Twenty years of Assessment and Treatment with Children and Adolescents: An Evidence-Based Approach to the Executive Functions

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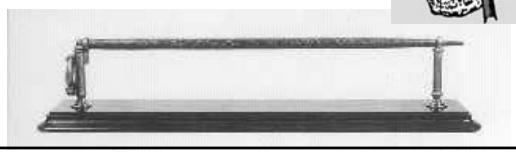
Financial Disclosure

I have **financial relationships to disclose:**

Royalty from: Psychological Assessment Resources, Inc.

Phineas Gage: Cavendish, VT 1848

- 3' tamping iron shot through left cheek and exited left frontally
- Destroyed much of left frontal lobe



Phineas Gage: A changed man

"He is fitful, irreverent, indulging at times in the grossest profanity, impatient of restraint or advice when it conflicts with his desires; at times pertinaciuously obstinate yet capricious and vascillating. His friends and acquaintances said he was no longer Gage"

Harlow, 1868

Behavior is in the Brain

Executive Functions & the Frontal Lobes: A Conceptual View

"There is no unitary executive function. Rather, distinct processes related to the frontal lobes can be differentiated which converge on a general concept of control functions."

Stuss, D.T., & Alexander, M.P. Psychological Research, 2000.

Executive function is a multidimensional construct:

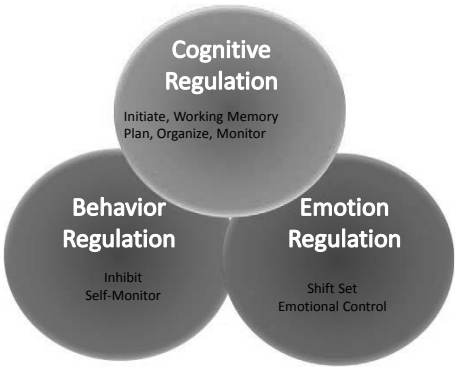
An umbrella term encompassing distinct, but interrelated, abilities that contribute to management of goal directed behaviors including inhibiting, shifting, regulation emotions, initiating, planning, organizing, and monitoring while holding goals in working memory.

Gioia, Isquith, Guy & Kenworthy, 2000

Orchestration of basic cognitive processes during goal-oriented problem-solving

Neisser, 1967

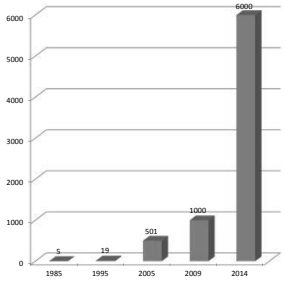
Three Factor Model



Interest in Executive Function in Children

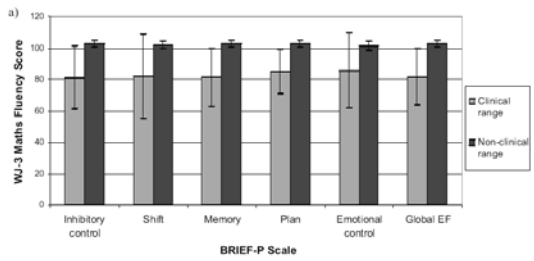
- 5 articles in 1985
- 14 articles in 1995
- 501 articles by 2005
- >1000 articles by 2010
- >6000 articles by 2014

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



Why Are Executive Functions Important?

Associations between teacher ratings on the BRIEF-P at 4 years and performance on WJ3 Math Fluency at 6 years



Clark, CA, Pritchard, VE & Woodward, LJ. (2010). Preschool executive functioning abilities predict early mathematics achievement. Developmental Psychology, 46, 1176-91.

Developmental Psychology
2014, Vol. 50, No. 10, 2369–2379
© 2014 American Psychological Association
0012-1649/14/$12.00 http://dx.doi.org/10.1037/a0037493

Relations Between Inhibitory Control and the Development of Academic Skills in Preschool and Kindergarten: A Meta-Analysis

Nicholas P. Allan, Laura E. Hume, Darcey M. Allan, Amber L. Farrington, and Christopher J. Lonigan
Florida State University

Table 1
Meta and Subgroup Analyses

Variable	Q_B (*df*)	*k*	*r*	95% CI LL	95% CI UL	*p*
Overall	347.70	85	.27	.24	.29	<.001
Inhibitory control measure	8.63 (1)	81				.003
Hot		20	.17	.12	.24	<.001
Cool		61	.28	.25	.31	<.001
Behavioral task vs. parent report	6.81(1)	87				.010
Behavioral task		75	.28	.25	.31	<.001
Parent report		12	.16	.08	.25	<.001
Behavioral task vs. teacher report	2.10 (1)	85				.147
Behavioral task		75	.28	.25	.31	<.001
Teacher report		10	.22	.13	.30	<.001

Effects of the Student Success Skills Program on Executive Functioning Skills, Feelings of Connectedness, and Academic Achievement in a Predominantly Hispanic, Low-Income Middle School District

Matthew E. Lemberger, James P. Selig, Hannah Bowers, and Jennifer E. Rogers

The authors examined the effects of the Student Success Skills program on executive functioning, feelings of connectedness, and academic achievement of a sample of 193 middle school students in a predominantly Hispanic and economically challenged school district in the southwestern United States. Using multilevel regression analyses in a two-level randomized design, the authors found treatment effects for multiple executive functioning scales, feelings of connectedness to classmates, and mathematics and reading achievement.

Cogn Ther Res (2014) 38:612–620
DOI 10.1007/s10608-014-9629-5

BRIEF REPORT

Executive Function Deficits in Daily Life Prospectively Predict Increases in Depressive Symptoms

Allison M. Letkiewicz · Gregory A. Miller · Laura D. Crocker · Stacie L. Warren · Zachary P. Infantolino · Katherine J. Mimnaugh · Wendy Heller

Behavioural ratings of self-regulatory mechanisms and driving behaviour after an acquired brain injury

Per-Ola Rike[1], Pål Ulleberg[2], Maria T. Schultheis[3], Anna Lundqvist[4], & Anne-Kristine Schanke[1,2]

Abstract

Objective: To explore whether measurements of self-regulatory mechanisms and cognition predict driving behaviour after an acquired brain injury (ABI).
Design: Consecutive follow-up study.
Participants: At baseline participants included 77 persons with stroke and 32 persons with a traumatic brain injury (TBI), all of whom completed a multidisciplinary driving assessment (MDA). A follow-up cohort of 34 persons that succeeded the MDA was included.
Baseline measurements: Neuropsychological tests and measurements of self-regulatory mechanisms (BRIEF-A and UPPS Impulsive Behaviour Scale), driving behaviour (DBQ) and pre-injury driving characteristics (mileage, compensatory driving strategies and accident rates).
Follow-up measurements: Post-injury driving characteristics were collected by mailed questionnaires from the participants who succeeded the MDA.
Methods: A MDA, which included a medical examination, neuropsychological testing and an on-road driving test, was considered in the decision for or against granting a driver's license. Self-regulatory mechanisms and driving behaviour were examined for research purposes only.
Results: At baseline, self-regulatory mechanisms were significantly associated to aberrant driving behaviour, but not with neuropsychological data or with the outcome of the on-road driving test. Aspects of self-regulation were associated to driving behaviour at follow-up.
Conclusion: It is recommended that self-regulatory measurements should regularly be considered in the driving assessments after ABI.

Performance Measures

- Verbal Fluency / Figural Fluency
- Stroop Color-Word Interference Test
- Rey-Osterrieth Complex Figure
- Tower of Hanoi / Tower of London
- Wisconsin Card Sorting Test
- Mazes
- Trail Making
- Continuous Performance Tests
- n back
- Go/No-go

Advantages of EF Performance Tests:

- Increased specificity of processes
- Increased task control and internal validity
- Decades of research on test behavior

Limitations to Performance Tests:

Performance tests tap individual components of executive function over a short time frame and not the integrated, multidimensional, relativistic, priority-based decision-making that is often demanded in real world situations

(Goldberg & Podell, 2000)

Is there another way?

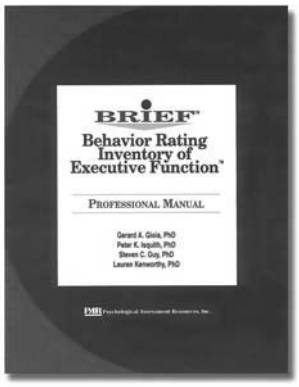
- Executive → Execute (Do it!)
- Where? Real world
- Ecological validity: predicting the everyday
- Does our everyday behavior reflect the "executive?"
- Can we measure it reliably?

1994- Recognized need for:

- external validation, ecological validity for tests
- Standardized data about everyday executive function
- Standardized parent / teacher/ self ratings
- assess multiple aspects of executive functions
- Time & cost efficiency

What's in a name

- Children's Behavior Questionnaire (*CBQ*)
- Executive Function Questionnaire (*EFQ*)
- Developmental Executive Function Test (*DEFT*)
- Behavioral Evaluation of Executive Function (*BEEF*)
- Behavioral Assessment of Regulatory Function (*BARF*)
- Planning and Organization Rating Questionnaire (*PORQ*)
- Behavioral Evaluation of Executive Regulation (*BEER*)
- Behavior Rating Inventory of Executive Function (*BRIEF*)



A BRIEF Geneology

2000 2003 2004 2005

Executive Function Rating Scales

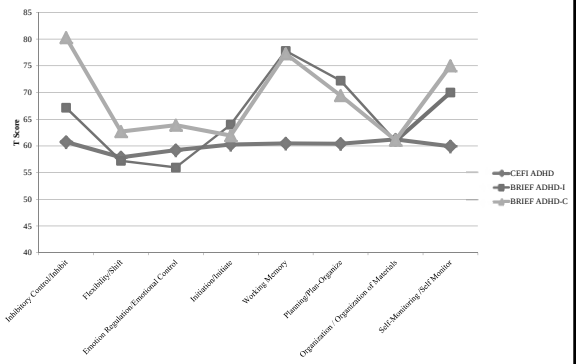
- BRIEF- Behavior Rating Inventory of Executive Function
- Frontal Systems Behavior Scale (FrSBe)
- DEX (Behavioural Assessment of the Dysexecutive Syndrome)
- DREF- Delis Ratings of Executive Function
- BDEFS-CA- Barkley Deficits in Executive Function, Child & Adolescent
- CEFI- Comprehensive Executive Function Inventory

	BRIEF	BDEFS	DREF	CEFI
Ages	2-90	5-81	5-18	5-18
Forms	PTS	P	PT	PTS
Valid Scales	8	5	3	1
Languages	>60	1	1	2
Total References	964	13	1	3
Peer-Reviewed	815	7	0	2
Clinical Trials	47	0	0	0

Selected BRIEF studies (2015):

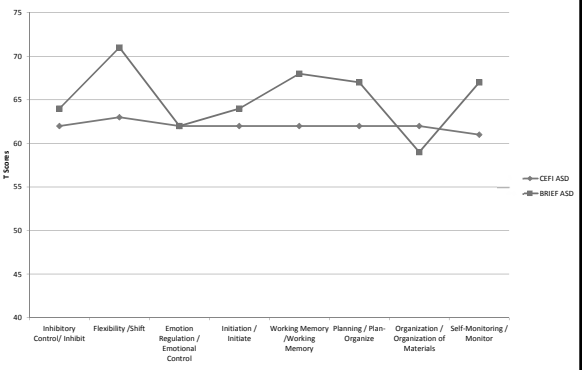
Author	Clinical Group
Gautman	BRIEF correlates with MRI in TD but not in FAS
Capdevilla	BRIEF & CBCL distinguish ADHD and Sluggish Cognitive Tempo
Willoughby	18p deletion syndrome
Winter	Late effects of Brain Tumor and ALL
McCann	BRIEF Factor Structure in very low birth weight
Sorenson	Stroop interference condition predicts BRIEF Inhibit
Hanssen	Goal attainment in therapy with MS
Kenzele	Childhood Cancer Survivor Study
Lemberger	Student Success intervention in low income primarily Hispanic schools
Kavanaugh	BRIEF in Epilepsy
Brinkman	Cancer outcomes
Mason	BRIEF sensitive to DRD4 gene in Down's Syndrome
Boivin	BRIEF factors in Malaria and HIV in Uganda
Graziano	Pre-k readiness intervention
Skogan	Pre-k Profiles of EF in Netherlands
Chevignard	Position paper on evaluation of children with brain tumor

Parent Ratings on BRIEF Scales in ADHD



Note: CEFI re-scored as T scores with M=50+/-10 to match BRIEF scores
*From CEFI Manual; **From Gioia et al., 2002 Profiles of Everyday Executive Function

Parent Ratings on CEFI & BRIEF in ASD



*From CEFI Manual; **From Gioia et al., 2002 Profiles of Everyday Executive Function

Clinical Profiles: ADHD

Validity of the EF Theory of ADHD

- 83 Studies
- 3734 ADHD vs 2969 Controls
- Effects .43 - .69
- No subtype differences
- BUT < ½ in ADHD showed impairment on any EF tasks

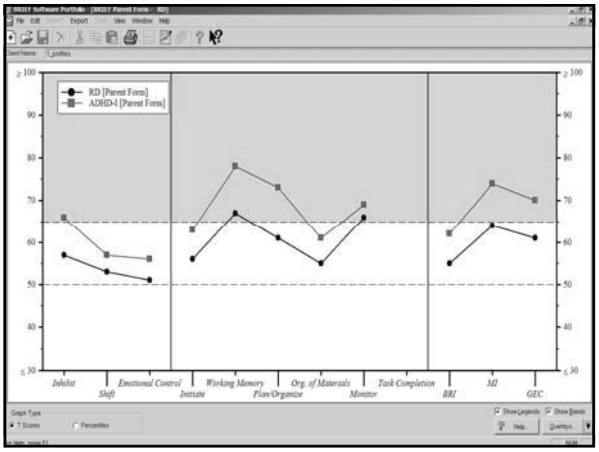
Tasks:	% Impaired
Stop signal RT	82
CPT Commissions	
CPT Omissions	77
WCST Perseveration	
Trails B time	
TOH/TOL	59
Porteus Mazes	
ROCF	
Sentence Span	
Digits Backward	

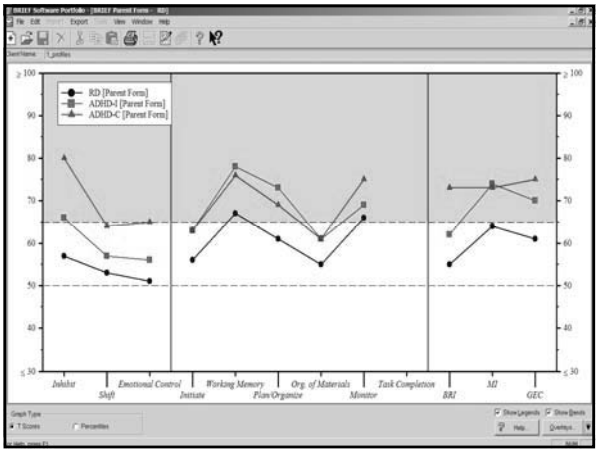
Willcutt, Doyle, Nigg, Faraone & Pennington, 2005

Profiles of Everyday Executive Function in Acquired and Developmental Disorders

Gerard A. Gioia[1], Peter K. Isquith[2], Lauren Kenworthy[1], and Richard M. Barton[3]
[1]Children's National Medical Center, Washington, DC, USA, [2]Dartmouth Medical School, Hanover, NH, USA, and [3]Dartmouth College, Hanover, NH, USA

- 34 Reading Disorder
- 27 ADHD-I
- 26 ADHD-C
- 54 ASD
- 33 Moderate TBI
- 34 Severe TBI
- 208 Controls





BRIEF-2 WM & Inhibit Predict ADHD

Classification Measure	TD vs. ADHD		ADHD-C vs. ADHD-I		
	Working Memory T≥65	Function 1[a]	Inhibit T≥65	Inhibit T≥70	Function 2[b]
Sensitivity	0.76	0.88	0.82	0.67	0.97
Specificity	0.9	0.87	0.51	0.71	0.51
PPV	0.89	0.87	0.82	0.87	0.85
NPV	0.79	0.88	0.5	0.44	0.86
Likelihood Ratio +	7.77	6.88	1.68	2.36	2
Likelihood Ratio -	0.27	0.14	0.36	0.46	0.06
Correct Hit Rate %	83.08%	87.59%	73.68%	68.42%	84.96%

[a] Function 1 = Inhibit, WM, EC

[b] Function 2 = Inhibit, Shift, Initiate

Isquith, Kenealy, Roth & Gioia, 2015
Diagnostic Accuracy of the BRIEF-2 for Children with ADHD

EXECUTIVE FUNCTIONS: PERFORMANCE-BASED MEASURES AND THE BEHAVIOR RATING INVENTORY OF EXECUTIVE FUNCTION (BRIEF) IN ADOLESCENTS WITH ATTENTION DEFICIT/ HYPERACTIVITY DISORDER (ADHD)

Maggie E. Toplak,[1] Stefania M. Bucciarelli,[2] Umesh Jain,[3] and Rosemary Tannock[4]

Table 2 Mean (*SD*) Performance in ADHD and Comparison Control Groups on Executive Function Performance-Based Tasks.

	ADHD ($n = 45$)	Controls ($n = 42$)	F	η^2
Inhibition Stop task–SSRT	2.29 (0.20)	2.19 (0.14)	8.22*	0.09
Working Memory Verbal and spatial working memory composite	19.11 (6.04)	23.71 (4.32)	16.50**	0.16
Set Shifting Trailmaking Part B time	75.40 (22.47)	59.67 (22.09)	10.82**	0.11
Planning Stockings of Cambridge standard score–Minimum number of moves for five-move problem	−1.31 (1.44)	−0.48 (1.09)	9.11*	0.10

$^{**}p < .001$, $^{*}p < .01$.

Table 3 Parent and Teacher BRIEF Ratings for ADHD and Comparison Controls.

	ADHD	Controls	F	η^2
Parent BRIEF Scales (n = 46 for ADHD group, and n = 44 for Control group)				
Inhibit Index *T*-score	67.35 (13.55)	47.27 (7.74)	73.56**	0.46
Shift Index *T*-score	64.02 (12.44)	48.05 (7.72)	52.99**	0.38
Working Memory Index *T*-score	77.15 (11.48)	48.55 (8.42)	180.29**	0.67
Plan/Organize Index *T*-score	72.35 (7.85)	49.27 (9.36)	160.95**	0.65
Teacher BRIEF Scales (n = 37 for both groups)				
Inhibit Index *T*-score	69.68 (17.95)	48.84 (8.71)	40.38**	0.36
Shift Index *T*-score	72.35 (22.10)	47.68 (7.61)	41.24**	0.36
Working Memory Index *T*-score	79.05 (16.90)	50.35 (10.71)	76.18**	0.51
Plan/Organize Index *T*-score	78.68 (17.65)	50.14 (11.54)	67.81**	0.49

$^{**}p < .001$. Standard deviation in parentheses.

Toplak et al., 2009

Clinical Profiles: ASD

Classification Accuracy of BRIEF-2 in ASD

Classification Measure	Parent		Teacher	
	TD vs. ASD [a]		TD vs. ASD [b]	
	Shift T≥65	Shift T≥70	Shift T≥65	Shift T≥70
Sensitivity	0.73	0.53	0.61	0.4
Specificity	0.93	0.96	0.94	0.99
PPV	0.91	0.93	0.92	0.98
NPV	0.77	0.67	0.71	0.62
Likelihood Ratio +	10.61	13.9	10.83	42
Likelihood Ratio -	0.29	0.49	0.41	0.61
Correct Hit Rate %	83.02%	74.62%	77.83%	69.34%

[a] n = 524; [b] n = 212;

Updated BRIEF Profiles in Children with Autism Spectrum Disorders
Y. Granader, P. Isquith, R. Dudley, L. Kenworthy, 2015

Executive functioning in individuals with a history of ASDs who have achieved optimal outcomes

Eva Troyb[1], Michael Rosenthal[2], Inge-Marie Eigsti[1], Elizabeth Kelley[3], Katherine Tyson[1], Alyssa Orinstein[1], Marianne Barton[1], and Deborah Fein[1,4]

Table 2 Performance on D-KEFS Color-Word Interference Subtest.

	HFA	OO	TD	F	p	η_p^2	Post hoc
n	43	34	34				
Completion Times:							
Color Naming	9.67 (2.99) (3–15)	10.24 (3.06) (5–15)	10.29 (3.04) (3–15)	0.51	.61	.01	
Word Reading	(3.22) (2–15)	(2.09) (7–16)	(2.45) (3–15)	4.46	.01	.08	G-H; OO>HFA
Inhibition	9.65 (3.61) (1–15)	10.06 (3.51) (1–15)	10.62 (2.4) (5–16)	0.84	.44	.02	
Inhibition/Switching	8.79 (3.19) (1–13)	9.12 (3.29) (1–15)	10.32 (1.92) (6–14)	2.83	.06	.05	TD>HFA

Child Neuropsychology 2014

Table 3 Group Performance on the D-KEFS Verbal Fluency Subtest.

	HFA	OO	TD	*F*	*p*	η_p^2	Post hoc
n	43	34	34				
Primary Measures:							
Letter Fluency	10.23 (3.14) (5–17)	11.68 (3.53) (6–19)	11.00 (3.32) (6–19)	1.83	.17	.03	
Category Fluency	10.60 (3.79) (3–19)	12.44 (3.65) (5–19)	11.06 (2.95) (6–19)	2.72	.07	.05	OO > HFA ($p = .06$)
Category Switching – Total Correct Resp.	11.12 (3.16) (3–17)	10.94 (2.86) (6–17)	11.06 (3.35) (1–19)	0.03	.97	.01	
Category Switching – Accuracy	10.57 (3.12) (4–17)	10.74 (2.61) (5–16)	11.24 (3.07) (5–17)	0.50	.61	.01	
	10.05	9.24	9.91				

Troyb et al., 2014

Table 5 Group Performance on the BRIEF.

	HFA	OO	TD	*F*	*p*	η_p^2	Post Hoc
n	38	25	32				
Inhibit	62.13 (14.72) (42–94)	51.00 (10.10) (40–72)	45.63 (7.10) (37–72)	19.02	<.001	.32	G-H: HFA > TD, OO
Shift	69.24 (13.56) (41–95)	49.60 (9.45) (38–71)	42.94 (5.97) (36–61)	59.89	<.001	.59	G-H: HFA > OO > TD
Emotional Control	61.13 (11.53) (41–89)	48.56 (9.69) (37–76)	42.88 (8.31) (36–73)	30.23	<.001	.41	G-H: HFA > TD, OO
Initiate	60.68 (11.97) (39–86)	49.04 (9.74) (35–70)	45.59 (8.16) (35–63)	20.85	<.001	.31	HFA > TD, OO
Working Memory	62.50 (11.90) (40–90)	52.72 (12.30) (36–79)	45.19 (7.74) (36–63)	22.60	<.001	.36	G-H: HFA > OO > TD
Plan/Organize	60.78 (10.59) (41–80)	48.76 (11.22) (33–77)	45.97 (7.89) (33–63)	21.54	<.001	.33	HFA > TD, OO
Org. of Materials	57.03 (9.91) (36–72)	50.44 (8.53) (37–72)	47.78 (7.22) (37–63)	10.43	<.001	.19	HFA > TD, OO
Monitor	63.95 (8.83) (47–78)	49.32 (9.50) (27–66)	46.19 (9.68) (28–68)	36.23	<.001	.45	HFA > TD, OO

Troyb et al., 2014

Parent ratings more sensitive than performance tests

It is important to note that parent report of EF revealed considerably more differences in the performance of the HFA group as compared to the other two groups, than did direct testing of EF. This discrepancy may indicate that individuals with HFA are able to demonstrate age-appropriate EF tasks under optimal testing conditions, but show difficulty with these activities in everyday situations. This discrepancy may also reflect parental bias, in that parents of individuals with ASDs may over- or underreport current symptoms relative to their prior functioning. This study would have benefitted from the inclusion of a teacher's rating on the BRIEF in order to limit parental bias and to assess EF in school settings.

Troyb et al., 2014

Clinical Profiles: TBI

BRIEF Scale Profiles in Peds TBI

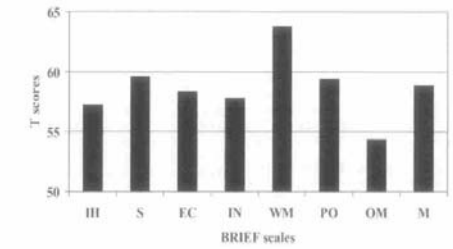


Fig. 1. Performance on BRIEF clinical scales. IH = inhibit, S = shift, EC = emotional control, IN = initiate, WM = working memory, PO = plan/organize, OM = organization of materials, M = monitor.

N = 48

Vriezen & Pigott, 2002, Child Neuropsychology

Neurobehavioral Measures in 10 Children with TBI at 12 Months post injury

TABLE 3. GROUP DIFFERENCES ON NEUROBEHAVIORAL MEASURES 12 MONTHS POST-INJURY

	TBI, mean (SD)	*OI, mean (SD)*	*p-Value*
DAS Verbal	96.0 (14.3)	98.7 (18.9)	NS
DAS Nonverbal	95.8 (15.9)	104.3 (19.0)	NS
DAS Spatial	93.4 (21.8)	101.3 (2.8)	NS
DAS General Cognitive Ability	94.5 (17.6)	101.1 (14.2)	NS
Bracken School Readiness Composite	100.9 (18.6)	108.2 (11.5)	NS
WJ Letter Word Identification	101.7 (15.8)	105.1 (13.5)	NS
WJ Applied Problems	100.2 (19.6)	104.7 (14.3)	NS
WJ Spelling	95.6 (18.3)	101.4 (10.1)	NS
CASL Pragmatics	102.7 (18.1)	104.9 (17.7)	NS
CBC Internalizing	52.1 (10.4)	45.5 (6.5)	NS
CBC Externalizing	**57.3 (9.0)**	**45.1 (7.6)**	**0.004**
BRIEF Global Executive Composite	**61.8 (10.1)**	**49.9 (11.1)**	**0.02**
Social Competence	**44.4 (12.4)**	**54.9 (6.9)**	**0.03**

Chertkoff Walz, Cecil, Wade, & Michaud, 2007, Journal of Neurotrauma

Neuroimaging Studies

Neuroimaging Correlates of BRIEF Working Memory Scale in Typically Developing Children (n = 35)

Table 3. Correlations between neuropsychological measures and volumetric MRI

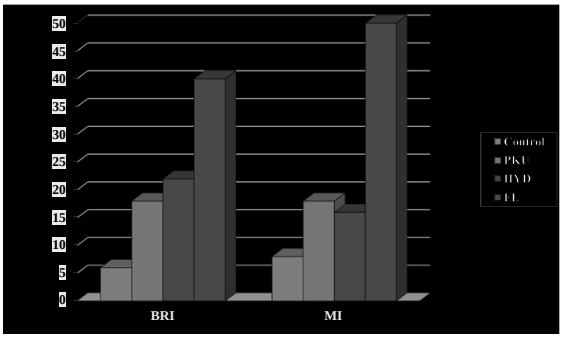
Variables	1	2	3	4
1. BRIEF Working Memory T-Score	—			
2. CBCL Anxious/Depressed T-Score	.207	—		
3. WJ-III Auditory Working Memory SS	−.279	.185	—	
4. WJ-III Spatial Working Memory SS	−.100	.043	.233	—
5. Frontal Gray	**−.463**	.035	.373	.143
6. Parietal Gray	−.216	−.132	.076	.019
7. Temporal Gray	.051	.197	.225	.087
8. Occipital Gray	.280	−.020	.041	.137
9. Frontal White	−.038	−.028	−.172	−.164
10. Parietal White	.051	−.170	−.336	−.209
11. Temporal White	.269	.026	−.297	.058
12. Occipital White	.385	.112	−.082	.085

Note. BRIEF = Behavior Rating Inventory of Executive Function; CBCL = Child Behavior Checklist; WJ-III, Woodcock Johnson III Auditory Working Memory Standard Score; SS = Standard Score. Lobar volumes are normalized to adjust for total cerebral volume. Rows 1–4 are zero-order correlations; rows 5–12 are partial correlations (correcting for age). The bolded value is $p < .01$ (two-tailed).

Mahone, Martin, Kates, Hay & Horska, 2009, JINS, 15, 31-41.

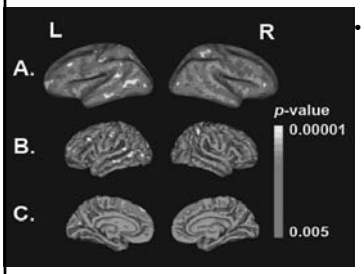
BRIEF Index Scores for Controls and Children with PKU, Hydrocephalus, and Frontal Lesions

Anderson, Anderson, Northam, Jacobs & Mikiewicz, 2002



Proportion of Children in Clinical Groups with T > 65

Diffuse Cortical Thinning Correlated with BRIEF Working Memory in Pediatric TBI



- WM correlated with:
  - Inferior temporal
  - Left fusiform
  - Superior parietal
  - Inferior Parietal

Merkley, Bigler, Wilde, McCauley, Hunter, & Levin, 2008, Journal of Neurotrauma

Behavior and corpus callosum morphology in 22q11.2 deletion syndrome

- Children with VCF had larger CC's than controls
- Children with VCF+ADHD had smaller splenium volumes than those with VCF only
- VCF+ADHD had higher BRIEF scores, $\eta^2 = .44$
- BRIEF scores correlated with splenium volume:
  - Composite r = -.70
  - Inhibit r = -.76

Antshel, Conchelos, Lanzetta, Fremont & Kates (2005). Psychiatry Research: Neuroimaging.

Executive Function and DTI in Pediatric TBI

Wozniak, Krach, Ward, Mueller et al., 2007

- Examined Fractional Anisotropy (FA) in 14 children with mild-moderate TBI vs Controls
- Higher FA = better white matter organization
- Three regions: Inferior frontal, superior frontal, supracallosal
- FA was significantly lower in all three regions for children with TBI
- Compared FA with EF tests and ratings

Test	TBI	Control	*p*
WISC-IV FS IQ	109.93 (15.74)	113.29 (9.14)	.496
VCI	108.79 (20.02)	111.43 (15.36)	.698
PRI	113.00 (18.09)	112.50 (10.63)	.930
WMI	104.93 (15.33)	106.93 (13.47)	.717
PSI	100.36 (12.47)	109.00 (8.71)	.043*
WCST Errors (SS)	97.77 (18.40)	104.15 (16.54)	.361
FAS Total Score (z)	-0.701 (0.750)	-0.575 (0.755)	.662
Stroop interference (t)	51.50 (5.79)	55.79 (5.49)	.055
Trails-B (time)	61.69 (24.06)	50.94 (16.10)	.181
Tower of London—excess moves (*z-score)*	-0.120 (0.922)	0.740 (0.360)	.004*
Trails-A (time)	25.53 (8.14)	19.96 (3.89)	.030*

BRIEF Scale

	TBI		Control		p
Emotional control	61.85	(10.07)	46.92	(8.03)	<0.001*
Inhibit	59.69	(8.57)	50.85	(9.93)	0.023*
Shift	58.69	(7.65)	49.77	(9.04)	0.012*
Initiate	60.77	(9.58)	49.23	(9.51)	0.005*
Monitor	63.46	(10.57)	47.31	(7.77)	<0.001*
Plan/organize	65.92	(11.51)	48.23	(10.18)	<0.001*
Organization of materials	56.38	(13.00)	52.31	(10.58)	0.389
Working memory	67.23	(8.96)	46.62	(7.90)	<0.001*

Executive Correlations with white matter integrity:

	Frontal	Supracallosal
• Tower of London	.40*	.52*
• Trials A time	-.58*	-.60*
• WISC-IV PSI	.24	.41*
• BRIEF Emotional Control	-.45*	-.53*

Neuroanatomical correlates of behavioral rating vs performance measures of working memory in typically developing children and adolescents

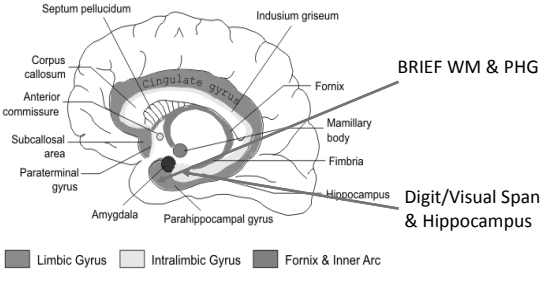
Faridi, Karama, Burgaleta, White, Evans, Fonov, Collins & Waber, NIH Brain Development Cooperative Group. (2014).

Method

- Longitudinial data from NIH MRI study
- N=347, 6-16 years, 54.3% girls
- Race, ethnicity, SES census matched
- Correlated lobar, amygdala, hippocampus, basal ganglia volumes with:
  - BRIEF WM EC INH scales
  - WISC-III Digit Span
  - CANTAB Spatial Working Memory

Faridi, Karama, Burgaleta, White, Evans, Fonov, Collins & Waber, NIH Brain Development Cooperative Group. (2014).

The Limbic System



BRIEF WM & PHG

Digit/Visual Span & Hippocampus

- Ratings and tests tap different substrate- be cautious with labels
- BRIEF WM reflects “momentary binding of items and context” in memory, thus may reflect episodic memory
- While not “working memory” per se, BRIEF WM captures important element of real world functioning not assessed on tests

Faridi, Karama, Burgaleta, White, Evans, Fonov, Collins & Waber, NIH Brain Development Cooperative Group. (2014).

Summary

- Executive function is a multimodal construct comprised of several executive functions
- Rating scales and performance tests are useful, but scales are more efficient/sensitive
- Rating scales can efficiently identify specific targets for intervention

Learning Executive Function 1965

Learning Executive Function circa 2014:

Specific Interventions

REVIEW

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

Adele Diamond[1]* and Kathleen Lee[1]

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

www.devcogneuro.com

Working Memory Training

- Most studied intervention
- 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
- Combination of WM and Inhibition training: those trained on WM did not improve on Inhibition and vice versa

Aerobics?

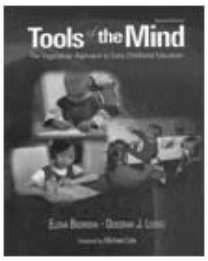
- Running improved 8-12 yr olds' cognitive flexibility and creativity but not non-EF skills
- 2 hrs fitness training improved working memory in 7-9 year olds vs controls

Martial Arts Executive Training?

Martial arts training (with mindfulness) associated with improved attention, generalized to tests and classroom

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



- Children with poor EF gain most from training
- Largest differences seen on more demanding EF tasks; Little on low demand tasks
- Must be continuously challenged; keeping status quo does not lead to improvement
- Transfer of EF benefits fairly narrow

Diamond et al, 2011

It is not <u>what</u> we do
but <u>how</u> we do it.

Adele Diamond, 2015

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 (lande 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

Journal of Attention Disorders
16(3) 202-220
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DOI: 10.1177/1087054711427199
http://jad.sagepub.com
SAGE

George J. DuPaul[1], Lisa L. Weyandt[2], Joseph S. Rossi[2], Brigid A. Vilardo[1], Sean M. O'Dell[1], Kristen M. Carson[1], Genevieve Verdi[2], and Anthony Swentosky[2]

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)*

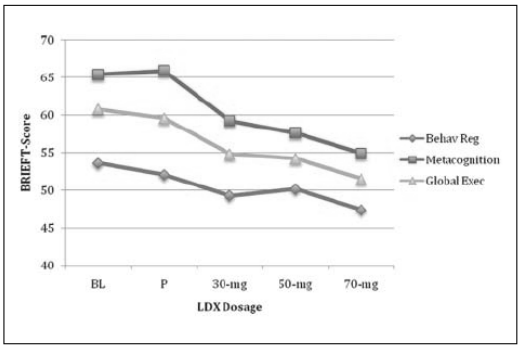


Figure 3. Self-report ratings of executive functioning across dosage conditions

DuPaul et al., 2012

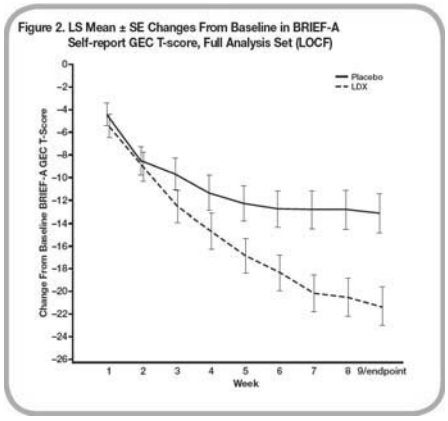
Effect of Lisdexamphetamine Dimesylate (Vyvanse) in Adults with Executive Dysfunction and Partial or Full remission of Major Depression

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*



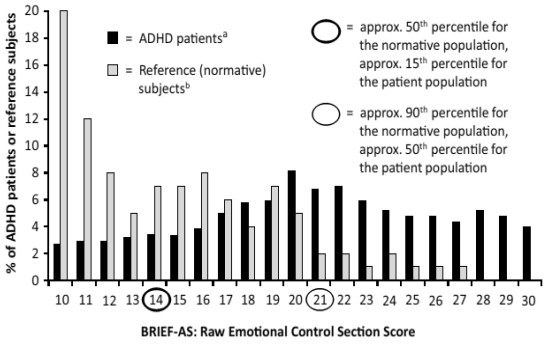
The effects of atomoxetine on emotional control in adults with ADHD: An integrated analysis of multicenter studies

P. Asherson [a,*], S. Stes [b,c], M. Nilsson Markhed [d], L. Berggren [e], P. Svanborg [f], A. Kutzelnigg [g], W. Deberdt [h]

- Emotional control recognized as a characteristic in ADHD for 100 years
- Thought to be associated with ADHD, but recent evidence suggests it may be a core symptom
- Treatment studies show emotional control responds to treatment for ADHD
- Integrated analysis of 2846 adults with ADHD treated with atomoxetine and 829 placebo controls in 10-12 week clinical studies

P. Asherson et al. / European Psychiatry 30 (2015) 511–520

BRIEF-A Emotional Control scores in ADHD vs Controls



Treatment effects in Atomoxetine vs Placebo

Table 4
Efficacy data: change from baseline to endpoint[a] in selected scales for the placebo-controlled population (LYDZ, LYEE studies), analyzed using ANCOVA.

	ATX	Placebo	*P*-value (ATX vs. placebo)
BRIEF-AS total: n	335	352	
Change from baseline, mean (95% CIs)	−21.63	−13.46	< 0.0001
	(−24.20, −19.06)	(−16.00, −10.92)	
Effect size	0.34		
BRIEF-AS Emotional control: n	338	353	
Change from baseline, mean (95% CIs)	−2.37	−1.60	0.0128
	(−2.81, −1.94)	(−2.03, −1.18)	
Effect size	0.19		
BRIEF-AS Emotional control in patients with subscores > 20: n	142	141	
Change from baseline, mean (95% CIs)	−4.73	−3.31	0.0081
	(−5.48, −3.97)	(−4.07, −2.55)	
Effect size	0.32		

P. Asherson et al. / European Psychiatry 30 (2015) 511–520

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

A Cognitive-Behavior Therapy and Mentoring Program for College Students With ADHD

Arthur D. Anastopoulos and Kristen A. King. *University of North Carolina at Greensboro*

	1	2	3	4	5	6	7	8
ADHD Knowledge	Introduction to ACCESS What is ADHD?	What causes ADHD?	Assessment of ADHD	How does ADHD affect school? Does ADHD only affect school?	Depression, anxiety, and other things that may go with ADHD Sex, drugs, and ADHD	What medications are used to treat ADHD?	Is medication the only way to treat ADHD?	A look into the future
Behavioral Strategies	Accessing resources at UNCG	Choosing tools: using a planner and notebook	Getting organized	Getting the most from classes	Studying effectively	Taking exams Managing papers and long term projects	Healthy lifestyle Handling relationships	Setting long-term goals Maintaining your skills
Cognitive Therapy	What is cognitive therapy?	Recognizing maladaptive thinking	Replacing maladaptive thinking with adaptive thinking	How can adaptive thinking help me manage ADHD and improve my school work?	Dealing with emotions and resisting harmful temptations	Sticking with treatment	Improving relations with friends and family	An "adaptive thinking" look into the future Relapse Prevention

Figure 1. Session-by-Session Outline for Group Cognitive-Behavior Therapy Component of ACCESS.

Cognitive and Behavioral Practice 22 (2015) 141-151

Table 2
Results for Measures Assessing Functional Outcome

Measure	Pretreatment *M* (*SD*)	Posttreatment *M* (*SD*)	*t*	Cohen's *d*
CAARS-S:L				
Inattention	19.40 (4.52)	15.20 (4.71)	4.81*	0.76
Hyper–Imp	13.88 (6.23)	12.33 (5.74)	1.99**	0.31
Total	33.25 (8.73)	27.55 (8.77)	3.80*	0.60
BRIEF-A				
Metacognition	93.71 (9.25)	81.15 (14.36)	4.84*	0.86
Behavioral Regulation	62.26 (9.84)	54.59 (11.15)	4.29*	0.74
Global Executive	155.97 (15.14)	135.74 (22.37)	4.97*	0.88
BDI-II	17.24 (9.93)	14.74 (11.78)	1.54***	0.27
BAI	18.47 (11.95)	15.26 (9.77)	1.99**	0.35

Note. All *t* tests performed using raw scores; CAARS-S:L = Conners Adult ADHD Rating Scale, Self-Report, Long Version; Inattentive = DSM-IV inattentive symptoms; Hyper–Imp = DSM-IV hyperactive–impulsive symptoms; Total = DSM-IV ADHD symptom total; BRIEF-A = Behavior Rating Inventory of Executive Function–Adult Version; BDI-II = Beck Depression Inventory–II; BAI = Beck Anxiety Inventory.
* $p < .001$; ** $p < .06$; *** $p < .15$.

Cognitive and Behavioral Practice 22 (2015) 141-151

N=43

The effects of problem-solving skills training based on metacognitive principles for children with acquired brain injury attending mainstream schools: a controlled clinical trial

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

D. Y. K. CHAN[1,2] & K. N. K. FONG[2]
Disability and Rehabilitation, 2011; 33(21–22): 2023–2032

Table I. 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. Homes exercises – identifying the scenarios behind their real-life problems

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

Table III. Comparison of groups in post-test scores of dependent variables.

Dependent variable		Experimental group ($n=16$) Mean (SD)	Comparison group ($n=16$) Mean (SD)	p
TONI-3	Post-test	36.94 (3.73)	21.94 (6.02)	0.000*
	Change	11.69 (7.51)	0.94 (1.95)	
BRIEF	Post-test	51.94 (3.87)	69.69 (16.44)	0.000*
	Change	−15.62 (5.34)	0.75 (2.32)	
COPM – performance				
Child's perspective	Post-test	22.88 (3.26)	15.38 (4.43)	0.000*
	Change	7.62 (2.75)	0.25 (0.86)	
Parent's perspective	Post-test	21.13 (2.71)	11.75 (4.37)	0.000*
	Change	8.38 (6.60)	0.00 (0.00)	

A Collaborative Problem-Solving Model of Everyday Executive Function Intervention

Mark Ylvisaker & Tim Feeney

- Knowledge Base
- Settings
- Delivery System
- Tool Kit

Knowledge Base

- Operational Definitions of EF
- Clinical Profiles
- Assess executive functions

Settings: Where to Intervene?

- Home
- School
- Community (Job, sports, theater, peers)

Delivery: Who Intervenes?

- Key Personnel: Mentor/ coach/ co-conductor
- "With" not "for"
- External to internal

Tool Kit

- Targeted Functional Domains
- Strategies
- Scripts/ Routines

EF Intervention

General Principles

- Teach goal-directed problem-solving process,
- within everyday meaningful routines,
- having real-world relevance and application,
- using key people as models & "coaches"

Based on the work of Mark Ylvisaker & Tim Feeney

Goal-Plan-Do-Review

GOAL

What do I want to accomplish?

PLAN

How am I going to accomplish my goal?

MATERIALS/ EQUIPMENT	STEPS/ASSIGNMENTS
1.	1.
2.	2.

PREDICTION: HOW WELL WILL I DO?

Self rating	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Other Rating	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

How much will I get done?

DO

PROBLEMS	SOLUTIONS
1.	1.
2.	2.
3.	3.

REVIEW: HOW DID I DO?

Self rating	1	2	3	4	5	6	7	8	9	10
Other rating	1	2	3	4	5	6	7	8	9	10

WHAT WORKED?	WHAT DIDN'T WORK
1.	1.
2.	2.

WHAT WILL I TRY NEXT TIME?

COACHING

Intervention strategy in which a "coach" (adult or peer) works with a student to set goals (long-term, short-term, daily) designed to enhance executive skills and lead to improved self-regulation.

Dawson, P. Guare, R. (2012). Coaching Students with Executive Skills Deficits, Guilford Press

Key Components of Coaching

- Goal-setting (long, short-term)
- Correspondence training
- Coach in daily goal-oriented plans
- Teach students self-management

Goal-Setting

Evidence shows that individuals who set goals are more likely to achieve higher levels of performance.

Have student set goals

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

Online Counselor Assisted Problem Solving (CAPS)

- 7 sessions address common consequences of TBI using a problem solving framework.
- Training in problem-solving and communication skills to address family/ teen-identified goals.
- Initial session face-to-face in family's home.
- All sessions include online module and videoconference with psychologist.

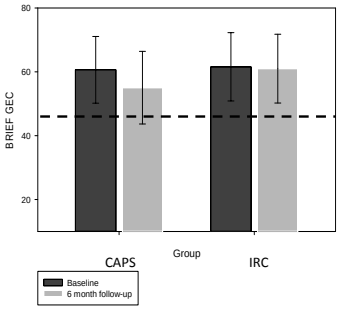
The CAPS Intervention

- 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

Study Design

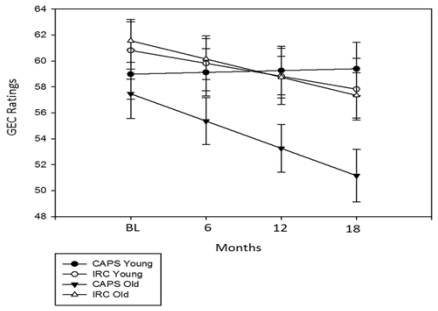
- Randomized Controlled Trial, single blind
- Multicenter cross-section study
- CAPS group (57) had web /videoconference intervention.
- Control group (63) had internet resources regarding TBI (Internet Resource Comparison; IRC)
- All received computers and high speed internet access
- Evaluators were naïve to group assignment (single blind)
- Average age at injury 14.5 years, 3.6 months post injury
- Mean GCS 10.05; 40% with severe TBI
- Outcome Measure: BRIEF

Post-Intervention in Older Adolescents



- 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

Longitudinal Results

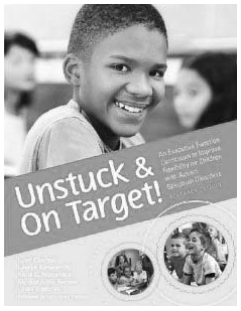


Kurowski et al., 2014 *JAMA Pediatrics*

Conclusion

- CAPS improved executive function immediately post-intervention
- benefits maintained up to 12 months in older adolescents
- Large, randomized controlled treatment trials for pediatric TBI demonstrating efficacy of an online problem solving intervention for management of executive dysfunction
- Utilization of the CAPS intervention clinically should be considered

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

Flexible	• Flexible is stronger • If I am flexible, more good things happen for me
Unstuck	• I'm getting stuck on __, how can I get unstuck?
Compromise	• Let's compromise so we both get some of what we want
Whim/On Target	• Is this a whim, or are we on target? • What is our target goal?
Plan A/Plan B	• What is our plan? • What is our Plan B?
Big Deal/Little Deal	• Is this a big deal or a little deal? • How can we make this big deal into a little deal?
Choice/No Choice	• Do we have a choice about this? • Is this a no choice situation?

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Choice/No Choice	• Do we have a choice about this? • Is this a no choice situation?

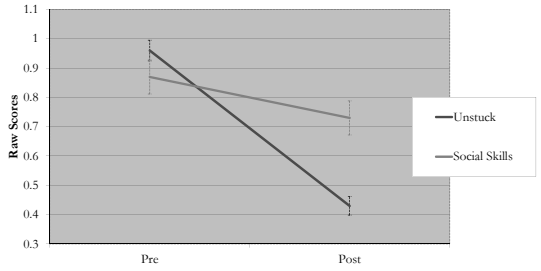
Goal What do we want to do? → **Plan** How will we do it? → **Do** Let's try our plan → **Check** How did it work?

"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

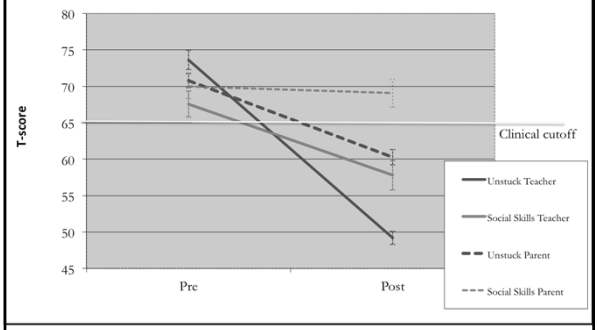


Cohens *d*=-0.72

Kenworthy & Anthony et al, 2014

Parent & Teacher BRIEF Shift

Higher score = Less flexible

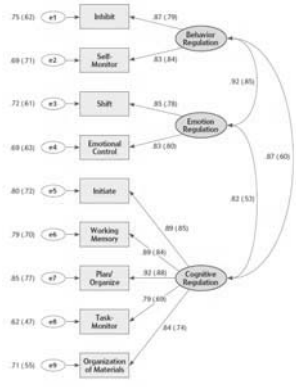


Parent Cohen's *d*=-0.64; Teacher Cohen's *d*=-0.89

Enhancements 2015

- Gender, ethnicity, parent education & geographic stratified standardization sample
- No meaningful effects of demographics
- Shorter by a quarter
- Improved empirical validity of scale and index structure
- Increased parallelism in forms
- New validity scale
- 12-item Screening forms

Parent Form Confirmatory Factor Analysis



Clinical Validity

Clinical Groups		
ADHD-Combined	ADHD/Learning Disability	Tumor
ADHD-Inattentive	ASD	Epilepsy
ADHD-Sluggish Cognitive Tempo	Neurofibromatosis type 1	Diabetes
TBI	Acute lymphoblastic leukemia	Anxiety
Learning Disability		

Representative Standardization Sample

- A large standardization sample (1,400 Parent/Teacher; 803 Self-Report) matched by age, gender, ethnicity, parent education level, and geographic region to recent nationwide population figures. 50 States are represented.

Demographic Characteristics of the BRIEF2 Standardization Sample

	N (%) or *M* (*SD*)		
	Sample		
Characteristic	Parent	Teacher	Self-Report
n	1,400	1,400	803
Gender			
Male	49.1	48.6	49.3
Female	50.9	51.4	50.7
Age (years)			
M	11.51	11.51	14.50
SD	4.03	4.03	2.29
Range	5-18	5-18	11-18
Race/ethnicity (%)			
Caucasian	56.1	61.4	65.3
African American	14.1	11.6	11.6
Hispanic	18.9	18.4	15.7
Other	10.9	8.6	7.5
Parent education level (%)			
<12	10.5	11.5	11.1
12	26.6	27.9	26.3
13-15	28.7	26.5	27.8
16+	34.2	34.1	34.9

Note. Percentages may not sum to 100% due to rounding.

Concise Scales

More concise scales that reduce respondent burden (Approximately 10 minutes)

	BRIEF			BRIEF-2		
Scale	Parent	Teacher	Self-Report	Parent	Teacher	Self-Report
Inhibit	10	10	13	8	8	8
Self-Monitor	N/A	N/A	N/A	4	5	5
Shift	8	10	10	8	8	8
Emotional Control	10	9	10	8	8	6
Initiate	8	7	N/A	5	4	N/A
Task Completion	N/A	N/A	10	N/A	N/A	7
Working Memory	10	10	12	8	8	8
Plan/Organize	12	10	13	8	8	10
Task-Monitor	N/A	N/A	N/A	5	6	N/A
Organization of Materials	6	7	7	6	5	N/A
Monitor	8	10	5	N/A	N/A	N/A
Additional Clinical Items	14	13	N/A	N/A	N/A	N/A
Infrequency	N/A	N/A	N/A	3	3	3
Total	**86**	**86**	**80**	**63**	**63**	**55**

Equivalence with BRIEF

- No new items on clinical scales, allowing for consistency of data collection between the BRIEF and BRIEF2.

Increased Sensitivity

- Items were selected for maximum performance in over 6000 clinical cases
- Increased sensitivity to executive function problems in clinical groups, such as attention-deficit/hyperactivity disorder (ADHD) and Autism Spectrum Disorders (ASD)

Parallelism in Item Content

- Increased parallelism in item content and order with most items shared between the Parent Form and Teacher Form and approximately half of the items also shared with the Self-Report Form
  - easier to compare and contrast raters.
  - base rates of rater discrepancies provided

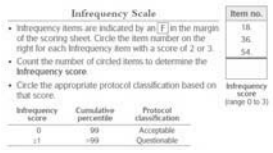
Factor Structure

- Scales supported by factor analysis
- Three indexes consistent with accepted theory: Behavior Regulation, Emotion Regulation, and Cognitive Regulation

Infrequency Scale

Helps identify unusual responding

Parent Form	Teacher Form	Self-Report Form
Forgets his/her name	Forgets his/her name	I forget my name
Has trouble counting to three	Has trouble counting to three	I have trouble counting to three
Cannot find the front door of home	Cannot find the front door of school	I cannot find the front door of my home



Infrequency Scale

- Infrequency items are indicated by an F in the margin of the scoring sheet. Circle the item number on the right for each Infrequency item with a score of 2 or 3.
- Count the number of circled items to determine the **Infrequency score**.
- Circle the appropriate protocol classification based on that score.

Infrequency score	Cumulative percentile	Protocol classification
0	99	Acceptable
≥1	>99	Questionable

Item no.
18.
36.
54.

Infrequency score (range 0 to 3)

Screening Forms

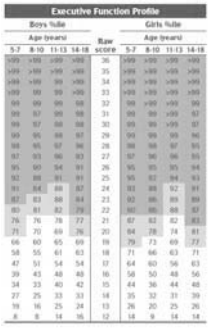
- New 12-item parallel Screening Parent, Teacher, and Self-Report Forms
- Quickly indicate whether executive function assessment is needed
- Correlate with Global Executive Composite scores < .90

Screening Forms (cont.)

- Cutoffs by normative group

  Light shading = potentially clinically elevated

  Dark shading = clinically elevated



New Statistics that Support Interpretation

- Reliable change indexes
- Interrater agreement metrics
- Base-rate tables for standardization & clinical samples
- Contingency statistics (sensitivity/specificity, Likelihood ratios)

Reliable Change

Table G.1

BRIEF2 Parent Form Reliable Change Scores by Significance Level

	Significance level				
Scale/index/composite	ns	.20	.10	.05	.01
Inhibit	0-5	6-7	8	9-11	12
Self-Monitor	0-7	8-9	10-11	12-14	15
Behavior Regulation Index	0-5	6-7	8	9-11	12
Shift	0-6	7	8-9	10-12	13
Emotional Control	0-5	6-7	8-9	10-12	13
Emotion Regulation Index	0-5	6-7	8	9-11	12
Initiate	0-5	6-7	8-9	10-12	13
Working Memory	0-3	4	5	6-7	8
Plan/Organize	0-5	6-7	8-9	10-12	13
Task-Monitor	0-7	8-9	10-11	12-15	16
Organization of Materials	0-5	6-7	8	9-11	12
Cognitive Regulation Index	0-4	5	6-7	8-9	10
Global Executive Composite	0-4	5-6	7	8-10	11

Note. ns = not significant.

Interrater Agreement Metrics

Table 3.10

Percentages of the Combined Clinical Sample With *T*-Score Differences Between BRIEF2 Parent and Teacher Form Index and Global Executive Composite Scores

T-score difference	BRIEF2 Teacher Rating			
	BRI	ERI	CRI	GEC
Parent more than 20 *T* > Teacher	7.5	12.5	9.3	9.1
Parent 10 *T* to 20 *T* > Teacher	17.7	18.4	17.9	19.3
Parent and Teacher within ± 10 *T*	54.6	53.0	58.9	57.3
Parent 10 *T* to 20 *T* < Teacher	12.1	10.8	10.2	9.6
Parent more than 20 *T* < Teacher	8.1	5.2	3.7	4.6

Base Rates – Standardization Sample

Table E.1

BRIEF2 Parent Form Base Rates of Elevated T-Scores for the Standardization Sample

	Percentage of sample[a]		
Scale/index/composite	≥70	≥65	≥60
Inhibit	5	9	16
Self-Monitor	4	8	16
Behavior Regulation Index	5	10	17
Shift	5	10	18
Emotional Control	6	10	19
Emotion Regulation Index	6	10	17
Initiate	5	9	15
Working Memory	5	10	16
Plan/Organize	4	8	16
Task-Monitor	4	8	15
Organization of Materials	5	7	14
Cognitive Regulation Index	5	9	17
Global Executive Composite	6	11	17

[a] n = 1,400.

Base Rates – Clinical Samples

Table M.1

BRIEF2 Parent Form Base Rates of Elevated T Scores for ADHD-Combined (ADHD-C) and Typically Developing (TD) Groups

	Percentage of sample					
	≥70		≥65		≥60	
Scale/index/composite	ADHD-C[a]	TD[b]	ADHD-C[a]	TD[b]	ADHD-C[a]	TD[b]
Inhibit	61	2	78	7	89	13
Self-Monitor	48	2	64	7	78	14
Behavior Regulation Index	66	3	78	7	89	14
Shift	45	1	63	8	75	14
Emotional Control	48	4	58	9	70	16
Emotion Regulation Index	49	3	65	8	76	14
Initiate	44	2	59	8	72	13
Working Memory	61	2	76	6	86	15
Plan/Organize	36	1	57	5	75	13
Task-Monitor	35	2	63	5	74	12
Organization of Materials	32	3	41	5	64	15
Cognitive Regulation Index	50	2	71	6	82	14
Global Executive Composite	66	1	80	6	91	14

[a] n = 218; [b] n = 218.

Contingency Statistics

Table F.1

BRIEF2 Parent Form Classification Measures for the Working Memory and Inhibit Scale in the ADHD Research and Clinical Samples

Classification Measure	TD vs. ADHD		ADHD-C vs. ADHD-I			
	ADHD Research Sample[a]	ADHD Clinical Sample[b]	ADHD Research Sample[c]		ADHD Clinical Sample[d]	
	Working Memory *T*>65		Inhibit *T*>65	Inhibit *T*>70	Inhibit *T*>65	Inhibit *T*>70
True positive	101	282	80	66	170	133
False positive	13	20	17	10	40	18
False negative	32	95	18	32	48	85
True negative	120	357	18	25	119	141
Sensitivity	0.76	0.75	0.82	0.67	0.78	0.61
Specificity	0.90	0.95	0.51	0.71	0.75	0.89
Positive predictive value	0.89	0.93	0.82	0.87	0.81	0.88
Negative predictive value	0.79	0.79	0.50	0.44	0.71	0.62
Positive likelihood ratio	7.77	14.10	1.68	2.36	3.10	5.39
Negative likelihood ratio	0.27	0.27	0.36	0.46	0.29	0.44
Correct hit rate %	83.08	84.75	73.68	68.42	76.66	72.68

Note. TD = typically developing.

[a] n = 266; [b] n = 754; [c] n = 133; [d] n = 377.