The Quest for Transfer

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In order to yield transfer effects, a training paradigm should:
- require the use of working memory skills
- require the use of multiple processes
- match the participants’ capacity in terms of difficulty
- discourage the generation of task-specific strategies

Training Young Adults
General Procedure (Basic Design):

- Training for 4 sessions (2/2)
- Non-trained outcome measures (transfer)

Non-trained outcome measures (transfer)

Test tasks:
- 3 Days training
- 2 Days training
- Control Group

Specific Training Effects:

Transfer Effects (WM & GF):

Dose-Response Curve:

Transfer to GF (Composite Measures):

Figure 1. Performance increase in the trained task shown separately for 4 training groups. For each session (week), the average level of n achieved by the participants is presented (y-axis) (Jaeggi et al., 2008).

Our results provide evidence of transfer from training on a demanding working memory task to various nontreated outcome (transfer) measures. This transfer resulted even though the trained task was entirely different from the outcome measure itself (e.g., transfer to visuospatial reasoning after verbal training). Furthermore, the amount of gain in intelligence critically depended on the amount of training: more training resulted in more improvement in fluid intelligence. That is, the training effect was dosage-dependent. Finally, transfer to spatial skills occurs as a function of either single visuospatial, verbal, or dual n-back training, thus, it is domain-general.

Training Older Adults

Old-old Adult Training Study
- Mean age: 80.1 years (SD = 3.6)
- 12 weeks of training, twice a week (in groups)
- 2 interventions: cognitive vs physical exercise

Young-old Adult Training Study
- Mean age: 68.1 years (SD = 2.6)

Figure 2. Standardized improvements (pre vs. post) for the control and trained groups in working memory and fluid reasoning (Jaeggi et al., 2009).

Figure 3. Gain on fluid intelligence as a function of training time following dual n-back training. The longer the training duration, the larger the gain (Jaeggi et al., 2008).

Conclusion:

Our results provide evidence of transfer from training on a demanding working memory task to various nontreated outcome (transfer) measures. This transfer resulted even though the trained task was entirely different from the outcome measure itself (e.g., transfer to visuospatial reasoning after verbal training). Furthermore, the amount of gain in intelligence critically depended on the amount of training: more training resulted in more improvement in fluid intelligence. That is, the training effect was dosage-dependent. Finally, transfer to spatial skills occurs as a function of either single visuospatial, verbal, or dual n-back training, thus, it is domain-general.

Training Typically Developing Children

N-back Training
- Mean age: 9.3 years (SD = 1.5)
- 4 week training (20 sessions)

Figure 4. Standardized improvements in various fluid intelligence measures (composite) for the control and trained groups (left: Jaeggi et al., 2010; right: Jaeggi et al., 2014).

Conclusion:

Our results with older adults demonstrate that it is possible to improve memory and fluid intelligence in in this population using an intervention targeting working memory, indicating that induced plasticity is possible even in advanced age. Further, we replicated the dose-response effect observed in young adults, as well as the domain-independent effects of n-back training.

Training Results for Older Adults

Figure 5. Training tasks (visuospatial/verbal).

Figure 6. Training and transfer tasks.

Figure 7. The gain scores for the transfer effects visualized in units of standard deviations (Buschkuehl et al., 2008).

Figure 8. Standardized gain scores for the transfer effects visualized in units of standard deviations (Seippel et al., 2013).

Figure 9. The panel on the left shows transfer to the various outcome measures. The panel in the middle illustrates performance gains in Gf as a function of training improvement (small vs large training gain vs active control). The right panel shows the long-term effects approximately 3 months after training completion (Jaeggi et al., 2011).