Subjective Fatigue in Children with Hearing Loss: 

*Is it a problem and how do you measure it?*

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Modern Developments in Audiology (MDA)

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What is fatigue?

• 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

“It is recommended that the term fatigue be absolutely banished from precise scientific discussion”.

----Muscio (1921)
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
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
A variety of approaches have been used:

**Subjectively**—
- Using questionnaires and survey instruments

**Behaviorally**— **and performance decrement**
- A decline in (cognitive) task performance due to sustained (mental) demands

**Physiologically**—
- Physiological changes or biomarkers associated with mental fatigue
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.......”.

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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

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

- 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?
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)

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

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

Alhanbali et al., 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]
  – What factors modulate fatigue in AHL?
    • Objective hearing difficulty? [No!]
    • Perceived hearing difficulties (HHIE/A)?
• Strong relationship between high levels of hearing handicap and subjective fatigue

• Fatigue increases with increases in hearing handicap

• Esp. for “significant” handicap scores (HHIE/A scores >42)
  • Limited association for lower handicap scores

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

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

“My brain needs a rest from listening.”
- Students 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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“What do the data say?

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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*

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

- 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

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

Mean data collapsed across parent/child reports

* p< 0.05
Only 2-9 point differences

Hornsby, et al., (in press)
Fatigue in CHL compared to children with other chronic health conditions

- CHL report similar, or more, fatigue 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

\[ r = -0.117 \]
\[ p = 0.382 \]

Hornsby, et al., (in press)
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).

- Similar association between CELF and cognitive fatigue seen in CNH ($r=0.36$, $p=0.02$).

Hornsby, et al., (in press)

Similar results seen for
- CELF and overall fatigue
- PPVT and cognitive fatigue

Better Language Ability
- Similar association b/w CELF and Cognitive Fatigue seen in CNH ($r=0.36$, $p=0.02$)
Can a parents report be used as a proxy for child ratings?

No... 😞
Effect of Parent/Child report

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*
Developing a Listening-Related Fatigue Scale

The Vanderbilt Fatigue Scale (VFS)
For adults: VFS-AHL
For children: VFS-CHL
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
Fatigue Scale Development Process

• Phase 1: Defining the issues
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• Phase 3: Initial Psychometric Evaluation
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,...”

“Listening-Related Fatigue”

- Social (External Behaviors)
- Physical (Sleep/Rest)
- Emotional (Internal States)
- Cognitive (Attention)

“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

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

- Listening fatigue is a daily struggle.

-Frequency Scale

-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...

![Graph showing mean frequency of problems across different categories: Cognitive, Emotional, Physical, Social. The categories are further subcategorized into No HL, Mild, Moderate, Severe, Profound.]
Vanderbilt Bill Wilkerson Center

What about kids with hearing loss?

NOT SURE IF I SHOULD TAKE A NAP

OR CRY ABOUT BEING TIRED
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

Thanks for Listening!

Visit the Listening and Learning Lab’s website at http://my.vanderbilt.edu/listeninglearninglab
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<td>Behaviors: Social life is severely impacted by listening fatigue. Exhibits avoidance behaviors and isolates oneself from social gatherings to cope with listening fatigue.</td>
<td>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.</td>
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<td>Behaviors: Social life is moderately impacted by listening fatigue. May avoid and/or withdraw from certain social gatherings.</td>
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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 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,..”

“I feel like my ears are about to fall off.”

“It’s like my brain’s getting, um, very tired of hearing this…”

Social-Emotional (Internal-External Behaviors)

Physical (Sleep/Rest)

Cognitive (Attention)

Listening-Related Fatigue
### Sample items from the VFS-CHL

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<th>Never</th>
<th>Rarely</th>
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- 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.