

The Evidence for Executive Function Intervention

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Peter Isquith is co-author of the Behavior Rating Inventory of Executive Function family of instruments (BRIEF), the Tasks of Executive Control (TEC), and the Multimodal Assessment of Cognition and Symptoms (MACS), some of which may be discussed at this presentation.

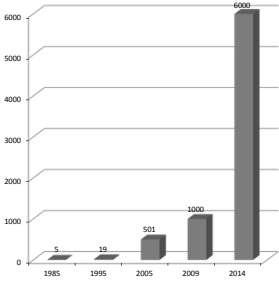
Overview

- A Brief overview of Executive Function
- General findings
- Specific intervention studies
- Collaborative Everyday Problem Solving Model

Interest in Executive Function in Children

- 5 articles in 1985
- 14 articles in 1995
- 501 articles by 2005
- >1000 articles by 2010
- >6000 articles by 2014

• Bernstein & Waber
In Meltzer (2007) *Executive Function in Education*

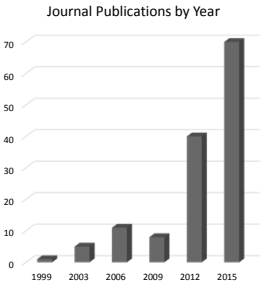


Year	Number of Articles
1985	5
1995	14
2005	501
2009	1000
2014	6000

Executive Function Intervention Studies

- 1st article in 1999
- 14 articles by 2005
- 33 articles by 2010
- 155 articles by 2015

• PsycInfo Search 11/2/2015
• "executive function" & "Clinical trial, outcome, or treatment study"



Year	Number of Publications
1999	1
2003	14
2006	33
2009	33
2012	155
2015	155

Why Improve /Enhance Executive Functions?

ASP Ψ Communiqué

EF has been described as the single best predictor of school readiness (Blair & Razza, 2007).

Moreover, EF has been implicated in numerous facets of functioning, such as academic, social, Psychological and behavioral domains (Zhou, Chen & Main, 2012).

EF is associated with the prefrontal cortex and generally develops according to age-related trends. That is, EF emerges in the first few years of life, becomes fully mature by late adolescence, and declines with normal aging (Best & Miller, 2010). It is clear that EF develops at different rates for different individuals. Research with preschool and elementary children has distinguished three central components of EF: working memory, attentional flexibility/shifting, and inhibition (Lehto, Juujarvi, Kooltra, & Puukkinen 2002). Importantly, seminal research with adults has yielded a similar 3-component model (Miyake et al., 2000). By knowing about the developmental trajectory of EF and its components, school psychologists are better equipped to identify EF deficits or delays and promote EF growth through early intervention.

Executive functions predict:

- School readiness more than IQ, reading or math (e.g., Alloway et al., 2005; Blair, 2002)
- School success from pre-k to college (e.g., Alloway & Alloway, 2010; Gathercole et al., 2010, Duncan et al., 2007).
- Achievement, health, wealth, quality of life across the lifespan, often more than IQ or SES (e.g., Moffitt et al., 2011)

What are executive functions?

Executive control is
“The orchestration of basic cognitive processes during goal oriented problem solving”

in Cognitive Psychology
 Ulric Neisser, 1967

<u>Functions of the “Orchestra”</u>	<u>Functions of the “Conductor”</u>
• Perception	• Inhibit
• Attention	• Self-Monitor
• Language processes	• Shift Flexibly
• Visual-spatial processes	• Modulate Emotions
• Memory	• Initiate
• Sensory inputs	• Working Memory
• Motor outputs	• Plan
• Knowledge & skills	• Organize
• social	• Task-Monitor
• academic	

Interventions: General Findings

REVIEW

Interventions Shown to Aid Executive Function Development in Children 4 to 12 Years Old

Adele Diamond^{1*} and Kathleen Lee²

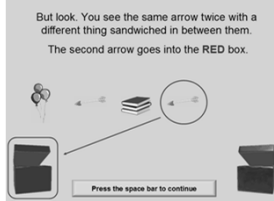
Diamond, A. & Lee, K. (2011) Science, 333
www.devcogneuro.com

Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not

Adele Diamond¹, Daphne S. Ling

Developmental Cognitive Neuroscience 18 (2016) 34–48

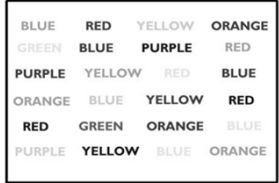

Working Memory Training



- Most studied intervention
- Narrow Transfer: Gains do not generalize beyond WM
- Some evidence of gains in classroom
- Gains maintained at six months
- Gains more limited at 1 year

Inhibition Training

- More limited success
- No evidence of transfer beyond computer


Aerobics?

- People who are more physically active and fit have better executive functions
- Meta-analyses of aerobic exercise alone in older adults showed little to no EF benefits
- 2 of 3 studies in children found little to no EF change

Martial Arts Executive Training?

Martial arts training *with mindfulness* associated with improved attention, emotion regulation, and behavior regulation vs regular PE

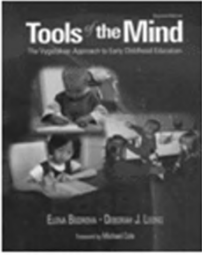
Yoga with *mindfulness* resulted in better EF



- Two studies compared groups with physical training, cognitive training, or combined
- Physical training alone did not improve EF
- Cognitive training with physical activity improved EF
 - Oswald et al., 2006; Moreau et al., 2015
- Few studies (no studies?) have examined EF benefits in sports with mindfulness

Tools of the Mind

- Preschool curriculum based on Vygotsky's notions of development
- Pretend play requires inhibition, flexibility, and working memory
- Children involved in Tools program showed better performance on range of EF tasks



- When “Tools” was used as an add-on, gains were limited and narrow
- When incorporated across the school day, gains were much larger and replicated
- BUT children with no EF risks showed minimal gains
- Children with low SES showed marked gains
– Blair & Raver, 2014; Diamond et al., 2007

- Take Aways:**
- Direct EF training may improve an EF skill in isolation but transfer is narrow
 - How an EF activity is presented is as important as the activity (i.e., coaching or mentoring)
 - EF’s need to be continually challenged
 - Those with problems benefit more
 - Training across the curriculum has greater benefit

Specific Interventions

Medication Intervention Studies using Rating Scale Measures

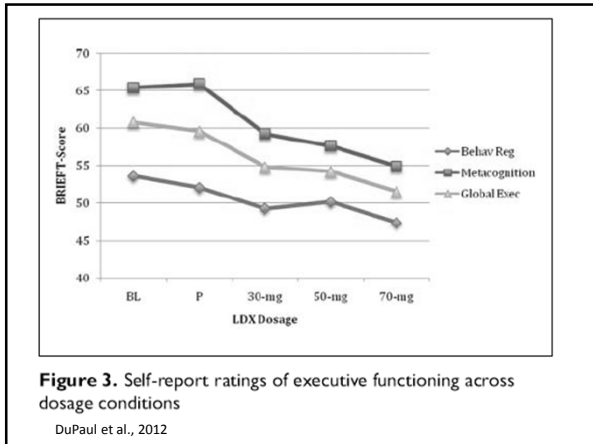
ADHD	Other
Biderman et al., 2011	Tourette’s: Cummings et al., 2002
DuPaul et al., 2012	TBI: Beers et al., 2005
Findling et al., 2009	Depression: Roth et al., 2012; Madoo et al., 2014
Maziade et al., 2009	Hypertension (Iande et al., 2010)
Turgay et al., 2010	
Yange et al., 2011	

Double-Blind, Placebo-Controlled, Crossover Study of the Efficacy and Safety of Lisdexamfetamine Dimesylate in College Students With ADHD

George J. DuPaul¹, Lisa L. Weyandt², Joseph S. Rossi², Brigid A. Vilaro¹, Sean M. O’Dell¹, Kristen M. Carson¹, Genevieve Verdi², and Anthony Swentosky²

Abstract
Objective: To evaluate stimulant medication on symptoms and functioning for college students with ADHD using double-blind, placebo-controlled, crossover design. **Method:** Participants included 24 college students with ADHD and 26 college students without psychopathology. Lisdexamfetamine dimesylate (LDX) was examined for ADHD participants over five weekly phases (no-drug baseline, placebo, 30-, 50-, and 70-mg LDX per day). Self-report rating scales of functioning and direct assessment of ADHD symptoms, verbal learning/memory, and adverse side effects were collected (baseline only for control students). **Results:** LDX was associated with large reductions in ADHD symptoms and improvement in executive functioning along with smaller effects for psychosocial functioning. Reduction in ADHD symptoms was found for 86.4% of participants; however, large differences in symptoms and executive functioning remained relative to controls. **Conclusion:** LDX is a safe, efficacious treatment for symptom relief in college students with ADHD. Research documenting medication effects on academic functioning and evaluating psychosocial/educational interventions is needed. (*J of Att. Dis.* 2012; 16(3) 202-220)

Journal of Attention Disorders
16(3) 202-222
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sagepub.com/journalsPermissions.nav
DOI: 10.1177/1063426911427299
http://jad.sagepub.com
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Effect of Lisdexamphetamine Dimesylate (Vyvanse) in Adults with Executive Dysfunction and Partial or Full remission of Major Depression

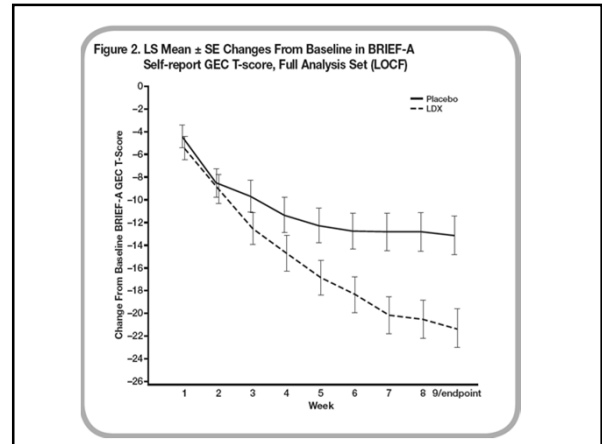
✓ DSM-IV dx of MDD- recurrent, no psychotic features

Table 1. Self-Report and Informant BRIEF-A GEC T-Scores and MADRS Total Scores Full Analysis Set (LOCF)

	LDX (n=71)	Placebo (n=72)
BRIEF-A Self-Report GEC T-score		
Baseline, mean ± SD	76.8±9.66	74.2±8.88
Endpoint, mean ± SD	55.2±16.15	61.4±14.61
LS mean (95% CI) reduction at endpoint	-21.2 (-24.5, -17.9)	-13.2 (-16.5, -9.9)
LS mean (95% CI) treatment difference	-8.0 (-12.7, -3.3)	P=0.0009
BRIEF-A Informant GEC T-Score		
Baseline, mean ± SD	63.9±10.81	63.1±11.01
Endpoint, mean ± SD*	54.8±11.85	59.6±10.71
LS mean (95% CI) reduction at endpoint	-9.3 (-11.6, -6.9)	-3.3 (-5.7, -1.0)
LS mean (95% CI) treatment difference	-5.9 (-9.3, -2.6)	P=0.0006
MADRS total score		
Baseline, mean ± SD	12.7±3.23	11.8±3.77
Endpoint, mean ± SD	7.6±6.28	8.9±5.67
LS mean (95% CI) reduction at endpoint	-5.0 (-6.3, -3.6)	-3.1 (-4.4, -1.8)
LS mean (95% CI) treatment difference	-1.9 (-3.7, 0.0)	P=0.0465

*Data are based on n=66 for LDX and n=67 for placebo.

Madhoo et al. (2014) *Neuropsychopharmacology*



Non-medication interventions using Rating Scales as Outcome Measures

Liver transplant: Sorenson et al., 2011
 Chemotherapy: Kesler et al., 2011; McDonald et al., 2013
 Corticosteroids: Mrakostsky, 2012
 Family Problem Solving: Wade et al., 2004, 2005
 Cognitive Remediation: Beck et al., 2010; Hahn-Markowitz 2011, Toglia 2010
 Flexibility in ASD: Kenworthy et al., 2014

The effects of problem-solving skills training based on metacognitive principles for children with acquired brain injury attending mainstream schools: a controlled clinical trial D. Y. K. CHAN^{1,2} & K. N. K. FONG²

- 32 children with mod-severe TBI
- 32 non-injured children
- Participated in problem solving skills training to teach metacognitive awareness and problem solving

Disability and Rehabilitation, 2011; 33(21-22): 2023-2032

Table 1. Summary of problem-solving skills training programme.

Session	Theme	Heuristics	Examples of activity
1	Paying attention	1. Minimise environmental distraction 2. Maintain attention through different sensory inputs, e.g. auditory, visual	1. Warm-up games (introducing each other) 2. Vigilance exercises, e.g. cancellation exercises 3. Home exercises – writing down their problems in real-life 4. Self-evaluation
2	Remembering and organising	1. Association 2. Grouping 3. Categorisation	1. Review of previous session 2. What's wrong? (picture card games in daily life) 3. Classifying daily objects into groups 4. Association pictures, e.g. wood/furniture, tram/ferry, ruler/watch 5. Self-evaluation 6. Home exercises – categorising daily objects at home
3 and 4	Defining the problem, gathering information and goals setting	1. Problem documentation 2. Note taking	1. Review of previous sessions 2. Treasure hunts 3. Recording information exercises, e.g. shopping in the supermarket to facilitate grouping, association and categorisation 4. Role playing: 'I am a little teacher' (identifying problems for students) 5. Reading newspapers and picking up relevant information 6. Group and self-evaluation 7. Home exercises – identifying the scenarios behind their real-life problems

Disability and Rehabilitation, 2011; 33(21-22): 2023-2032

5 and 6	Planning	1. Brainstorming 2. Think aloud 3. Means-end analysis	1. Review of previous sessions 2. Role playing: 'Being a salesman' (employing the brainstorming strategy) 3. Role playing: 'I am a detective' (employing the means-end analysis) 4. Group and self-evaluation 5. Home exercises – brainstorming solutions when they face different problems
7-10	Representing the problem	1. Visual imagery 2. Flow chart 3. Mind mapping 4. Time estimation	1. Review of previous sessions 2. 'Pictionary' game 3. Chocolate factory manufacturing line (employing the mind-mapping technique) 4. Time estimation – to make their bed and desktop 5. Planning a final group project 6. Group and self-evaluation 7. Home exercises – focussing on mind mapping and time estimation
11 and 12	Monitoring	1. Forward and backward chaining 2. Error prediction and goals checking 3. Repetition and error finding 4. Recognising limitation	1. Review of previous sessions 2. Debating (making arguments and conclusive statements) 3. Planning for a graduation ceremony (involving in organising an event and role playing) 4. Group and self-evaluation 5. Home exercises – revision of all metacomponents

Disability and Rehabilitation, 2011; 33(21-22): 2023-2032

Correspondence Training

Correspondence training is based on evidence that individuals who make a verbal commitment are more likely to follow through.

Have students verbally state goals

Meet with students to make daily plans linked to their goals.

Basic Format: R.E.A.P.

Review: go over plans from previous session to determine if carried out

Evaluate: Did the student carry out plan? If not, why not?

Anticipate: Plan tasks to accomplish today--review upcoming tests, assignments.

Plan: Have the student identify when he plans to do each task and *how* he plans to do each task.

Change in grades with coaching

	A-B	C-D
Before coaching	19	81
During coaching	63	37

Chi Square = 39.41, p < .001

Family Problem-Solving Therapy for Adolescents with TBI

- Structured development of a realistic and optimistic approach to address problems
- Parents and teens collaborate in defining a problem and identifying solutions
- Provides a problem-solving heuristic to address executive dysfunction following TBI

Kurowski, Wade, Kirkwood, Brown, Stancin & Taylor. (2013). Online problem-solving therapy for executive dysfunction after child traumatic brain injury. *Pediatrics*, 132(1), doi:http://dx.doi.org/10.1542/peds.2012-4040

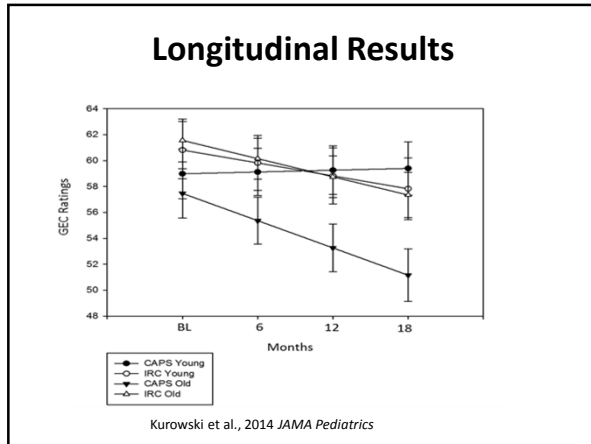
The CAPS Intervention

- 7 core sessions
 - Face-to-face introduction/overview
 - Staying Positive
 - Solving Problems
 - Dealing with Cognitive Challenges
 - Staying in Control
 - Handling Crises
 - Planning for the Future

Post-Intervention in Older Adolescents

Group	Baseline	6 month follow-up
CAPS	~80	~75
IRC	~80	~75

- GEC mean change **CAPS -4.78**, IRC -0.86 (F=6.74, p=0.01)
- Similar results for BRI and MI subscales in older adolescents (High school age)
- No significant differences in CAPS and IRC in the entire sample or younger teens



Real-World Collaborative Problem-Solving Intervention for EF in ASD

Lauren Kenworthy & Laura Anthony, Children's National

- ### Unstuck Philosophy: Principles of Remediation
1. Teach by Doing—Coaching Model: Support, Fade, Generalize
 2. Talk Less—Self-regulatory scripts
 3. Be consistent
 4. Provide visual cues
 5. Collaborate, use humor, have fun
- Ylvisaker & Feeny, 1998; Feeny & Ylvisaker, 2008

Unstuck and On Target!

Introduction	• Guide to Using This Manual	Topic 5	• Why Be Flexible?
Topic 1	• The Meaning of Flexibility	Topic 6	• Your Goals: Getting What You Want
Topic 2	• Cognitive Flexibility Defined	Topic 7	• Scripts for How to Be Flexible
Topic 3	• Coping Strategies	Topic 8	• Journey to Target Island
Topic 4	• Personal Heroes	Topic 9	• Being Flexible Makes You a Good Friend
		Topic 10	• Flexible Futures

Flexible	<ul style="list-style-type: none"> • Flexible is stronger • If I am flexible, more good things happen for me
Unstuck	<ul style="list-style-type: none"> • I'm getting stuck on __, how can I get unstuck?
Compromise	<ul style="list-style-type: none"> • Let's compromise so we both get some of what we want
Whim/On Target	<ul style="list-style-type: none"> • Is this a whim, or are we on target? • What is our target goal?
Plan A/Plan B	<ul style="list-style-type: none"> • What is our plan? • What is our Plan B?
Big Deal/Little Deal	<ul style="list-style-type: none"> • Is this a big deal or a little deal? • How can we make this big deal into a little deal?
Choice/No Choice	<ul style="list-style-type: none"> • Do we have a choice about this? • Is this a no choice situation?

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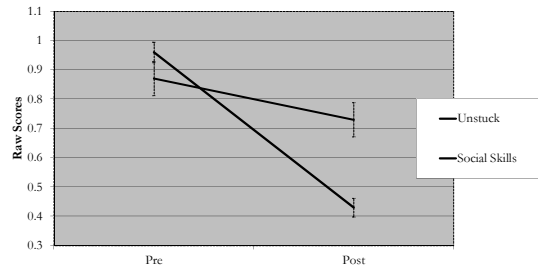
Goal <small>What do we want to do?</small>	Plan <small>How will we do it?</small>	Do <small>Let's try our plan</small>	Check <small>How did it work?</small>
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“Real World,” Well-Matched Methods

- 67 3rd-5th grade children in 14 schools randomized
- Children met full criteria for diagnosis and were already receiving services
- Existing school staff led interventions
- Interventions matched on number of sessions (28) and training:
 - Interventionists: Manual, 7 training sessions, 2 fidelity observations with feedback
 - Parents: Manual, 2 training sessions, visual supports
 - Mainstream Teachers: 1 training session, visual supports

Mean Challenge Task Flexibility

Higher score = Less flexible

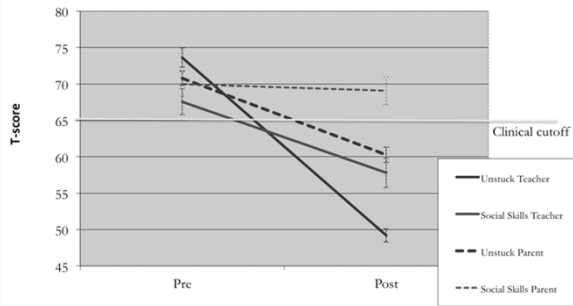


Cohens $d=-0.72$

Kenworthy & Anthony et al, 2014

Parent & Teacher BRIEF Shift

Higher score = Less flexible



Parent Cohen's $d=-0.64$; Teacher Cohen's $d=-0.89$

Summary

- Executive functions are highly predictive of near and long-term outcomes
- We *can* improve executive functions
- A coaching model across the curriculum may be most effective
- Add specific programs to address particular deficits

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