Cognitive Aging: Opportunities and Challenges
Ursula M. Staudinger

Human Aging in 2015 is only a snapshot in time!
Aging and old age has been different in the past and will yet be different in the future.

Interactive Nature Creates Room for Plasticity

Staudinger, 2015
Annual Review of Gerontology and Geriatrics
Two Components of Intellectual Development
Pragmatics (Experience) versus Mechanics (Speed)

Knowledge Structure Changes with Expertise
From Novice to Expert

Experience Compensates Decline in Mechanics

Beyond Compensation: Buffer Decline?

Baltes, Lindenberger & Staudinger, 2006

Baltes, Lindenberger & Staudinger, 2006
Age-Related Decline in Cognitive Mechanics in Previous Cohorts

Three Facilitators of Positive Cognitive Plasticity

Decline of cognitive mechanics starts later
Health status of 80 yrs. old = 70 yrs.-old 20 yrs. Ago
Increases in intellectual functioning across cohorts
Education, nutrition
Decline in the mechanics is less pronounced
Training interventions (task exercise + strategy, physical exercise)

Three Facilitators of Positive Cognitive Plasticity

Not Only Longer, Also More Healthy Years
Health Age ≠ Chronological Age

Societies of Longer Lives

Max. Life expectancy (yrs)

Dependent yrs.
Active yrs.

Christensen et al., 2007
Oeppen & Vaupel Science 2002 updated

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Three Facilitators of Positive Cognitive Plasticity

Decline of cognitive mechanics starts later
- Health status of 80 yrs. old = 70 yrs. old 20 yrs. Ago
- Increases in intellectual functioning across cohorts e.g., Education, nutrition
- Decline in the mechanics is less pronounced
  - Training interventions (task exercise + strategy, physical exercise)

Also Progress in the Oldest Old (93 & 95 yrs.)...

<table>
<thead>
<tr>
<th>Cognitive composite score</th>
<th>1900 cohort</th>
<th>188 cohort</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>21.4 (6)</td>
<td>23.8 (6)</td>
<td>0.0081</td>
</tr>
<tr>
<td>Median (25-75)</td>
<td>23.0 (18-26)</td>
<td>24.0 (19-22)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Missing data (%)</td>
<td>16% (15%)</td>
<td>24% (25%)</td>
<td>0.0057</td>
</tr>
</tbody>
</table>

Immediate Recall

Consequences of Cognitive Aging on the Population Level: Decline

- Spatial Reasoning
- Speed
- Vocabulary
- Fluency

Same Chronological Age Implies Different Cognitive Age at Different Historical Times

1.5 SD across 50 years

Seattle Longitudinal Study; e.g. Schaie, 1996

Consequences of Cognitive Aging on the Population Level: Decline

- Male Rapid Aging
- Male Slow Aging
- Female Rapid Aging
- Female Slow Aging
Three Facilitators of Positive Cognitive Plasticity

- Decline of cognitive mechanics starts later
- Health status of 80 yrs. old = 70 yrs. old 20 yrs. Ago
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Training Compensates Losses in the Mechanics
Classical Evidence for Exogenous Resilience
Neuronal Correlate of Training Gains (Method of Loci): **Compensation**

Difference Posttest – Pretest during Retrieval

![Brain images](Image)

Nyberg et al., 2003

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Physical Training Interventions (6, 12 months)

**Modify** the Cognitive Mechanics >60yrs.?

![Graph](Image)

Voelcker-Rehage, Godde & Staudinger, 2011

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Neuronal Level: More Efficient Prefrontal Processing at Higher Levels of Aerobic Fitness (**Reactivation**)

Nordic Walking – CG & 3. – 1. MP

![Brain images](Image)

![Graph](Image)

Voelcker-Rehage, Jeltsch, Godde, & Staudinger, 2015

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**Indication for Personalized Plasticity**

Effectivity of Physical Intervention Depends also on Genetic Predisposition

![Graph](Image)

Particularly for val/val carriers higher motor fitness is associated with better cognitive performance

Voelcker-Rehage, Jeltsch, Godde, & Staudinger, 2015
Age-Related Decline in Cognitive Mechanics in Previous Cohorts

More Work-Task Changes Associated with Higher Levels of Cognitive Functioning

Sample: Assembly Line Workers, 16 yrs. Treatment, N=38
Controlled for: Baseline Cognition & Openness, Leisuretime Activities

More Work-Task Changes (as compared to few changes):

- More Gray Matter in Regions Relevant for Learning and Attention

Cognitive "Training" through Varied Work Biographies

"Challenge it or Loose it"

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Yet Another Challenge.....

Negative Plasticity through Old-Age Stereotypes

Positive Perspective on Old Age

Lower Survival Probability ( Median) due to Negative Own Old-Age Image

controlled for: obj. health, SES, SWB etc.
partial mediator: will to live

Levy et al., 2000

Older Employees in Companies with Negative Old-Age Stereotype less Motivated and less Productive

Noack & Staudinger, 2009; N = 647; controlled for Age and BMI

η² = .03
η² = .02
Summary Cognitive Plasticity

- Yes, there is plasticity in the cognitive mechanics.
- Underlying mechanisms less clear:
  - Compensation (e.g., learning a strategy, motivation)
  - Physical reactivation
- More systemic longitudinal, ideally country comparative, data sets are needed.
- Cognition in vivo: Measurement challenges yet to be mastered