Communication Assistive Technology for Elderly People with Hearing, Speech or Memory Loss

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A Family Reunion Dinner Outing
&
My mother and my father

Old parents

Me

Me: We are going to have a family get-together over lunch.

Mom: Where are we going?

Me: We are going to the same Chinese restaurant we went last time for a family get-together.

My mother and loss of hearing

… a little later

Mom: Where are we going?

Me: We are going to the same Chinese dim sum place we went last time.

… in the car on the way to the restaurant

Mom: Where are we going?

Me: We are going to the same Chinese restaurant.
Uh… are you wearing your hearing aid?

Mom: (does not have it on) Hmm… Yes… Ah, here I have it.

My father and memory loss

In the car, close to the restaurant.

Mom: (to Dad) If Steve (my nephew) comes and bows, please say ‘hi to him. Last time we met, you did not even say a word to him.

Dad: ok

At the restaurant, Steve comes and says ‘hi.

Steve – now

… a little later

Dad: Who is he?

Mom: He is Steve, your second daughter’s only son.

Dad: Did she have a son?

Mom: Yes, of course. He used to be cute when he was small, but not any more…

My mother and unclear speech

grandson

At the restaurant

… a whisper a little later

Grandson: What has grandma just said? Did she just talk about Steve? She murmurs and I can't really figure out what she's saying.

Me: Mom, are you wearing your denture?

…

Helping Other People Easily

My mother and loss of hearing

… a little later

Mom: Where are we going

Me: We are going to the sa

… in the car on the wa

Mom: Where are we going

Me: We are going to the sa… Chinese restaurant.
Uh… are you wearing your hearing aid?

Speech → Visual Image

Mom: (does not have it on) Hmm… Yes… Ah, here I have it.

What my parents would like to see

Me: We are going to have a family get-together over lunch

Mom: Where are we going?

Me: We are going to the same Chinese restaurant we went last time

… a little later

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Speech → Visual Image

…

My mother and loss of hearing

Speech → Visual Image

Complementary!

My father and memory loss

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Mom: (to Dad) If Steve (my nephew) comes and bows, please say 'hi to him. Last time we met, you did not even say a word to him.

Dad: ok

At the restaurant, Steve comes and says 'hi. Steve – now

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Mom: He is Steve, your second daughter's only

Dad: Did she have a son?

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Visual Image → memory

My mother and unclear speech

grandson

At the restaurant

… a whisper a little later

Grandson: What has grandma just said? Did she just talk about Steve? She murmurs and I can't really figure out what she's saying.

Me: Mom, are you wearing your denture?

…

Visual Image → speech

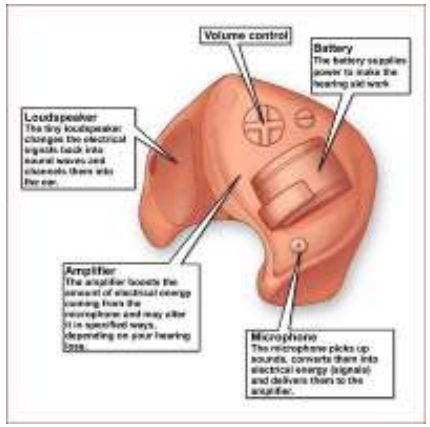
General Needs –
Why Assistive Communication Technology?

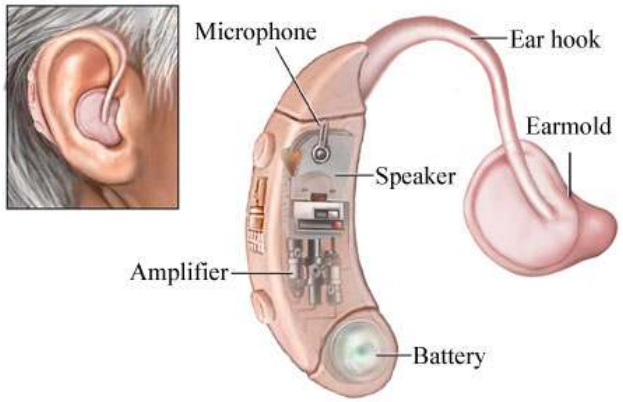
- **Reduced hearing is common-and the provision of hearing aids inadequate-among elderly people** in the UK [Science Blog, April 2002]
- around 14,900 were given a whispered voice test to assess hearing performance.
- 2537 (8%) of the participants reported a lot of difficulty hearing and 13 630 (42%) a little or a lot of difficulty. Around a quarter of participants given the whispered voice test failed the test (3795 [26%]), the proportion increasing sharply with age. Nearly half the participants who wore a hearing aid at the time of testing failed the whispered voice test (998 of 2180 [46%]). More than half the people who failed the test did not own a hearing aid. 2200 (only 60%) of 3846 people who owned a hearing aid said they used it regularly.
- **Hearing loss in elderly people is important because it is disabling and potentially treatable.**
- Most research on treatment for hearing impairment has focused on medical and surgical treatments rather than rehabilitative approaches. Yet the latter are generally more effective for the types of hearing impairment common among elderly people. **Rehabilitative approaches** such as the use of hearing aids, assistive listening devices, and aural rehabilitation services **can improve a person's ability to communicate** even when the underlying cause of the hearing impairment cannot be cured,… [Hard of hearing advocates, “Hearing Impairment and Elderly People”]

“When someone in the family has a hearing loss,
the entire family has a hearing problem” [Mark Ross, a famous audiologist]

Current State of Technology - Hearing Aids

- Conventional – analog/linear hearing aid (~$500)
- Programmable – better sound quality
- Fully digital – background noise elimination, directional microphones, feedback management





- **Issues:**
  - One-at-a-time
  - Concept development
  - Concept-to-concept navigation & switching
  - Uncommon device

Current State of Technology - Speaking Aids

- Character (typed/symbol) → Sound
- Word board: Word (typed/symbol) → Sound
- Sentence (typed/symbol) → Sound (word-by-word)
- Artificial Larynx: Signal (electronic/pneumatic) → Sound

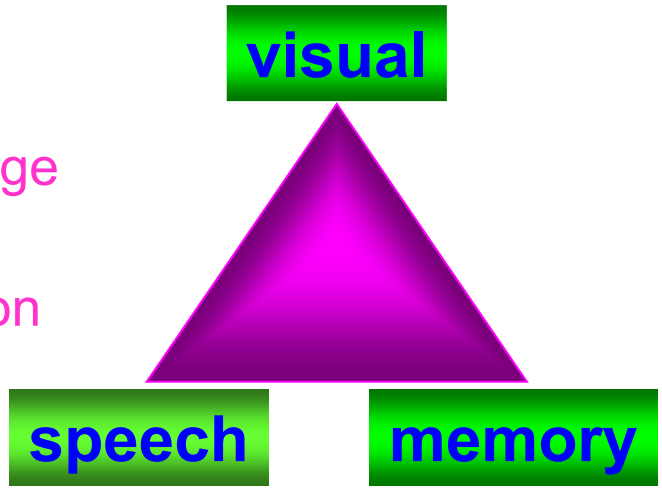
- **Issues:**
  - One-at-a-time
  - No aid for concept exploration
  - No aid for concept-to-concept navigation & switching
  - Uncommon device

Forthcoming State of Technology

Essential Features

As an assistive technology

- **As a hearing aid:**
  Speech recognition → Visual Image
- **As a speaking aid:**
  Visual Image → speech generation
- **As a memory aid:**
  → Visual Image



Essential Features

- **Navigation:** visual image as scenario
  - **Horizontal:** context switching
  - **Vertical:** from shallow/general to deeper/specific
- **Learning:** detect patterns of user behavior
  - **Customization for sound, image layout, context switching**
  - **reminder**
  - **diagnostic aid to medical doctors (e.g., Alzheimer's disease)**

Forthcoming State of Technology

Key Characteristics

- **One device, One Common device, One Componentized device**
- **Widely available** – platform-independent & easily downloadable (e.g, Open Cellular Telephony: *Google Android* project)
- **Affordable**
- **Easy to use**
- **Aesthetics**
- **Intelligent**
- **Customizable and Adaptive**

Key Research Challenges

- **only so many images can be shown, but which should be shown?**
  - the mostly frequently used ones are shown (maintain a list)
  - maintain context (e.g., an evening outing)
  - maintain scenario (e.g., eat at a restaurant, watch a movie)
- **an image has an imprecise meaning**
  - meaning clarification mechanism is needed (e.g., thru several sub-icons)
  - maintain context
  - maintain scenario
- **speaking a sentence or a series of sentences is hard**
  - maintain context
  - maintain scenario
- **only one word/sentence at a time – inconvenient, time-consuming, unnatural**
  - maintain and associate with an icon several sentences (i.e., several icons) that are typically/frequently spoken (through evolving patterns – detect, maintain and update patterns)
- **for memory loss, what should be the cue?**
  - main context
  - maintain scenario
  - maintain typical patterns

Abstract/vague concept → visual image