Aging and Cognition: Decline and Compensation

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NICE Knowledge Exchange

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Aging and Memory: Downhill all the Way?

Is it really downhill all the way??

Mostly YES!!

But losses differential!
Age-related memory losses are differential

- **Types of memory that hold up well**
  - Primary memory (telephone numbers)
  - Long-term memory for facts (but access?)
  - Procedural memory

- **Types of memory that fall off**
  - Working memory
  - Episodic memory
  - Prospective memory
Age-related memory loss a function of:

1. PERSON unable to execute controlled processing  
   (self-initiated activity; frontal inefficiency)
2. TASK requires self-initiated processing
3. ENVIRONMENT fails to compensate  (via cues, context)

<table>
<thead>
<tr>
<th>Task</th>
<th>Environmental Support</th>
<th>Self-Initiated Processing</th>
<th>Age-Related Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaided recall of events and intentions</td>
<td>increases</td>
<td>need increases</td>
<td>increases</td>
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<tr>
<td>Cued Recall</td>
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<td>Recognition Memory</td>
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<tr>
<td>Procedural Memory</td>
<td>increases</td>
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</tbody>
</table>
Some experimental studies

Usually two groups

• Older Adults (60-80 yrs.) Volunteers!!

• Younger Adults (18-30 yrs.) Usually students—paid or course credit

• Matched (as far as possible) on Years of Education (Young > Old) Vocabulary Level (Old >> Young!)
Locating the Loss

Encoding? Retrieval? Both??
“Repair” encoding – Age decrement reduced?

1) Performing actions

2) (a) Enhance meaningfulness (LOP)
   (b) Plus recognition

3) Schematic Support …..using knowledge
‘Subject-Performed Tasks’

- Participants asked either to learn a list of verbal commands, e.g.
  - “Pick up the watch”
  - “Point to the ceiling”
- Or ….carry out the actions
- Later unexpectedly asked to recall all the commands and actions
- Study by Michael Ronnlund et al.
Learning Names
(Experiment with Dr. Angie Troyer)

- Participants asked to LEARN 8 names
- Three other sets of 8 names – “interference”
- “Say first LETTER of name”
- “Generate a RHYME to the name”
- “Generate a MEANINGful association”
- All 32 types mixed up
- “Please recall ALL names”
- Recognition test --- 32 names plus 64 new names
Recall and Recognition as a Function of age and type of processing

Recall

Recognition
Memory for Numerical Information

• Older adults show impairments for arbitrary associations

• Critical factor: the degree to which information can be meaningfully related to form a unit of information

• Memory for grocery prices, regular or inflated

• Study by Dr. Alan Castel
• How does “schematic support” influence binding for grocery items and prices?
• Block 1-Market-value items (regular price)
• Block 2-Over-priced items (unusual price)
• Cued recall: given each item, recall price
• Older adults should be better at binding market value prices than unusual prices

Cereal $3.59
Juice $17.19
Recall Price?
Recall Accuracy

Age x Price Interaction
p<.0001
Contextual Support and Aging
Studies with Astrid Schloerscheidt

Contexts - rich pictorial scenes
Targets - words or photos of objects

10 scenes, each paired with 8 or 12 targets

1. Recall of scene given target object
2. Recognition of target, varying context

Effects of aging?
1. Poor recall of context?
2. More dependent on context?
Schloerscheidt & Craik (in prep)

8 objects with each of 10 scenes

1. **Context recall**

   20 objects – scene?

   Young = 0.72 \quad p < .001

   Old = 0.35
Schloerscheidt & Craik (in prep)

Objects (Words or Pictures) x Scenes

**Words**

- 12 words paired with each of 10 scenes = 120

**Pictures**

- 12 pictured objects with each of 10 scenes = 120

In each case 120 old items + 60 new items

Test was item recognition

Contexts = Original, Switched, None, New
Contextual Support - Conclusions

1. Context Recall
   Old << Young

2. Item Recognition
   Age x Words / Pictures  p<.001
   for Young - Original Context > Others
   for Old - No context effects for Pictures
   - Large effect for Words
Measuring Processing Resource Costs

1) Compare encoding and retrieval costs
2) Compare costs for Young and Old
3) Visual tracking task
   (a) Subject encodes or retrieves word pairs presented auditorily
   (b) while tracking randomly moving target on screen
   (c) Baseline: deviation while tracking only
   (d) Dual-task costs – extra deviations while also encoding or retrieving (6-sec interval)
distance from baseline in mm
old retrieval
old encode
young retrieval
young encode
Hierarchical Model

1) Older adults have especial problems with
   (a) names
   (b) specific contexts and sources

2) Something in common?

3) Notion that knowledge is represented hierarchically
   (a) Individual episodes $\rightarrow$ general knowledge
   (b) Specifics – names/instances – at ends of branches
   (c) General facts, gist, etc. = higher nodes

4) Possibility that higher nodes easier to access; lower nodes difficult for
   (a) Older adults?
   (b) Younger under DA?
   (c) Depressed patients?
Hierarchical Model

- Context free knowledge
- "Semantic memory"
- "Episodic memory"
- "Know"
- "Remember"
- Specific names
- Global concepts
- Contextual detail

Diagram:
- Top node representing Context free knowledge
- Branching down to "Semantic memory" and "Episodic memory"
- Further branching to "Know" and "Remember"
- Specific names at the bottom
Bilingualism and Aging
Simon Task

Bialystok, Craik, Klein, & Viswanathan, 2004

- 94 participants between 30 and 80 years
- Half bilingual matched by age
- Background measures of working memory, language proficiency, intelligence (Cattell)
Control

Rule: red square $\rightarrow$ left     green square $\rightarrow$ right
Simon Effect
Rule: red square → left    green square → right
Mean Simon Effect by Decade

![Graph showing the mean Simon effect by decade. The x-axis represents age groups (30-39, 40-49, 50-59, 60-69, 70-79), and the y-axis represents RT difference (milliseconds). The graph compares monolingual and bilingual participants. The trend shows an increase in RT difference with age.]
Bilingualism and Alzheimer’s Disease

• Mentally stimulating activities → ”cognitive reserve” (Stern, 2000)
• Years of education important component of cognitive reserve
• Significantly better cognitive functioning in AD for patients with cognitive reserve (Scarmeas et al., 2003)
• Does bilingualism contribute to cognitive reserve?
Patient Study

• 159 patients at Memory Clinic
  – 78 monolingual
  – 81 bilingual

• All patients with diagnosis of dementia, MMSE < 26, classifiable by language group
## Results

Bialystok, Craik, & Freedman (2007)

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Years Duration</th>
<th>Years of Education</th>
<th>MMSE</th>
<th>Onset Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mono-lingual</td>
<td>78</td>
<td>3.5 (2.9)</td>
<td>12.2 (4.0)</td>
<td>19.9 (5.9)</td>
<td>71.9 (10.3)</td>
</tr>
<tr>
<td>Bilingual</td>
<td>81</td>
<td>3.2 (2.2)</td>
<td>10.8 (4.2)</td>
<td>18.5 (6.9)</td>
<td>75.9 (8.9)</td>
</tr>
</tbody>
</table>
Bilingualism and Aging

• Bilinguals appear to have better “cognitive control”
• Better inhibition of unwanted information
• Better selection of wanted information
• Large effects in young children; small effects in young adults; larger again in older adults
• One of several ‘protective factors’ against aging?
General Summary

• Age-related memory loss, but differential
• Tasks that require self-initiation, recollection
• Loss of processing resources = DA
• Need to repair both encoding and retrieval
• Retrieval costs are particularly high for Old
• Modifying aging effects? ....bilingualism?
Acknowledgements

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THANK YOU!!

THE END