

**SENSORY REGULATION AND EXECUTIVE FUNCTION: AN INTEGRATIVE APPROACH**

Lindy Joffe, OTD, OTR/L  
California Association of Occupational Therapists  
November 8, 2024

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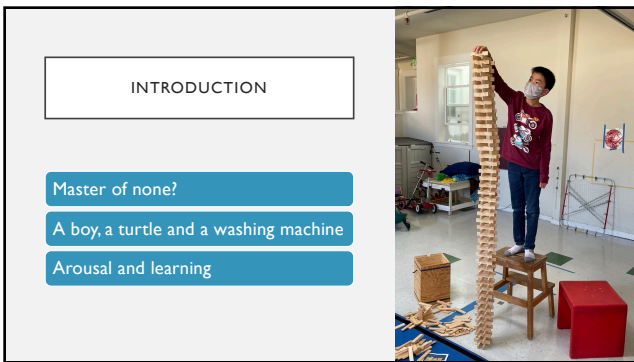
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**INTRODUCTION**

- Master of none?
- A boy, a turtle and a washing machine
- Arousal and learning

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**DEFINITION OF EXECUTIVE FUNCTION (EF)**

"...the set of **self-regulatory** skills involved in the conscious **goal-directed** modulation of **thought, emotion, and action**"  
[emphasis added]  
(Zelazo, 2015, p. 56)

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**SEROTONIN - DOPAMINE  
FEEDBACK LOOP**



**Serotonin**  
 Intrapersonal space  
 Internal emotional regulation  
 Metabolic (not emotional) in nature - gives energy for things not driven by external reward  
 How we feel



**Dopamine**  
 Extrapersonal space  
 Goal-directed behavior  
 Metabolic - energy for externally driven action  
 Motivation toward action



**Feedback Loop**  
 Toggle between neurochemical systems  
 Match or mismatch?  
 • Mismatch = problem in regulatory system  
 • E.g. Dopamine-dependent engagement

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**EXECUTIVE FUNCTION**

Air traffic controller

- Great cortical organizer
- Cognitive organization
- Behavioral regulation
- Emotional regulation
- Goal-directed behavior

(Baggetta & Alexander, 2016; Cramm et al., 2016; Josman & Meyer, 2019)

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**EXECUTIVE FUNCTION**

Hot vs. cold executive function

**Hot**

- Emotion/motivation

**Cold**

- Abstract/decontextualized
- Devoid of reward or punishment
- Can be distinct but more often function in concert

(Takeuchi et al, 2013; Zelazo, 2015)

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**EXECUTIVE FUNCTION**

Component parts

- Inhibition
- Shift
- Working memory
- 25+ more identified

(Baggetta & Alexander, 2016; Josman & Meyer, 2019)

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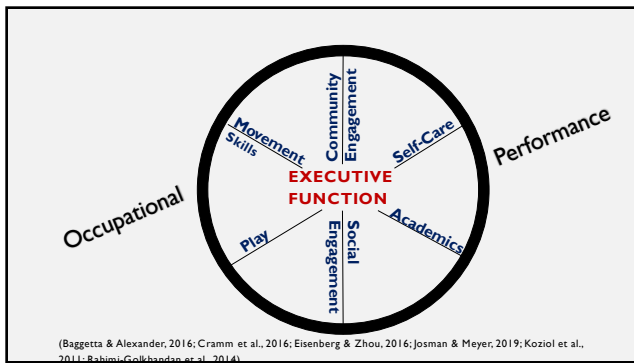
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**VERY BRIEF NEUROLOGY - PREFRONTAL CORTEX (PFC)**

- Primary neural structure involved in executive function (Takeuchi et al., 2013)
- Hot executive function – orbital regions
- Cold executive function – dorsolateral regions
- Constantly receives and sends signals throughout the cortical and subcortical areas of the brain (Funahashi & Andrea, 2013)

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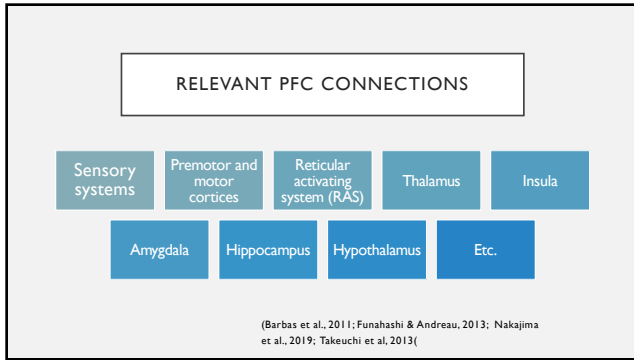
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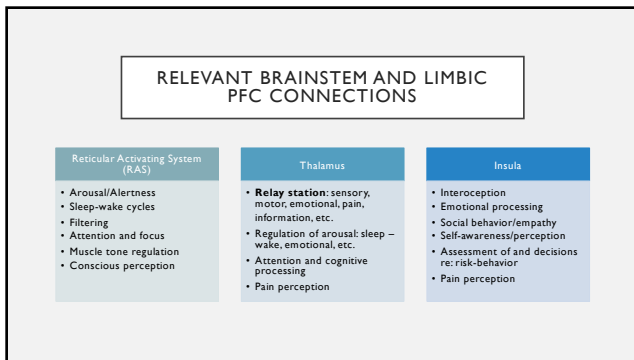
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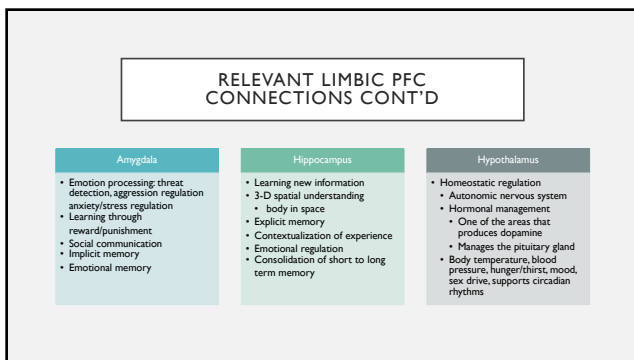
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- Modulates all sensory systems
  - Auditory (Nakajima et al., 2019)
  - Visual (Funahashi & Andreau, 2013; Nakajima et al., 2019; Skirzewski et al., 2022)
  - Vestibular (McCarthy et al., 2023)
  - Tactile/somatosensory (Romo & de LaFuente, 2013)

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- Primary functions
  - Filters information
  - Suppresses distractors
  - Directs attention
  - Enhances sensory discrimination
    - Relates to background noise suppression

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- Primary functions (cont'd)
  - Alters autonomic response
    - Via limbic and RAS connections
  - Integrates input from diverse modalities
  - **Strong role in decision-making related to sensory modalities**
    - Where do we direct our attention?

(Barbas et al., 2011; Funahashi & Andreau, 2013; Nakajima et al., 2019; Romo & de LaFuente, 2013; Skirzewski et al., 2022; Takeuchi et al., 2013)

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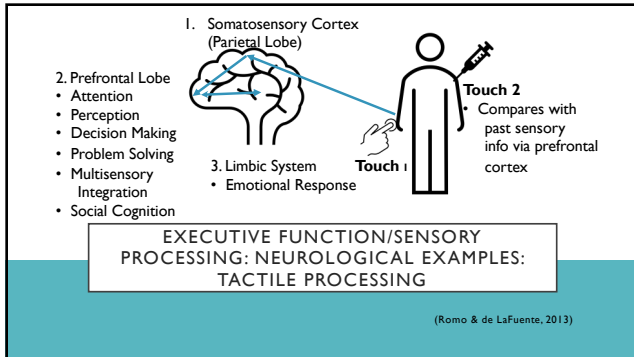
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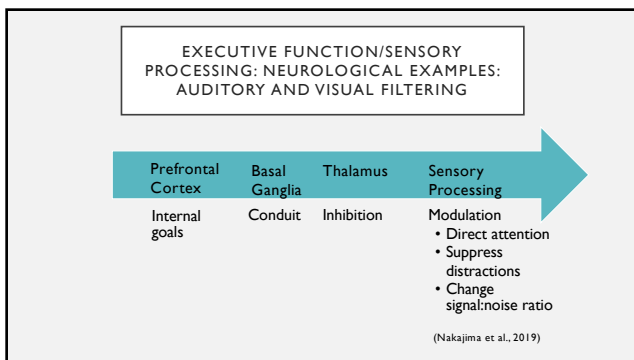
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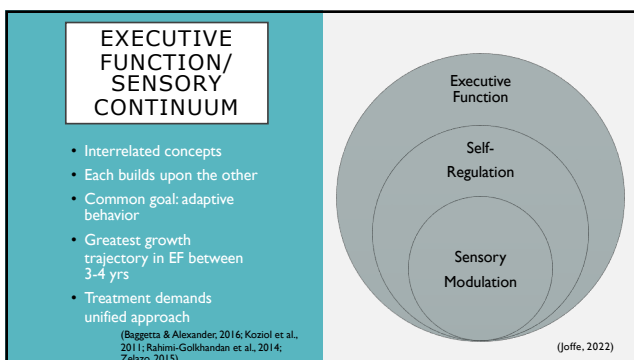
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**EXECUTIVE FUNCTION SKILLS –  
DEVELOPMENTAL COORDINATION DISORDER**

- Greater EF challenges than seen in ADHD
- Use of inappropriate, ineffective strategies
- Focus on irrelevant details
- Decreased self-monitoring
- Decreased self-regulation

--Hyland & Polstajko, 2012; Jolic & Whitebread, 2011;  
Rahimi-Golkhandan et al., 2014

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**EXECUTIVE FUNCTION SKILLS –  
GRAPHOMOTOR CHALLENGES**

- Difficulty with:
  - Working memory
  - Planning
  - Impulse control
  - Cognitive shift
  - Organizational skills

--Rosenblum, 2018

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**PUTTING IT  
TOGETHER**



Huberman Lab Podcast

Dr. Lisa Feldman Barrett: How to Understand Emotions

Episode 146  
October 16, 2023

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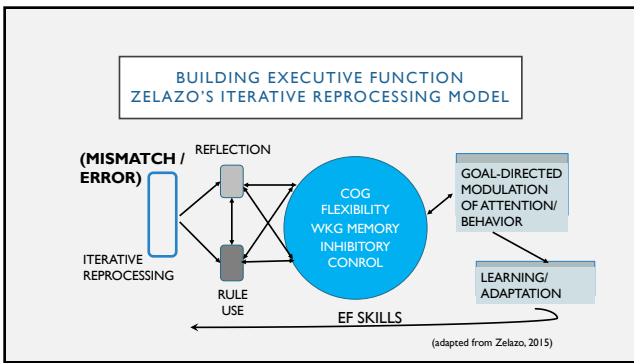
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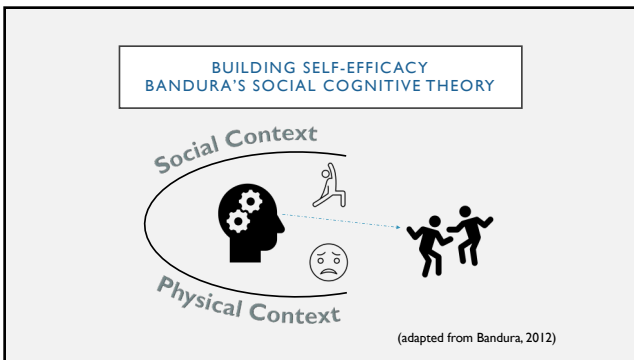
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**BUILDING INTEGRATION  
EMBODIED COGNITION  
THEORY**


Sensory, motor, and cognitive systems are fundamentally inseparable

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Purposeful behavior at the core of human intelligence

**Integration of systems is key**

(Fincher-Kiefer, 2019)



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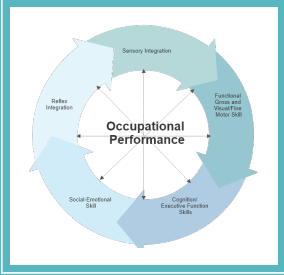
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-Joffe, 2022

**INTEGRATIVE  
TREATMENT MODEL**

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- Referred at 3 years old due to "severe sensory regulatory challenges"
- Preschool teachers/parent report:
  - Sweet and engaged,
  - Easily overstimulated
  - Aggressive with peers
  - Lost in his spatial surroundings

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- Initial assessment
  - Low tone - sat with a posterior pelvic tilt, rounded back, extended neck
  - Visually disorganized
  - Cooperative
  - Poor play skills - knocked over furniture in the wait room and lifted the train table during his first session

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- Post-completion of FM scales of PDMS-2:
  - Difficult to engage, fatigued/disorganized
  - Wandered into other children
  - Tripped over things in his path
  - Walked into objects without apparent awareness of his own body or the space around him

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- Integrative approach
  - Auditory
  - Vestibular
  - Motor
  - Reflex Integration
    - Proprioceptive
  - Visual-Vestibular

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- Integrative approach
- Executive function/cognitive
  - Visual perception
  - Problem-solving
- Relationship-based approach
- Family and school engagement

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- Case management
- Multidisciplinary/team approach
  - Speech/language therapy
  - Social skills group
  - Vision therapy
  - Auditory processing
  - Intermittent psychotherapy

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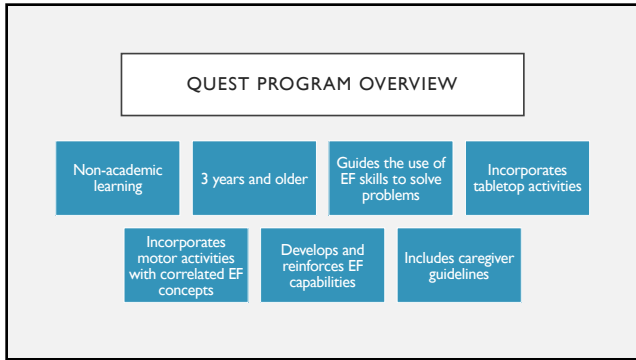
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A central box titled "SELECT ASSESSMENT TOOLS" is positioned next to a 3D illustration of a maze. Below the title, a list of assessment tools is provided:

- Behavior Rating Inventory of Executive Function (BRIEF-P or BRIEF-2)
- Beery-Buktenica VMI and Supplements
- Complex Visual-Motor Task
  - Draw-a-Person, Boat Drawing, Complex Figure Drawing
- Jigsaw Puzzle
- Obstacle Course

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Three examples of simple line drawings of houses are shown at the top. Below them is a central box titled "HOUSE DRAWING" set against a teal background.

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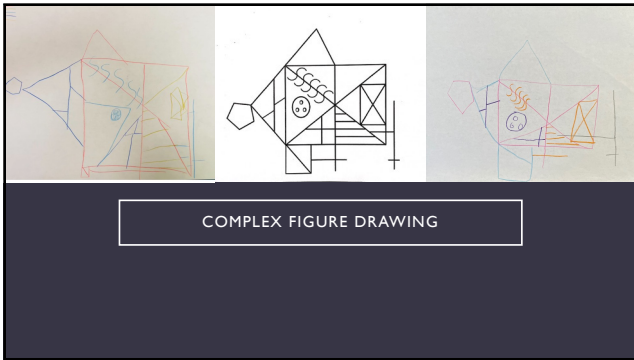
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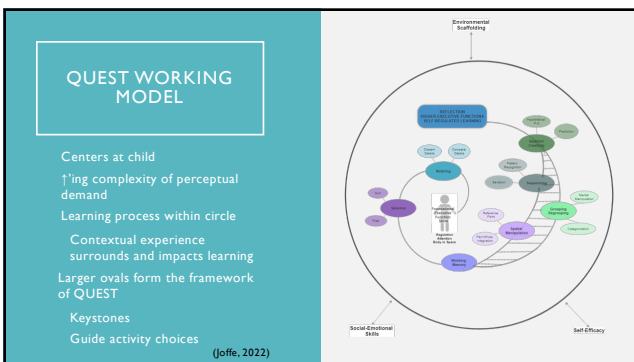
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- KEYSTONES**
- Noticing
  - Salience
  - Working Memory
  - Spatial Manipulation
  - Grouping/Regrouping
  - Sequencing
  - Ideation/Creativity

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THERAPEUTIC USE OF SELF

- Therapist as empathic mirror
- Avoid didactic model
- **Discovery must belong to the child**
- Importance of productive struggle
  - Struggle is essential for growth
  - Therapist as co-regulator

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NOTICING

Requires active engagement	Demands and directs attention	Perceives detail	Compares and contrasts
	Hearing = Seeing	Listening = Noticing	

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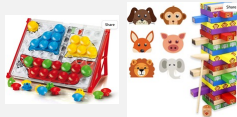

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NOTICING  
ACTIVITY EXAMPLES

- Key components
  - Matching, simple sorting, searching
- Learning Resources Sorting Surprise Pirate Treasure
- Quercetti Fantacolor
- Animal Jenga
- Smithsonian Spot the Difference

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SALIENCE

- "The quality of being particularly noticeable or important; prominence"  
--Oxford Language Dictionary
- Requires the ability to sort and filter
- Beginning of abstraction
- Fundamental building block of all purposeful activity




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NOTICING VIDEO EXAMPLE




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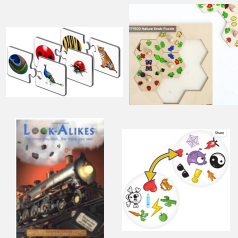
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SALIENCE ACTIVITY EXAMPLES

- ❖ Requires a higher level of filtering
  - More complex background
  - Determination of important features
- Spot Me Self-Correcting Puzzles
- Rolf Knob Hexagon Puzzles
- Look-Alikes Books
- Spot It Games




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WORKING MEMORY

- Key component of EF
- Enables mental image
- Manipulation of info within that frame
- Transition point from observation to action




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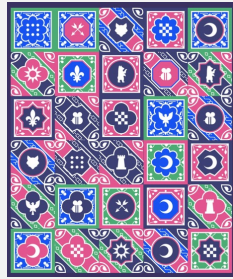
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SALIENCE EXPLORATION




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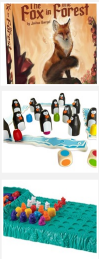
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WORKING MEMORY ACTIVITY EXAMPLES



- Pengolo
- Mastermind for Kids
- The Fox in the Forest
- Four Funky Frogs
- Egg Scramble Challenge
- Zoologic
- Sequence

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SPATIAL  
MANIPULATION

- The ability to hold salient information in working memory and perceptually organize it in a framework that makes sense
- Dependent upon:
  - Part: whole integration
  - Ability to maintain and shift reference point
- Skills may differ in 3-D space

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SPATIAL MANIPULATION  
ACTIVITY EXAMPLES

- ❖ Manipulation of objects in flat and 3-D space
- Safari Animal Jigsaw Puzzles
- Block Puzzles
- Penguins On Ice
- Buildzi
- Origami

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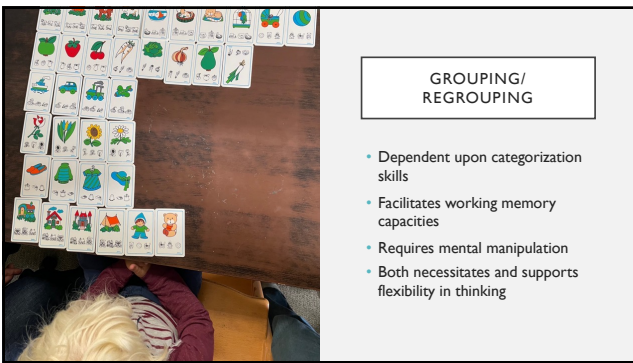
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GROUPING/  
REGROUPING

- Dependent upon categorization skills
- Facilitates working memory capacities
- Requires mental manipulation
- Both necessitates and supports flexibility in thinking

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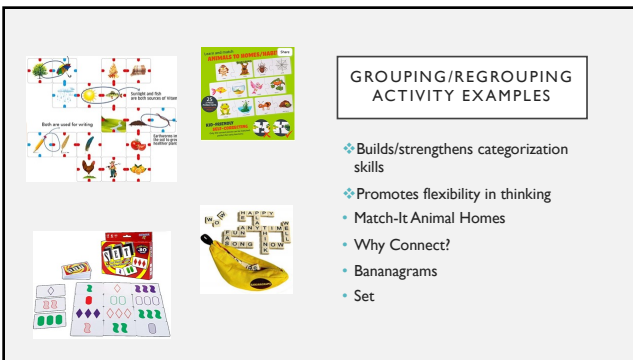
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GROUPING/REGROUPING  
ACTIVITY EXAMPLES

- ❖ Builds/strengthens categorization skills
- ❖ Promotes flexibility in thinking
- Match-It Animal Homes
- Why Connect?
- Banagrams
- Set

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GROUPING/REGROUPING  
VIDEO EXAMPLE



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SEQUENCING

- Includes:
  - Pattern recognition and completion
  - Organization of information in a serial structure
- Dependent upon foundational capacities
  - Filtering skills
  - Attention to salient details
  - Strong working memory
  - Manipulation of information over space and time
  - Shifting of reference point within the larger whole



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SEQUENCING  
ACTIVITY EXAMPLES



- ❖ Strengthens the ability to shift within a known structure
- ❖ Develops patterning skills
- GraceDawn Animal Dominoes
- Pancake Pile-Up Relay Game
- Puzzelations
- Gravity Maze
- Ticket to Ride

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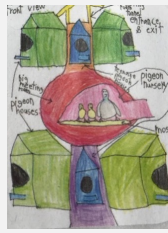
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IDEATION/CREATIVITY

- Creation, organization, and follow-through of own ideas
- Includes both:
  - Generation of novel activities
  - Problem-solving for novel solutions
- May include:
  - Prediction
  - Hypothetical thinking
  - Imagination



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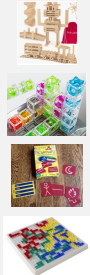
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IDEATION/CREATIVITY  
ACTIVITY EXAMPLES

- Building activities
  - Kaplas/kevas, magnetiles, legos, pipe tubes, zoobs, erector sets, tinker toys, building an OC, writing a quest, etc.
- Creative games
  - Pictionary, Blokus, Hedbanz, charades, Apples to Apples, etc.
- "Apprenticeship" building



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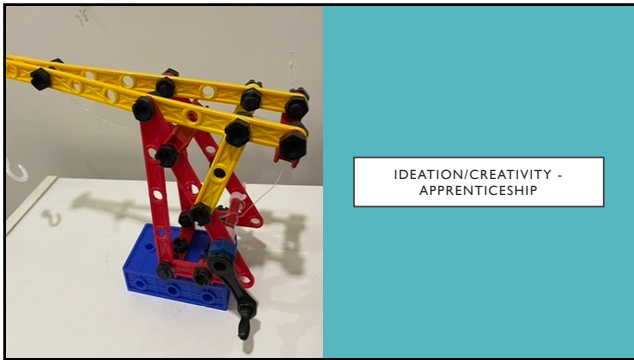
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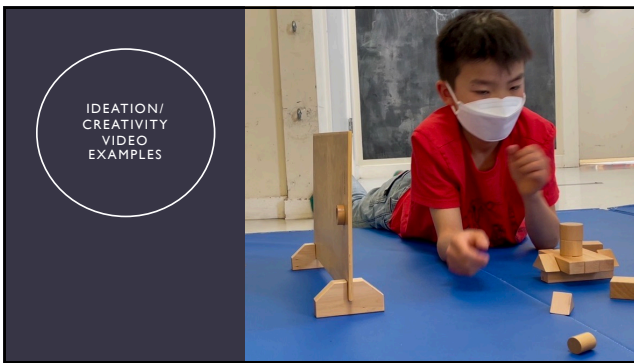
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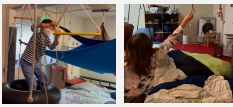
**QUEST OBSTACLE COURSE**

Incorporates concepts from throughout the QUEST program

Integrates motor with problem-solving work

Builds strategies for multi-layered demands

Adds complexity to overall challenge



An evil genius has left a sink bomb in the sea. It will go off in an hour and make the place smell terrible unless you do the following:

- 1) Plug up the large gas tube near the waterfall.
- 2) Demagnetise the six ropes that lead in.
- 3) Destroy the three standing circuit towers.
- 4) Disentangle the switch, hidden in an orange bag.

**BREATHE DEEPER! SMILE!**

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QUEST VIDEO EXAMPLE



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OUTCOMES

- Regulation
- Curiosity
- Grit

"She's taught me how to handle hard things."  
--S, age 8



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THANK YOU!

Questions/comments?

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