The Age-Ability-Productivity Paradox

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Knowledge, Abilities & Age

Why is this topic important?

- The historically recent change to low birth rates and death rates produces aging populations where there are fewer young workers to replace retiring older workers.
- Economic prosperity depends on productivity in the labor force.
- Pensions and health care systems generally also depend on labor force productivity.
- Aging adults will have to work longer in part to sustain public pension and health care systems.
Older, but more productive?

- Cappelli (2003)
  - “Because older workers are already experienced and trained, the average quality of the labor force should actually improve over time, especially so if senior workers delay retirement.”

- However, the nature of work is probably changing with an increased emphasis on learning new skills.

- Will the knowledgeable older workers in the developed countries be able to compete with younger, faster-learning “off-shore” workers?
  - India, China
Knowledge and Productivity

- The Industrial and Organizational psychology field stresses the importance of KSA s for deciding on who should be able to occupy a particular job category: *Knowledge, Skills, Abilities*.

- General intellectual ability (G) is a good predictor of initial job performance and even initial performance in lab skill acquisition tasks such as ATC (Ackerman, 1990), but other predictor variables do better later in the learning curve.
Cognitive Changes with Age

- Crystallized intelligence, a form of acquired knowledge, is usually stable until very late in life.
- Fluid intelligence, ability to quickly solve novel problems, shows declines from the 20s or 30s of ~2 SD units for a 50-year interval.

Abilities and Age

Age Groups

-20's 30's 40's 50's 60's 70's 80's

Perceptual Speed
Spatial Ability
Working Memory
Memory - Recall
Verbal Ability

Park Lab n = 350
Peak Performance and Age

Longitudinal GM Performance

[Graph showing the relationship between age and chess rating (SD units). The graph illustrates a peak in performance around age 30, with a decline thereafter.]
Older Workers: Productivity

Are older workers less productive than younger ones?

- Meta-analyses (e.g., McEvoy & Cascio, 1989, examining about 100 studies) show that there is no significant relationship between job productivity (work output, supervisor ratings) and the age of the worker.

- Obsolescence is likely to be a greater threat to productivity than is age (Sparrow & Davies, 1988)
  - Although these two factors are usually correlated, they need not be.
Knowledge, Abilities & Age: Caveat – Conceptual not Path Analysis

Knowledge → .3
Job Training Outcome → +?
Work Productivity → +.6
Intellectual Abilities → +.5
Age → -4
Wage → +.4

Knowledge, Abilities & Age: Caveat – Conceptual not Path Analysis

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Schmidt & Hunter 1996
Older workers and Absenteeism

Do older workers suffer more from absenteeism?

- Martocchio’s meta-analysis suggested that both voluntary absenteeism and involuntary (health-related) were inversely related to age using frequency of occurrence and time-loss indices
  - Younger workers have more avoidable and involuntary absenteeism than older workers.
  - Gender moderated the effect, with women showing no relationship between age and absenteeism, but for men it was negative
  - Effects are small: $r = -0.2$, $r = -0.1$ for frequency, time-loss
Older workers and Turnover

- Job change rates are generally much lower for older than younger workers.
  - Swaen, Kant, van Amelsvoort, & Beurskens, 2002
- Hence training costs for a company may be lower with older workers.
Do older workers suffer more job-related injuries? 

- Most time-loss injuries happen to workers in their first year of employment.
- The trend is for fewer injuries with age, though more costly ones that keep older workers off the job longer.

- Root (1981)
Learning Job Skills

Can older workers learn new technology?

- Meta-analysis suggests that older individuals have poorer outcomes from training than younger ones

- Studies of software application learning (word processing, spreadsheets) have shown that older novices can reach similar performance levels as younger novices, though they took longer to do so.
  - If older workers have learned one word processing package, they may show equally effective learning as younger, equivalently-experienced, software users.
Charness, Kelley, Bosman & Mottram Study (2001)

- We investigated training and re-training of young, middle-aged, and older adults in word processing software.
- They trained for 3 days on self-paced tutorials designed for Word for Windows.
Time to Complete the Final Performance Test (Min.)

- **Novice Users**
  - Young: ~30 min.
  - Middle: ~45 min.
  - Old: ~70 min.

- **Experienced Users**
  - Young: ~20 min.
  - Middle: ~40 min.
  - Old: ~60 min.
Score on Final Performance Test (Max=90)
Score on Multiple Choice Quiz
(Max=40)

![Graph showing score distribution for Novice Users and Experienced Users across different age groups.](image-url)
Efficiency on Final Performance Test (Correct Solutions/Minute)

![Graph showing efficiency measure for Novice Users and Experienced Users, classified by age groups (Young, Middle, Old).]
# Regression: Performance Factor

<table>
<thead>
<tr>
<th>Predictors</th>
<th>B</th>
<th>SE</th>
<th>Beta</th>
<th>p (2-tail)</th>
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<tbody>
<tr>
<td>Constant</td>
<td>0.093</td>
<td>0.071</td>
<td>0</td>
<td>0.195</td>
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<tr>
<td>Interface</td>
<td>0.329</td>
<td>0.070</td>
<td>0.326</td>
<td>0.000</td>
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<td>Age</td>
<td>-0.298</td>
<td>0.085</td>
<td>-0.296</td>
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<td>JOL score</td>
<td>0.201</td>
<td>0.078</td>
<td>0.200</td>
<td>0.013</td>
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<tr>
<td>Digit-Symbol Median RT</td>
<td>-0.242</td>
<td>0.084</td>
<td>-0.244</td>
<td>0.006</td>
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<tr>
<td>Software Experience</td>
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<td>0.077</td>
<td>0.393</td>
<td>0.000</td>
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<tr>
<td>Age X Software experience</td>
<td>0.239</td>
<td>0.074</td>
<td>0.230</td>
<td>0.002</td>
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</tbody>
</table>

\[ F (6, 68) = 24, \ p < .01, \ R^2 = .68 \]
Regression: Time Factor

<table>
<thead>
<tr>
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<th>SE</th>
<th>Beta</th>
<th>p (2-tail)</th>
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</thead>
<tbody>
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<td>.000</td>
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<tr>
<td>Age</td>
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<td>0.065</td>
<td>0.471</td>
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<td>Clock RT</td>
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<tr>
<td>Software Experience</td>
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<td>0.064</td>
<td>-0.534</td>
<td>.000</td>
</tr>
<tr>
<td>Age x Software Experience</td>
<td>-0.247</td>
<td>0.067</td>
<td>-0.230</td>
<td>.000</td>
</tr>
</tbody>
</table>

\[ F (4, 72) = 49, \ p < .01, \ R^2 = .73 \]
Older Workers and Slowing

Are older workers slower than younger ones?

- There is general slowing with age, particularly for speeded performance, but this relationship is modified by the skill of the individual. For typing, despite slowing in reaction time, older typists type at the same rate as younger ones. (They compensate by looking farther ahead in the text that they are transcribing.)

- The Days Inn hotel chain reported that although older sales reps handled calls more slowly, they had a higher booking rate for rooms. On a cost-benefit analysis, older workers were more efficient than younger ones.
  - McNaught & Barth (1992)
Motivation and Older Workers

- Age-related negative changes in abilities may be balanced by age-related increases in knowledge

- What happens to motivation to train or retrain?
  - Many studies, starting with British research in the 1960s by the Belbins, have shown greater reluctance for older workers to retrain

- Older workers seem more attuned to corporate policies and realistic about outcomes
  - Colquitt, Lepine & Noe (2000); Noe & Wilk (1993) note that if training does not truly improve access to rewards, older workers won’t participate

- Better “tacit knowledge” for older workers?
Designing to Support Knowledge Acquisition and Expertise

- Expertise that depends on acquiring domain-relevant knowledge and procedures often resides in hard to get places, such as mentors’ heads
  - Knowledge elicitation techniques can help to extract this
    - Hoffman, Shadbolt, Burton & Klein, 1995

- However, aging tends to limit the speed with which such knowledge can be accessed or acquired

- Design better technology systems for putting “information at your fingertips” may help

- Take into account age-related changes in perception, cognition, and psychomotor speed when designing tools and environments
Lightpen Minimizes Age Differences

Age x Device Interaction

<table>
<thead>
<tr>
<th>Age</th>
<th>Mouse</th>
<th>Lightpen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old</td>
<td></td>
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Mean Median RT (ms)
Investing in Productivity

- Age is not a good predictor of worker productivity
- Age is a good predictor of physical and mental decline
- Obviously, older workers have learned how to compensate for those negative changes
  - Further research is needed to identify compensatory mechanisms
- However, we need to invest in tools and training to augment everyone’s productivity
  - more urgent, given their cost, for older workers
Final Reflections on Knowledge, Abilities, and Age

- An optimist says the glass is half full.
- A pessimist says the glass is half empty.
- An engineer says the glass is twice as big as it needs to be.
- A gerontotechnologist says either the water source and glass need to be redesigned or the user needs better training.
- Perhaps our focus needs to shift to designing interventions aimed at supporting high-level performance (CREATE).