Moving on up to Executive Functions

Martha S Burns, Ph.D.
OSSPEAC
October, 2014

Selected References

- Burns, M. (2011) Apraxia of Speech in Children and Adolescents: Applications of Neuroscience to Differential Diagnosis and Intervention. Perspectives on Neuropsychology and Neurogenic Speech and Language Disorders. ASHA: April

Selected References (continued)

Neuroscience of Pre-Frontal Lobe Function

Brodmann's area map and colored outlines by process

Overview of Recent Neuroscience Research

The major lobes

Some reading areas

DeHaene, 2009
Dorsolateral Pre-frontal lobe

Basics: anatomy and physiology

BA 44 and 45 (and their cortical-cortical pathways) are not specific to aspects of human speech—they participate in the neural processing role shared by human and non-human primates that ultimately evolved into the human capability for speech.

The existence of area 44 and 45 in the monkey ventro-lateral frontal lobe implies fundamental role is not limited to human language, rather a general cognitive role that was adapted in humans to serve linguistic processing as well.

Ventromedial Pre-frontal Cortex
Early fMRI studies of networks: Neurons that fire together wire together in networks.
Neuronal communication system
Inferior Longitudinal Fasciculus – links vision to sound
Tracts mature at different rates

Lebel et al., 2008
Pre-frontal Lobes

- Ventromedial – includes anterior limbic system
  - Theory of mind (mentalizing) (with R TPJ)
  - Self-perception
  - Motor monitoring
  - Self-monitoring
  - Important in delayed gratification
  - Empathy
- Dorsolateral – Executive functions (cognitive control)
  - Organization, planning, flexibility
  - Task switching
  - Inhibitory control
  - Working memory
  - Processing speed

Attentional Networks for Cognitive (Executive) Control, Response Inhibition

Behavioral Self-Regulatory Functions

- VMPFC – emotional processing including:
  - Reward processing
  - Behavioral self-regulation
  - Social Cognition
Activating Regulatory Functions

- Providing initiative and energizing behavior
  - At a level appropriate to the situation
  - Appropriate to attaining individual's goals
- Limited medical pathology results in disorders of activation and drive
- Clinically known as apathy or abulia

Recruiting cognitive control. Using fMRI, Kerns et al. (Science, 2004) examined activation of the ACC and LPFC in consecutive trials of the Stroop test in human subjects. (Left) When the word presented to subjects is in a different color from the color the word denotes—an incongruent trial (i)—the resulting conflict regarding which action plan to execute induces an increase in ACC activity. (Right) When the first incongruent trial is followed by a second incongruent trial (+1), there is increased activity in the LPFC due to recruitment of cognitive control during the first trial, resulting in a shorter reaction time for the test response. The authors propose that detection of conflicts between plans of action by the ACC leads to recruitment of cognitive control in the LPFC.

Response inhibition – stroop test
REsponse inhibition – Stroop Test

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Metacognitive Processes (Stuss, 298-299, in Miller and Cummings, 2007)

- Frontal poles
  - Most recently evolved
  - Bridge self-regulatory and executive cognitive functions
    - Because of unique position to integrate EF with drive related and emotional inputs
  - Personality, social cognition, self-awareness, and intellectual consciousness

Smart but Scattered: The Revolutionary Approach to Helping Kids Reach their Potential, Peg Dawson and Richard Guare

- Advance organizer
- Ready-made plans for teaching your child to complete daily routines
- Building response inhibition
- Improving emotional control
- Strengthening sustained attention
- Promoting, planning and organizing
- Time management
- Flexibility
- Goal Direction
Smart but Scattered Teens: The “executive skills” program for helping teens reach their potential. Richard Guare, Peg Dawson and Colin Guare. The Guilford Press

- Chapters on: enhancing response inhibition, increasing emotional control, boosting flexibility, promoting planning and organizing, fostering organization, improving time management, encouraging—goal directed persistence, cultivating metacognition

Boosting Executive Skills in the Classroom, A practical guide for educators. Joyce Cooper-Kahn, Margaret Foster

- The EF Smart Classroom
- Supporting students who need more help
  - Planners
  - Materials
  - Reading
- The EF Smart School
- Planning for Change
- Online materials

Changes in Brain Structure in Maturing Young People

A little more conversation, a little less action — candidate roles for the motor cortex in speech perception

Sophie K. Scott, Carolyn McGettigan and Frank Eisner
Nature Reviews Neuroscience, April 2009

Fluency, grammar, and the Brain

The inferior frontal cortex is all about selecting and sequencing sounds in words, grammatical prefixes and suffixes, and fluency


Frontal Lobe Development of Specialized Regions During Maturation

• The Prefrontal Cortex: Functional Neural Development During Early Childhood
• Satoshi Tsujimoto
• Neuroscientist 2008; 14; 345 originally published online May 8, 2008
Plots of grey-matter density are based on data by Gogtay et al. 2004 and illustrate the local grey-matter density in the mid-dorsolateral prefrontal cortex in red, in the angular gyrus of the parietal cortex in blue, in the posterior superior temporal sulcus of the temporal cortex in purple, and in the occipital pole in green.

Frontal Lobe development depends on integrity of lower level systems

Why focus on perceptual problems? They create unstable states in the brain

- Irrelevant stimuli capture attentional resources
- They are incorrectly coded as salient or novel
- They enter into working memory, and increase activity in subcortical noradrenergic and dopaminergic systems.
- This creates an unstable state in the brain, leading to further inappropriate learning (see Mercado et al, 2001; Kilgard, 2002)
In order for prefrontal cortical operations to engage in efficient decision-making and adaptive behavior, the brain must be able to continuously make accurate predictions about the near future. These predictions rely on rapidly and accurately comparing high-fidelity perceptions of our current internal and external environments with past experiences. Vinogradav, et al2012

Activity dependent neuroplasticity (Vinogradav, 2012)

• “The prefrontal cortical association areas are uncommitted at birth, programmed to be shaped over the lifetime by the individual’s unique perceptual, cognitive, and affective experiences.”

• “This high degree of learning-dependent brain plasticity—combined with the availability of advanced computerized technology allows us to deliver well-defined and constrained learning events to the brain.”


Critical active ingredients of neuroscience-informed approach to cognitive intervention

1. precise engineering of stimuli and tasks in order to improve the speed and accuracy of relevant information processing throughout the targeted neural system(s), including lower and higher levels of processing (Ahissar, 2009)

2. Highly intensive training schedules of carefully controlled and constrained learning events along with individualized adaptation of task difficulty to drive learning and preserve reward schedules. The relevant ‘skills’ must be identified, isolated, then practiced through hundreds if not thousands of trials on an intensive (ie, quasi-daily) schedule (Roelfsema 2010)
Critical active ingredients of neuroscience-informed approach to cognitive intervention

3. In order to maximize enduring plastic changes in cortex, the learner must attend to each trial or learning event on a trial-by-trial basis and a very high proportion of the learning trials must be rewarded immediately (rather than at the end of a block of trials or on a trial-and-error basis) (Roelfsema 2010)

Vinogradav (2012)

- These studies in children show that repetitive training (implicit learning) that focuses on relatively lower-level impairments can result in clinically meaningful generalized improvements in real-world behavior and affect.

So essential to training executive functions we need to make certain the perceptual systems are intact

- Assessment of Auditory Processing impairments
- Treatment of auditory processing problems
  - Fast ForWord Language and Literacy program
  - Earobics
A meta-analysis of medial prefrontal cortex (mPFC) activations suggests that social cognition tasks, which involve person perception, and metacognitive tasks activate areas in the anterior rostral MFC (arMFC). By contrast, activations from action monitoring tasks occur in the posterior rostral region of the MFC (prMFC), and activations from tasks involving the monitoring of outcomes occur in the orbital MFC (oMFC).

ASSOCIATION PATHWAYS OF THE PREFRONTAL CORTEX

- **Early developing** - Pathways linking occipital and inferotemporal cortex with the frontal cortex
  - Inferior Longitudinal Fasciculus – ILF
  - Inferior Fronto-Occipital Fasciculus – IFO
- **Later developing** - Pathways linking the posterior parietal cortex with the frontal cortex
  - Three branches of the Superior Longitudinal Fasciculus - SFI, SFII, SFIII
  - Anterior projections of the IFO
  - Pathways linking the Superior Temporal Cortex with the frontal cortex
  - Arcuate Fasciculus - part of the SF
  - Extreme Capsule
  - Uncinate Fasciculus - UF

**Rapidly Developing Tracts**

Reach 90% of maximum FA before age 11 years
Turken and Dronkers (2010 in press) speech, fluency and grammar pathways

Buckholtz and Meyer-Lindenberg (2012) Connectomes patterns with developmental disorders

Frontoparietal

Cognitive domain
- Working memory
- Goal-directed attention
- Performance monitoring

Symptom domain
- Inattention/distractibility
- Working memory deficits
- Executive dysfunction

Buckholtz and Meyer-Lindenberg (2012) Connectomes patterns with developmental disorders

Default Mode Network

Cognitive domain
- Mentalizing (theory of mind)
- Perspective-taking
- Self-representation

Symptom domain
- Inseparability to social cues
- Attachment deficits
- Impaired empathy
Helen Neville, 2010

- Findings on the overlay of language to the motor sequences of tool use
- Video

Effects of Exercise on neurodevelopment in children *Nature Reviews Neuroscience*

Be smart, exercise your heart: exercise effects on brain and cognition

*Charles H. Hillman, Kirk J. Erickson and Arthur F. Kramer*

[January 2008 | Volume 9]
Different dimensions of adult cortical plasticity are enabled by the behaviorally-context-dependent release of:

- acetylcholine (focused attention/reward) (Kilgard, Bao)
- dopamine (reward, novelty) (Bao)
- norepinephrine (novelty) (Bollinger)
- serotonin (Bollinger)
- et alia

In infants, exposure-based plasticity is relatively uniform. In older children, learning-induced changes are complexly "nuanced" by differences in behavioral context that result in the differential release of 6 or 7 modulatory neurotransmitters.
Theory of Mind

• The Right Temporal Parietal Junction in Theory of Mind
• The Medial Pre-Frontal Lobe in Self Perception and Understanding Others
• The Relationship of Future Planning and Compassion for Others

Saxe, 2006

• The developmental trajectory from attending to:
  – Human faces and bodies (infants),
  – to understanding goal-directed actions (toddlers),
  – to the uniquely human representational theory of mind (preschoolers),
• is reflected in the functional profiles of three regions in lateral occipitotemporo-parietal cortex

Right Parietal Junction

• Research of Rebecca Saxe on the importance of the Right Parietal Junction in thinking about another person’s thoughts
  – We have been attributing theory of mind to pre-frontal lobe function but……..
  – Saxe's research points to the importance of the RPJ in Theory of Mind and Social Cognition in general
• Since children develop social skills early – see new research on intention and affiliation as early as nine months old (Bloom, Wynn, etc.) – this may be the precursor to full TOM skills that later emerge with other areas
Brain regions implicated in human social cognition. (a) Medial regions (b) Lateral regions

Detecting presence of an intentional actor - right extrastriate body area (green). Reasoning about others' representation of mental states - the right temporo-parietal junction (blue) Perceiving intentional action - posterior right superior temporal sulcus (purple). In medial prefrontal cortex, two regions are apparent: ventral MPFC associated with attributing emotion (red) and dorsal MPFC, possibly linked to reasoning about triadic relations (yellow). The posterior cingulate region, not discussed in this article but commonly recruited for social cognitive tasks, is shown in white.

Recruiting cognitive control. Using fMRI, Kerns et al. (Science, 2004) examined activation of the ACC and LPFC in consecutive trials of the Stroop test in human subjects. (Left) When the word presented to subjects is in a different color from the color the word denotes - an incongruent trial (i) - the resulting conflict regarding which action plan to execute induces an increase in ACC activity. (Right) When the first incongruent trial is followed by a second incongruent trial (i+1), there is increased activity in the LPFC due to recruitment of cognitive control during the first trial, resulting in a shorter reaction time for the test response. The authors propose that detection of conflicts between plans of action by the ACC leads to recruitment of cognitive control in the LPFC.
The social network

• Not only does language development require long LH fiber tracts that link speech perception in the temporal lobe to pre-frontal lobe regions for auditory working memory, speech accuracy, grammar and fluency

• But the social network requires long fiber tracts in the right hemisphere with very similar trajectories


Three Views of the Social Brain (A) The original view elaborated a set of brain structures originally proposed by Leslie Brothers (Brothers, 1990). (B) The current view ties subsets of these structures together into functional networks that subserve particular components of social cognition; both (A) and (B) are from Kennedy and Adolphs, 2012.

Right Hemisphere Organization for Theory of Mind and Social Skills

• Development of Facial Recognition, Voice Recognition and Social Skills

• Right vs. Left Hemisphere Organization for Object And Face Recognition

• The Right Temporo-Parietal Region and Theory of Mind

• Developmental Disorders of Theory of Mind and Social Skill Development

• Right Hemisphere Lesions – Pragmatics vs. Apraxia

• Evidence-Based Interventions
Results showing that discrimination of emotional expressions in bimodal (audiovisual) stimuli emerges earlier than discrimination of emotional expressions in unimodal auditory or visual stimuli. After habituation to happy expressions on different faces, 7-month-old infants could discriminate this expression from fearful and angry expressions when the stimuli were presented upright but not when they were inverted.

Emotion-related neural systems (the amygdala and the orbitofrontal cortex (OFC)) receive visual information from cortical regions that are involved in the visual analysis of invariant and changeable aspects of faces (face-sensitive regions in the fusiform gyrus and the posterior superior temporal sulcus (pSTS)).

The Social Sense: Susceptibility to Others’ Beliefs in Human Infants and Adults

- In a reaction time study (adults) and viewing duration (infants) using cartoons of false and true beliefs
  - show that adults and infants as young as 7 months automatically encode others’ beliefs
  - and that, surprisingly, others’ beliefs have similar effects as the participants’ own beliefs
Video: social skill development

Developmental Disorders of Theory of Mind

- Autism and Non-verbal Learning Disabilities
- Evidence-based intervention research

Mindblind Eyes: An Absence of Spontaneous Theory of Mind in Asperger Syndrome
- Atsushi Senju, Victoria Southgate, Sarah White, Uta Frith
- SCIENCE VOL 325 14 AUGUST 2009
Eye-tracking task that has revealed the spontaneous ability to mentalize in typically developing infants

In familiarization trials, participants were familiarized to an event in which (A) the puppet placed a ball in one of two boxes, (B) both windows were illuminated and chimes sounded, and (C) an actor reached through the window above the box in which the ball was placed and retrieved the ball. The participants were familiarized to the contingency between (B) and (C).

In (D), the puppet moves the ball while the actor is looking away. This operation induces a false belief in the actor about the location of the ball.

Fig. 2 (A) Mean (± SEM) DLS (19) and (B) the ratio of the number of participants who made correct first saccades in each group: AS, participants with Asperger syndrome (n = 19); NT, neurotypical participants (n = 17). *P < 0.05; **P < 0.01. Dotted lines indicate chance level. Statistical test used: (A), t test; (B), binomial test.

Interventions for TOM

- Michelle-Garcia Winner
- Brain HQ
- Mind Reading
Social Skills: Michelle Garcia Winner

- [www.socialthinking.com](http://www.socialthinking.com)

Winner’s basic approaches

- Taking perspective – she was a pioneer in working on TOM with adolescent ASD
- Humor – she believes that children with ASD need to learn to laugh at themselves
- Social Skills – unlike the social scripts she advocates developing a view of the other, how they think and what they might think of you

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**Talkabout**

1. Improving the awareness of self and others, including physical appearance, likes, dislikes and problem solving;
2. Allowing clients to assess their own communication skills;
3. Taking the client through eight levels of body language;
4. Talkabout the way we talk: improving paralinguistic skills;
5. Taking the client through the processes needed to improve conversational and listening skills;
6. Awareness and use of assertiveness skills. Practical and user-friendly, this comprehensive workbook is an essential resource for therapists running social skills groups.
Visual Thinking Strategies for Individuals With Autism Spectrum Disorders

In this groundbreaking book, Arwood, Kaulitz and Brown explore and explain how persons at different levels of sensory and cognitive functioning need visual information presented differently to facilitate their individual thinking and learning. This information helps us all (parents and professionals) to shift our perspective away from using visuals that make sense to us, to creating visuals that are designed to facilitate a student’s understanding. This book clearly demonstrates the ‘science’ behind the art!

Pathways for Learning I and II

An outstanding resource of Visual Organizers that helps children better recognize the predictable patterns within classroom language experiences.

This resource provides visual organizers for use with:
- Vocabulary and Concept Development
- Associations
- Categories
- Multiple Meaning Words
- Analogies
- Compare/Contrast
- Cause and Effect
- Literature note taking and comprehension: Organizing Story Details, Main Ideas, Story Sequence and Chapter Summaries
- Story Elements: Characterizations, Setting, Conflict, Theme Analysis, Context and Significance
- Classroom Content: Lesson Preview/Review, Topic/Lesson Summary, Outlining Notes, Unit/Chapter/Lesson Connections/Current Events, Historical People/Event Outlines, Geography Themes, Biography

T.O.M. Implications for ADHD

- Novelty seeking – norepinephrine enhancement may contagious for young children
- Outgoing nature – attractive to other children
- Open attention -
- Impulsivity – leads to interrupting others, problems with conflict management (outbursts and disinhibition)
Children and severely impaired adults -
Other higher cognitive skills

Gestalt Processing

• Understanding the main idea
• Explaining the main idea
• Synthesis of information – including part-whole relationships and categorization
• Story formation
• Planning
• Problem solving
• Gestalt in conversations – the social importance of gestalt processing

Example of story for main idea

Peter, Peggy and Jack are friends. They each have a special pet. Peter has a dog named Major. Peggy has a fish named Jenny. And Jack has a cat named Abe. Major and Abe chase each other, but Abe tries to eat Jenny. The kids all love to play with their pets.
Gestalt Processing
Story formulation

• Select topic/theme
• Select main idea
• Generate vocabulary
• Generate sentence for each vocabulary word
• Connect sentences to main idea

Mind Reading

• The Interactive Guide to Emotions - Version 1.3
• Simon Baron-Cohen
• http://www.jkp.com/mindreading/demo/index.php
Left Hemisphere Organization for Motor Planning, Motor Sequencing and Motor Monitoring

- Inferior Frontal Gyrus Development as a Bridge to Pre-Frontal Lobe Function
- Speech Development vs. Motor Skills Acquisition
- The Role of Perception in Motor Skill Acquisition
- The Role of the Mirror Mechanism in Motor Skill Acquisition

Mirror neuron system (MNS) (red) and its main visual input (yellow) in the human brain. Anterior area located in the inferior frontal cortex. A posterior area in the rostral part of the inferior parietal lobule (IPL). Together, these three areas form a core circuit for imitation.

Mirror Neuron System: Motor Planning and Motor Meaning

Children with and w/o autism on fMRI while they observed or imitated facial emotional expressions (a). Children with autism show reduced activity in (MNS) in the pars opercularis of the inferior frontal gyrus. This correlated with the severity of disorder.
But, does MNS overlap with TOM?

- Overwalle and Baetens (2009) – meta-analysis of 200 fMRI studies
- Mentalizing system is recruited when observers explicitly attend to goals or when actions are unexpected and inconsistent
  - Inconsistent or anomalous movement might be outside the perceiver’s repertoire of familiar movements, so the mirror system cannot be of help – to resolve this inferences of higher-level goals seem to be needed
  - When the perceiver reflects on a high-level intention of an action, this might engage the mentalizing system
- A decisive test could be the activation of the mirror system in verbal stories involving simple and immediate action goals

Developmental Disorders of Theory of Mind

- Autism and Non-verbal Learning Disabilities
- Evidence-based intervention research

Figure 3. Caudate pathway involved in face processing in typical adult subject (A) and in an adult with autism (B). *Bigger isn’t better – here we see a lack of efficiency*
EXECUTIVE FUNCTION IN
TRAUMATIC BRAIN INJURY

MECHANISMS OF TRAUMATIC BRAIN INJURY


Figure 5: Skull base. The skull cap has been removed, exposing the inner surface of the frontal base of the skull, with the various anatomic structures with the three cranial fossae clearly defined. The inner surface of each fossa is clearly observable. The general location of the hippocampus (medial wall of the middle cranial fossa) and where the base of the frontal lobe is located (anterior cranial fossa) are depicted. A = frontal crest; B = anterior cranial fossa; C = sphenoid body; D = petrous bone; E = parietal temporal bone; F = clival bone and base of the sella turcica; G = clivus; H = frontal magnum; I = sphenoid
Figure 6. Parasagittal plane through the long axis of the hippocampus in post-mortem. Note how the temporal pole is “ripped” and “burst” by the middle cranial fossa as well as the sharp edge of the sphenoid ridge, as it juts into the intertemporal fossa. The head of hippocampus is approximately 2 cm from the sphenoid ridge and, when brain compression occurs, can deform over the sphenoid ridge. See Figures 11 and 12. From Atlas of the Human Brain (2nd ed., p. 95) by J. K. Myllymäki, P. Pääkkönen, and J. K. Mustonen, 2004, Amsterdam: Elsevier. Copyright 2004 by Elsevier. Adapted with permission.

Tests of Executive function and Cognitive Control

Psych Batteries and Tests that can be used by SLP's
Buckholtz and Meyer-Lindenberg (2012) Connectomes patterns with developmental disorders

Cognitive domain
- Threat detection
- Affective responsiveness
- Emotion regulation
- Fear extinction

Symptom domain
- Fear/anxiety
- Illusion
- Hypervigilance
- Affective instability

Buckholtz and Meyer-Lindenberg (2012) Connectomes patterns with developmental disorders

Cognitive domain
- Behavioral flexibility
- Reinforcement learning
- Emotion-based decision-making
- Approach motivation
- Salience attribution

Symptom domain
- Impulsivity/compulsivity
- Hedonic/motivational symptoms
- Risk-taking
- Psychosis

Buckholtz and Meyer-Lindenberg (2012) Connectomes patterns with developmental disorders

Cognitive domain
- Mentalizing (theory of mind)
- Perspective-taking
- Self-representation

Symptom domain
- Inflexibility to social cues
- Attachment deficits
- Impaired empathy
Promote the capacity to:

follow classroom rules, regulate affect, sit still, and learn-on-demand through listening and watching (McClelland et al., 2007.)
Adele Diamond 2011

“Children with worse executive functions benefit most from [executive function] activities; thus, early executive-function training may avert widening achievement gaps later”

Processing, listening and reading, is enhanced by *expressive language and oral reading*

Neuronal communication system
Assessments

• Objective – isolate deficient processes and guide rehabilitation
• Most Frequently Used Include:
  – Set-shifting – Wisconsin Sort Test (WCST)
  – Planning – Trail Making Test, Part B
  – Fluency tasks
• Shown to be related to focal DLPFC lesions

Task Switching

• Card sorting
• Go/no-go [Simon says]
  – Can increase complexity to increase task switching
Card sorting

Activation Regulating Functions

- Damage to left or right medial frontal regions results in poor capacity to generate or maintain actions or mental processes
- Fluency tasks
- STROOP Test – problems maintaining a selected target
  – Sensitive to DLPFC and VMPFC lesions

Response inhibition – Stroop Test

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Other Assessments used in research that can be applied for clinical use

- Dots incongruent vs. dots congruent
- Object or picture sorting where the sorting rule is switched

Dots mixed task

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In the congruent condition, the correct response is to press the dot on the same side as the stimulus. In the incongruent condition, the response and stimulus are on opposite sides. In the mixed condition, equal numbers of congruent and incongruent trials are randomly intermixed.

Inhibition/distractibility

- Holding information in mind while inhibiting a prepotent response
  - Day-night
  - Tapping (When I tap once you tap twice)
  - Appearance-reality (clouds)
Supporting Students Who Need More Help

- Specific Interventions for Specific Targets
  - Planners
  - Materials
    - Trapper Keeper
    - Locker Organizers with weekly checks
    - Google Docs or email to self to backup
    - TIGERS folder (for younger or students with greater disabilities)
  - Reading
    - Warm-ups
    - $10 words

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Planners

- Entries for every class – including none
- Long term projects, due date entered sideways
- Long term projects, workdays assigned
  - 1-10 confidence scale for tests
    - 1 – I don’t understand material at all
    - 10 – I will ace this test
    - 8-9 ready for test
- Thursday grade checks – student asks teacher
  - Time to get missing assignments in or improve poor quality assignments
- Thursday note to teachers – “is everything in and passing? Is there anything I need to do?”
- Sunday weekly preview with parents or Friday pm weekly preview with interventionist
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From Jossey-Bass, 2013, *Boosting Executive Skills in the Classroom*

### Specific Interventions for Specific Targets - Materials

<table>
<thead>
<tr>
<th>Org of Materials</th>
<th>Planning and Org</th>
<th>Working Memory</th>
<th>Task Monitoring</th>
<th>Task Initiation &amp; Completion</th>
<th>Emotional Control</th>
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</thead>
<tbody>
<tr>
<td>Trapper Keeper w/ weekly checks</td>
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<td>Locker org w/ weekly checks</td>
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<td>Google Dac/ email to self backup</td>
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<td>TIGERS</td>
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TIGERS (Take Initiative: Get Everything Reading for School) Folders

- For younger or more severely impaired students
  - Special homework folders
  - Place daily work in one pocket and homework in the other pocket
  - Be consistent and organize every day

Specific Interventions for Specific Targets - Reading

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<tr>
<td>Warmup</td>
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<td>Reasoning</td>
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<tr>
<td>Highlight $10$ words texts</td>
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<tr>
<td>$10$ words stories</td>
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<tr>
<td>$10$ words assign.</td>
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Task Specification
- Explicit Instruction and Explanation
- Demonstration
- Lower-Order Questions

Decision Making
- Higher-Order Questions
- Feedback
- Prompts
- Think-Aloud Modeling

Direct
- Framing
- Mnemonics
- Verbal Self-instruction
- Visual Cues
- Self-Prompting

Indirect
- Mental Imagery
- Self-Instruction
- Self-Questioning
- Self-Monitoring
- Problem Solving
- Automaticity

Key Points

Learner Initiated

Four Quadrant Model, Greber et al 2007
Four Quadrant Model of Facilitated Learning


Goal Setting (Jensen & Snider, 2013)
Improving fluid intelligence with training on working memory


Proceedings of the National Academy of Sciences
May, 2008

Counting span task

• Selective attention – inhibition of yellow dots
• Holding information in mind while executing another mental option
• Updating the information held in mind on each trial
• Temporal order memory

Please count the number of grey dots aloud?

How many grey dots?
Please count the number of grey dots aloud

How many grey dots? Last time?

Please count the number of grey dots aloud

How many grey dots? Last time?

Please count the number of grey dots aloud

How many grey dots? Last time?
Working memory activities for children
Burns, 2010

• Concentration (matching cards – regular deck or Old Maid)
• N – Back tasks
  • I am going to say a letter, tell me when a letter is the same as you heard _______ back
• I am going on a trip (using alphabet or numbers)
• Scavenger hunt with a mental list
  — First find the rock with next to the dandelion
  — Then follow the arrow you find under the rock to a large tree
  — Look behind the large tree and find a clue about the bridge
  — Follow the clue to find a prize
• Following Directions – Strategies (say it to yourself), visualize what I say then follow your visual map, imagine doing it
• PT – route memory, sequential movement games
• OT - Smart Moves
• A display of toys or a list of words — remove one or more. What is missing?
• Retelling stories – plan ahead for the kind of information that will need to be retold
  — Character list, chronology, chapter headings etc.

Word Recall Exercises

Word recall requires consideration of the following:
1. Frequency of occurrence (the more common/familiar the word the easier it is to recall — common is relative to the speaker)
2. Superordinates are usually easier than subordinates – chairs vs. rocker
3. Related to fluency in general – and fluency is dependent on practice
   1. Not just practice recalling words but practice with expressive formulation in general
   2. Musical training may help APD as well as fluency
4. Reading fluency builds language fluency — written formulation builds oral fluency

• Blogspot entries
  — Play on Words
    • Multiple meanings
  — Smart Talk
    • For younger children — mealtime, bath time, dressing time
  — Potter Puzzles
    • Character names in alphabetical order by category, eg. Wizards
    • Character names in chronological order by book

Commercially available treatment materials
Group activities

- Consider adding new technology to enhance:
  - Critical thinking using the internet
    - Design a search
    - T.O.M. – use view international internet sites to learn how other nations view
      - Civil war
      - Battle of Lexington
  - Using cell phones to answer questions about news items or group activities
  - Use Google docs to compare notes

Computerized approaches

- Scientific Learning Corporation – Fast ForWord has many exercises that enhance:
  - Working memory – especially auditory-verbal
  - Planning and organization
  - Disinhibition
  - Problem solving (especially Reading 4 and 5)
- CogMed
  - Working memory – especially visual non-verbal

Approaches for children with EF disorders and ASD
Computerized Self-Ordered Pointing Task

Each time an item is touched, the screen is refreshed, and the items reappear in the same grid. However, the location of any item in the grid will have changed, so previous responses must be encoded by the appearance of the stimulus, not by location. Choosing the same spatial location repeatedly would not result in a good score.

N.Y. Times November 1, 2010

A camera operator observed Carmen and Saul Aguilar during a therapy session with their son Emilio at 7 months old. Emilio showed signs of autism, and his older brother, Diego, received a diagnosis at age 2.

By APRIL DEMBOSKY
Published: November 1, 2010
SACRAMENTO — In the three years since her son Diego was given a diagnosis of autism at age 2, Carmen Aguilar has made countless contributions to research on this perplexing disorder.