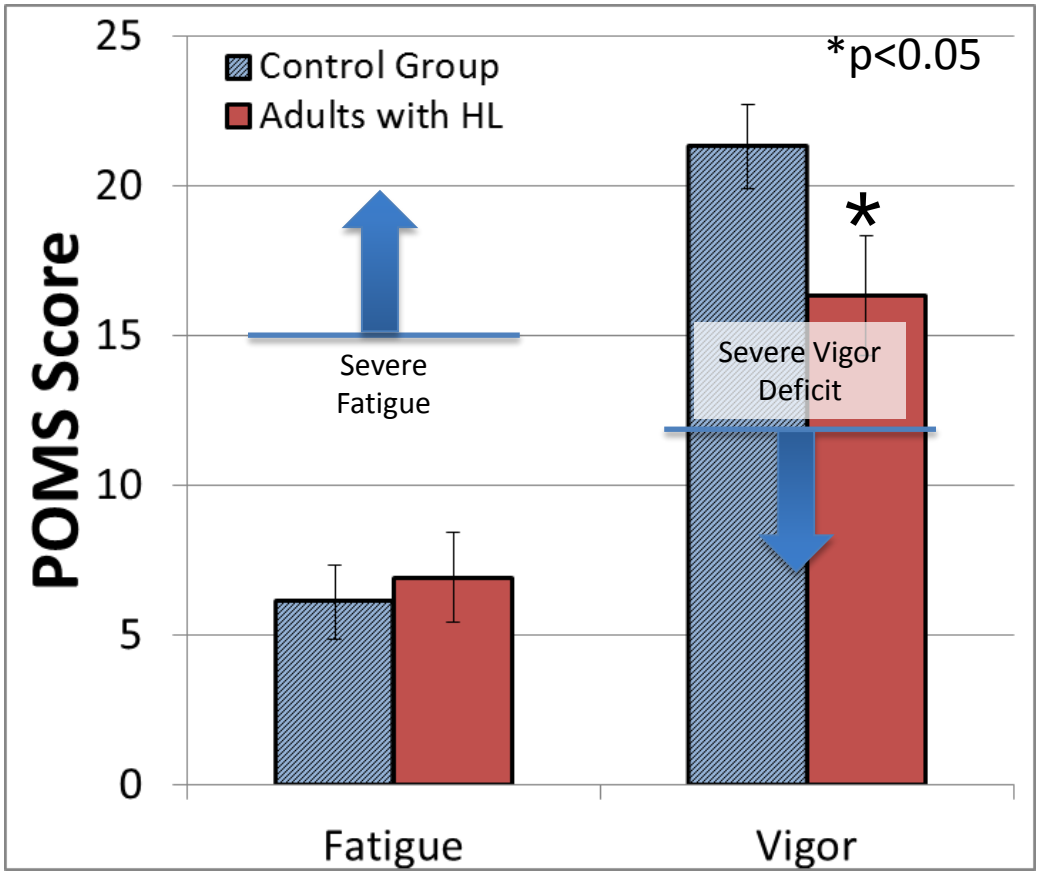
- What do the data say?

Subjective fatigue in people with HL

- When assessed using validated, generic, measures: Are problems of fatigue or vigor deficits increased in adults (AHL) or children with HL (CHL)?
  - If so, what factors modulate their fatigue?
- Let's start with adults-

Subjective fatigue in Adults with HL



- Compared to POMS normative data, older adults seeking help for HL report
  - similar fatigue but
  - significantly lower vigor

- Age range: 55-94 years
- N= 116

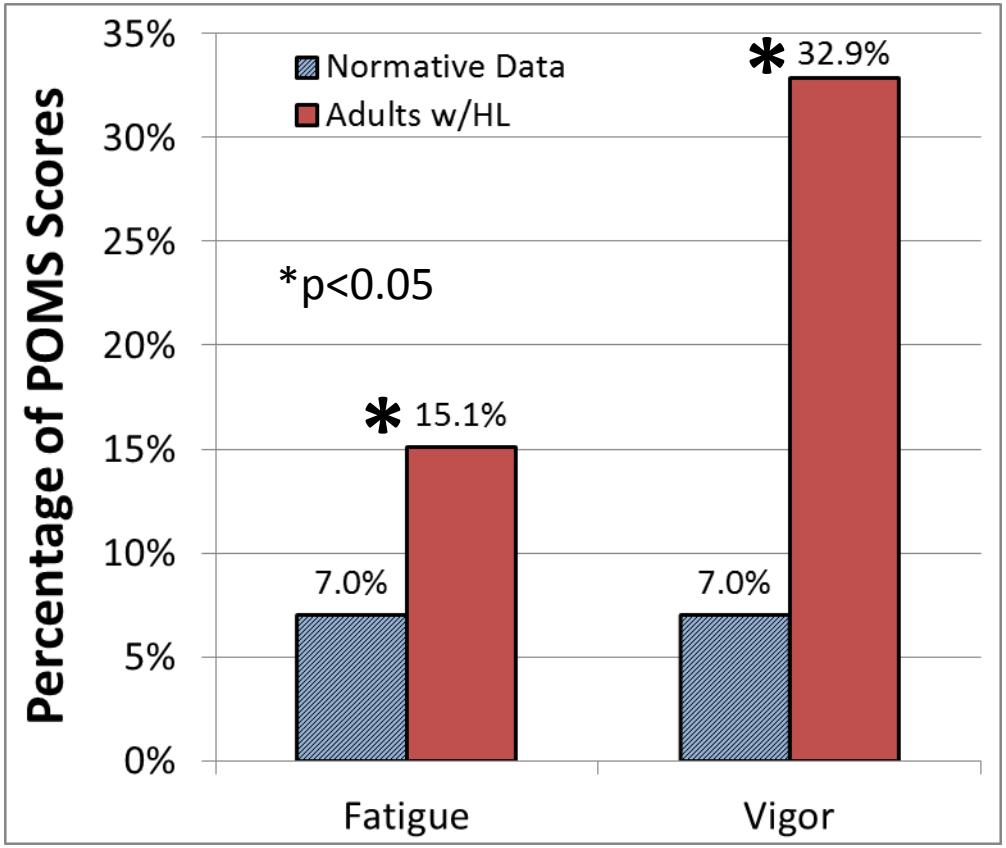
POMS= Profile of Mood States (McNair et al., 1971)

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

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

- **More than 2 times** as likely to report severe fatigue and
- **More than 4 times** as likely to report severe vigor deficits!
- Severe = >1.5 st. dev. above mean

Percentage of adults subjectively reporting severe fatigue and vigor deficits



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

Subjective fatigue in Adults with HL

- Is subjective fatigue a problem for people with hearing loss?
  - Using validated, generic, measures are problems of fatigue or vigor deficits increased in adults with HL (AHL)? **[Yes, partly- esp. severe]**

Subjective fatigue in Adults with HL

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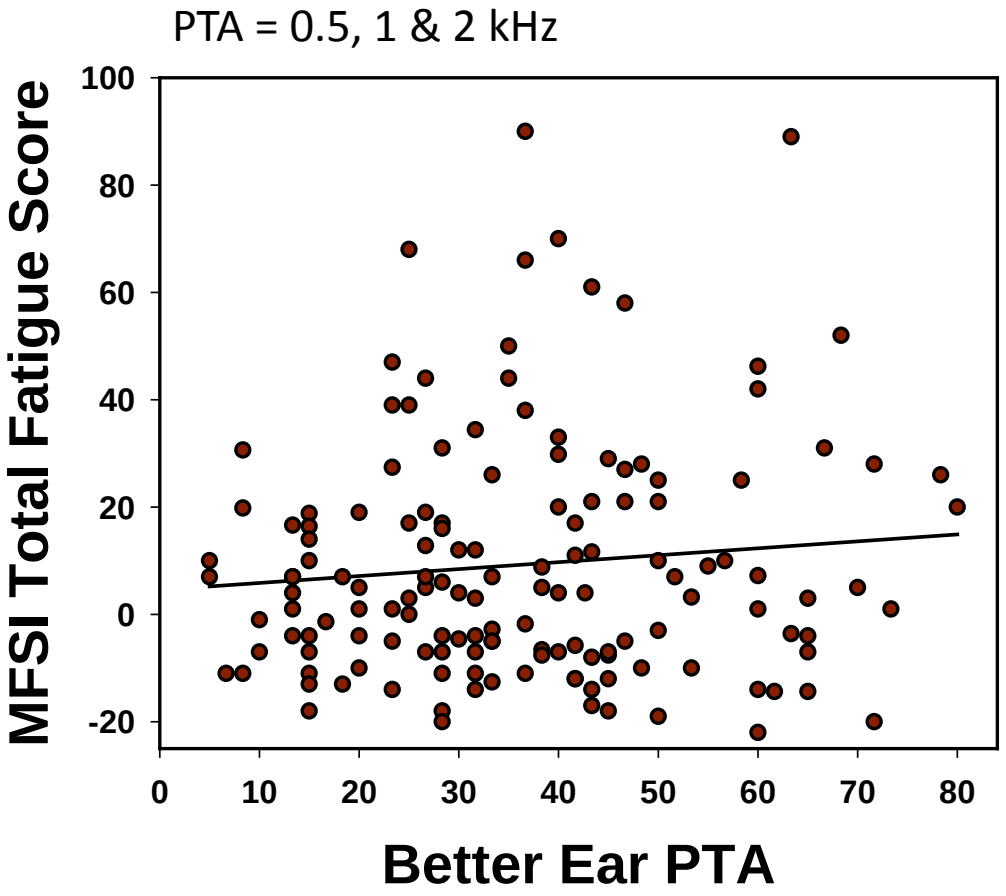
  - Using validated, generic, measures are problems of fatigue or vigor deficits increased in adults with HL (AHL)? **[Yes, partly- esp. severe]**
  - What factors modulate fatigue in AHL?
    - Objective hearing difficulty?

Degree of Loss (PTA) and fatigue



MFSI= Multidimensional fatigue symptom inventory- short form
-Assess General, Physical, Emotional, Mental fatigue and Vigor (and total)

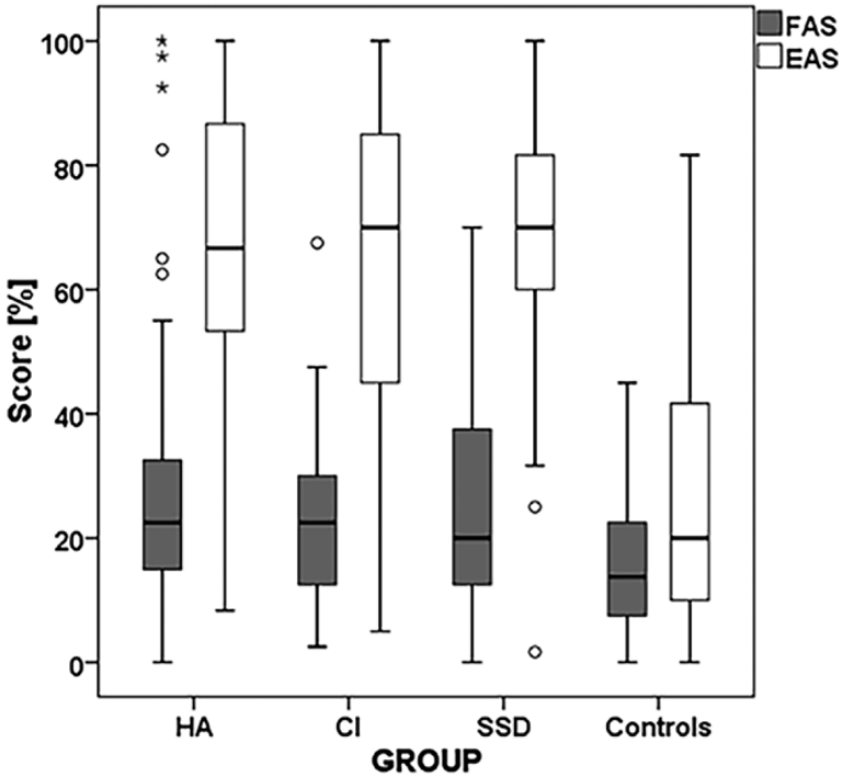
Hornsby, B. & Kipp, A. (2016)

- Surprisingly, **no association** bw degree of loss and any fatigue/vigor domain
  - Similar result for POMS data as well

- N= 143
- Age range: 22-94 years
- PTAs: 5-80 dB (Median: 33 dB)

Type of hearing loss and fatigue

- Alhanbali et al (2016) assessed subjective fatigue and effort in four adult groups:
  - NH & HL (HA, CI & SSD)
  - Age matched groups
  - N= 50/group
- All HL groups reported more fatigue and effort
  - No differences in fatigue bw HL groups
  - Much larger effects of HL on effort than fatigue



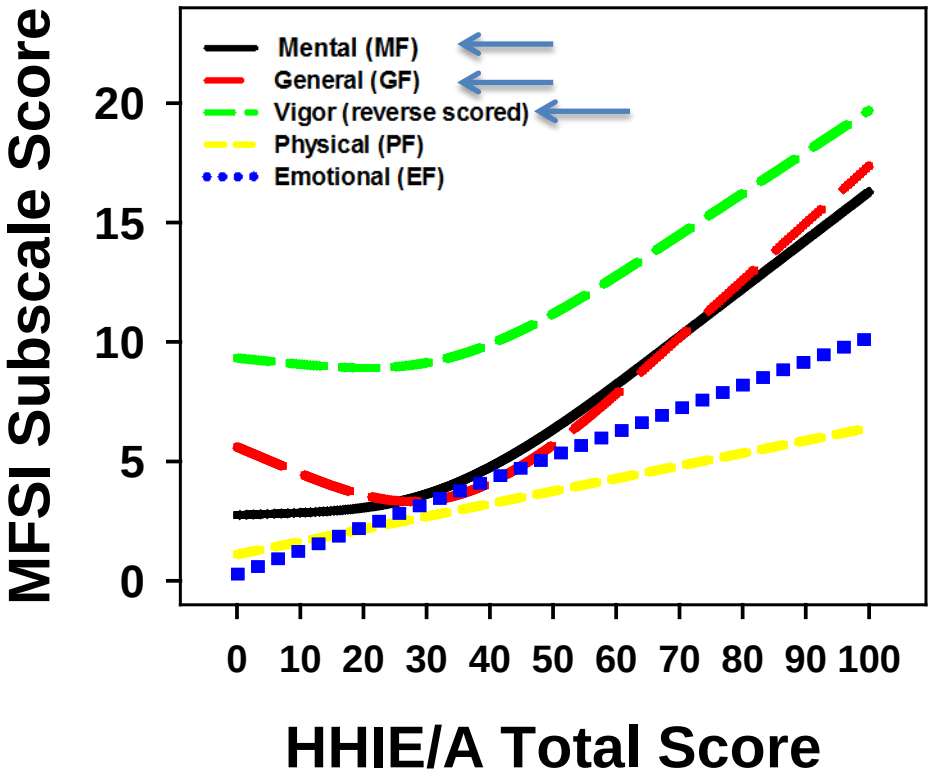
Alhanbali et al., 2016

- Fatigue measure- Fatigue Assessment Scale (FAS)
- Effort measure- 3 items from SSQ + 3 additional items

Subjective fatigue in Adults with HL

- Is subjective fatigue a problem for people with hearing loss?
  - Using validated, generic, measures are problems of fatigue or vigor deficits increased in adults with HL (AHL)? **[Yes, partly- esp. severe]**
  - What factors modulate fatigue in AHL?
    - Objective hearing difficulty? **[No!]**
    - Perceived hearing difficulties (HHIE/A)?

Hearing handicap and fatigue



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

- Fatigue increases with increases in hearing handicap
- Esp. for "significant" handicap scores (HHIE/A scores >42)
  - Limited association for lower handicap scores

- Strong relationship between high levels of hearing handicap and subjective fatigue

Take Home Points- Adults

- Generic fatigue measures suggest, in everyday settings
  - Fatigue and vigor deficits are increased in at least a subset of adults with HL,
    - Especially at risk for more **severe** fatigue and vigor deficits
- This increased risk is not associated with the magnitude of hearing loss (i.e., PTA)
  - But is associated with perceived hearing difficulties (i.e., psychosocial consequences of hearing loss- HHIE/A scores)

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What about kids with hearing loss?

Hearing Loss, Listening Effort and Fatigue- Child and Parent Report

"My child will zone out or go into a bubble when she needs a break from listening."
- Parent of a child with hearing loss

"My child will withdraw at the end of a long day of listening."
- Parent of a child with hearing loss

"My brain needs a rest from listening."
- Students with hearing loss

"Trying harder to listen and understand drains me and makes me feel down."
- Student with hearing loss

"First thing I do when I get home is take my hearing aids out. I just need a break."
- Student with hearing loss

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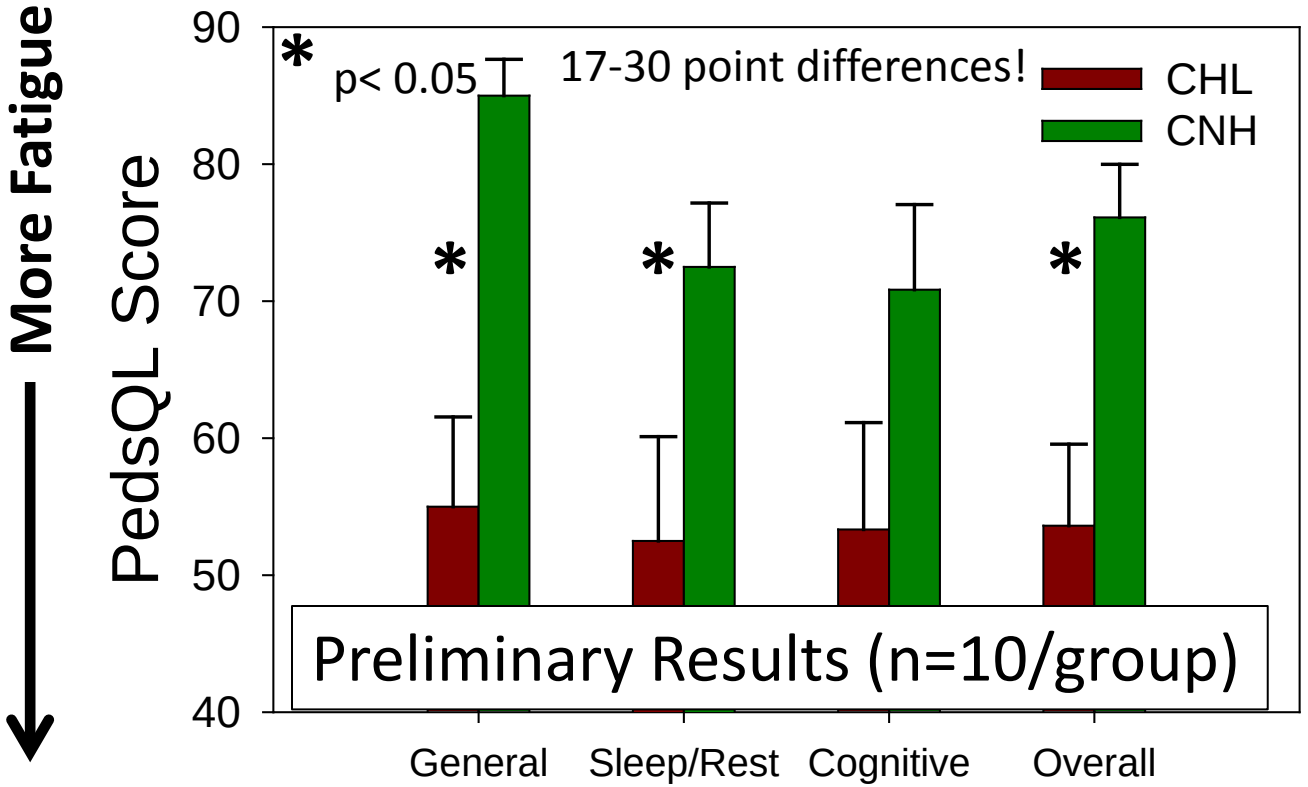
Subjective fatigue in Children with HL

PedsQL-MFS: Pediatric Quality of Life- Multidimensional Fatigue Scale (Varni et al., 2002)



- 10 CNH and CHL
  Aged: 6 – 12 years
- Diverse group of CHL
  - 4 mild-moderate losses; bilateral hearing aids
  - 2 asymmetric losses; unilateral hearing aids
  - 4 CI users with bilateral profound losses

- CHL reported significantly more fatigue. Pervasive across domains

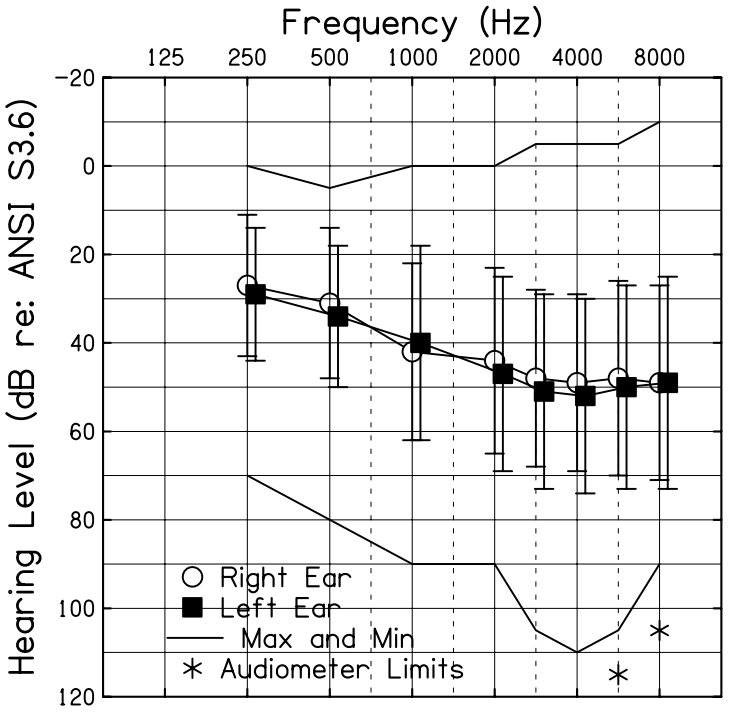
Hornsby, et al., (2014)

Subjective fatigue in Children with HL

Full study results

- Participants
  - CNH and CHL (6-12 years old)
    - **and their parents**
  - Bilateral, mild to moderately-severe, permanent hearing loss
  - Inclusion/Exclusion:
    - No CI users
    - In general education classrooms
    - No diagnosis of cognitive impairment, autism or developmental disorder

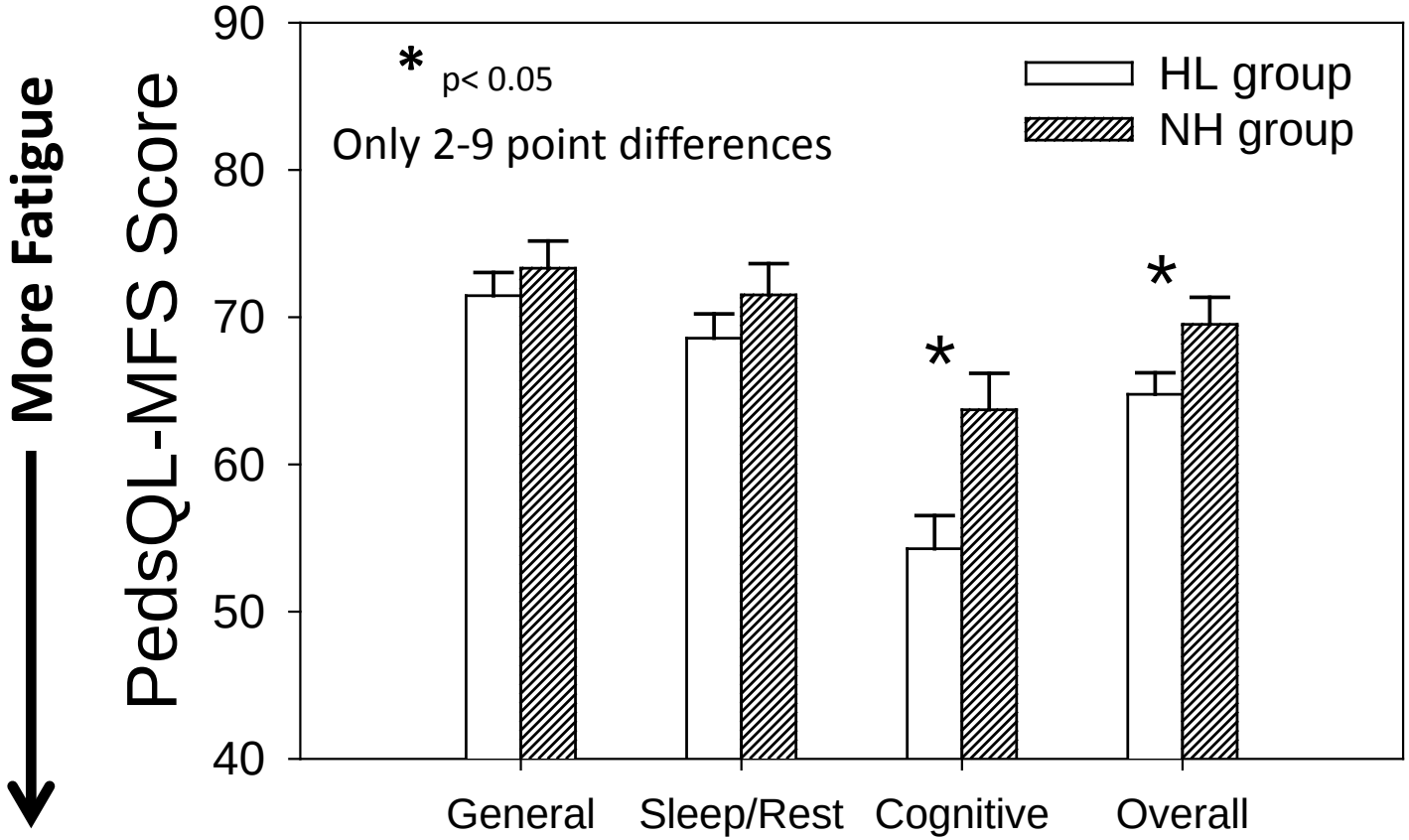
Hornsby, et al., (in press)



- Experimental (CHL) group **(n=60)**
  - 31 males (52%), 29 females
  - Age = 10.0 (1.9) years
- Control (CNH) Group **(n=43)**
  - 26 males (60%), 17 females
  - Age = 9.1 (2.3) years

Subjective fatigue in Children with HL

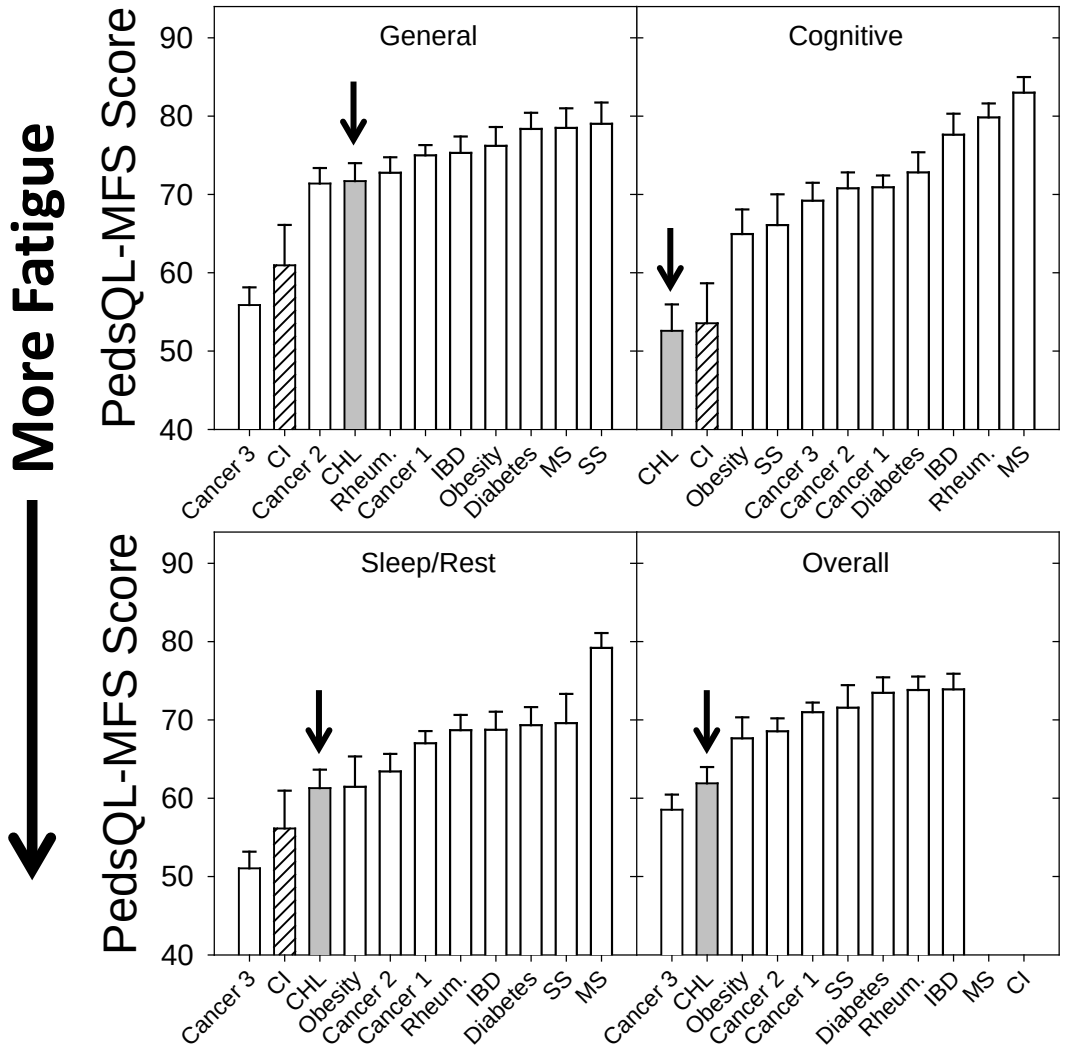
Mean data collapsed across parent/child reports



- Current data shows main effect of HL but smaller effects
  - No interaction with Parent/Child report

Hornsby, et al., (in press)

Fatigue in ***CHL*** compared to children with other chronic health conditions



↓ = current data

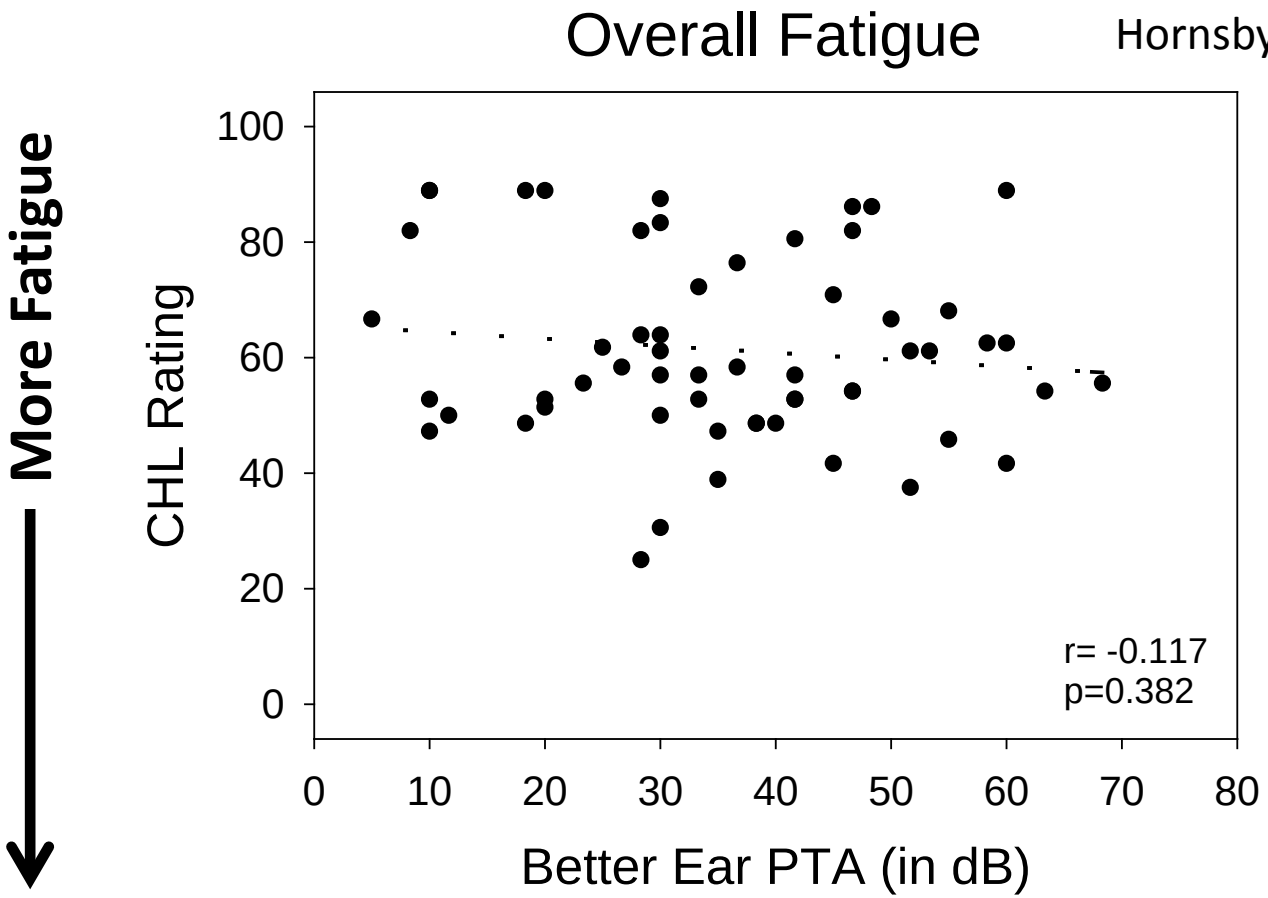
- CHL report **<u>similar, or more, fatigue</u>** than children with other chronic health conditions.

Hornsby, et al., (in press)

Factors influencing fatigue in CHL

- What factors modulate fatigue in CHL?
  - Degree of hearing loss (PTA)?
  - Intelligence, language or receptive vocabulary?
    - TONI, CELF, PPVT

Fatigue ratings are NOT associated with degree of hearing loss



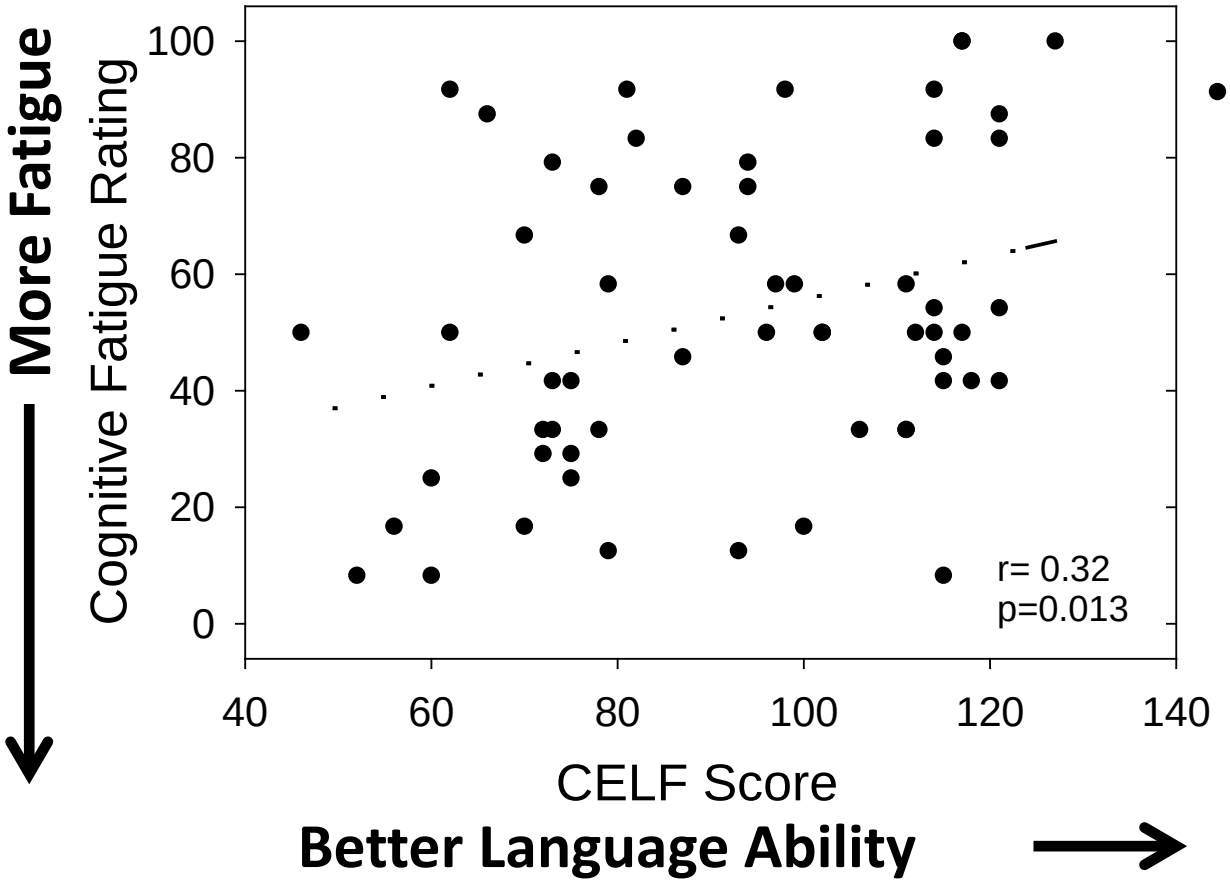
- No association between degree of loss and fatigue
  - Regardless of domain, or PTA measure; Same as adult data

Factors influencing fatigue in CHL

- What factors modulate fatigue in CHL?
  - Degree of hearing loss (PTA)? **[No!]**
- What about Intelligence (TONI), language (CELF) or receptive vocabulary (PPVT)?
  - No associations b/w general or sleep/rest fatigue and any measure (TONI, CELF or PPVT)
  - But significant associations b/w **Cognitive fatigue and CELF and PPVT** (but not TONI)
    - Similar for **Overall fatigue**

As language ability (CELF score) improves Cognitive fatigue is reduced (higher scores)

Hornsby, et al., (in press)



- Similar results seen for
  - CELF and Overall fatigue
  - PPVT and Cognitive fatigue

- Similar association b/w CELF and Cognitive Fatigue seen in CNH (r=0.36, p=0.02)

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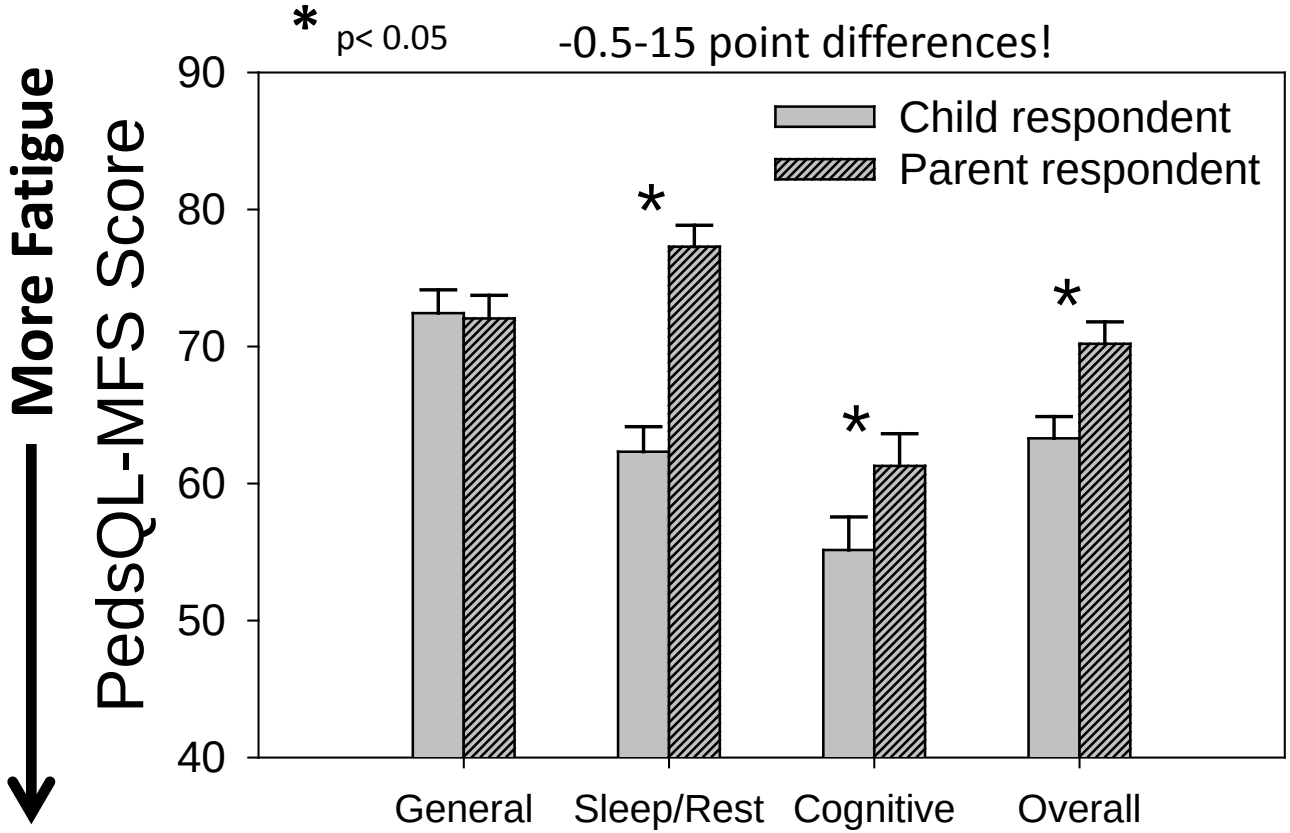
Can a parents report be used as a proxy for child ratings?

No… ☹

Effect of Parent/Child report

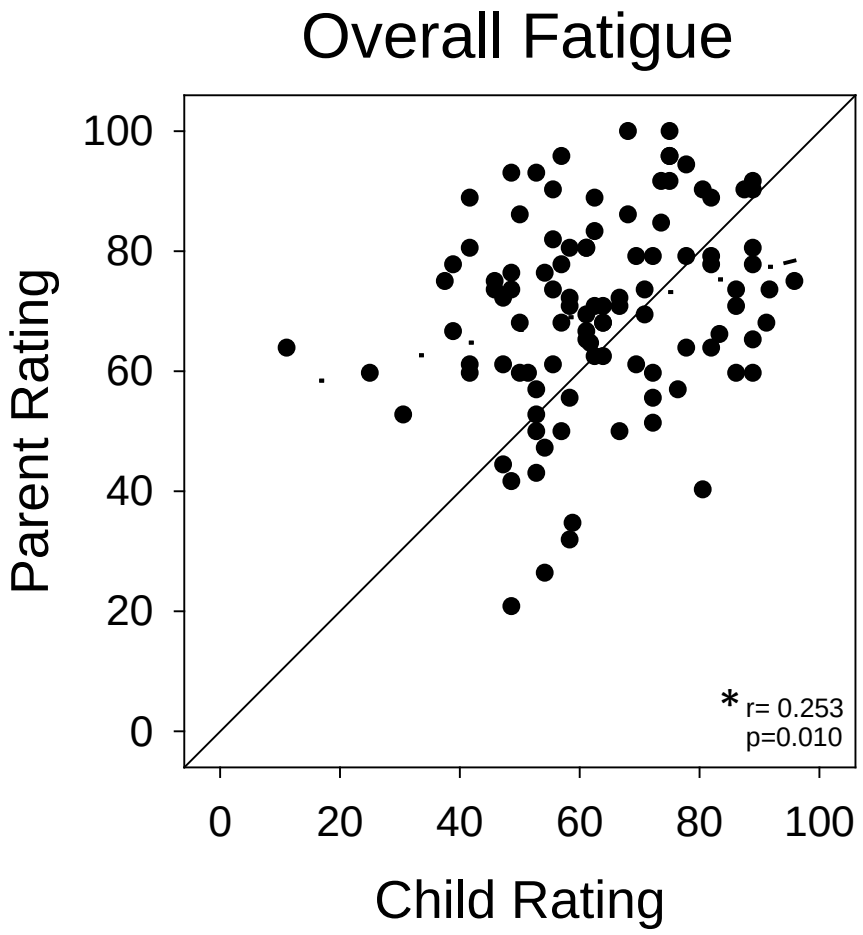
Mean data collapsed across HL/NH groups



- Parents generally *underestimate* the child's fatigue
  - No interaction with HL group

Parent-Child Correlations

- Correlations between parent and child ratings were weak (general, cognitive, overall), or not significant (Sleep/Rest)
  - Consistent with prior work in this area



*Similar, or poorer, correlations observed across all domains

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Developing a Listening-Related Fatigue Scale

The Vanderbilt Fatigue Scale (VFS)

For adults: VFS-AHL

For children: VFS-CHL

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Fatigue Scale Development Process

- Phase 1: Defining the issues
  - Literature Review: Background theory & constructs
  - Focus groups: Individual percepts
    - Adults w/HL, children w/HL and their parents, and teachers of CHL
- Phase 2: Item Development
  - Expert review
  - Cognitive interviews
- Phase 3: Initial Psychometric Evaluation

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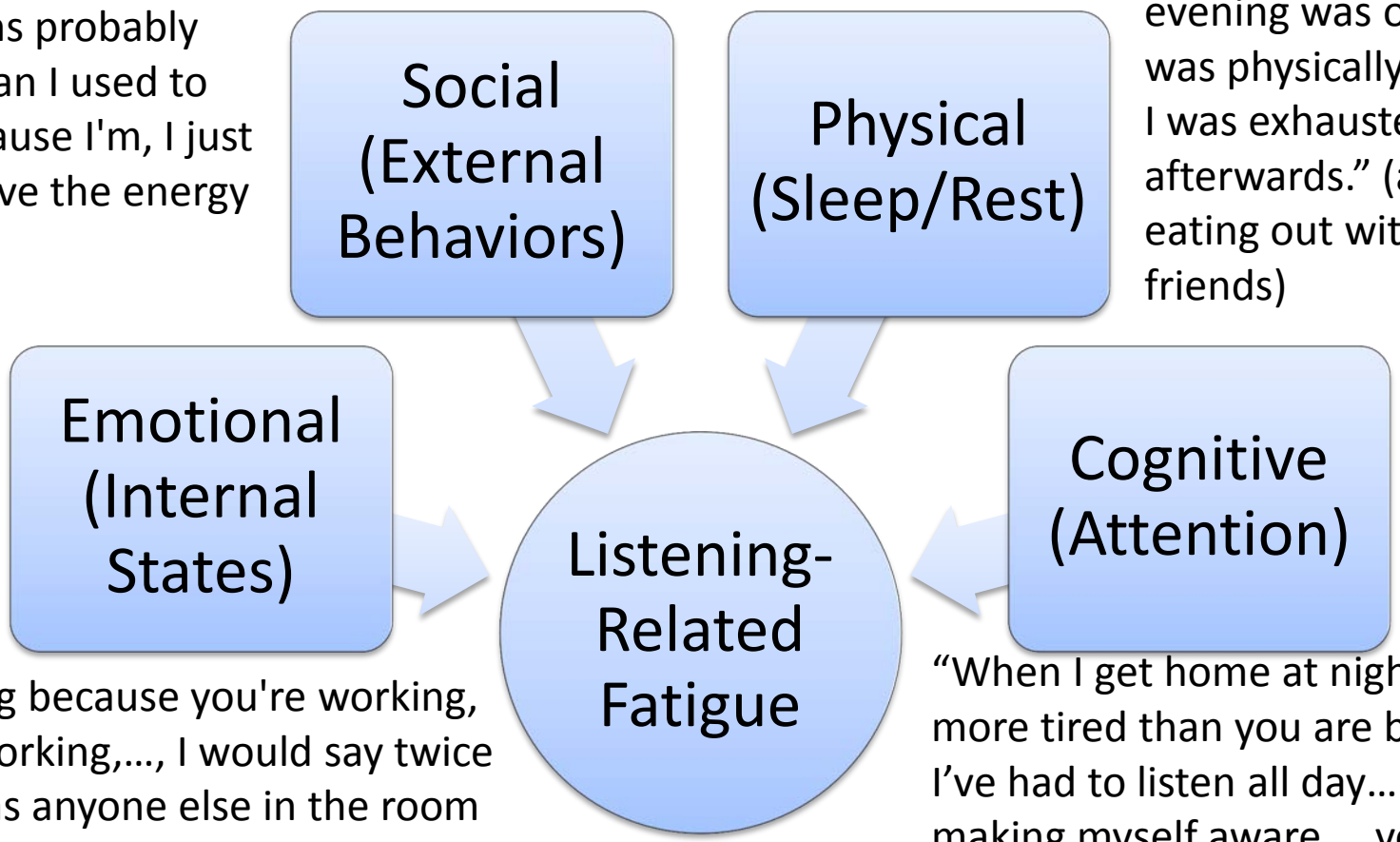
Phase 1: Defining the issues- AHL

"I avoid a lot of situations probably more than I used to just because I'm, I just don't have the energy for it,…"



"I gave up,... after the evening was over, I was physically tired… I was exhausted afterwards." (after eating out with friends)

"It's tiring because you're working, you're working,…, I would say twice as hard as anyone else in the room probably. And then emotionally, it's just frustrating and sad…"

"When I get home at night I'm more tired than you are because I've had to listen all day…Mentally making myself aware…, you got to be tuned in to everything going on around you,…"

Sample items from the VFS-AHL

Never/Almost Never	Rarely	Sometimes	Often	Always/Almost Always
O	O	O	O	O

- It takes a lot of energy to listen and understand.

-Frequency Scale

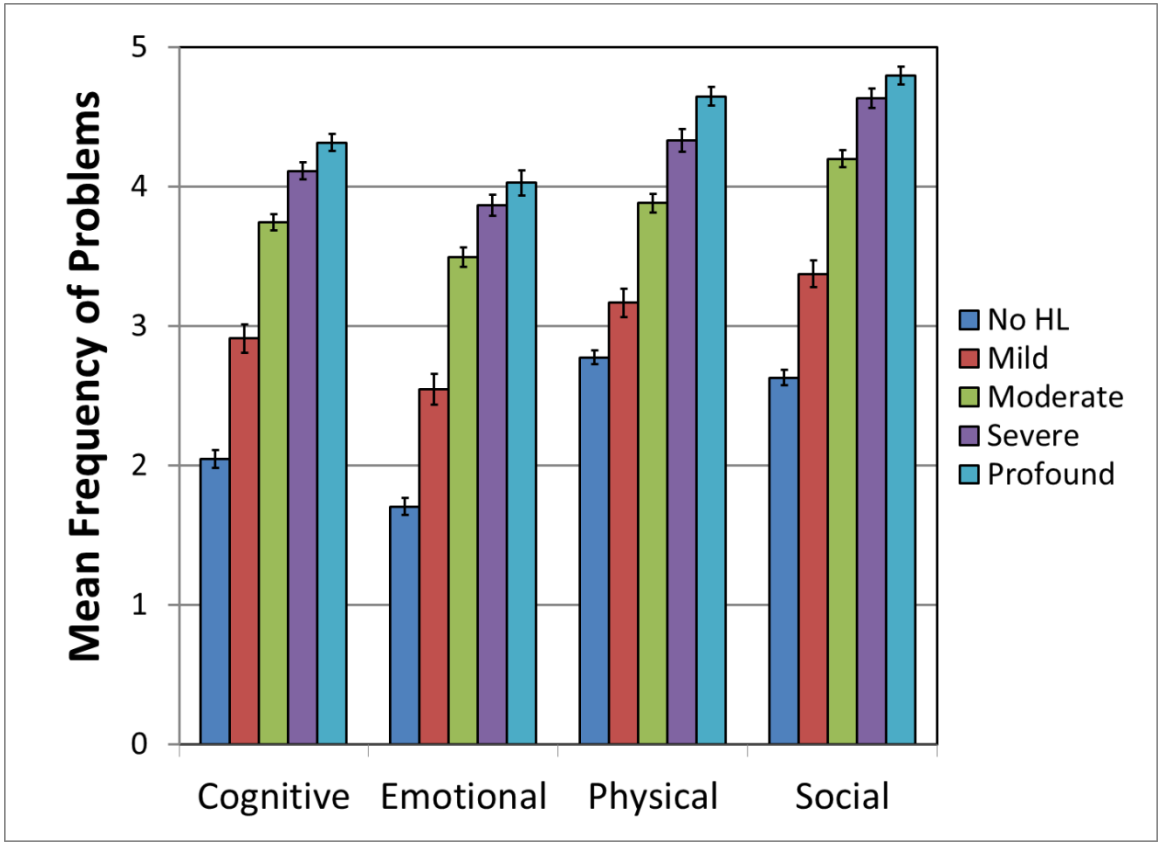
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
O	O	O	O	O

- Listening fatigue is a daily struggle.

-Agreement Scale

Phase 3: Pilot Testing- AHL

- Data collected via online and hard copy instruments from ~500 participants.
- Analyses are ongoing…
  - Initial work is promising
  - More later…



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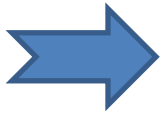
What about kids with hearing loss?

We know that kids are not little adults!

- Moderator: “So… 'fatigue', what do you think of when you hear that word?"

- Child: “I never heard that word, so, like, fatigue sounds like phantom, so maybe a squid?”


Take Home Points

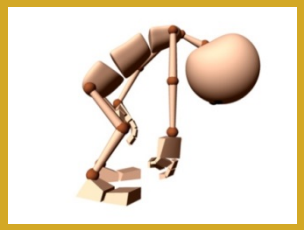
- School-age children with mild-moderately severe HL
  - Experience more fatigue, especially cognitive fatigue, compared to control groups
  - Their fatigue is comparable, or greater, than that reported by children with other chronic health conditions
- Higher fatigue ratings are
  - Are not modulated by degree of hearing loss
  - But are associated with poor language abilities (CELF scores), in both CHL and CNH

- A listening-related fatigue scale is under development!

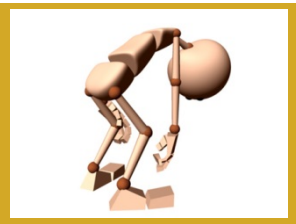
Implications for Practice

- Be on the lookout for fatigue!
- Help us educate the community & the students

For review see Bess, Gustafson & Hornsby, 2014. J Ed Audiol, 20, 1-14; and Bess & Hornsby, 2014. SIG 9 Perspectives on Hearing and Hearing Disorders in Childhood, 24(2), 25-39.



Thanks for Listening!



Visit the Listening and Learning Lab's website at **http://my.vanderbilt.edu/listeninglearninglab**

Initial Construct Map- AHL

Level	D1: Emotional (Internal states)	D2: Cognitive (attention)	D3: Social (external behaviors)	D4: Physical (sleep/rest)
3- Severe Fatigue				
2-Moderate Fatigue				
1-Mild Fatigue				

Initial Construct Map- AHL

Level	D1: Emotional (Internal states)	D2: Cognitive (Attention)	D3: Social (External behaviors)	D4: Physical (Sleep/Rest)
3- Severe Fatigue	Behaviors: Becomes **extremely sad, upset, angered, stressed** and/or **emotionally exhausted** by listening difficulties /fatigue. Situations: Across a **wide range** of easy-challenging listening situations	Behaviors: Becomes **unwilling /unable to maintain effort and attention** when completing even routine mental activities. Becomes very unfocused and/or consciously decides to disengage (e.g., **shuts down, gives up**). Situations: Across a **wide range** of easy-challenging listening situations	Behaviors: Social life is **severely impacted** by listening fatigue. **Exhibits avoidance** behaviors and **isolates** oneself from social gatherings to cope with listening fatigue. Situations: Across a **wide range** of easy-challenging listening situations.	Behaviors: Feels **exhausted, drained** and/or **worn out** from listening. Requires **naps, additional sleep, and/or silent time** to recover from listening fatigue. Regular breaks need to be scheduled into the day. Reports of **significant sleep problems**. Reports **significant headache problems**. Reports **need to remove** hearing device. Situations: Across a wide range of easy-challenging listening situations.
2-Moderate Fatigue	Behaviors: Becomes **stressed, sad, frustrated, upset** and/or **emotionally tired** by listening difficulties/fatigue. Situations: **Moderately-challenging** listening situations or worse	Behaviors: Must apply **substantial mental effort to overcome difficulties remaining attentive** when listening and following conversations. May **tune/zone out**. May need prompting. Situations: **Moderately-challenging** listening situations **or worse**	Behaviors: Social life is **moderately impacted** by listening fatigue. **May avoid and/or withdraw** from certain social gatherings. Situations: **Moderately-challenging** listening situations **or worse**	Behaviors: Feels **tired** after listening. **May** take listening **breaks** to recover. **May** get **headaches** from listening. **May** show **abnormal sleep habits/patterns**. **May turn down** hearing device. Situations: **Moderately-challenging** listening situations **or worse**
1-Mild Fatigue	Behaviors: Becomes **irritated, embarrassed or anxious** from listening difficulties/fatigue.	Behaviors: **Some difficulty** following fast-paced conversations and remaining attentive.	Behaviors: Social life is **mildly** impacted by listening fatigue. May avoid and/or withdraw from certain social gatherings.	Behaviors: May exhibit mild tiredness after listening. Would enjoy a **short rest or a listening break** (not a requirement).

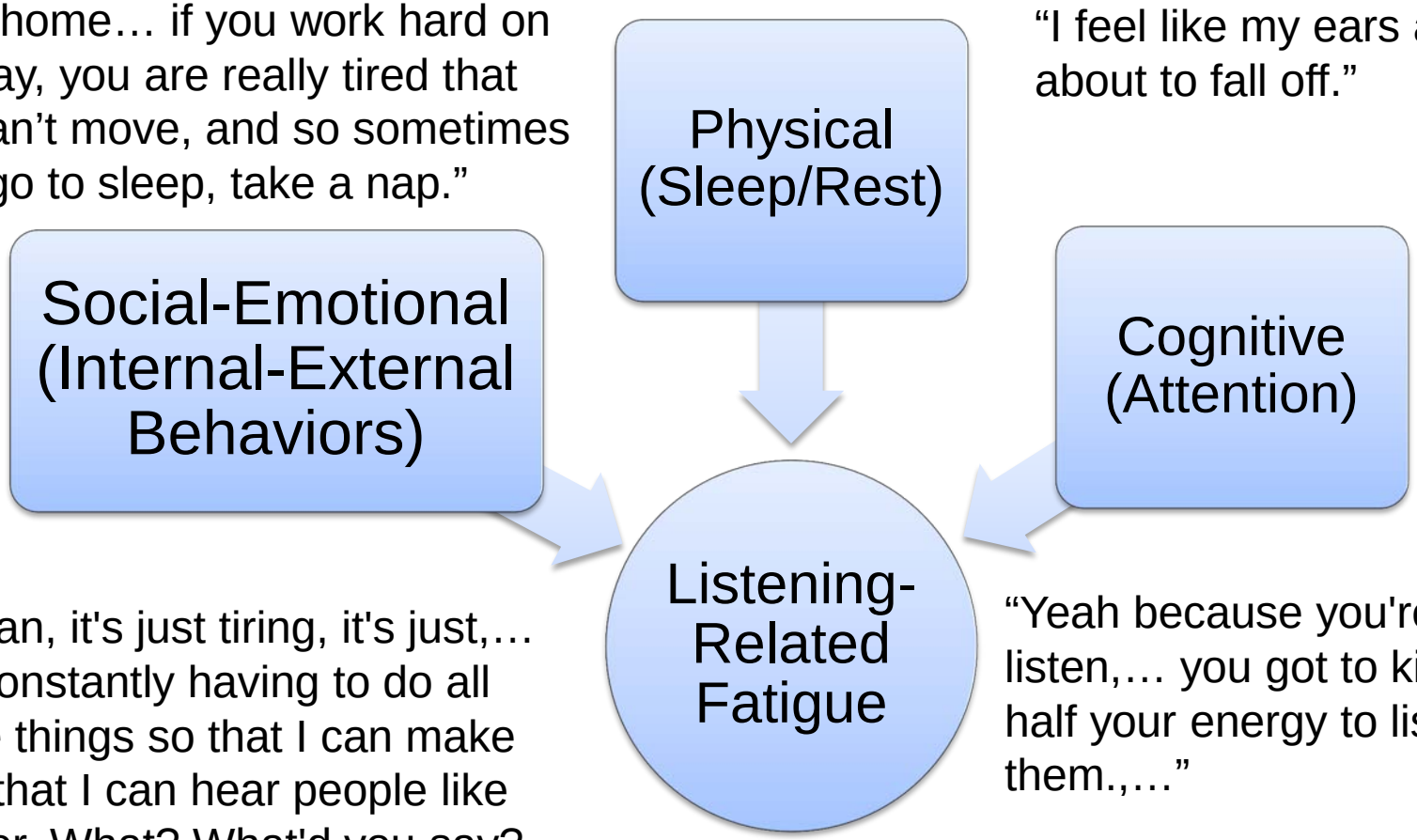
Initial Construct Map- AHL

Level	D1: Emotional (Internal states)	D2: Cognitive (Attention)	D3: Social (External behaviors)	D4: Physical (Sleep/Rest)
3- Severe Fatigue	Behaviors: Becomes **extremely sad, upset, angered, stressed** and/or **emotionally exhausted** by listening difficulties /fatigue. Situations: Across a **wide range** of easy-challenging listening situations	Behaviors: Becomes **unwilling /unable to maintain effort and attention** when completing even routine mental activities. Becomes very unfocused and/or consciously decides to disengage (e.g., **shuts down, gives up**). Situations: Across a **wide range** of easy-challenging listening situations	Behaviors: Social life is **severely impacted** by listening fatigue. **Exhibits avoidance** behaviors and **isolates** oneself from social gatherings to cope with listening fatigue. Situations: Across a **wide range** of easy-challenging listening situations.	Behaviors: Feels **exhausted, drained** and/or **worn out** from listening. Requires **naps, additional sleep, and/or silent time** to recover from listening fatigue. Regular breaks need to be scheduled into the day. Reports of **significant sleep problems**. Reports **significant headache problems**. Reports **need to remove** hearing device. Situations: Across a wide range of easy-challenging listening situations.
				easy-challenging listening situations.
2-Moderate Fatigue	Behaviors: Becomes **stressed, sad, frustrated, upset** and/or **emotionally tired** by listening difficulties/fatigue. Situations: **Moderately-challenging** listening situations or worse	Behaviors: Must apply **substantial mental effort to overcome difficulties remaining attentive** when listening and following conversations. May **tune/zone out**. May need prompting. Situations: **Moderately-challenging** listening situations **or worse**	Behaviors: Social life is **moderately impacted** by listening fatigue. **May avoid and/or withdraw** from certain social gatherings. Situations: **Moderately-challenging** listening situations **or worse**	Behaviors: Feels **tired** after listening. **May** take listening **breaks** to recover. **May** get **headaches** from listening. **May** show **abnormal sleep habits/patterns**. **May turn down** hearing device. Situations: **Moderately-challenging** listening situations **or worse**
1-Mild Fatigue	Behaviors: Becomes **irritated, embarrassed or anxious** from listening difficulties/fatigue.	Behaviors: **Some difficulty** following fast-paced conversations and remaining attentive.	Behaviors: Social life is **mildly** impacted by listening fatigue. May avoid and/or withdraw from certain social gatherings.	Behaviors: May exhibit mild tiredness after listening. Would enjoy a **short rest or a listening break** (not a requirement).

Phase 1: Defining the issues- CHL

"It's also frustrating well like when I come home… if you work hard on that day, you are really tired that you can't move, and so sometimes I just go to sleep, take a nap."

"I feel like my ears are about to fall off."



"I mean, it's just tiring, it's just,… like constantly having to do all these things so that I can make sure that I can hear people like this, or, What? What'd you say? Or having people get annoyed by it,…"

"Yeah because you're trying to listen,… you got to kind of use half your energy to listen to them.,…"

"It's like my brain's getting, um, very tired of hearing

Sample items from the VFS-CHL

- I use a lot of energy trying to understand what others are saying.
- I get annoyed when I have to listen in a noisy place.
- I get stressed when I have difficulty understanding others.
- I get sleepy after listening for a long time.
- I need a break after listening in a noisy place.