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Hearing, cognition, and healthy aging: Social and public health implications of the links between age-related declines in hearing and cognition

Kathy Pichora-Fuller, PhD
Department of Psychology

Based on:

Learning Outcomes

As a result of this course, you will be able to:

- Describe the association between age-related hearing loss and other age-related health issues.
- Explain how social psychological factors may be a basis for the associations between age-related hearing loss and cognitive decline.
- Explain how social factors influence and are influenced by age-related hearing loss to guide new approaches to audiologic practice.
Outline

1. Health and aging across the lifespan
2. Auditory-cognitive-social links
3. AR to promote healthy aging

Aging Population & Hearing Loss
(based on Statistics Canada data)
Health is a complete state of well-being:
- Physical well being
- Mental well being
- Social well being

Health is **NOT** merely the absence of disease or infirmity.

State of optimum health is called “wellness”

**World Health Organization (WHO)**
**Definition of Health (1948)**

**Issues in Adult Development and Aging**

*Figure 1.6* Each person is the product of the interaction of biological, psychological, sociocultural, and life-cycle forces.
Health is...

“...the capacity of people to adapt to, respond to, or control life’s challenges and changes.”

(Frankish et al., 1997)
**A Model of Disability in Later Life**

- **Disability:**
  - Effects of chronic conditions on people’s *ability to engage in activities that are necessary, expected, and personally desired in their society.*

- **ENABLEMENT**
- **PATIENT-CENTRED CARE**

---

**Competence and Environmental Press**

- **Competence** is the theoretical upper limit of a person’s capacity to function
  - biological health
  - sensory-perceptual functioning
  - motor skills
  - cognitive skills
  - personality

- **Environments** can be classified on the basis of the varying demands they place on the person, a notion called “environmental press”
  - physical, social

- Competence x environmental press ~ (mal)adaptive behavior and affect
- Adaptation level: balance competence & press
A Framework for Maintaining and Enhancing Competence (Pp. 168 – 170)

- How to optimize the overall sense of competence
  - Apply three key adaptive mechanisms for aging
    - **Selection**
      - Select subset of options to focus resources on
    - **Optimization**
      - Find best way to achieve goal (e.g., improve by practice)
    - **Compensation**
      - Use alternative route to find solution
  - The SOC model
    - [http://www.margret-baltes-stiftung.de/PBB-Website/SOC.html](http://www.margret-baltes-stiftung.de/PBB-Website/SOC.html)

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Do Older Adults Have Social Lifestyles That Place Fewer Demands on Hearing?

*J Am Acad Audiol 23:97-111 (2012)*

Yu-Hsiang Wu*
Ruth A. Bentler*

N = 27

"The data are consistent with the hypothesis that older adults have less active social lifestyles that place fewer demands on hearing”

“Social lifestyle, rather than age, is likely a better predictor of listening demand”
Perspective of an Older Adult who Lives with Hearing Loss

“When you are hard of hearing you struggle to hear; When you struggle to hear you get tired; When you get tired you get frustrated; When you get frustrated you get bored; When you get bored you quit.

-- I didn’t quit today.”

Avoid by withdrawal from social interaction!

Social Costs associated with Impaired Hearing

“Hearing aids are surgical appliances, but they generally have not yet been accorded a footing equal to that of trusses, artificial limbs, or spectacles. The deaf have gathered for themselves misleading, exaggerated information from newspaper advertisements, and the choice of instrument has been unusually haphazard.” (Page 244-245, 1939)

Describes that hearing aids can help to prevent hearing impaired individuals from social isolation.
Health states associated with being isolated:

1. Cognitive impairment
2. Depression
3. Cardiovascular disease
4. Physical decline
5. Early mortality


All cause mortality ~ Sensory impairment

Kaplan Meier plots for all-cause mortality rates by type of sensory impairment adjusted for relevant confounders

Males
Females

N=4926 Icelandic individuals aged 67+

Fisher et al Age Ageing 2013
Feeny et al J Clin Epidemiol 2012
Hearing loss is a risk factor for having **automobile accidents** in a large cohort of male workers in Quebec.

<table>
<thead>
<tr>
<th>Hearing status</th>
<th># who had at least 1 accident</th>
<th>Prevalence ratio (age-adjusted)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>7473</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Just noticeable HL</td>
<td>1966</td>
<td>1.06</td>
<td>1.01, 1.11</td>
</tr>
<tr>
<td>Mild HL</td>
<td>777</td>
<td>1.13</td>
<td>1.05, 1.21</td>
</tr>
<tr>
<td>Moderate HL</td>
<td>559</td>
<td>1.18</td>
<td>1.08, 1.27</td>
</tr>
<tr>
<td>Severe HL</td>
<td>622</td>
<td>1.31</td>
<td>1.20, 1.42</td>
</tr>
<tr>
<td>Total</td>
<td>11397</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Attributable risk of traffic accident to HL = 5.6%

N=46030 male workers

Clear dose-response

The impact of hearing loss on the driving performance of 107 seniors with normal visual acuity and cognitive function tested on a closed road circuit.

<table>
<thead>
<tr>
<th>Type of distraction</th>
<th>Mean driving score</th>
<th># signs correctly recognized</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Normal/mild HL</td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>Moderate/severe HL</td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Hickson et al, JAGS 2010
Hearing loss

- Increased perceptual effort drains cognitive resources available for other purposes

Ears - "Listening" - Life

- Hearing
- Mobility
- Vision
- Cognition
- Converse
- Remember to tell news
- Cross a street

Driving?
Falls?
When Does Cognitive Aging Start?

Estimates of age-specific prevalences of Alzheimer’s disease (AD), Mild Cognitive Impairment (MCI), and Non-Affected (NAs), aged 60–85, assuming 1.0% rate for conversion from NA to MCI at age 60.

**Hearing loss and cognitive decline**
Health ABC cohort (Lin et al., JAMA Intern. Med. 2013)

*Note: very similar results for the digit-symbol substitution test*

**Hearing loss and Incident Dementia**
Baltimore Longitudinal Study of Aging cohort (Lin et al., Arch Neurol, 2011)

<table>
<thead>
<tr>
<th>HL severity</th>
<th>HR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mild</td>
<td>1.89 (1.00-3.58)</td>
</tr>
<tr>
<td>moderate</td>
<td>3.00 (1.43-6.00)</td>
</tr>
<tr>
<td>severe or more</td>
<td>4.94 (1.09-22.4)</td>
</tr>
</tbody>
</table>

Cox proportional hazards model adjusted for age, sex, race, education, diabetes, smoking and HTN. Hazard ratios relative to normal hearing.
Interactive Effects of Physical Activity and Diet

Scarmeas et al. (2009) JAMA, 302, 627-637.
Cognitive Benefits of Better Hearing

- Slower cognitive decline in Alzheimer’s cases with better hearing (Peters, Potter, & Scholer, 1988; Wahl & Heyl, 2003)
- Reduced rate of decline in scores on a cognitive screening test over a six-month period following intervention with hearing aids (Allen et al., 2003)
- Hearing aid use reduced problem behaviors judged by caregivers of adults with dementia (Palmer et al., 1998)
- Older adults using hearing aids have better emotional and social well-being and greater longevity (Appolonio et al., 1996; Cacciato et al., 1999; Naramura et al., 1999; Seniors Research Group, 1999)

Cognitive Hypotheses & Training

- Cognitive Compensation Hypothesis (Li, Krampe, & Bondar, 2005; Li & Lindenberger, 2002)
  - declining sensory (and motor) functions are compensated by higher-level cognitive and attentional processes

- CRUNCH - Compensation-Related Utilization of Neural Circuits Hypothesis (Reuter-Lorenz & Cappell, 2008)
  - additional brain regions are recruited by older adults when capacity limits are reached in a given task or combined tasks.

- STAC - Scaffolding Theory of Aging and Cognition (Park & Reuter-Lorenz, 2009)
  - there is the potential to enhance such compensation by training.
Mild Cognitive Impairment
(e.g., Troyer & Murphy, 2007)

- Active lifestyle ~ risk of future dementia
  - **Cognitive** engagement
    - Tasks involving problem-solving, decision-making, learning, remembering new information
  - **Social** interaction
    - Rich social stimulation and active social network
    - Participating in group activities and interactions
  - **Physical** activity
    - Some activities are done in groups, with music

- Enriched environments
- Group interventions
- Communication-related disorders???
Outline

1. Health and aging across the lifespan
2. Auditory-cognitive-social links
3. AR to promote healthy aging

Sensory-Cognitive-Social Trio

1. Quality of auditory input affects memory
   (e.g., Rabbit, 1968; 1990; Pichora-Fuller et al., 1995; Wingfield, 1996)

2. Hearing loss reduces communication functioning, increasing risk for social isolation
   (e.g., Appollonio et al., 1996; Bess et al., 1989; Crews & Campbell, 2004; Keller et al., 1999;
   Laforge et al., 1992; Murov et al., 1990a, 1990b; Rudberg et al., 1993; Reuben et al., 1999;
   Sindhusake et al., 2001; Weinstein & Ventry, 1982)

3. Engagement in leisure activities is related to cognition and health
   (e.g., Bassuk et al, 1999; Fabrigoule et al., 1995; Fratiglioni et al., 2000; Hultsch et al., 1993;
   Mousavi-Nasab, 2012; Strawbridge et al., 1998; Wang et al. 2002)


Hypotheses
(Danielsson, Dupuis, Pichora-Fuller, in prep)

1. Social withdrawal mediates the association between hearing loss and cognitive decline

2. Cognitive functioning mediates the association between hearing loss and social withdrawal

3. Social withdrawal can be caused by hearing loss and/or cognitive decline (all effects of aging)
## Participants

<table>
<thead>
<tr>
<th></th>
<th>Betula, Sweden</th>
<th>Stigma, Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>297</td>
<td>273</td>
</tr>
<tr>
<td>Age (years)</td>
<td>M = 67 (35-90)</td>
<td>M = 71 (56-96)</td>
</tr>
<tr>
<td>Education</td>
<td>M = 14 YoE (36% &gt; secondary)</td>
<td>M = 16 YoE (81% &gt; secondary)</td>
</tr>
<tr>
<td>Employed</td>
<td>62%</td>
<td>76%</td>
</tr>
<tr>
<td>Female</td>
<td>45%</td>
<td>64%</td>
</tr>
<tr>
<td>Married</td>
<td>73%</td>
<td>54%</td>
</tr>
<tr>
<td>Good General Health</td>
<td>84%</td>
<td>82%</td>
</tr>
</tbody>
</table>

### Hearing Variables Used in Models

- Pure-tone thresholds (worse ear; 3, 4, 6, 8 kHz)

![Graph showing pure-tone thresholds (worse ear; 3, 4, 6, 8 kHz)](chart)
### Leisure Activities

<table>
<thead>
<tr>
<th>Betula, Sweden</th>
<th>Stigma, Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;How many times have you done _____ in the last 3 months?&quot; (16)</td>
<td>&quot;In the past year did you _____?&quot; (13)</td>
</tr>
<tr>
<td>Mean for 4 activities = 8.17 +/- 2.2</td>
<td>Mean for 4 activities = 2.93/4 +/- 1.16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>travel</td>
<td>go to a restaurant</td>
</tr>
<tr>
<td>visit family/friends</td>
<td>go to a movie</td>
</tr>
<tr>
<td>go to a movie, concert, theatre</td>
<td>go to a concert/theatre/dance</td>
</tr>
<tr>
<td>play a musical instrument</td>
<td>go to a cultural/arts festival</td>
</tr>
<tr>
<td>read a newspaper… magazine… book</td>
<td>go to a museum/art gallery</td>
</tr>
<tr>
<td>handicrafts… hunting… hobbies</td>
<td>use library services</td>
</tr>
<tr>
<td>write poetry/prose… photography….act</td>
<td>watch TV/listen to radio</td>
</tr>
<tr>
<td>attend committee meetings</td>
<td>attend a religious service</td>
</tr>
<tr>
<td>visit family/friends</td>
<td>exercise</td>
</tr>
</tbody>
</table>

#### Umeå Social

- Age
  - Hearing Loss
  - Memory
  - Social Leisure

#### Toronto Social

- Age
  - Hearing Loss
  - Memory
  - Social Leisure
Early vs Later Presbycusis

- Associations between hearing loss and cognition and social interaction would likely be stronger for those with greater impairment.

- Nevertheless, even in early presbycusis, associations are already apparent.
The 60-69 year olds with unacknowledged or unaddressed hearing loss had significantly increased risk of prevalent social isolation and lower cognitive scores.

Outline

1. Health and aging across the lifespan
2. Auditory-cognitive-social links
3. AR to promote healthy aging
AR: Aging and Social Factors

- Social Support
- Stress
- Ageism and stereotype threat
- Self-efficacy

Effort and fatigue
- Stress and anxiety
- Social life restrictions
- Impact on intimate communication
Bi-directional Effects?

- hearing problems may exacerbate communication problems accelerating cognitive and psychosocial declines in older adults

- age-related social factors may exacerbate poor perceptual and cognitive performance
Social Relationships and Health

JAMES S. HOUSE, KARL R. LANDIS, DEBRA UMBERSON

Recent scientific work has established both a theoretical basis and strong empirical evidence for a causal impact of social relationships on health. Prospective studies, which control for baseline health status, consistently show increased risk of death among persons with a low quantity and sometimes low quality of social relationships. Experimental and quasi-experimental studies of humans and animals also suggest that social isolation is a major risk factor for mortality from widely varying causes. The mechanisms through which social relationships affect health and the factors that promote or inhibit the development and maintenance of social relationships remain to be explored.

has, however, been less clear. Does a lack of social relationships cause people to become ill or die? Or are unhealthy people less likely to establish and maintain social relationships? Or is there some other factor, such as a misanthropic personality, which predisposes people both to have a lower quantity or quality of social relationships and to become ill or die?

Such questions have been largely unanswered before the last decade for two reasons. First, there was little theoretical basis for causal exploration. Durkheim [1] proposed a theory of how social relationships affected suicide, but this theory did not generalize to morbidity and mortality from other causes. Second, evidence of the association between social relationships and health, especially in general human populations, was almost entirely retrospective or cross-sectional before the late 1970s. Retrospective studies from death certificates or hospital records ascertained the nature of a...
Social Support

**Definition:** The perception and actuality that one is cared for, has assistance available from other people, and that one is part of a supportive social network.

Typically categorized into 4 kinds of acts:
- **Emotional** support (empathy, love, trust)
- **Instrumental** support (tangible aid, money, service)
- **Informational** support (advice, suggestions, information)
- **Appraisal** support (constructive feedback, affirmation)

**Social Support and Hearing Aid Satisfaction**


Research questions:
1. Is there a significant correlation b/t social support and hearing aid satisfaction?
2. How does social support compare with other known correlates of hearing aid satisfaction?

Methods: Distributed questionnaires to users of hearing instruments
- Study 1: 173 adults (mean age = 68.9 years, SD = 13.4)
- Study 2: 169 adults (mean age = 32.0 years, SD = 13.1)
Questionnaires/Measures

- Satisfaction with Amplification in Daily Life (SADL)
- Hearing aid benefit (APHAB)
- Hearing Handicap Inventory for Adults (HHIA)
- Health Related Quality of Life (HRQoL)

- Experience with hearing aids
- Daily hearing aid usage

- Personality: the Big 5 Inventory

- Perceived Social Support (FSSQ)

Duke-UNC Functional Social Support Questionnaire (FSSQ)

Here is a list of some things that other people do for us or give us that may be helpful or supportive. Please read each statement carefully and place an X in the column that is closest to your situation. Give only 1 answer per row.

<table>
<thead>
<tr>
<th>1. I have people who care what happens to me.</th>
<th>2. I get love and affection.</th>
<th>3. I get chances to talk to someone about problems at work or with my household.</th>
<th>4. I get chances to talk to someone I trust about my personal or family problems.</th>
<th>5. I get chances to talk about money matters.</th>
<th>6. I get invitations to go out and do things with other people.</th>
<th>7. I get useful advice about important things in life.</th>
<th>8. I get help when I am sick in bed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much less than I would like</td>
<td>Less than I would like</td>
<td>Some but not as much as I would like</td>
<td>Almost as much as I would like</td>
<td>As much as I would like</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Perceived social support is the strongest correlate of hearing aid satisfaction in both studies!

\[ R = 0.34, \ p < 0.01 \]
\[ R = 0.48, \ p < 0.01 \]

**Summary: Social Support in Audiology**

Significant others can potentially:

- Encourage help seeking
- Advocate for (or against) the adoption of hearing aids
- Assist with the care and operation of hearing aids
- Boost/reinforce motivation during rehab
- Facilitate communication
- Increase treatment adherence
- Reduce hearing handicap by participating in AR classes
- Decrease hearing-related psychological distress
- Foster hearing aid satisfaction
Coping with STRESS

- People respond differently to stress
  - imbalance in person-environment fit

- The impact of any potentially stress event is greatly influenced by how a person appraises it (Lazarus & Folkman, 1984)
  - **Primary Appraisal**: Is the event harmful, threatening, or challenging?
  - **Secondary Appraisal**: What are my coping resources? Are they adequate?
  - **Reappraisal** – changes in the situation may change the appraisal

- Coping is the process of trying to manage demands that are appraised as taxing or exceeding one’s resources

- As vulnerability (lack of coping) increases, it takes less stress to → trigger illness

---

**Life Cycle Model of Stress**

- **Prenatal stress**
- **Postnatal stress**
- **Stress in adolescence**
- **Stress in adulthood**
- **Stress in aging**

- **Amygdala**
- **Frontal cortex**
- **Hippocampus**

---

**Figure 2** | The life cycle model of stress. How the effects of chronic or repeated exposure to stress (or a single exposure to severe stress) at different stages in life depend on the brain areas that are developing or declining at the time of the exposure. Stress in the prenatal period affects the development of many of the brain regions that are involved in regulating the hypothalamus-pituitary-adrenal (HPA) axis — that is, the hippocampus, the frontal cortex and the amygdala (programming effects). In adulthood and during aging the brain regions that undergo the most rapid decline as a result of aging (red bars) are highly vulnerable to the effects of stress hormones. Stress during these periods can lead to the manifestation of incubated effects of early adversity on the brain (manifestation effects) or to maintenance of chronic effects of stress (maintenance effects). PTSD, post-traumatic stress disorder.
Stereotype Threat

- Risk of confirming a negative stereotype of a group with which one identifies
  - Self or other stereotype
  - Reduced walking speed
  - Working memory
  - Hearing thresholds

Negative Views of Aging, Self-perceptions and Memory and Hearing Performance
Chasteen, Pichora-Fuller, Dupuis, Singh, & Smith, *Psychology & Aging*, 2015
Attitudes, Stereotypes, and Ageism

- Attitudes in general population are more negative re: older than younger adults
- Negative stereotypes are destructive for longevity and self-perception

BUT

- Elderly, 50+ years, with positive self-perception live 7.5 years longer
- Positive attitudes correlated with less frailty
- Self-efficacy facilitates coping

Self-Efficacy Theory

- Self-Efficacy
  - Belief individuals have in their abilities to accomplish skills to achieve a certain behavior, including health behaviors (Bandura, 1989, 1997)

- Patients with high self-efficacy beliefs for skills needed to manage a health condition:
  - Increased compliance with treatment/management recommendations
  - Improved subjective and objective outcomes
  - Higher health-related quality of life
  - Persevere in face of difficulty
  - Put forth greater effort in managing condition
Self-efficacy in ARHL


Health Promotion

- "… is the process of enabling people to increase control over & to improve their health." (WHO, 1986 – Canadian Charter on Health Promotion)

- "… is any combination of educational, organizational, economic & environmental supports for actions conducive to health." (Green & Kreuter, 1991)

- …. programs enhance the “FIT” between people & their surroundings (Stokols, 1996)
Overview of Self Management Approach

Self Management
A person’s active participation in achieving *their own* best health and wellness through gaining confidence, knowledge, and skills to manage physical, social and emotional aspects of life

Self Management Support
The range of *organizational, community and provider* strategies to support the active participation of individuals in achieving their best health and wellness

Good Hearing Health Could Contribute to Healthy Aging

**STAY ACTIVE**

**PRESERVE**
communication and social interaction
- slow cognitive decline
- reduce risk for adverse events
- improve benefit from health care

Promote Healthy Lifestyles
Vancouver, British Columbia
World Congress of Audiology
September 18-22, 2016
http://www.wca2016.ca/