Revisiting Alzheimer’s and Audiological Management, and Mini-Update

John D. Durrant, PhD, CCC-A, FASHA
A momentary diversion (yet aging-related):

Symposium on Electrocochleography, June 12-14, 1974, Albert Einstein College of Medicine, Yonkers, NY.

Were YOU there???
AD patients are much like other patients of similar age.

**Hearing disorder management in Alzheimer’s disease patients**

JOHN D. DURRANT, PHD, KATHLEEN J. GILMARTIN, MA, AUDREY HOLLAND, PHD, DONALD B. KAMERER, MD, AND PHILIP NEWALL, MS

Research on the status of the auditory system of patients with Alzheimer’s disease (AD) has failed to reveal abnormalities of the peripheral, sub-cortical or primary cortical pathways specific to the disease, although hearing impairment is prevalent among AD patients.
Analysis of Counted Behaviors in a Single-Subject Design: Modeling of Hearing-Aid Intervention in Hearing-Impaired Patients with Alzheimer’s Disease

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with
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Familiar “image” of aging and hearing: Signif. impact on comm. + Psychosocial impact.

Furthermore, diseases such as Alzheimer’s or other dementia may carry their own risks of difficulty with central processing.

Bottom Line: losing auditory AND memory function is worse than losing either alone. We submit, and the overall motivation for our work is, that this “double whammy” goes largely untreated/unmanaged in geriatric health care.
Does this mean, however, that somehow patients such as those with Alzheimers are necessarily less “aidable”?

- **Considerations?**
  1. Aid less beneficial, a priori?
  2. Patients more difficult to test/manage?
  3. Basic hearing performance different?

- We do not have the clinical bases yet to adequately evaluate point #1. (The reason for this will become evident.) But, even if this is the case, is this an excuse not to aid?

- We previously evaluated #2 & 3. Summary to follow:
<table>
<thead>
<tr>
<th>Group</th>
<th>SRT (dB)</th>
<th>Speech Recognition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RE</td>
<td>LE</td>
</tr>
<tr>
<td>Az D:</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Control:</td>
<td>31</td>
<td>29</td>
</tr>
</tbody>
</table>

**Hearing Aid User?** \{n\}

<table>
<thead>
<tr>
<th>Group</th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Az D:</td>
<td>9</td>
<td>1*</td>
</tr>
<tr>
<td>Control:</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

Adapted from Durrant et al., Hearing disorder management in Alzheimer's disease patients, Hear. Inst. 42(1), 1991:

*Control and Az D groups age matched to within ±5 years and hearing-loss matched to within 10 dB.*
Modeling behavior: Study of HA intervention in AD

- Clinical procedures related to patients with Alzheimer’s Disease (AD) largely fail to address the patient’s hearing.
- Given the challenges of this population, unconventional indicators of treatment efficacy may be required.
- Palmer et al (1999) reported on caregiver-tracked behaviors as outcome measures for hearing aid (HA) treatment (intervention).
- Real data from reports of the patient’s significant other, however, are quite noisy.
- We thus sought to model the patient’s behavior, namely as a first-order dynamic system, characterized by responses following an exponential time course.
Modeling behavior: Study of HA intervention in AD

Real data, about 40 days before and following intervention.
AAS 2002

Hours HA Use per Day vs Days

- Days: 0 to 80
- Hours HA Use per Day: 0 to 18

- Target range indicated

Graph showing the hours of HA use per day over days.
"Exponential" Schedule (with best-fit exponential model)

Start HA Use (day 1)

Day

Prescribed Hours of HA Use
Aim--Model behavior as impulse response of behavior systems, i.e. hearing aid [HA] use and “negative” AD behaviors (e.g. television too loud, negativistic responses, etc.):

Assumption 1: HA use follows an asymptotic growth characteristic; therefore, these data were fit using the equation

$$\text{hours use} = u(1-e^{-v\cdot\text{days}})$$  \hspace{1cm} (Eq. 1)

where $u$ and $v$ are scaling constants estimated via curve fitting.

Assumption 2: the count in “negative” behaviors is inherently adaptive, and thus also asymptotic, such that

$$\text{events} = a\cdot e^{-b\cdot\text{days}} - c$$  \hspace{1cm} (Eq. 2)

where $a$, $b$ & $c$ are constants (scaling factors) estimated via the curve-fitting algorithm.
a. Days
Events per Day
0 2 4 6 8 10

b. Days
Events per Day
0 2 4 6 8 10

C. Hours HA Use per Day
Events per Day
0 2 4 6 8 10 12

*HA Use (relative)
Modeling behavior: Study of HA intervention in AD:
Fitted data from a group of subjects providing data on the same behavior and similar patterns of initial HA use, but different outcomes
All but S#7 considered to have gained significant HA benefit; S#8’s results are unusual, but suggest net benefit of intervention. Best fit curves provide potentially useful quantification, such as time-constant of intervention.
Modeling behavior: Study of HA intervention in AD

- The results of such modeling suggest predictable outcomes of hearing aid intervention...
- … or at least useful parameters of quantification (e.g. time-constant).
- Approach permitting critical assessment of effects of intervention from observations made by the patients significant other.
- Use in this and other difficult-to-test populations warrant further study.
Modeling behavior: Study of HA intervention in AD

**EPILOGUE – Why the proverbial slow-boat to China?**

- Most recent work in the literature (not much!):
Authors of this review submit, in effect, that:
- there are precious few papers out there on-point (indeed)...
- but with several other related articles (per effects of dementia general and others)...
- clearly establish the combined issues of general neglect of Alz patients for their hearing health care...
- and the critical need for special attention to them.
EPILOGUE – Why the proverbial slow-boat to China?

- The most recent article of general relevance is that cited below: Lin and colleagues reported results obtained apropos numerous health care services, suggesting a clear link between deafness and dementia, even if its exact nature remains to be determined.

Modeling behavior: Study of HA intervention in AD

EPILOGUE—Possible/Likely(???) Causes of slow-boat...

- Funding issues
- Persistent limitations on the side of health care workers
- Attitudes of significant others of Alz patients
- Too much to bear more care-giving
- Mistrust of health care givers’ financial motives
- Misunderstanding of nature of what “mom” did with her hearing aid when she forgot… (not “stupid tricks”)
- OVERALL FAILING of Health Care—not getting out the message or even acknowledging—unaided hearing loss DOES exacerbate symptoms of Alz/dementia, if not to the point of biasing presumed level of dementia.
La vie est belle...