Plasticity in Old Age: The Influence of Lifespan Theory

Sherry L. Willis
University of Washington

First Presentation of ADEPT: Paul Baltes, Rosemary Blieszner, Steve Cornelius, Margie Lachman, Brian Hofland

Ray Cattell & John Nesselroade

Carolyn Nesselroade – ADEPT Coordinator
Training at Shell Point

Mike Marsiske, Carolyn Nesselroade

Manfred Diehl, Mike Marsiske, Carolyn
Plasticity in Cognitive Aging: Two Theoretical Perspective

I. Magnification Perspective

- Training would magnify individual differences (e.g. age) in cognition
- More able would exhibit greater plasticity
  • Outcome: Level of performance
- Design: Cross-sectional. Compare young & old
  • Life-span
- Intervention: Practice on task with no strategies or instruction
- Target:
  • Cognitive abilities
  • Neural plasticity precedes behavioral/cognitive change

Lindenberger, Lovden, Jaeggi, Lustig, Kuhn, Baltes, Li,
Plasticity in Cognitive Aging: Two Theoretical Perspective

I. Compensatory Perspective

- Focus on elderly, not young-old comparison
- Focus range of plasticity in elderly
- Individual differences reduced, not magnified as functioning of training – low functioning gain more
- **Design:** Treatment – control group comparison
- **Intervention:** instruction & strategies, rather than practice
- **Target:**
  - Cognitive abilities
  - Neural plasticity – low functioning may increase activation while higher functioning may decrease activation – outcomes vary with baseline level

Rebok, Marsiske, Willis, Belleville, Schaie, Gross, Parisi, Bier, Labouvie-Vief, Boron, Saczynski
Types of Behavioral Interventions

I. **Strategy training** – Compensatory Approach
   - Episodic memory (Rebok,)
   - Reasoning/Executive training (Willis,)
   - **Transfer** – transfer to tasks of same ability; limited transfer to other abilities

II. **Whole Task Practice** – Magnification Approach
   - N-back (working memory)
     - (Jaeggi, 2008; Au et al, 2015)
   - **Transfer** – considerable debate regarding transfer
Types of Behavioral Interventions

III. Component-specific & Variable Priority

– Reduce complexity of task by successively focusing on different components of task (Kramer, Boot, Bherer,)

– Adaptive training – individualized training
  • Calibrate change in item difficulty and speed

– Speed of Processing (UFOV) – variable priority
  • Ball, Edwards, Ross, Wadley

  Transfer – Transfer within multiple components. No transfer to memory or reasoning in ACTIVE trial

– Increase attention in dual task – MCI
  • Gagnon & Belleville, 2012
Types of Behavioral Interventions

IV. Multiple Domain Training – Combine Strategy & Component-Variable Priority

– MEMO (Belleville) – Utilization of multiple strategies
  • Loci, face-name, imagery
  • Pretraining on attention
  • Practice in Real life situations

V. Computer & Mobile Training: Two Approaches

1. Research-based cognitive training
2. Commercial product – casual video gaming

Boot, Charness, Kueider, Lampit, Baniqued, Basak, Voss, Kramer
Types of Behavioral Interventions

V. Computer & Mobile Training: Two Approaches

1. Research-based cognitive training
   – Enhance training via technical resources
   – Adaptive training, graphics

2. Commercial - Casual video gaming
   – Unclear specific abilities being trained by games
   – Findings not reported in High impact journals
   – Consensus reports – Express concerns
   – Lower satisfaction amg elderly users
Neuroimaging: ** Predictor of Training & ** Outcome of Training

I. Baseline Neuroimaging as **Predictor**:
   - Baseline Hippocampal volume predict Episodic memory training effects
   - Striatum volume predict Attention Control

II. Neuroimaging as Training **Outcome**:
   - Training can increase or decrease neural activation on task, depending on baseline level of activation

Belleville, Lustig, Park, Dahlin, Nyberg, Engvig, Kramer, Brehemer
Success of Cognitive Training

• Cognitive plasticity has been shown for a number of different abilities, involving a variety of intervention approaches

• Training effects have been shown for:
  – Cognitively Normal
  – MCI
  – Demented

• Training effects in normal elderly are durable
  – ACTIVE trial reported maintenance of training (compared to control) at 10-year follow-up
Issues in Behavioral Interventions

Training Success BUT:

Various Approaches Focused on Different Cognitive Domains:

– Strategy training – episodic memory, reasoning
– Whole task practice – n-back, working memory
– Component-variable priority – attention, speed of processing,

Comparisons are Difficult!

Limited comparison of training same ability with different approaches!
Current & Future Directions

• Neural – Brain Stimulation

• Training & Real World Tasks
  • Cognitive Engagement and Leisure Activities
    – Quilting, Photography (Park)
    – Senior Odyssey (Stine-Morrow)
  • Cognitive Engagement & Volunteer Activities
    – Experience Corp (Carlson, Rebok)
  • Job Training & Everyday Tasks with Seniors
    – CREATE
How to Embed Cognitive Engagement in Elderly’s Daily Life?

THE HEALTHY EATING PYRAMID

Department of Nutrition, Harvard School of Public Health

- Daily Multivitamin plus Extra Vitamin D (for most people)
- Optional alcohol in moderation (not for everyone)
- Dairy (1-2 servings a day) or vitamin D/calcium supplements
- Healthy fats/oils: olive, canola, soy, corn, sunflower, peanut, and other vegetable oils; trans-free margarine
- Whole grains: brown rice, whole wheat pasta, oats, etc.

Vegetables & Fruits

Healthy Fats/Oils

Whole Grains

Fish, Poultry & Eggs

Nuts, Seeds, Beans & Tofu

Daily Exercise & Weight Control
Nutrition & Exercise Pyramids?
Embedding Engagement in Daily Life

• What are the basic components of cognitive engagement?
  – Primary abilities?
  – Executive Functions?
  – Frequency?
  – Intensity?
  – Physical & Social Context
  – Individual Differences?
  – Personalized or Individualized?
  – What is Successful Aging?