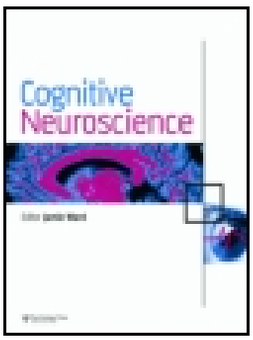

Cognitive Neuroscience

ISSN: 1758-8928 (Print) 1758-8936 (Online) Journal homepage: http://www.tandfonline.com/loi/pcns20

Training and transfer in aging – is pathway overlap really necessary?

Daniela Aisenberg, Zahira Ziva Cohen & Omer Linkovski

To cite this article: Daniela Aisenberg, Zahira Ziva Cohen & Omer Linkovski (2016): Training and transfer in aging – is pathway overlap really necessary?, Cognitive Neuroscience, DOI: 10.1080/17588928.2016.1206874

To link to this article: http://dx.doi.org/10.1080/17588928.2016.1206874

COGNITIVE NEUROSCIENCE, 2016
http://dx.doi.org/10.1080/17588928.2016.1206874

Taylor & Francis
Taylor & Francis Group

COMMENTARY

Training and transfer in aging – is pathway overlap really necessary?

Daniela Aisenberg, Zahira Ziva Cohen and Omer Linkovski

Department of Psychology, Ben-Gurion University of the Negev, Beer Sheva, Israel

ABSTRACT

Voelker et al. (this issue) discuss how training improves task speed. They suggest two constraints when exploring how training changes cognition through transfer: (1) a link between improved connectivity and response speed and (2) the transfer task should use pathways altered by training. Looking at the literature on aging, we believe the latter constraint should be reconsidered. We discuss evidence from developmental aging, questioning whether the transfer task necessarily requires using training task pathways. Additionally, we expand the discussion of state training to research on aging—specifically, the link between resting state network activity, mindfulness training, and executive functioning.

ARTICLE HISTORY
Received 5 May 2016
Published online
22 July 2016

KEYWORDS
Aging; training; executive-functions; resting state network (RSN); mindfulness

The literature on aging shows clear effects of changes in white matter on cognitive performance, but these changes cannot solely account for behavioral differences seen in reaction-time tasks (Kennedy & Raz, 2009).

The transfer effect of training in aging has been widely reviewed (Lövdén, Bäckman, Lindenberger, Schaefer, & Schmiedek, 2010; Lustig, Shah, Seidler, & Reuter-Lorenz, 2009). Many studies showed transfer effects to non-trained tasks: training complex video games improved performance on the Wechsler adult intelligence scale and tasks including mental rotation, visual change detection, and Raven's progressive matrices. Task-switching practice improved measures of switching (which might be considered near transfer) and measures of interference control, working memory, and fluid intelligence. Speed of processing training in the Advanced Cognitive Training for Independent and Vital Elderly was found to transfer and improve driving performance (Willis et al., 2006).

The question of common pathways was examined in neuroimaging studies. Some claim process-specific training can transfer and improve performance if it engages specific overlapping processing components and brain regions (Dahlin, Neely, Larsson, Backman, & Nyberg, 2008). Others point to processing efficiency change (possibly determining the magnitude of transfer effect) being a function of personal traits and brain plasticity (Lövdén et al., 2010).

In general, approaches incorporating training on multiple strategies or focusing on strategic processes applicable to many cognitive tasks (e.g., goal management) led to the greatest levels of transfer. Indications exist that protocols encouraging development of processes supporting task performance but not dictating specific strategies have a greater likelihood of transfer (Lustig & Flegal, 2008). Multimodal, more complex approaches should be developed, possibly including a social component as well as a cognitive one (e.g., participation in volunteer work). This may link the differentiated network and state trainings, and lead to better transfer effects.

Applying state training to aging, the elderly show correlation between reduced resting state network (RSN) activity and less effective executive functioning/processing speed (Damoiseaux et al., 2008).

Studies indicate mindfulness meditation training improves goal-directed attention, possibly counteracting cognitive decline associated with aging (e.g., Moynihan et al., 2013). Kurth, Cherbuein, and Luders (2015) found that long-term meditators exhibited reduced age-related hippocampal gray matter loss compared to age-matched controls. Prakash, De Leon, Klatt, Malarkey, and Patterson (2013) found individuals with higher trait-mindfulness demonstrated

CONTACT Daniela Aisenberg aisenber@post.bgu.ac.il

increased resting state functional connectivity in the posterior cingulate cortex and precuneus areas of the RSN.

Luders (2014) suggested meditation may influence brain structure and function by (1) stimulating neuroplasticity, including dendritic branching, synaptogenesis, myelinogenesis, and neurogenesis and (2) influencing brain health factors, including autonomic regulation, hypothalamic-pituitary-adrenal-axis regulation, and immune function, thereby serving a neuroprotective role. This possible link between state training and cognitive performance could explain transfer of training to non-trained tasks, even without overlapping pathways.

Research on healthy aging provides evidence for state training (e.g., mindfulness) influence on cognitive performance. Analyzing specific features/processes underlying everyday cognitive functions in healthy older adults is an ongoing methodological problem, and is required to deepen understanding of how transfer takes place. This is extremely important for interventions for the elderly, to improve their life quality and maintain cognitive abilities.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Dahlin, E., Neely, A. S., Larsson, A., Backman, L., & Nyberg, L. (2008). Transfer of learning after updating training mediated by the striatum. *Science*, *320*, 1510–1512. doi:10.1126/science.1155466

Damoiseaux, J. S., Beckmann, C. F., Arigita, E. J. S., Barkhof, F., Scheltens, P., Stam, C. J. … Rombouts, S. A. R. B. (2008). Reduced resting-state brain activity in the "default-network" in normal-aging. *Cerebral Cortex*, *18*, 1856–1864. doi:10.1093/cercor/bhm207

Kennedy, K. M., & Raz, N. (2009). Aging white-matter and cognition: Differential effects of regional variations in diffusion properties on memory, executive-functions, and speed. *Neuropsychologia*, *47*, 916–927. doi:10.1016/j.neuropsychologia.2009.01.001

Kurth, F., Cherbuin, N., & Luders, E. (2015). Reduced age-related degeneration of the hippocampal-subiculum in long-term meditators. *Psychiatry Research: Neuroimaging*, *232*(3), 214–218. doi:10.1016/j.pscychresns.2015.03.008

Lövdén, M., Bäckman, L., Lindenberger, U., Schaefer, S., & Schmiedek, F. (2010). A theoretical framework for the study of adult cognitive-plasticity. *Psychological Bulletin*, *136*, 659–676. doi:10.1037/a0020080

Luders, E. (2014). Exploring age-related brain degeneration in meditation practitioners. *Annals of the New York Academy of Sciences*, *1307*, 82–88. doi:10.1111/nyas.2014.1307.issue-1

Lustig, C., & Flegal, K. E. (2008). Targeting latent function: Encouraging effective encoding for successful memory training and transfer. *Psychology and Aging*, *23*, 754–764. doi:10.1037/a0014295

Lustig, C., Shah, P., Seidler, R., & Reuter-Lorenz, P. A. (2009). Aging, training, and the brain: A review and future directions. *Neuropsychology Review*, *19*, 504–522. doi:10.1007/s11065-009-9119-9

Moynihan, J. A., Chapman, B. P., Klorman, R., Krasner, M. S., Duberstein, P. R., Brown, K. W., & Talbot, N. L. (2013). Mindfulness-based stress-reduction for older adults: Effects on executive-function, frontal alpha asymmetry and immune function. *Neuropsychobiology*, *68*(1), 34–43. doi:10.1159/000350949

Prakash, R. S., De Leon, A. A., Klatt, M., Malarkey, W., & Patterson, B. (2013). Mindfulness disposition and default-mode-network connectivity in older adults. *Social Cognitive and Affective Neuroscience*, *8*(1), 112–117. doi:10.1093/scan/nss115

Willis, S. L., Tennstedt, S. L., Marsiske, M., Ball, K., Elias, J., Koepke, K. M., & Wright, E. (2006). Long-term effects of cognitive-training on everyday functional outcomes in older adults. *Jama*, *296*, 2805–2814. doi:10.1001/jama.296.23.2805