Psychology of Normal Aging/ Risk and Protective Factors for Mental Disturbances in Later Life

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Lecture 2
Cognitive Aging: The BIG Problem

- The retiring editor of a leading gerontological journal identified ‘The Ten Hot Topics in Aging’; cognitive decline was the first topic on his list; single most feared aspect of growing old (Martin, 2004)
- Cognitive impairment without dementia affects 1 in 4 adults aged ≥ 70 living in the community (Plassman et al., 2008); an estimated 5.5 million people in US have AD (Prince, 2013; Alzheimer’s Association, 2017)
- Major threat to people’s abilities to continue their everyday activities and maintain their independence
- Caring for older people who can no longer manage independently is a major public health issue
“I have two fixed ideas well known to my friends …… The first is the comparative uselessness of men above forty years of age. …… My second fixed idea is the uselessness of men above sixty years of age, and the incalculable benefit it would be in commercial, political and in professional life if, as a matter of course, men stopped work at this age.”

Dr. William Osler (Feb. 22, 1905)
Normal, Normative, Successful, and Optimal Cognitive Aging

- **Normal**: Predictable changes in cognition associated with getting older
- **Normative**: Neuropsychological functioning that falls within 1.5 or 2 standard deviations of the mean for age
- **Successful**: More than the absence of the dementia of AD or cognitive decline of MCI; many definitions, e.g., in top tier of performance relative to age-matched controls
- **Optimal**: Performing at a level en par with high functioning young adults?
Are there changes in cognitive ability as individuals get older, in the absence of disease?
Memory

• Ability to learn and retain new information over time

• Has been studied for a long time at multiple levels of analysis
  • humans and non-humans
  • individuals and populations
  • brain structure and function
  • data on potential interventions in humans and animal models
“To live is to remember and to remember is to live.”

- Samuel Butler

- Memory and memory decline is a major concern of older adults
- Memory ability is something everyone can understand and identify with
- Memory differences occur between younger vs. older adults
Memory complaints are not a new phenomena

- Mnemosyne: goddess of memory
- Aristotle: wrote a volume on memory
  - Mind as a wax tablet that memories made an impression on
  - These impressions faded with time
## Prevalence of Memory Complaint and Poor Memory Performance

<table>
<thead>
<tr>
<th>Age</th>
<th>N</th>
<th>Memory Complaint %</th>
<th>Poor Recall %</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-44</td>
<td>396</td>
<td>14.5</td>
<td>4.7</td>
</tr>
<tr>
<td>45-64</td>
<td>186</td>
<td>19.6</td>
<td>11.9</td>
</tr>
<tr>
<td>65-74</td>
<td>132</td>
<td>42.7</td>
<td>25.5</td>
</tr>
<tr>
<td>75-84</td>
<td>80</td>
<td>50.8</td>
<td>39.7</td>
</tr>
<tr>
<td>85+</td>
<td>16</td>
<td>88.3</td>
<td>43.6</td>
</tr>
</tbody>
</table>

*Bassett & Folstein, 1993*
Normal Cognitive Aging

Not just memory
Not just late in life
Not just small effects
Memory
Study the following words and then write as many as you can remember:
- Goat
- Door
- Fish
- Desk
- Rope
- Lake
- Boot
- Frog
- Soup
- Mule

Reasoning
Select the best completion of the missing cell in the matrix:

Spatial Visualization
Select the object on the right that corresponds to the pattern on the left:

Perceptual Speed
Classify the pairs as same (S) or different (D) as quickly as possible:
Age Changes in Cognitive Function

- Increased distractibility
- Lack of spontaneous use of learning strategies
- Retrieving information
- Slowing of information processing
- Working memory changes
- Executive function
Normal Cognitive Aging

Not just memory
Not just late in life
Not just small effects

Not well understood
Considerable variability at all ages
Cognitive Aging

The graph illustrates the decline in various cognitive abilities across different age groups. "Processing capacity" and "World knowledge" are shown to decrease with age, from the 20s to the 80s. The graph includes data for different tests and tasks, such as Digit symbol, Letter comparison, Pattern comparison, Letter rotation, Line span, Computation span, Reading span, Benton, Rey, Cued recall, Free recall, Shipley vocabulary, Antonym vocabulary, and Synonym vocabulary. The sample size for this study is 350 participants.
Aging, Cognitive Health, and Cognitive Decline

- Mild Cognitive Impairment
- Age-Associated Cognitive Impairment
- Mild Cognitive Impairment
- Alzheimer’s Disease

Cognitive Health?
Prevalence of cognitive decline:
EURODEM

% with >1.5 pts/yr decrease in MMSE

Launer et al, 1999
Incidence of dementia
EURODEM

Launer et al., 1999

Launer et al., 1999
Variability of Cognitive Changes with Age
Factors Contributing to Decreased Cognitive Function

- Depression
- Loss
- Physical well-being
- Medications
- Sensory changes/losses
- Nutrition
- ‘use it or lose it’
- Lack of exercise
Factors That Reduce the Risk of Cognitive Decline With Age

- Absence of cardiovascular disease and other chronic diseases
- Involvement in mentally stimulating activities
- Flexible personality style
- Marriage to a spouse with high cognitive status
- Maintaining high levels of processing speed into old age
- High life satisfaction
- Maintaining physical fitness
Developmental Plasticity

- A central concept in life-span theory and research
- Refers to the potential for change in adaptive capacity
- Implies that any given developmental outcome is but one of numerous possible outcomes
- Search for the conditions and range of developmental plasticity is fundamental to the study of life-span development
Reserve Capacity

• Degree of plasticity is contingent on an individual’s reserve capacity

• Constituted by the internal (e.g., cognitive capacity, physical health) and external (e.g., social network, financial status) resources available to the individual at a given point in time

• Involves the disjunction between competence and performance
Cognitive Reserve

- Cognitive reserve (CR)
  - Brain actively attempts to cope with brain damage (i.e., AD pathology) by using preexisting cognitive processing approaches or by enlisting compensatory approaches
  - Individuals with more CR would be more successful at coping with the same amount of brain damage
  - CR may modulate clinical expression of AD pathology

Stern, 2012
• Dementia is not an inevitable consequence of old age

• An active mental life can prevent mental decline
  “Intellectual activity gives buoyancy to the mind”
  “Old men retain their mental faculties provided their interest and application continue…”

• Mental gymnastics as anti-dementia strategy
Cognitive Reserve Chart

- Latent
- Pro-Drome
- Dementia

Cognitive Reserve

- NSAIDs
- Estrogens
- Antioxidants
- Statins
The Range of Reserve Capacity or Plasticity in Cognition

• *Baseline performance* – the individual’s current maximum cognitive performance potential, that is the most an individual can do with current internal and external resources

• *Baseline reserve capacity* – the current maximum potential of a person’s cognitive system when provided with optimizing conditions

• *Developmental reserve capacity* – an estimate of the potential level of cognitive performance following long-term intervention and practice aimed at changing a person’s cognitive system
SOC Model

- A life-span model of selective optimization with compensation (SOC)
- Involves the individual’s attempts to maximize gains (desirable outcomes or goals) and minimize losses (undesirable goals or outcomes)
- Influenced by cultural and personal factors as well as the position of the individual in the life course
- Has both universal and relativistic features
SOC: A Theory of Adaptive Development

• **Selection: Elective and Loss-Based**

Concerns directionality of development including selection of alternative outcomes and goal structures

• **Optimization**

Concerns means for achieving desired outcomes (attaining higher levels of functioning)

• **Compensation**

Concerns activation or acquisition of new means for counteracting loss/decline in means that threatens the maintenance of a given level of functioning
Example of SOC: Concert Pianist Arthur Rubenstein

- Played fewer pieces but practiced them more often (i.e., selection)
- Used contrasts in tempo to simulate faster playing (i.e., compensation)
- Reduced his repertoire (i.e., selection) which allowed him the opportunity to practice each piece more (i.e., optimization).
Example of SOC: Athlete Michael Jordan

• Focused only on basketball in youth, excluding swimming and skating (i.e., selection)
• Daily line drills and upper body training (i.e., optimization)
• Reliance on special footwear to deal with chronic foot injury (i.e., compensation)
Example of SOC: Old Typists

- Well-documented age changes in reaction time
- Old typists maintain high rate of typing speed compared to young typists
- Old typists anticipate the upcoming text better than young typists

Salthouse, 1984
Empirical Evidence for SOC

- Evidence has been supportive of theoretical approach
- Peak of using all of the SOC components is obtained for adults; older adults show less frequency of using optimization and compensation
- Partners who report higher use of SOC obtain higher scores on perceived developmental status and higher levels of well-being (Wiese, Freund, & Baltes, 2002)
- Older people suffering from health conditions such as osteoarthritis manage their illness by behaviors consistent with SOC (Gignac, Cott, & Badley, 2002)
Dual-Process Model of Intelligence

• Distinguishes between the *pragmatics* and the *mechanics* of the mind
• Involves both cultural and biological factors
• Similar to other dual-process models such as the fluid-crystallized model (Cattell, 1971; Horn & Hofer, 1992)
Mechanics and Pragmatics of Cognition

**Mechanics**
- content-poor
- universal, biological
- genetically predisposed

**Pragmatics**
- content-rich
- culture-dependent
- experience-based

**Basic Information Processing**
Crystallized and Fluid Intelligence
Wisdom: Trait and State

• Wisdom is a multidimensional construct
• “The power of judging rightly and following the soundest courses of action, based on knowledge, experience, understanding, etc.” (Webster’s New World College Dictionary, 1997, p. 1533).
• Wisdom is the product of knowledge and experience, but it is more than the accumulation of information; it is the coordination of this information and its deliberate use to improve well-being.
Definition of Wisdom

• Wisdom can be defined as good judgment and advice about important but uncertain matters of life.
• Can be considered a positive outcome of late-life potential.
• Reflects the pragmatics of cognition.
Wisdom and Successful Aging

- Wisdom: a positive predictor of successful aging (Baltes & Staudinger, 2000)
- Wisdom is more robustly linked to the well-being of older people than objective circumstances such as physical health, financial well-being, and physical environment (Baltes, Smith, & Staudinger, 1992; Clayton, 1982; Hartman, 2000)
- Development of wisdom is modifiable: Stressful life experiences can facilitate the development of wisdom, but as the ratio of negative to positive life experiences tips in favor of the negative, wisdom is inhibited (Hartman, 2000)
- Most authors who offer conceptualizations of wisdom have not considered possible interventions to stimulate its development across the life span (Parisi et al., 2009)
Wisdom as Expert Knowledge

- FACTUAL KNOWLEDGE in the fundamental pragmatics of life.
- STRATEGIC KNOWLEDGE in the fundamental pragmatics of life.
- Knowledge in the CONTEXTS of life and societal change.
- Knowledge which considers the UNCERTAINTIES of life.
- Knowledge which considers RELATIVISM of values and life goals.
Use of Wisdom Criteria to Evaluate Discourse About Life Matters (Example: A 14-year-old girl is pregnant. What should she consider and do?)

- **Factual knowledge**  Who, when, where? specific knowledge; general knowledge of emotions, vulnerability and multiple options (parenting, adoption, abortion)
- **Procedural knowledge**  Strategies of information search, decision making and advice giving; timing of advice; monitoring of emotional reactions; heuristics of cost-benefit analysis
- **Life-span contextualism**  Likely age sequence; sociohistorical and idiosyncratic context; coordination of life themes and temporal changes; contextual conflicts and tensions
- **Relativism**  Religious and personal preferences; current and future values, goals, motives; cultural and historical relativism
- **Uncertainty**  No perfect solution; optimization of gain and loss; future not fully predictable; backup solutions
Life Conditions Relevant for the Development of Wisdom

• Chronological age
• Extensive experience with a wide range of human conditions
• The practice of being a tutor or mentor
• Motivational dispositions such as generativity (Erikson, 1959) or the continuing motivation to expand one’s insights into matters of life and their mastery (Brim, 1992; Ryff, 1989)
Special Risks in Old Age

- Cognitive conditions
  - dementia
  - delirium
  - depression

- Co-morbidity

- Disability and dependency on family support
Risk Factors

• Neither necessary nor sufficient causal agents; are general risks for multiple disorders

• Epidemiologists often refer to risk factors instead of causes.

• Indicates a variable hypothesized to be related to the probability of an individual’s developing a disease.

• Increases the probability of developing a disorder.
Risk Factors for AD

• Age
  • Older age increases risk for AD, and may affect rate of progression

• Gender
  • In some studies, women have an increased incidence of AD compared to men, suggesting that gender may be a risk factor
  • Other support comes from reports on estrogen replacement protecting against AD
  • However, most studies, when controlling for longevity differences, have not found gender to be a significant risk factor (e.g., Kawas et al. 2000; Edland et al. 2002)
Gender and AD

Age- and sex-specific incidence rates of Alzheimer disease

Gender and AD, continued

# Cardiovascular Risk Factors and AD

<table>
<thead>
<tr>
<th>Study</th>
<th>Risk Factor</th>
<th>N</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kivipelto et al. (2001)</td>
<td>Midlife hypertension</td>
<td>1400</td>
<td>aOR 2.8 (1.1-7.2)</td>
</tr>
<tr>
<td>Ruitenberge et al. (2001)</td>
<td>History of hypertension</td>
<td>5468</td>
<td>aRR 1.4 (1.1-1.8)</td>
</tr>
<tr>
<td>Kivipelto et al. (2001)</td>
<td>Midlife high total Cholesterol</td>
<td>1400</td>
<td>aOR 2.2 (1.0-4.7)</td>
</tr>
<tr>
<td>Reitz et al. (2005)</td>
<td>Late life high total cholesterol</td>
<td>1168</td>
<td>aOR 1.6 (0.75-3.2)</td>
</tr>
</tbody>
</table>
Cardiovascular risk factors and AD, continued

• Diabetes Mellitus (DM)
  • DM is associated with cognitive decline, and with increased risk of stroke & vascular dementia
  • Relationship between DM & AD less clear, some studies show relationship, others do not
  • May be due to differences in age, ethnicity, sex, study design, length of follow-up, criteria used to define DM and AD, etc
Cardiovascular risk factors and AD, continued

- Obesity
  - Associated with vascular disease, but role as risk factor for AD is conflicting
  - No association between midlife obesity and late-life AD found in 3 longitudinal epidemiologic studies with 20+ years follow-up (HAAS, CRFADS, JAHS)
  - Swedish Longitudinal Population Study found significant association between overweight at age 70 and incident AD in following 10-18 years in women only
Stroke and AD

- Stroke
  - Cardiovascular Health Study reported that presence of angina, myocardial infarction, and peripheral arterial disease associated with higher risk of AD
  - Association between stroke and AD may be even stronger for those with hypertension and/or diabetes (Honig et al., 2003)
APOE and AD

- APOE comes in three “flavors” (alleles). Like genes for blood antigens, A, B, and O.
- APOE alleles are called $\varepsilon_2$, $\varepsilon_3$, and $\varepsilon_4$.
- Because we get one copy of each gene from each parent, everyone gets two APOE genes.
- There are six possible pairings, much like AA, AO, BB, BO, AB, and OO.
APOE and AD

The Possibilities:  
ε4/ε4
ε4/ε3
ε4/ε2
ε3/ε3
ε3/ε2
ε2/ε2 (very rare)

Typical Frequency:  
~ 2% are ε4/ε4
~ 24% are ε4/ε3
~ 2% are ε4/ε2
~ 61% are ε3/ε3
~ 11% are ε3/ε2
APOE and AD

• Those with ε4/ε4 tend to get AD between 65-80 and have 15-fold risk, (vs. ε3/ε3) after adjustment for age
• Those with ε4/ε3 get AD between 75 and 90 and have 3-4 fold risk
• The ε2 allele may confer decreased risk
Diet

- Lower caloric intake may reduce risk of AD, especially for those with the ε4 allele (Luchsinger JA et al., 2002)
- Dietary patterns may confer reduced risk for AD, particularly the Mediterranean diet (Scarmeas et al., 2006)
- Weekly fish consumption may reduce risk of AD by 60% compared with those who rarely eat fish (Morris MC et al., 2003)
- However, greater benefit may be for those without the ε4 allele (Huang et al., 2005)
Protective Factors and AD, continued

• Exercise / Physical Activity
  • Prospective studies have found an association between higher levels of physical activity and AD (e.g., Laurin et al., 2001)
  • Incident rate of dementia lower for those who exercise 3+/week compared to those who exercise less than 3x/week (HR 0.62, 95% CI 0.44 – 0.86) (Larson et al., 2006)
  • Problems include that exercise is normally self-report and usually in late-life
Protective Factors and AD

• Education
  • Several epidemiologic studies suggest that higher level of education is protective against AD
  • Relative risk for low versus high education and AD is 1.80 (95% CI 1.43, 2.27)
  • Relative risk for low and medium education versus high and AD is 1.44 (95% CI 1.24 – 1.67)

_Caamaño-Isorna et al., 2006_
Protective Factors and AD, continued

• Occupational attainment
  • Low lifetime occupational attainment may increase risk of AD (RR 2.25, 95% CI 1.32 – 3.06) (Stern et al., 1994)

• Risk may be greatest for those with both low educational and occupational attainment
Protective Factors and AD, continued

• Social engagement / leisure activities
  • Late-life participation in cognitively stimulating activities associated with 64% reduction in risk of incident AD (OR 0.36, 95% CI 0.20 – 0.65) (Wilson RS et al., 2002)
  • Data from the Kungsholmen project suggests that late-life participation in any stimulating activity, either mentally or socially oriented, may be associated 50% reduction in risk of dementia (Wang et al., 2002)
However, must consider whether no engagement in late-life is associated with prodromal AD

No association found between midlife social engagement and incident dementia in Honolulu-Asia Aging Study (Saczyński et al., 2006)
Possible Risk Factors for Vascular Dementia

- Old age
- Low levels of education
- Nonwhite race
- Hypertension
- Heart disease
- Smoking
- Diabetes mellitus

Ross, 1999
Possible Protective Factors for Vascular Dementia

- Unknown factors related to Western diet
- Antioxidant vitamin E
- Aspirin

Ross, 1999
Possible Risk Factors for Later Life Depression

- Female gender
- Single/no longer married
- Low education level
- Low income
- Stressful life events
- Living in a large city
- One or more chronic physical illnesses
- One or more functional limitations
- Cognitive impairment
- Small/no social network
- Low social support
- External locus of control

Sonnenberg et al., 2000
Possible Protective Factors for Later Life Depression

- Having one or more confidants
- Religiousness

Sonnenberg et al., 2000