

Executive Functions and Classroom Learning and Production

Presented by

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What Are Executive Functions?

- ❖ Directive capacities of the mind
- ❖ Multiple in nature, not a single capacity
- ❖ Cue the use of other mental abilities
- ❖ Direct and control perceptions, thoughts, actions, and to some degree emotions
- ❖ Part of neural circuits that are routed through the frontal lobes

Are Executive Functions and Intelligence the Same?

- ❖ Broad theoretical definitions implicitly or explicitly include executive control processes as part of “Intelligence”
- ❖ Narrow theoretical definitions often include executive functions implicitly as part of problem-solving or reasoning in “Intelligence”

Are Executive Functions and Intelligence the Same?

❖ Example of a narrow definition of intelligence:

“The ability to carry on abstract thinking.”

(L.M. Terman)

Are Executive Functions and Intelligence the Same?

- ❖ Example of a broad definition of intelligence:

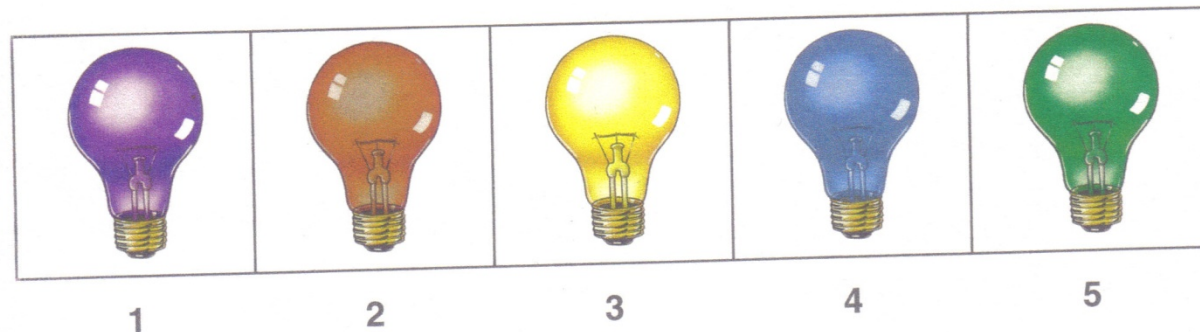
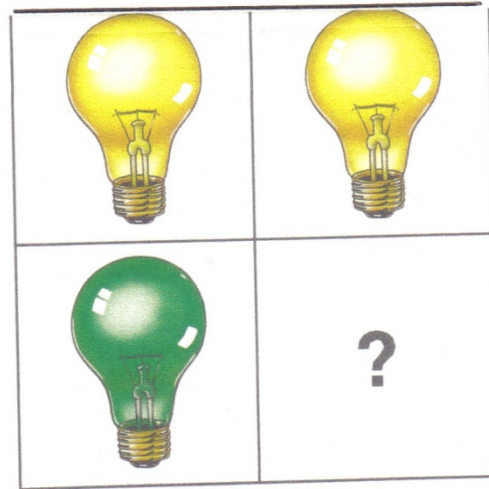
Intelligence is the capacity to learn from experience, using **metacognitive** processes to enhance learning, and the ability to adapt to the surrounding environment, which may require different adaptations within different social and cultural contexts. (R. Sternberg, 2003)

Executive Functions and Intelligence

- ❖ The concept of executive functions is not synonymous with the traditional concepts of intelligence or “IQ”
- ❖ Executive functions often are not directly assessed with standard intelligence tests

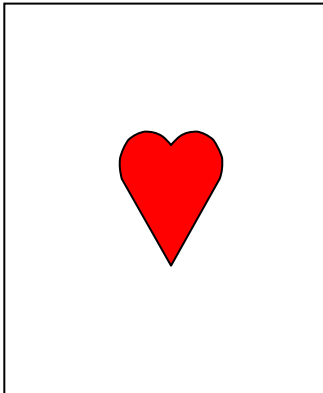
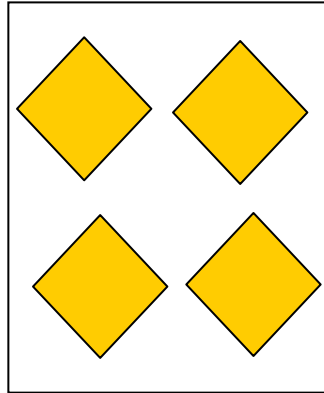
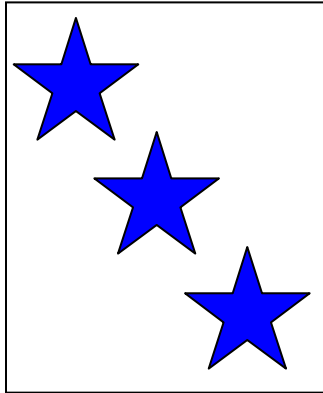
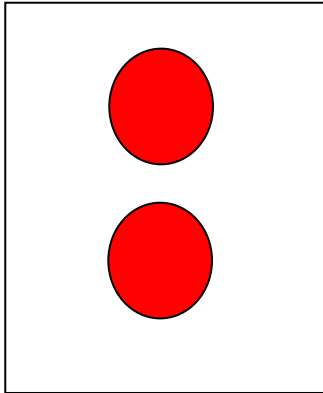
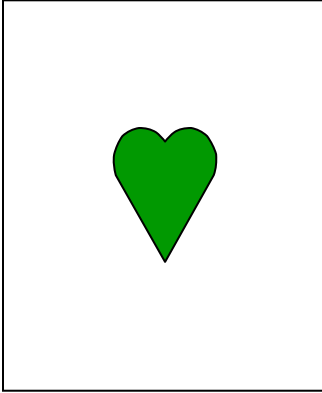
Measuring intelligence with a reasoning task

The yellow one goes with the yellow one.
Which one down here goes with the green one?



Measuring Executive Functions with a Reasoning Task

Directions for the Wisconsin
Card Sorting Test (WCST):
I can't tell you much about
how to do this task. Which of
these do you think this one
goes with? I'll tell you if your
answer is right or wrong.



Executive Functions and School

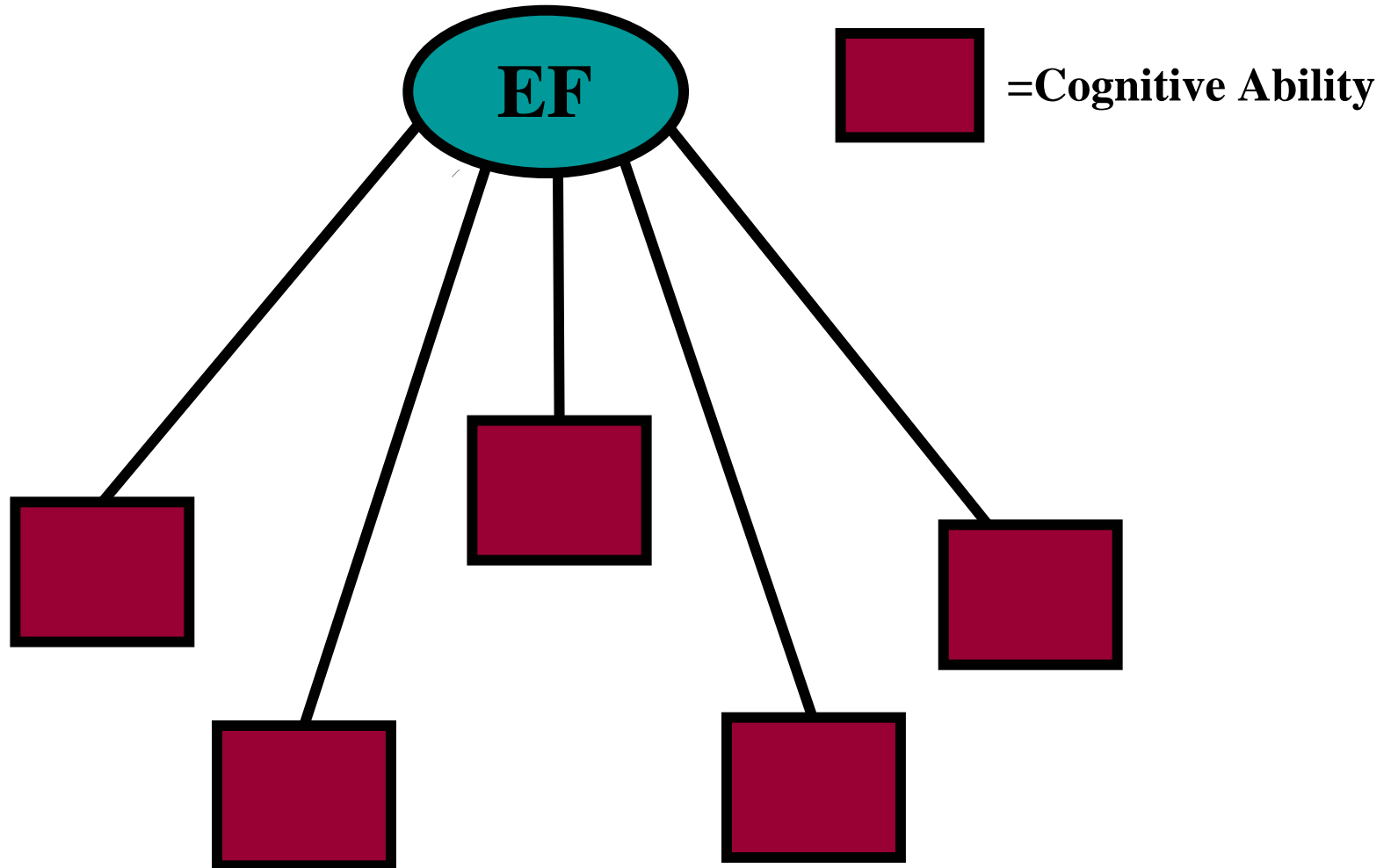
- ❖ The more classroom instruction resembles tests of executive functions like the Wisconsin Card Sorting Test (figure out what we're learning, I'll tell you whether you are right or wrong), the more executive difficulties are going to impact classroom learning and performance.

Executive Functions

Are Not a Unitary Trait

- Frequently referred to as “the CEO of the Brain” or the “Conductor of the Orchestra
- These metaphors
 - hint at the nature of EFs, but are far too general for effective understanding of the concept
 - create the impression of a central control center or a singular control capacity

EF as the Conductor of the Brain's Orchestra (i.e., EF as "g")



Executive Functions

Are Not a Unitary Trait

- ❖ The orchestra conductor analogy feeds into the “homunculus problem,” a paradox of infinite regress, or just a complex metaphysical maze.
- ❖ For practical everyday problem-solving in a more concrete manner, it is better to use the concept of a system of interrelated “co-conductors” rather than posit a single conductor.

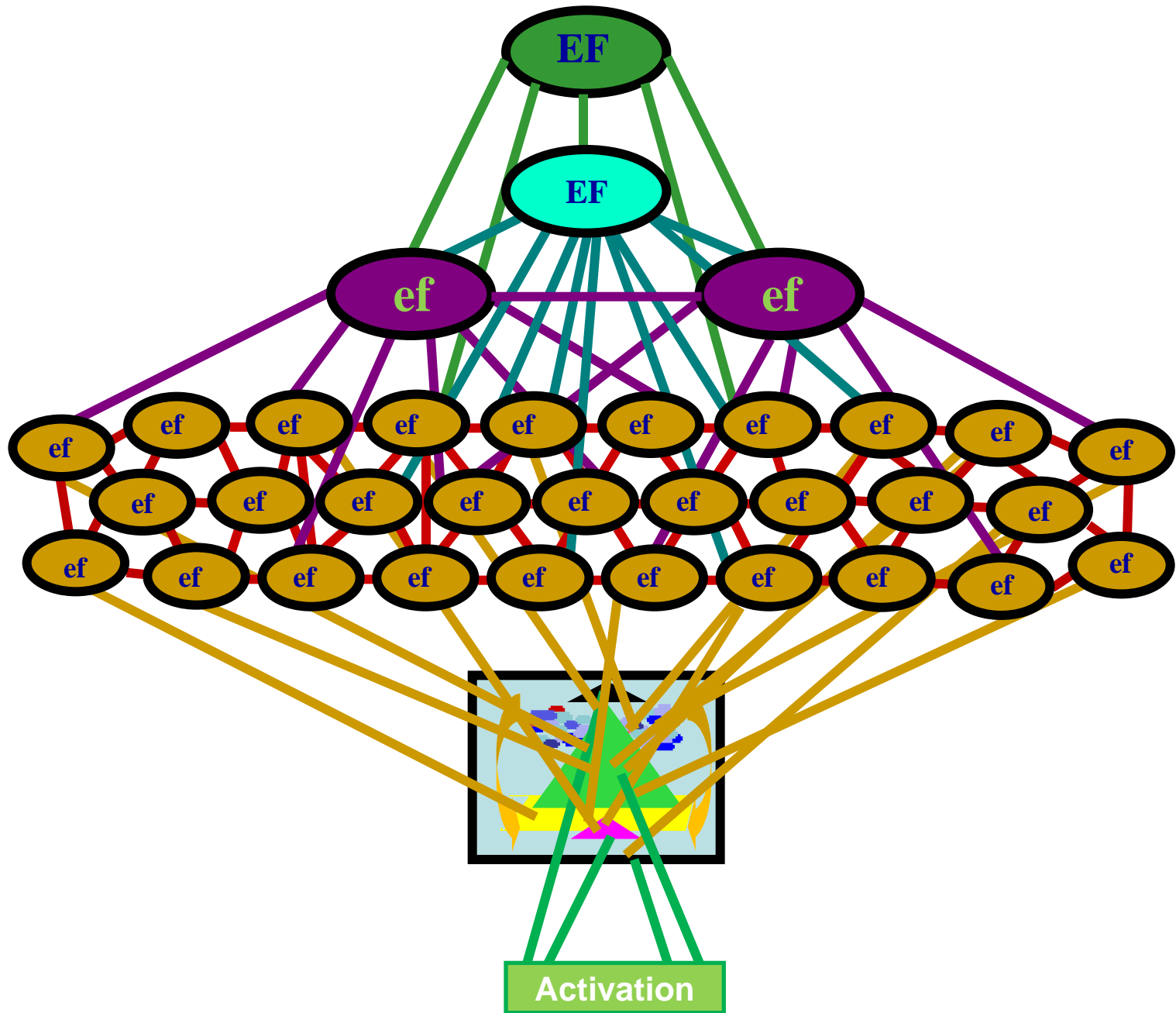
Executive Functions

Are Not a Unitary Trait

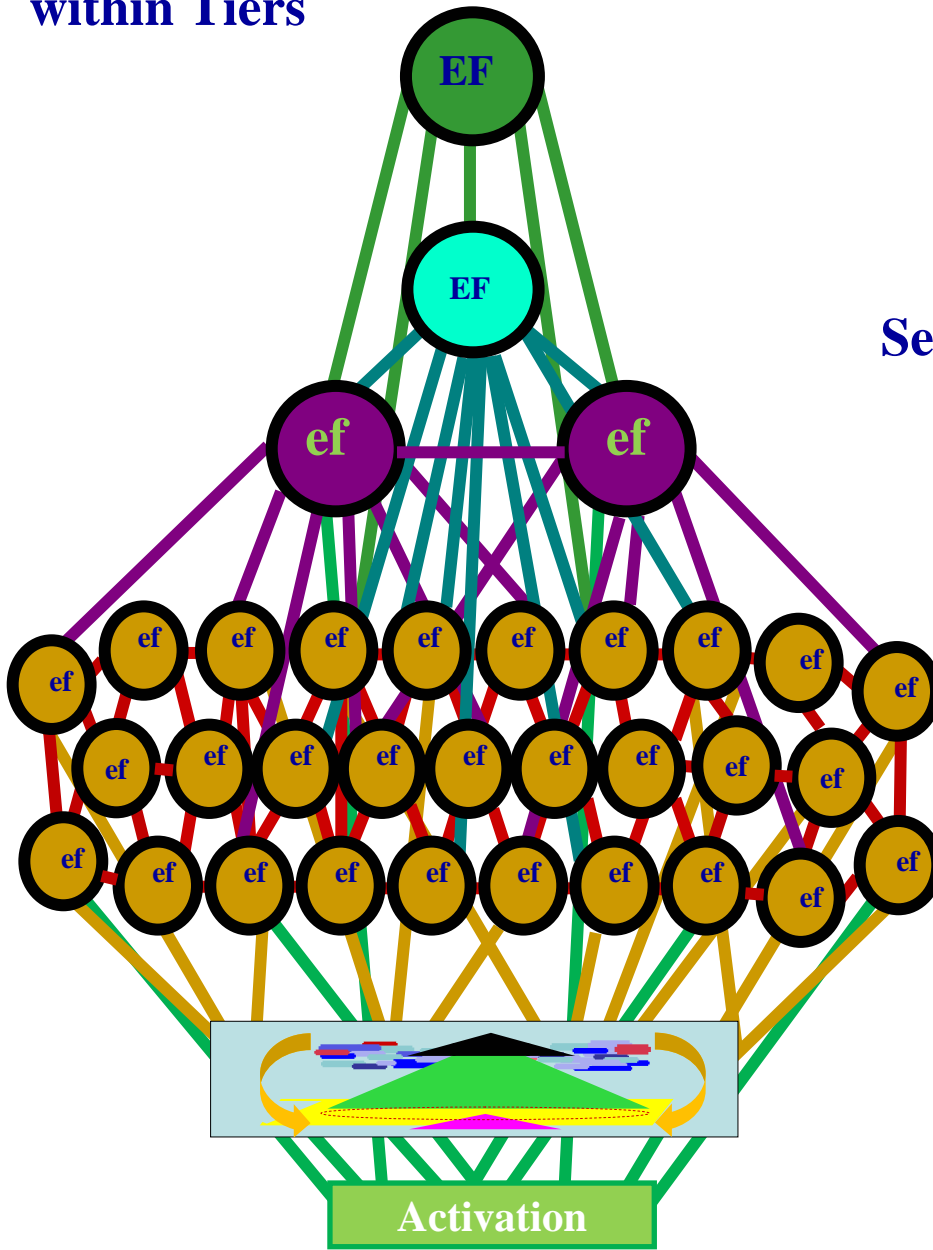
Appropriate Metaphors for Executive Functions:

- **A Team of Conductors and Co-Conductors of a Mental Ability Orchestra, or**
- **The Coaching Staff of a Mental Ability Football Team**

Co-Conductors in a Holarchical Model of EF



Tiers of Executive Function Self-Control and Executive Function Capacities within Tiers



Trans-Self Integration

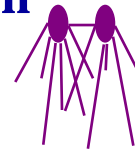


Self-Generation



Self-Realization

Self-Awareness
Self-Analysis



Self-Determination

Goal setting
Long-range Planning &
Foresight

Self-Regulation



Perceive
Focus
Sustain
Initiate
Inhibit
Gauge
Execute/Sequence
Stop/Interrupt
Shift
Flexible

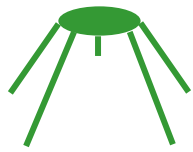
Modulate/Adjust
Monitor
Correct
Associate
Generate
Analyze
Compare
Hold
Manipulate
Store

Retrieve
Anticipate/Foresee
Plan (Short Term)
Organize
Decide
Sense Time
Estimate Time
Pace
Balance

Self-Activation

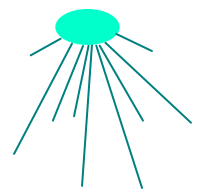


V. Trans-self Integration



Sense of source, Cosmic consciousness

IV. Self Generation

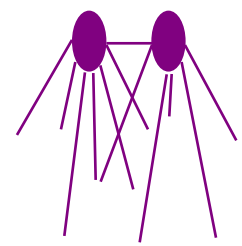


Mind-Body Integration, Sense of Spirit

III. Self Control:

Self Realization

Self Determination



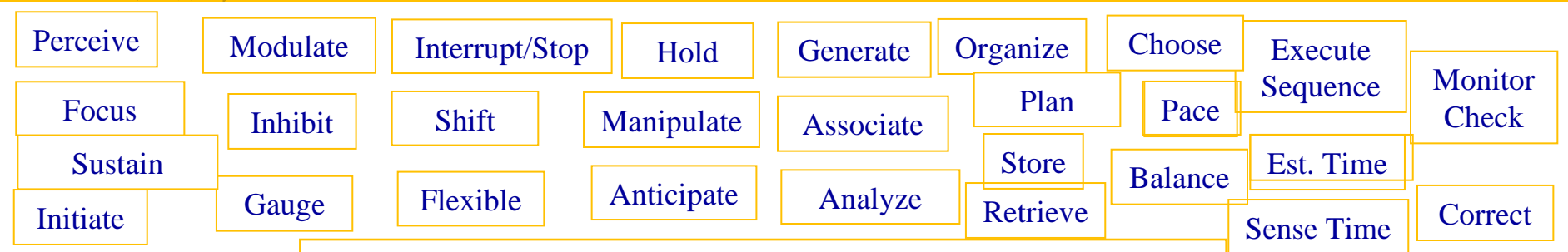
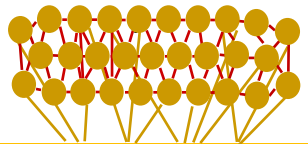
Self Awareness

Self Analysis

Goal Generation

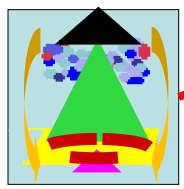
Long-Term Foresight/Planning

II. Self Control: Self Regulation



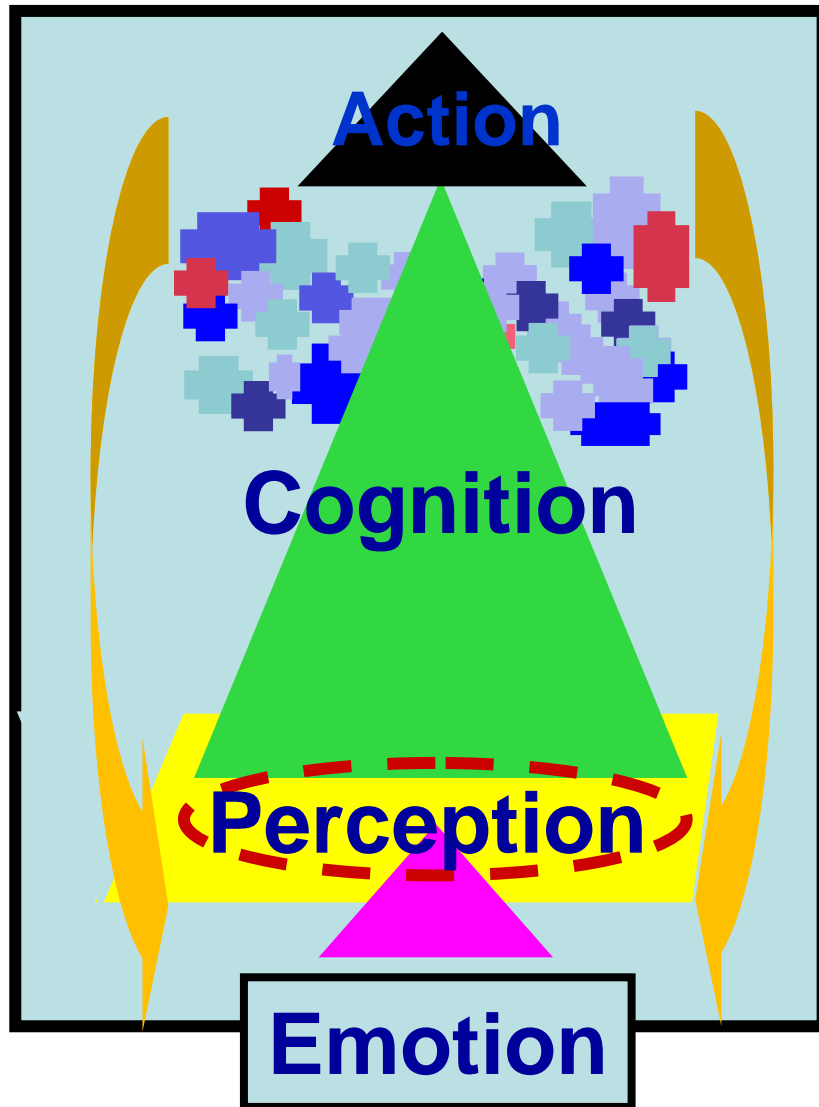
Sensation/Perception Cognition Emotion Action

I. Self Control: Self Activation



Awaken, Attend

Domains of Functioning Directed by Executive Functions



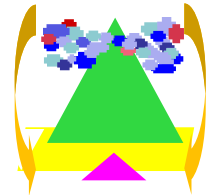
Action

Executive control of modes of output including behavior in the external world and storage and retrieval of internal representations



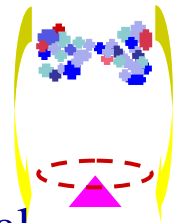
Cognition

Executive control of thoughts and thought processing



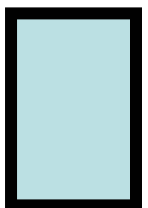
Perception

Executive control of modes of perceptual input including external sensory stimuli (visual, auditory, kinesthetic) and internal (representational) stimuli

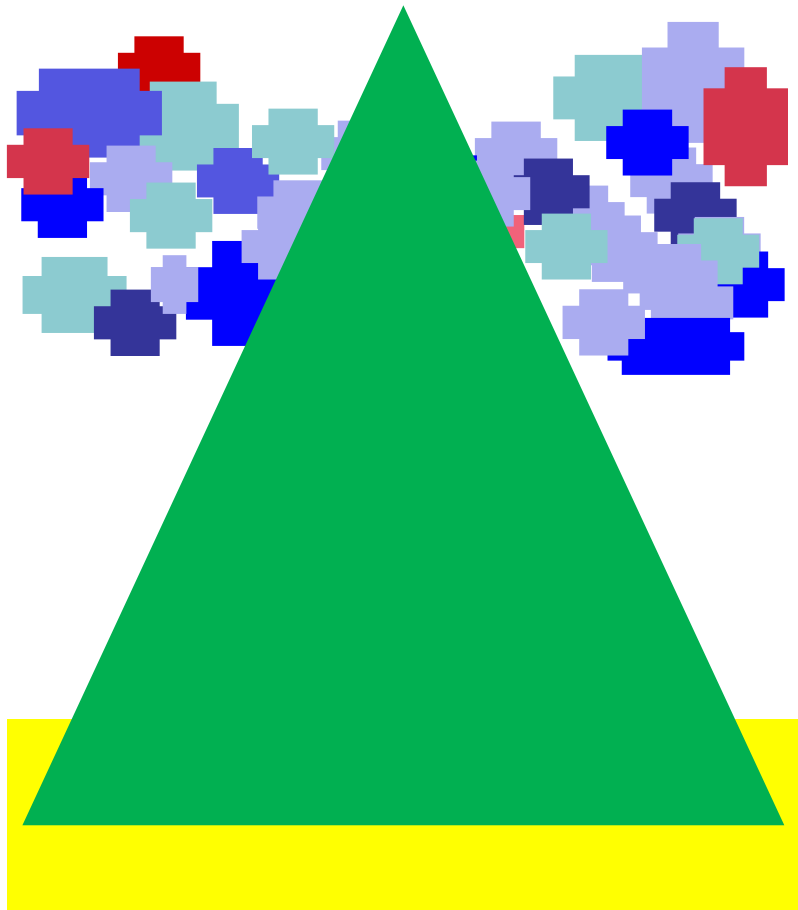


Emotion

Executive control of moods, feelings, and the processing of emotions

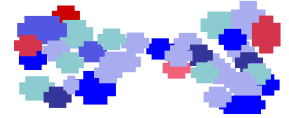


Time Frames of Reference – Memory Capacities



Recent and Remote Past

Retrieval from Long Term Store (accessing of Lexicons); thinking about the past



Extended

Immediate/Future

Holding and manipulating information in Active Working Memory; thinking about the future



Immediate Time Frame

Initial registration of information; perceiving in the present moment – the psychological sense of “now”



Self Activation

- ❖ Initiation and “ramping up” of basic executive functions related to an awakened state of mind and to overcoming sleep inertia.

Self Regulation

- ❖ A set of control capacities that cue and direct functioning across the domains of sensation/perception, emotion, cognition, and action
- ❖ The current model posits 29 self-regulation executive functions



31 Self-Regulation EFs

- ❖ Perceive
- ❖ Energize
- ❖ Initiate
- ❖ Inhibit
- ❖ Modulate
- ❖ Gauge
- ❖ Focus
- ❖ Sustain
- ❖ Stop/Interrupt
- ❖ Flexible
- ❖ Shift
- ❖ Hold
- ❖ Manipulate
- ❖ Organize
- ❖ Anticipate
- ❖ Plan
- ❖ Generate
- ❖ Associate
- ❖ Analyze
- ❖ Compare
- ❖ Choose
- Balance
- Store
- Retrieve
- Pace
- Sense Time
- Est. Time
- Sequence
- Execute
- Monitor
- Correct

Self Realization

- ❖ Directs cognitive processes that engage in self-awareness, self-reflection and self-analysis.
- ❖ Cues cognitive processes to access accumulated information about self and apply it in specific situations to initiate, sustain, or alter behavior.

Self Determination

- ❖ Foresight/Long-Term Planning and Goal Generation
- ❖ Directs the use of cognitive processes to construct visions of the future and plans for action over longer periods of time. Directs reflection on the past for purposes of improving or altering behavior and thinking in the future.

Self Generation

- ❖ Directs the posing of speculative questions related to the meaning and purpose of life and/or the ultimate source(s) of reality and physical existence, mind-body relationships, spirit, and soul; contemplates existence beyond the physical plane.
- ❖ Directs the generation of a philosophy of life used to guide self-awareness, self-realization and the other levels of executive function processes; serves as a basis for an ultimate source of intentional behavior direction.

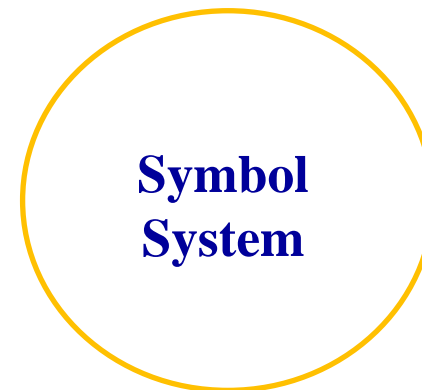
Trans-Self Integration

- ❖ Directs the engagement of mental processes that enable realization and experiencing of a trans-self state of ultimate or unity consciousness.
- ❖ In most spiritual traditions, this state is considered the highest achievement of human consciousness and therefore very different from the maladaptive states characteristic of clinical diagnoses of dissociative states.

Arenas of Involvement

- ❖ Executive control also varies depending on the Arena of Involvement
- ❖ The Four Arenas of Involvement are
 - ❖ Intrapersonal (Control in relation to the self)
 - ❖ Interpersonal (Control in relation to others)
 - ❖ Environment (Control in relation to the natural and man-made environment)
 - ❖ Symbol System (Control in relation to human made symbol and communication systems)

Executive Functions within Arenas of Involvement

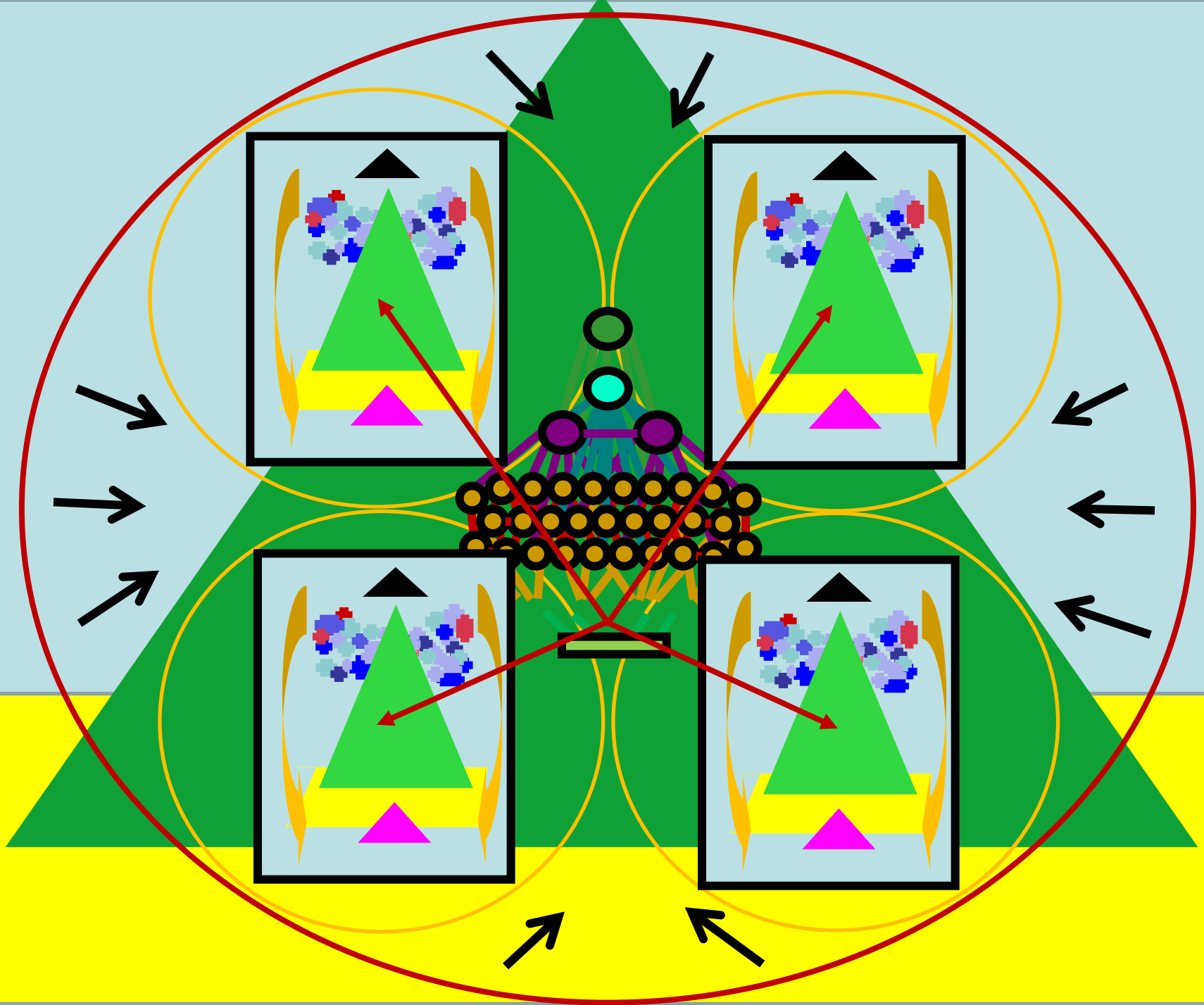


Intrapersonal ○
Control of Self in
Relation to Self

Intrapersonal ○
Control of Self in
Relation to Others

Environment ○
Control of Self in
Relation to Surroundings

Symbol System ○
Control of Self in Relation
to Culturally Determined
Modes of Communication
including Reading, Writing,
Mathematics, and
Communication Technologies



Executive Function Variability

- ❖ Executive control is highly dissociable; it can vary greatly depending on the domain of functioning that is being directed: sensation/perception, emotion, cognition, or action.
- ❖ Good executive control in one domain does not guarantee good executive control in the other domains; Poor control in one domain does not guarantee poor control in the other domains.

Executive Function Development

- ❖ Self-regulation executive functions are developing from the first years of life on throughout a person's entire lifetime.
- ❖ Large developmental shifts are noticeable, especially around adolescence.
- ❖ Because EFs are developmental in nature, natural maturational delays and lags are observed.

Executive Function Development

- ❖ Intraindividually, all EFs do not develop evenly. For any given individual, one EF can be more or less developed than any other EF at any given point in time.
- ❖ Interindividually, there is also great variation relative to chronological age. At the same age, different individuals will naturally vary considerably in their level of development of various EFs.

Executive Function Development and School

- ❖ Cultural change points (e.g., educational transitions to Preschool, Kindergarten, 1st grade, junior h.s., senior h.s., college, graduate school, and workplace entry) can serve to highlight EF developmental delays or significant deficiencies.

Executive Function

Development and School

- ❖ Some EF-based clinical syndromes, such as ADHD, demonstrate clear patterns of delayed developmental progression. Barkley (1998) estimates developmental delays of about 30% associated with various EF processes such as Inhibit, Manipulate, Shift, Sustain, Time, Monitor, Correct.

Executive Functions and Clinical Diagnoses

- ❖ “Deficits in PFC [prefrontal cortex, aka frontal lobes] function are evident in every neuropsychiatric disorder (indeed, the term “psychiatric problem” seems synonymous with PFC dysfunction).”

Arnsten & Robbins 2002 in *Principles of Frontal Lobe Function*

Executive Functions and Clinical Diagnoses

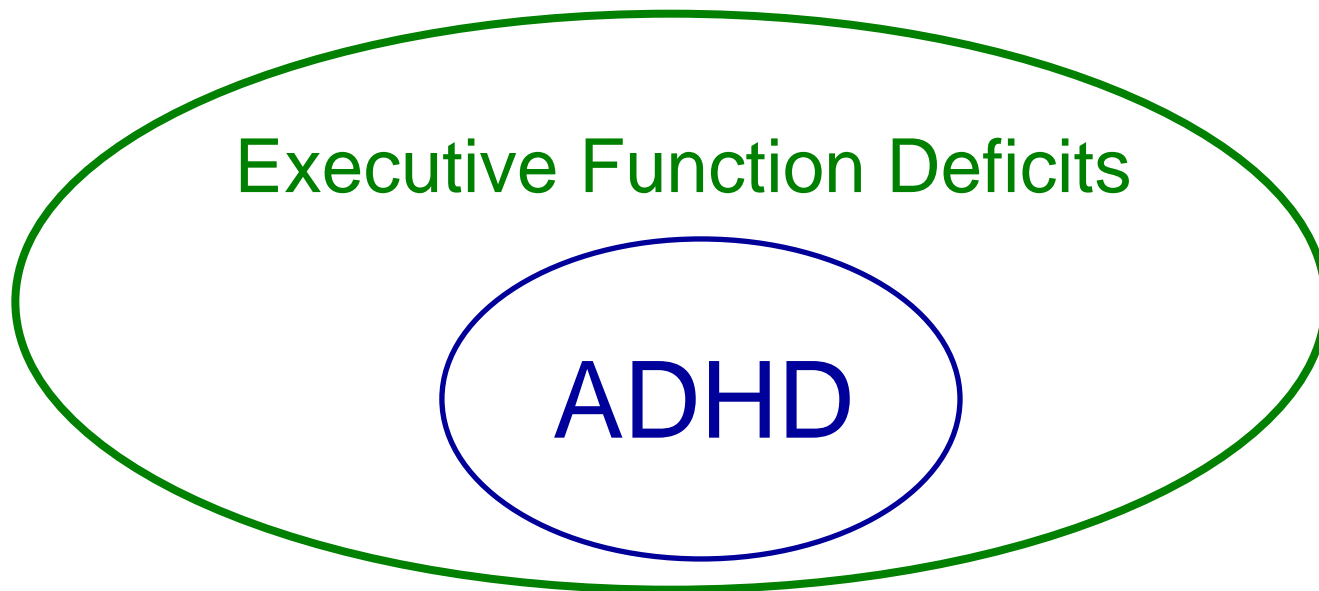
- ❖ Most of the clinical conditions described in the DSM-IV reflect some form of Executive Dysfunction
- ❖ The DSM-IV can be thought of as “A User’s Guide to All the Things That Can Go Wrong With the Frontal Lobes”

Executive Functions and Clinical Diagnoses

- ❖ A sampling of conditions involving EF deficits:
 - ❖ Autism Asperger's Syndrome
 - ❖ ADHD and ADD
 - ❖ Conduct Disorder
 - ❖ Oppositional Defiant Disorder
 - ❖ Depression and/or Anxiety
 - ❖ Obsessive-Compulsive Disorder
 - ❖ Fetal Alcohol Syndrome

Executive Functions and ADHD?

- ❖ All individuals with ADHD have executive functions deficits



- ❖ but not all individuals with executive functions deficits have ADHD.

Executive Functions

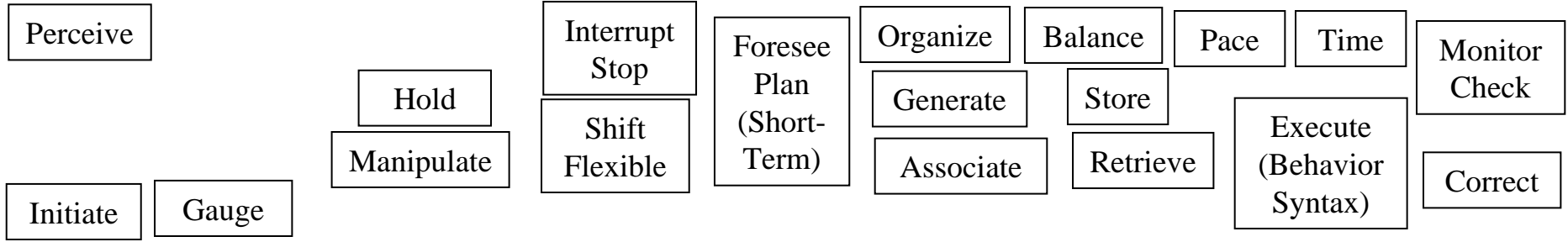
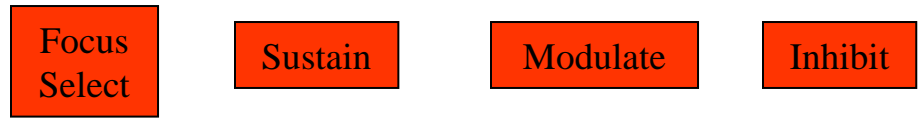
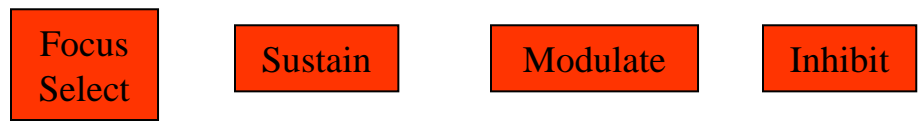
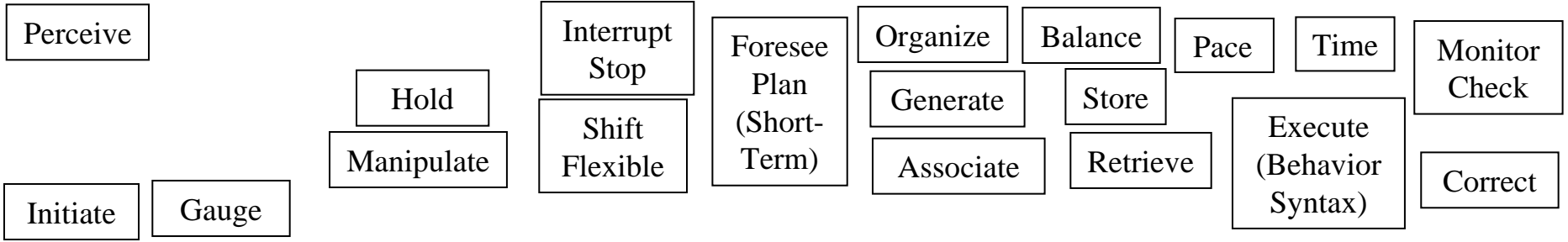
and ADHD

- ❖ EF and ADHD are not synonymous terms; rather ADHD is a condition involving EF deficits in:
 - ❖ Focus/Select, Sustain, Inhibit, Modulate
- ❖ Nearly all persons with ADHD also have additional self-regulation difficulties; the nature of these additional difficulties is what makes ADHD so variable from one person to the next and what causes confusion in diagnosis.

Executive Functions

and ADHD

- ❖ Pharmacological treatment of ADHD usually only addresses the problems associated with the EFs specific to ADHD (Inhibit, Modulate, Focus/Select, Sustain)
- ❖ Most persons with ADHD will require additional interventions to assist with the additional self-regulation difficulties that persist even when medication is being used effectively to treat the primary ADHD problems.



Executive Functions and School

- ❖ Although executive functions are used to guide cognitive processing involved in new learning, many new learning situations are structured in ways that reduce the need for strong executive direction.
- ❖ In contrast, demonstrating what has been learned usually requires significant involvement of executive control processes.

Internal versus External Control

- ❖ The neural circuits for executive function activation are routed differently depending on whether the activation is based on an internally driven desire or command versus an external demand.

Internal versus External Control

- ❖ Because internally driven production is much easier to accomplish than externally demanded production for children with “producing difficulties” their lack of production on demand often stands in stark contrast to their seemingly effortless production “when the spirit moves them.”

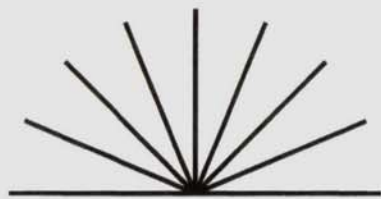
Internal versus External Control

- ❖ The on-demand deficiencies observed by others are often attributed to negative personal characteristics such as lack of responsibility, apathy, passive aggressive stance, or oppositional defiance.

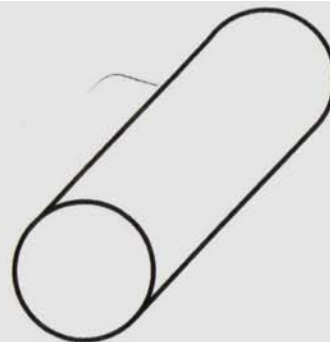
James Age 10, NEPSY Design Copying:



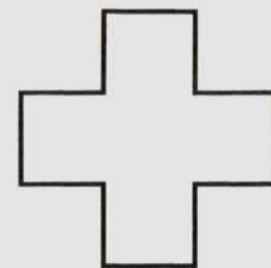
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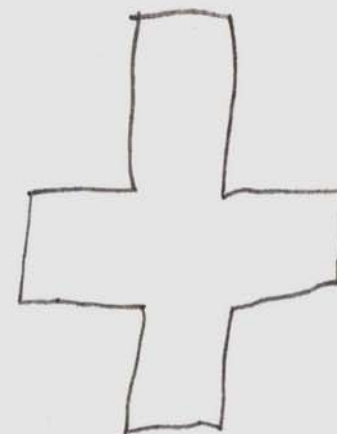
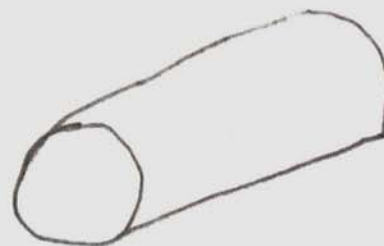
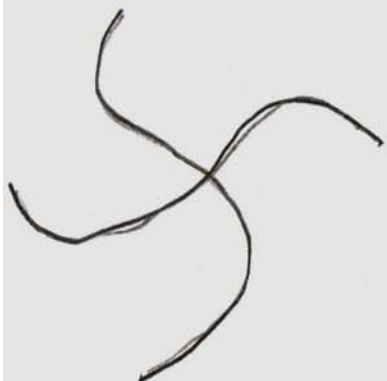
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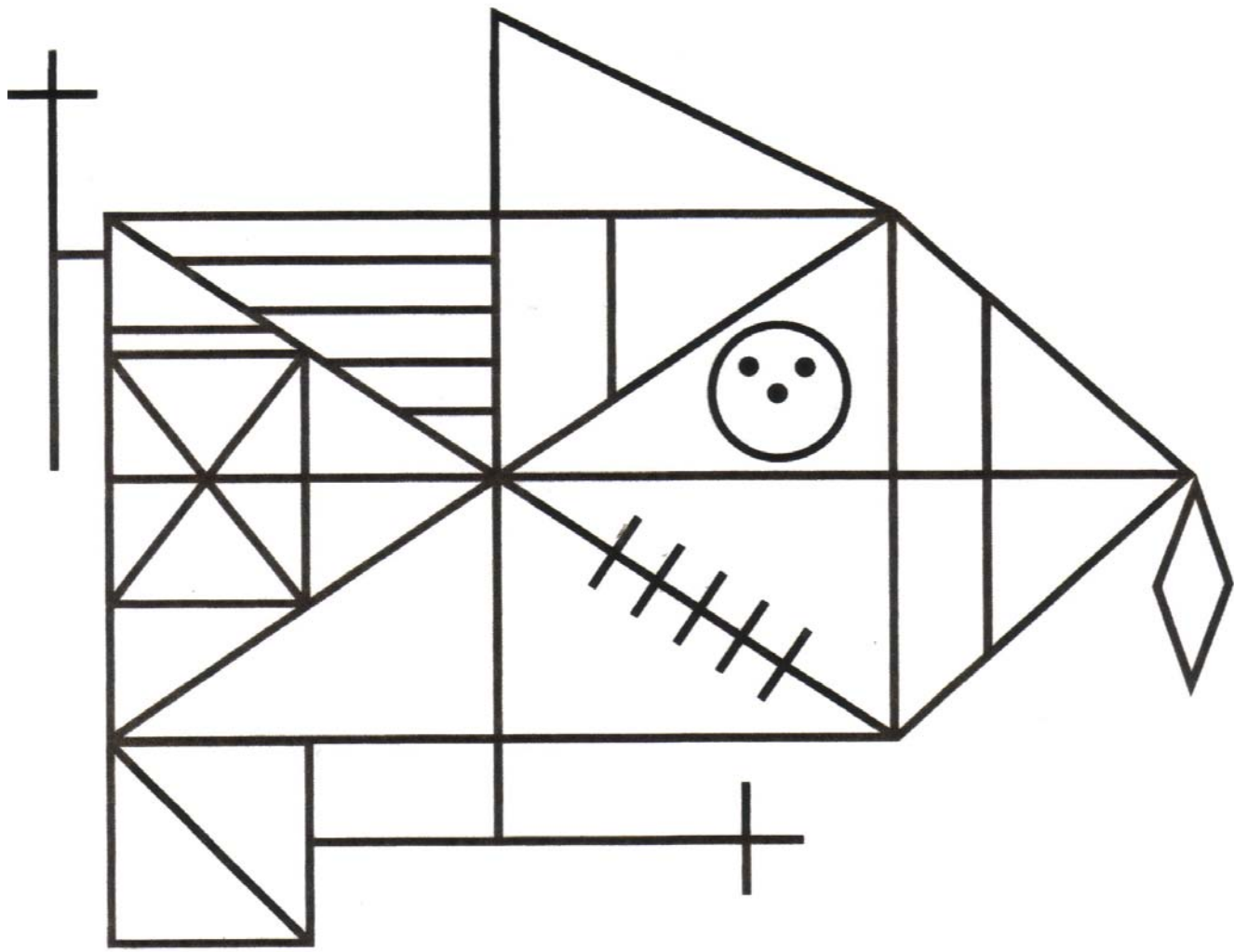
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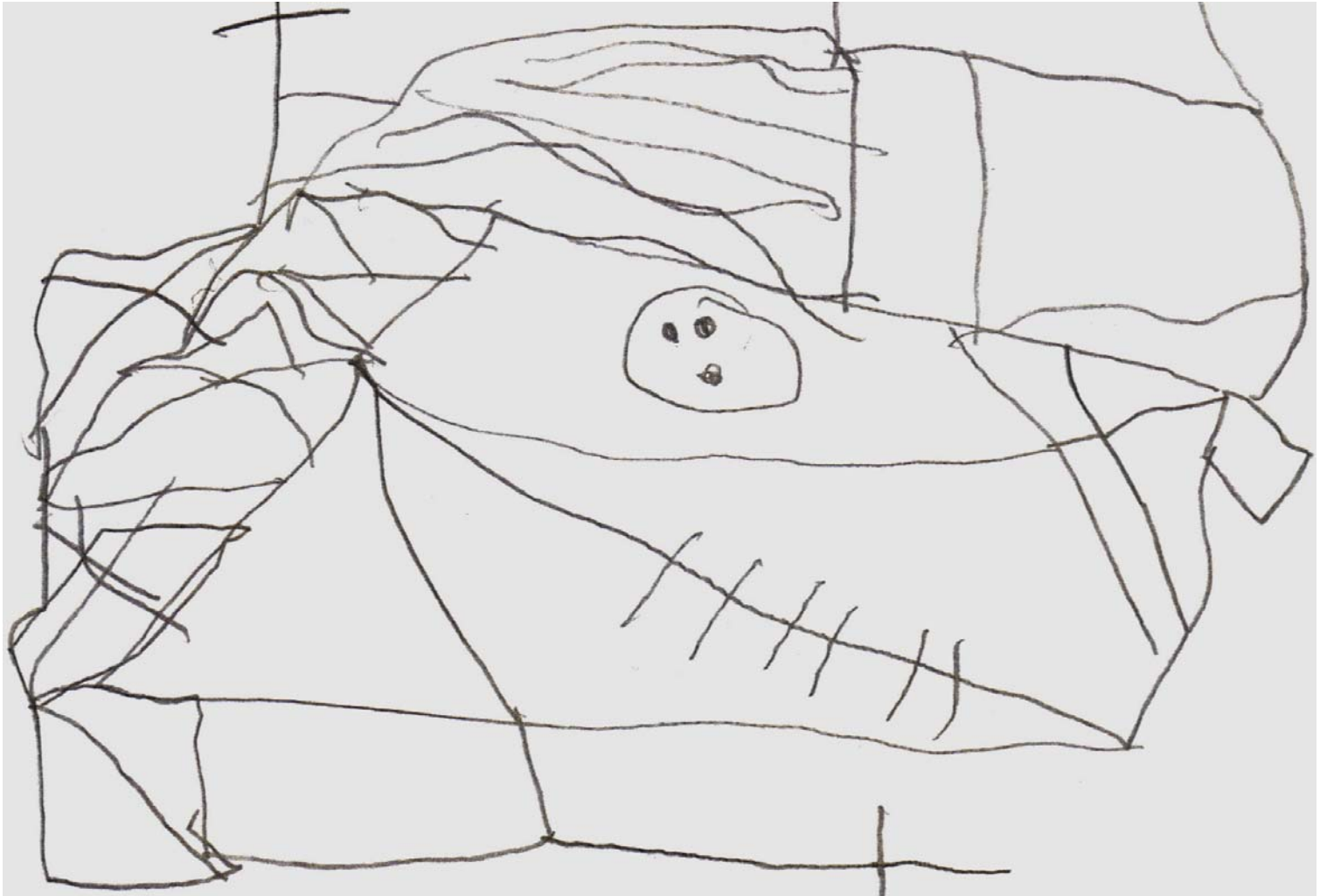


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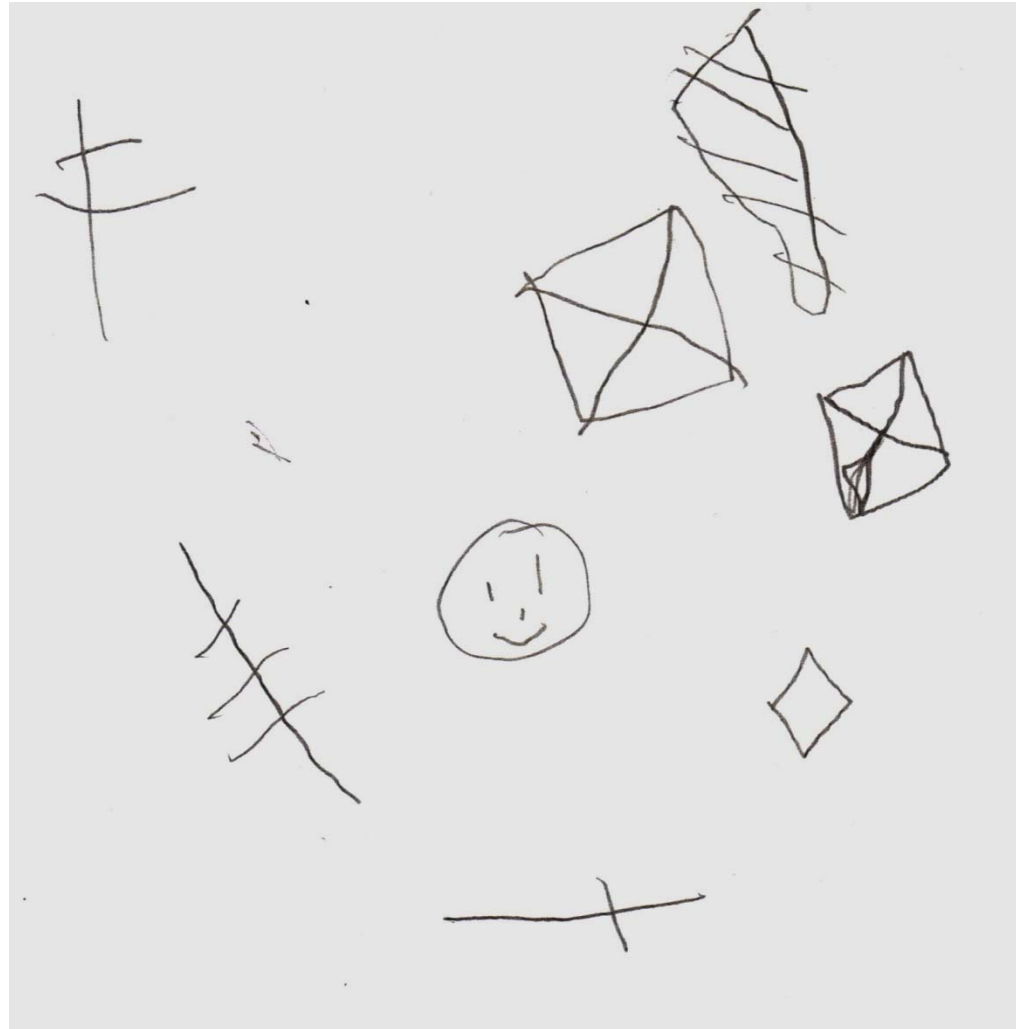


James Age 10,

Rey Complex Figure Copy:



James Age 10, Rey Complex Figure Recall after 3 minutes:



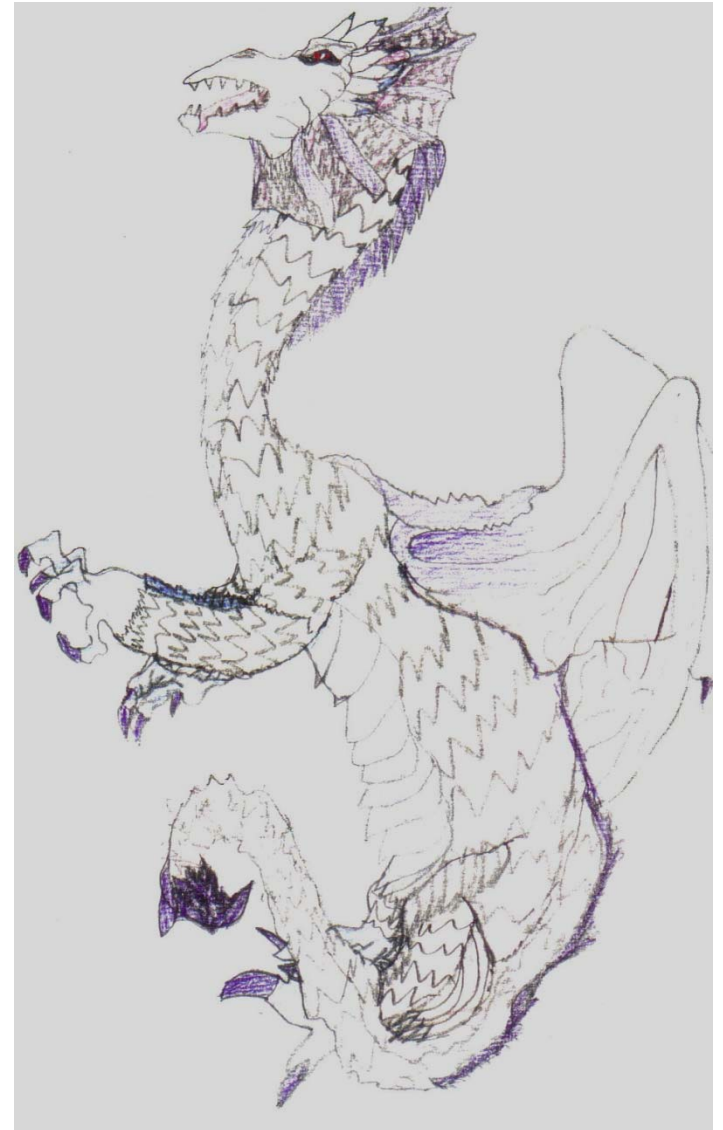
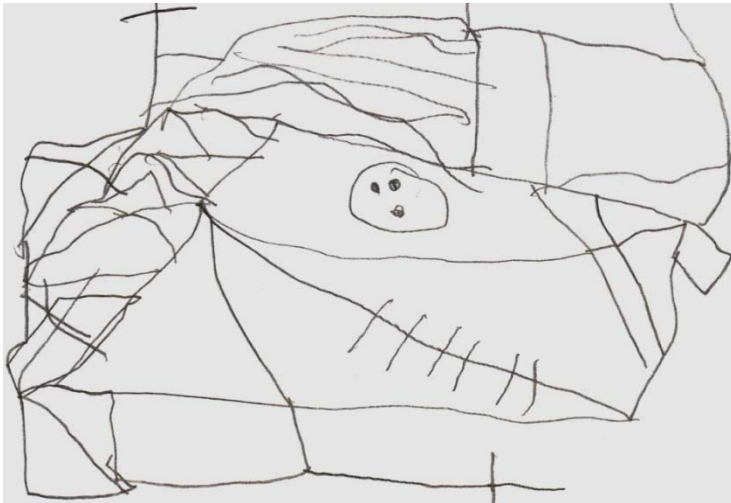
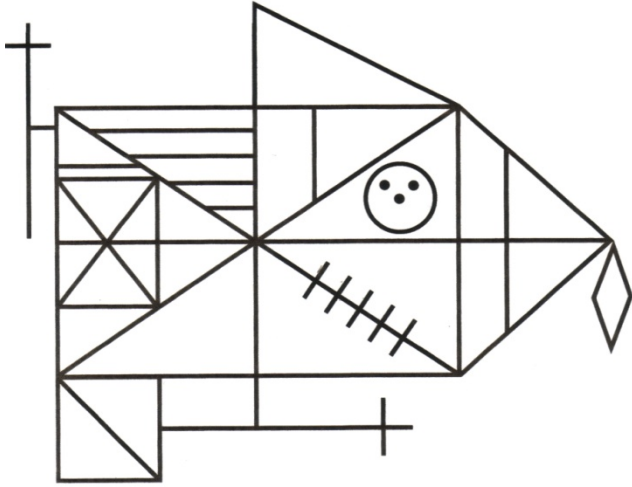
James Age 10,
Self-generated
freehand drawing



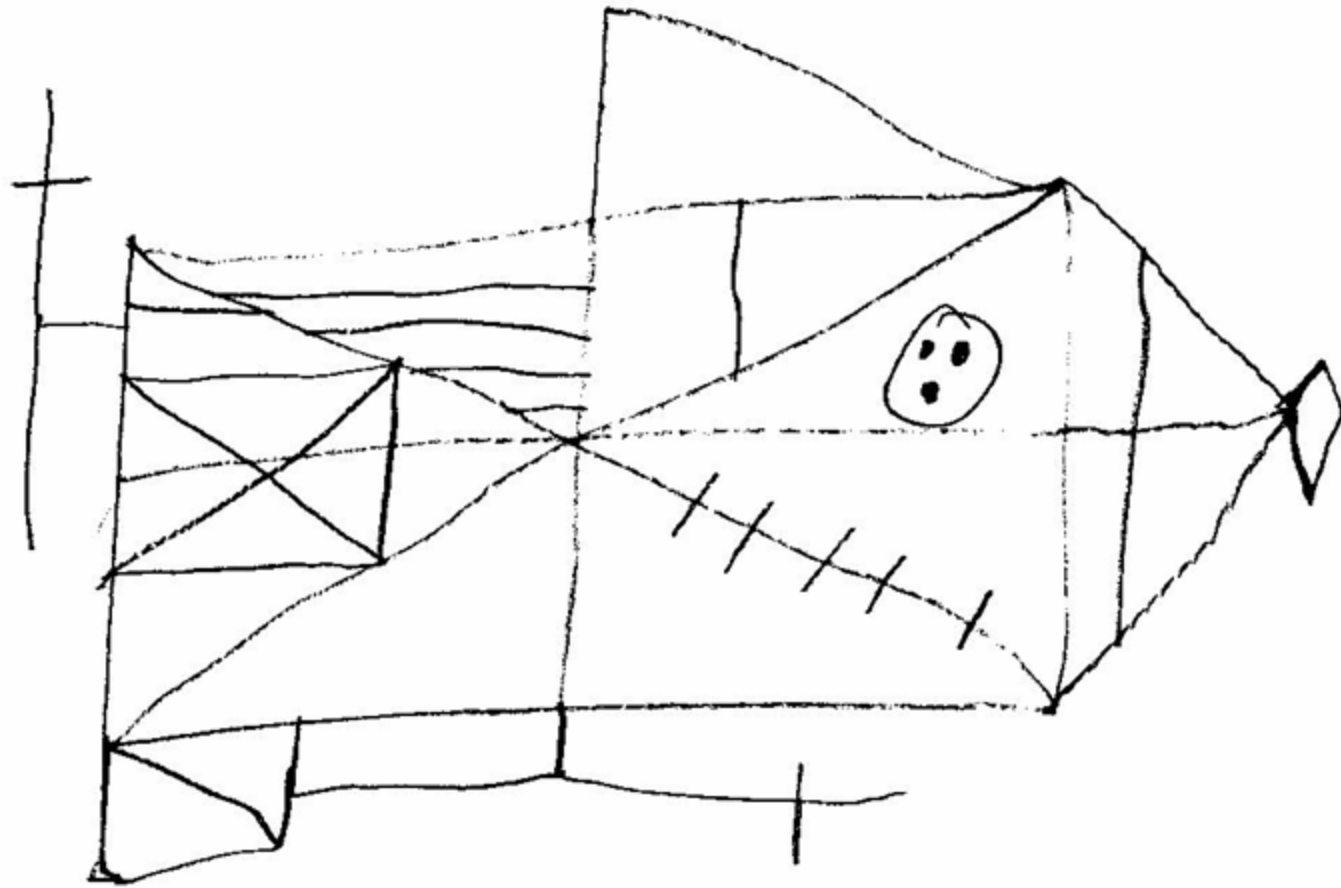
Production based on
External Demand:



Production based on
Internal Command:



**James Age 10, Rey Complex Figure Copy
Verbally Mediated by Psychologist:**

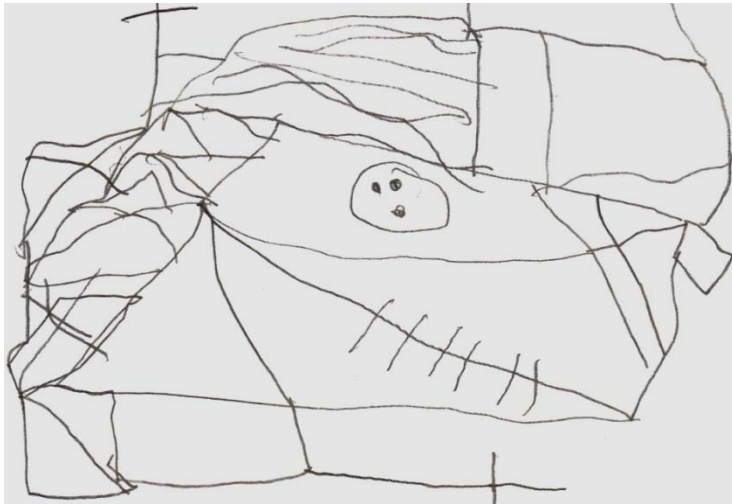




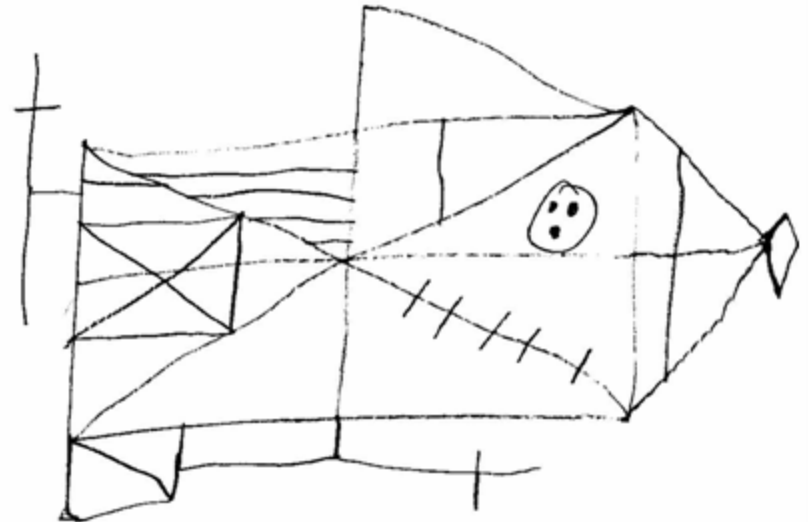
James Age 10,

Rey Complex Figure Copy:

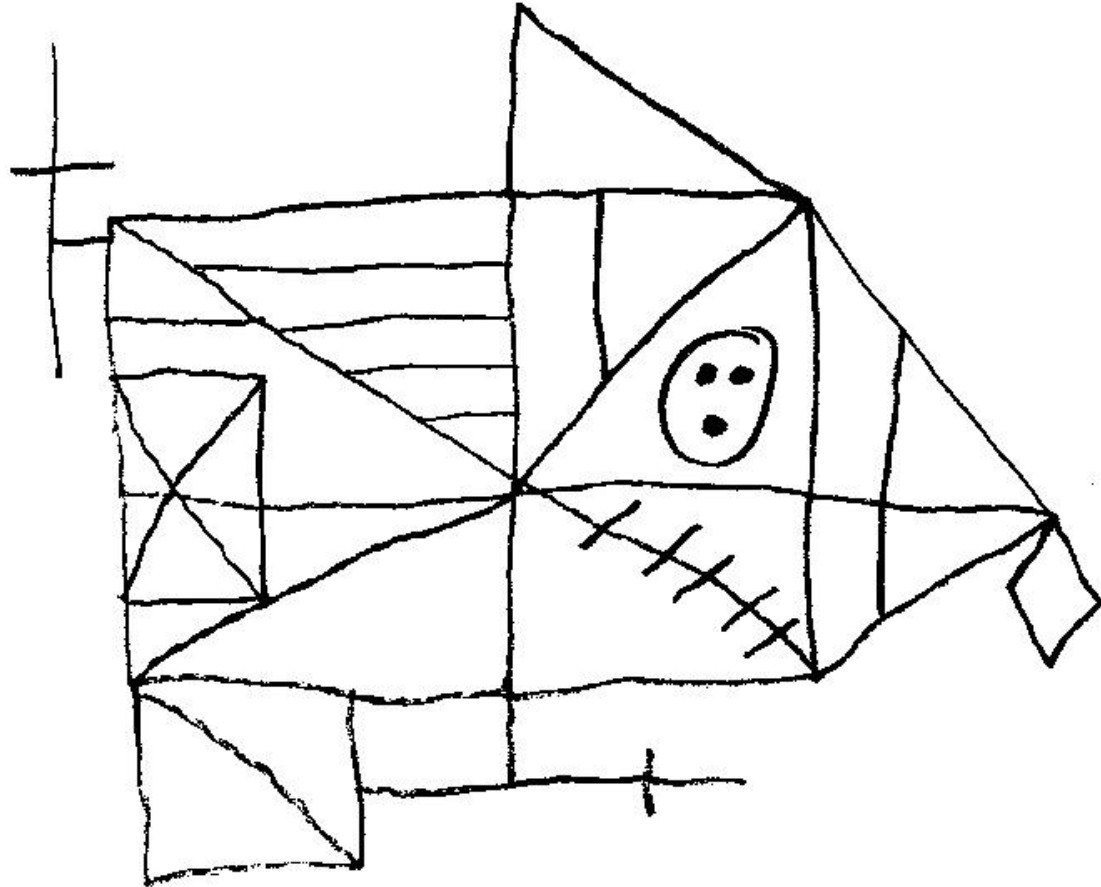
Self-initiated



Verbally Mediated



**James Age 10, Rey Complex Figure
Copy: On-Demand Self-Completed**



Producing versus Learning Difficulties

- ❖ As Martha Denckla has pointed out, Executive Function difficulties of a severe nature (especially in the Symbol System Arena) do not result in Learning Disabilities; they result in “Producing Disabilities.”

A General Model for Conceptualizing Learning and Producing Difficulties

