

Executive Functions and their Relationship to Sensory Integration and Self-Regulation in the Schools

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Objectives

- Participants will have gain an understanding of Executive Functioning (EF) and Self-Regulation
- Participants will become familiar with a "Model of Organization of Behavior"
- Participants will be able to apply concepts of the Model to inform their intervention
- Participants will become familiar with tools to assess EF and Self-Regulation
- Participants will become familiar with strategies and tools they can use to support EF and Self-Regulation in children

Topics to be covered

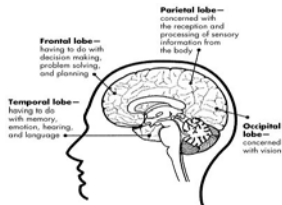
- Executive Functions (EF)
- Praxis – relationship to executive functions
- Arousal – self regulation and the relationship to executive functions
- What do we do in clinical practice

Developmental Trajectory of Executive Function

- Attentional control appears to emerge in infancy and develop rapidly in early childhood.
- Cognitive flexibility, goal setting, and information processing experience a critical period of development between 7 and 9 years of age, and are relatively mature by 12 years of age.
- Transitional period is thought to occur at the beginning of adolescence, and shortly after “executive control” is likely to emerge.

More on Executive Function...

- Executive functions gradually develop and change across the lifespan of an individual and can be improved at any time over the course of a person's life.
- Affected in a variety of diagnoses such as addiction, attention deficit hyperactivity, autism spectrum disorder, learning disabilities, etc.
- Internal control of behavior – inhibitory
- Primarily prefrontal functions, but influenced by other neurological processes



Executive Function

- Set of processes that all have to do with managing oneself and one's resources in order to achieve a goal
- Plan, organize, and complete tasks
- An umbrella term for the neurologically-based skills involving mental control and self-regulation



Definitions

Mental processes that enable us to:

- plan
- focus attention
- remember instructions
- juggle multiple tasks successfully.

The ability to:

- filter distractions
- prioritize tasks
- set and achieve goals
- control impulses (<http://developingchild.harvard.edu/science/key-concepts/executive-function/>)

EFs are adaptive, goal-directed behaviors that enable individuals to override more automatic or established thoughts and responses (Garon, 2008)

Definitions (cont.)

Cognitive Control of Behavior that Help reach a chosen goal

Includes:

- control over attention
- inhibition
- working memory
- cognitive flexibility
- reasoning
- problem solving, planning

A child with executive functioning challenges may struggle with:

- Impulse control: think before acting
- Emotional control: keep feelings in check
- Flexible thinking: adjust to the unexpected
- Working memory: keep key information in mind
- Self-monitoring: evaluate how you are doing
- Planning and prioritizing: decide on a goal and plan to meet it
- Task initiation: take action and get started
- Organization: keep track of things mentally and physically

Types of EF

3 types of executive functions

- Working memory: retain and manipulate pieces of information over short periods of time
- Mental flexibility: helps sustain and shift attention and apply different rules in different settings
- Self control: set priorities resist impulsive actions

<http://developingchild.harvard.edu/science/key-concepts/executive-function/>

Abilities included in EF

- Visualizing goals and outcomes
- Processing sensory information (integrating?)
- Perceiving time, distance/space, and force;
- Problem solving, evaluating possible outcomes and anticipating the consequences of actions
- Choosing the best action in relationship to possible outcomes, social expectations and norms
- Performing tasks necessary to carry out decisions

<https://www.verywell.com/executive-functioning-2162084>

Steps of Executive Functions

Analyze a task

Plan how to address the task

Organize the steps needed to carry out the task

Develop timelines for completing the task

Adjust or shift the steps, if needed, to complete the task

Complete the task in a timely way

<http://www.additudemag.com/adhd/article/7051.html>

Executive Functioning and Praxis Impacting Students

Executive Functions and Sensory Integration

An organizational process (Ayes, 1984)

Organization of behavior and praxis

Organization of behavior in space and time (Blanche & Parham, 2001)

A Model of Organization of Behavior and Executive Functions

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Executive Skills

(Dawson and Guare)

<http://www.smartbutscatteredkids.com/About/terms>

Response inhibition – think before acting

Emotional Control – managing emotions

Flexibility – being able to revise plans

Organization – keeping track

Planning/prioritizing – ability to plan and organize behavior

Goal directed persistence – having a goal and following to completion

Task initiation – no procrastination

Working memory – ability to hold information in memory

Stress tolerance – coping strategies

Sustained attention – maintain attention

Time management – ability to allocate time

Metacognition – self evaluation and self monitoring

Components of Organization of Behavior and their Relationship to Executive Functions

Self Regulation – Inhibition and modulation of the level of arousal → focused attention

Ideation: cognitive process that links purpose to action – goal directed behavior and flexibility

Short term and long term memory

Ability to motor plan and execute – contributes to goal directions

Space perception – visualization and space organization -

Sequencing and temporal organization – organizing the steps in an activity – time management

Interrelated Components Between SI terminology and EF terminology

SI Terminology:

- Registration
- Modulation
- Arousal
- Attention
- Regulation
- Ideation
- Motor planning
- Organization of behavior
- Self-regulation

Executive Functions:

- Emotion and self regulation
- Cognitive flexibility
- Problem solving and prioritizing
- Self monitoring
- Planning and prioritizing
- Sense of control
- Working memory
- Inhibition
- Control over attention

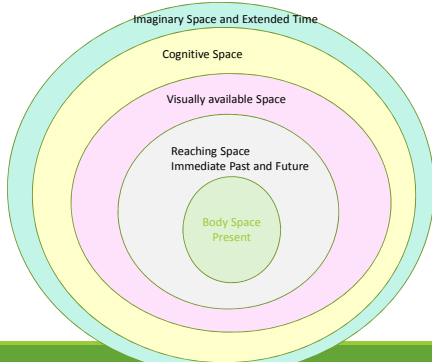
A Model of Organization

Based on Blanche and Parham, 2001

- As the child grows the organization of space and time increases in complexity.
- Organization of time
- Organization of space

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Organization of Time (Blanche, 2001)

Requires the perception of time: Time is perceived change.

Our notion of time depends on the perception of succession and duration (Frasser, 1963).

Frasser (1987): systems of time:

- biological time, represents species-specific reality of time (i.e. circadian rhythms)
- notice time or mature time – occurs through perception - clear distinction between present, past, and future - requires attention
- socio-temporal time: represents collective evaluation of time, socialization of time and shared time within a social system (Frasser, 1987)

Time and Socio-Emotional Functions

Perception of time and social goals

Cultural influences in the attitude towards time (Levine, 1997)

Perception of time, occupations, and diversional activities (Biley, 1992; Clark, 1997;)

What nervous system functions are involved in the perception of time?

Cerebellum, basal ganglia, and cortical regions

Internal timer

Intersensory perception

Temperature

Neurotransmitters

Apraxia

A disorder of chronological sequence (Goody, 1988)

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SUMMARY

In order to adapt to temporal constraints one needs to:

- perceive succession and duration through the sensory systems
- organize this information to give a clear sense of present in relation to past and future
- organize these aspects of time within the socio-cultural milieu

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Organization of Space

Euclidian spaces with distinct neural representations

- Body space, body surface, body percept
- Grasping space: space surrounding the individual
- Distal space: space that extends beyond grasping, but that can be seen

Cognitive space: representation of space in the brain. Includes all of the Euclidian spaces and space not visually available

Experiential space: a type of cognitive space dependent on experience continually remade by human activity. Requires to take temporal dimension into consideration and adds the dimension of meaning to cognitive space

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A Model of Organization

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First Level: Body space in the present

Space organized: The body and its boundaries

Temporal constrains organized: The present

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First 6 Months of Development (Blanche, 1998)

Development of body scheme through body exploration and simple movements in space

Increased control over head and trunk musculature

Appearance of intention and immediate anticipation of an action.

Basic imitation skills

Biological/circadian sleep/wake rhythms

Oral motor patterns

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2nd Level: Reach Space in Proximal Time

Space organized: reaching space

Temporal constrains organized: Immediate past and future

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2nd Level : Reaching

Sit down activities with a purpose
Copying/Imitating
Completing a fine motor task
Organizing the desk
Organizing dressing activity – pictures, lists
Examples: falling and getting back

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Third Level: Moving Through Visually Available Space and Time

Space organized: Visually available space

Temporal constrains: Immediate past and future

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Third Level: Visually Available Space (6 – 12 months)

- Refinement of sensory discrimination abilities
- Consistent evidence of intention
- Object permanence or maintaining a visual representation of an object (emergence of ideation)
- ability to relate one object to another as a precursor to constructional praxis
- Mobility in space through rolling, crawling and later walking which facilitates the development of space perception
- Copying/imitating

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Third Level: Visually Available Space

- Control the size of the visually available space to help organization
- Ideation – motor planning -
- Hold goals in memory while moving in space (falling and getting back)
- Recount past experiences
- Providing visual assistance to move in space (pointing)
- Example: the egg hunt, obstacle courses

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Fourth Level: Moving Through Cognitive Space in Extended Time

- Space organized: familiar cognitive space
- Temporal constrains organized: extended time (a day)

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4th Level – Cognitive Space and Extended Time

- Visualization –
- Use of simple maps of familiar space
- Organize daily routine (chunking)
- Plan future events – what will you do when you get home?
- Organize past experiences in temporal order (what did you do today?)
- Organize spatially – boxes, colors

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Fifth Level: School Age

- Writing a story
- Math and other academic skills
- Organization of behavior Ex. organizing homework
- Organizing the daily routine

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Fifth Level: Imagining Action in Distant Time

- Space organized: Cognitive space and imaginary spaces
- Temporal constrains organized: distant future

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Summary

As the child grows the organization of space and time increases in complexity.

Organizing space may play a role in establishing a gestalt or part whole relationship of the environment.

Organizing time plays a role in ordering the parts to the whole in a sequential meaningful manner.

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Tools and Strategies

Assessment

Difficult to assess because of its complexity – no pure assessment of specific EF

There are several rating scales (by proxy) which do not correlate with performance based tools

Few standardized performance based tools

Performance based test might have little ecological validity

Predictive validity is unclear

Young, Gurm & O'Donnell, 2017

Assessment Tools

Measuring Multiple Aspects

- Behavior Rating Inventory of Executive Functioning (BRIEF) (rating scale)(5 – 18)
- Behavior Rating Inventory of Executive Functioning (BRIEF) preschool version. (3-5)
- NEPSY II (Attention and executive function performance test) (3 -16)

Measuring Planning

- NEPSY II subtests (tower, clock) (performance tests)

Measuring inhibitory Control (computer tests)

- Conners Continuous Performance Test (8+)
- Conner's Kiddie (4-5)

Assessment Tools Continued...

- Performance Based Assessments e.g. Weekly Calendar Planning Activity (WCPA), a performance-based measure of executive function (EF)

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<http://www.additudemag.com/adhd/article/7051.html>

Intervention Approaches

Bierman, 2017

- Direct training and practice (computer)
- Improving teacher-child relationship
- Fostering the power of play (symbolic play, socio-dramatic play)
- Promoting socio emotional learning (Emotion regulation and social problem solving)
- Physical aerobic movement (but also refuted as just exercise, rather than planned/novel movement – movement with thought)
- Parenting Intervention (self regulation)

Other Intervention Approaches

Training specific functions

Movement with thought (Diamond, 2015)

- Occupational therapy interventions
 - Sensory Integration focusing on organization of behavior
 - Environmental strategies

<https://www.verywell.com/executive-functioning-2162084>

Give clear step-by-step instructions with visual organizational aids. Children with executive functioning disorders may not make logical leaps to know what to do. Be as explicit as possible with instructions. Use visual models and hands-on activities when possible. Adjust your level of detail based on the student's success.

Use [planners, organizers, computers, or timers](#).

Provide visual schedules and review them at least every morning, after lunch, and in the afternoon. Review more frequently for people who need those reminders.

Pair written directions with spoken instructions and visual models whenever possible.

If possible, use a daily routine.

Create checklists and "to do" lists.

Use [positive reinforcement](#) to help kids stay on task.

Break long assignments into smaller tasks and assign mini-timelines for completion of each. If children become overwhelmed with lists of tasks, share only a few at a time.

<https://www.verywell.com/executive-functioning-2162084>

Use visual calendars or wall planners at to keep track of long term assignments, deadlines, and activities.

Adults and teens may find time management planners or software such as the Franklin Day Planner, Microsoft Outlook calendar and task lists, or Palm Pilot helpful. If possible, try before you buy to ensure effectiveness.

[Organize the work space](#), and minimize clutter on a weekly basis.

Consider having separate work areas with complete sets of supplies for different activities. This reduces time lost while searching around for the right materials for a task.

Try to keep your strategies consistent across classrooms, at home, or in the workplace. People with executive functioning disorders are more likely to do well when their routines are similar in different settings.

Effects of Physical Exercise on Executive Functions: Going beyond Simply Moving to Moving with Thought

Ann Sports Med Res. Author manuscript; available in PMC 2015 May 19.

Adele Diamond* Department of Psychiatry, University of British Columbia, Canada

Abstract

Studies of the cognitive benefits of physical activity need to move beyond simple aerobic activities that require little thought (treadmill running, riding a stationary bicycle, or rapid walking) and resistance training. Many studies have looked at this in older adults, and the evidence points strongly to those activities having little or no cognitive benefit, certainly little or no improvement to the executive functions that depend on prefrontal cortex. There is encouraging evidence for other types of physical activity improving executive functions; however they have received far less study.

Effects of Exergaming on Executive Function and Motor Skills in Children With Autism Spectrum Disorder: A Pilot Study

American Journal of Occupational Therapy, January/February 2014, Vol. 68, 57-65.
doi:10.5014/ajot.2014.008664

Abstract:

Findings suggest that use of exergaming, specifically the Makoto arena, has the potential to be a valuable addition to standard intervention for children with ASD who have motor and EF impairments.

Optimize the Classroom Environment to Support Participation

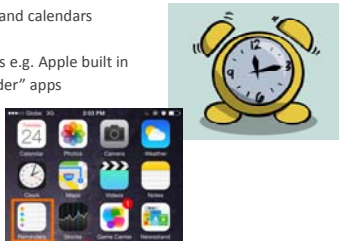
- o Reflect on the sensory characteristics of the classroom environment: auditory, visual, tactile/kinesthetic & movement
- o How do the sensory features of the classroom affect the students' alertness states?
- o What are some sensory barriers that students may encounter in a classroom?

Optimize the Classroom Environment to Support Participation

- o Modify the physical, sensory, and temporal environments
- o Embed sensory experiences in curricular activities and daily routines
- o Reduce extraneous stimuli

What strategies do you use to support EF?

- Alarms and calendars
- List apps e.g. Apple built in "reminder" apps
- Maps



Apps to Support EF

FTVS (First then visual schedule)	Good Karma Applications, Inc
Good Habit Maker	Jaidev Soin
Lickety Split	Swirly Studios LLC
Chore Monster	Choremonster, LLC
Choiceworks	Bee Visual LLC
CanPlan	University of Victoria
iLife App bundle	Apple

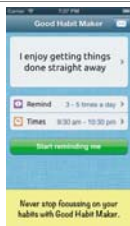
Apps to Support EF



Choiceworks

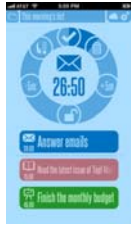


Apps to Support EF



Evernote

Apps to Support EF



Idea Sketch

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Wrap up

QUESTIONS AND ANSWERS

Thank-you!

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