

## Is a Positive Human Relationship Key to Whether a Program or Intervention Improves Executive Functions?

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Approaches with more in-person interaction between trainer and trainees (especially mindfulness approaches involving movement [e.g., t'ai chi & taekwondo] and promising school programs [e.g., MindUP & Tools of the Mind]) have been more successful at improving EFs than any computerized approach.

We did the largest & most comprehensive systematic review of approaches to improving executive functions (EFs). It includes all types of approaches & all ages (179 studies reported in 193 papers from all over the world).

All studies evaluated had ≥ 1 objective behavioral EF measure besides the trained task, had a control group, & were not correlational.

4 Metrics were used for Judging a Method's Efficacy in Improving EFs

- 1) % of Studies showing Suggestive Evidence of EF Benefits more EF improvement <u>or</u> better EF post-test performance than the control group on ≥ 50% of measures
- 2) % of Studies showing CLEAR Evidence of EF Benefits more EF improvement <u>and</u> better EF post-test performance than the control group on > 67% of measures
- 3) % of EF Measures Across all Studies where Experimental Grp showed More Improvement than the Control Grp
- 4) % of EF Measures Across all Studies where Experimental Grp Performed Better at Post-test than the Control Grp

% of Studies finding	% of Studies finding	% of EF Outcome	% of EF Outcomes
even Suggestive	<b>Clear Evidence of EF</b>	Measures on which	Measures on which
<b>Evidence of EF</b>	Benefits	Exp. Grp Improved	Exp. Grp performe
Benefits	(# of studies)	more than Control	better at Post-tes
(# of studies)		Grp	than Control Grp
		(# of measures)	(# of measures)

The 3 Approaches with the Best Results for Improving EFs all involve Trainer-Trainee In-Person Interaction

Mindfulness Practices involving Movement	100% (5)	50% ( 4)	82% (11)	80% ( 5)
Promising School Programs*	67% ( 6)	40% ( 5)	53% (19)	52% (25)
Non-Computerized Cognitive Training	67% (12)	20% (10)	45% (74)	30% (61)

## All computerized cognitive training methods have produced worse EF outcomes

Cogmed Training	54% (13)	27% (11)	34% (103)	28% (69)
N-back Training	30% (10)	30% (10)	18% (72)	18% (72)
Computerized Complex Span Training	33% ( 3)	0% ( 3)	30% (10)	22% ( 9)
Task-switching Training	40% ( 5)	0% ( 5)	48% (52)	26% (43)
Other Computerized Cognitive Training (incl. Commercial Products)	45% (22)	10% (20)	33% (145)	14% (125)

<sup>\*</sup> Promising School Programs: Attention Academy, Chicago School Readiness Program (CSRP), MindUP, Montessori, PATHS, and Tools of the Mind.

Our review is: Diamond, A. & Ling, D. S. (*in press, Oct 2019*) Fundamental questions surrounding efforts to improve executive functions (including working memory). In Bunting et al. (eds), An Integrative Approach to Cognitive and Working Memory Training: Perspectives from Psychology, Neuroscience, and Human Development. Oxford Univ. Press: NYC

The trainer-trainee relationship — especially a trainer who cares deeply about the trainees & believes fervently in their ability to succeed — seems a particularly potent driver of benefits.

The 3 approaches that produced the best EF results (mindful movement practices, promising school programs, & non-computerized cognitive training) involve more in -person interaction than computerized cognitive training. NO computerized cognitive training produced EF benefits as good as those 3 approaches.

Other findings consistent with that include:

- A recent study indicates that the in-person mentoring component of Cogmed might account for more of its benefits than the computer games (de Jong & Smit, submitted).
- When Cogmed has been compared to other programs with significant trainer-trainee interaction, Cogmed & the other programs produced similar benefits (Gray et al., 2012; van der Donk et al., 2015).
- Infants exposed to 12 sessions of a person speaking a foreign language to them or seeing a video of the same person saying exactly the same things learned phonemes through the live, but not the recorded, presentation (Kuhl et al., 2003).
- Across all early childhood program worldwide, the variable most predictive of success is the caring relationship between the adults and the children (Melhuis, 2004).
- The human interaction (the conversational turns between a child & an adult in listening & responding to one another) in the context of reading produces more benefit to language development, literacy, & the maturation of Broca's Area than the reading itself (Romeo et al., 2018).

References Cited