



ZERO TO THREE
Early connections last a lifetime

The Growing Brain

From Birth to 5 Years Old

A TRAINING CURRICULUM FOR
EARLY CHILDHOOD PROFESSIONALS

Aidan Bohlander, Claire Lerner, and Ross Thompson, Editors

– *Participant Manual* –

Unit 4: Cognition and Executive Function



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Preface

“The brain is a social organ of adaptation built through interactions with others.” (Cozolino, 2014, p. xvi)

The development of the growing brain is one of the most important topics in early childhood development, with significant implications for early childhood professionals. Research on infant brain development is exploding. With the advent of the magnetoencephalography (MEG) for infants, researchers can now see more clearly into a young child’s brain activity and learn what impact interactions have on certain aspects of development.

The greatest rate of brain growth and development is during the first few years of life. This rapid development occurs at the same time a child is making critical connections with his or her outside world. Because of such rapid brain growth during the first few years, early experiences have a disproportionately greater impact on the newly growing brain’s development.

Often, an early childhood professional provides one of the earliest human interactions an infant or young child will experience. The professional will play a significant role in determining the experiences and environment that shape and influence the construction of the early brain. When an early childhood professional and an infant interact together, each is inducing the other’s internal states of being. It’s the basic day-to-day experiences, be they nurturing or non-nurturing, that set the young child on his or her course of brain development.

It is for these reasons that ZERO TO THREE, in partnership with the University of Arkansas Early Care and Education Projects, developed The Growing Brain (TGB) curriculum for early childhood professionals. Since 1977, ZERO TO THREE has been translating research that helps us understand how the youngest children think, learn, and interact with the important adults in their lives. We turn that scientific knowledge into helpful tools and practical resources for parents, policymakers, and professionals, like yourself, to help make the lives of babies, toddlers, and their families better.

This Participant Manual, along with the other curriculum materials you’ve received, is intended to support your learning experience. In the Manual you will find key points from each presentation as well as discussion questions. Please use this Manual as a workbook during the course to record presentation and discussion highlights. Together with the other TGB materials, we hope it will serve as a valuable record of your learning and resource on early brain development that you will return to again and again as you work with young children.

Thank you for what you do each and every day to support the youngest and most vulnerable members of our society. Each interaction that you have with each young child is helping to shape the very structure of his or her brain. That is an incredible responsibility and privilege! Thank you for your participation in this course and your commitment to be a positive influence on the children and families you serve.

Reference

Cozolino, L. (2014). *The neuroscience of human relationships: Attachment and the developing social brain* (2nd ed.). New York, NY: WW Norton & Company.

Introduction

How wonderful to have this new resource on the brain and child development! I remember when we wrote our curriculum, *Early Development and the Brain: Teaching Resources for Educators* (Gilkerson & Klein, 2008), a colleague asked: “Is the brain a fad? What will be next?” The brain has hardly been a fad; as one of the central regulators of the body and of our experience with the world, its critical importance in understanding young children’s development and how best to nurture their growth will always be supremely important for anyone who cares about young children and is invested in nurturing their healthiest development.

We wrote the former curriculum for early childhood faculty and trainers so they could confidently teach about the brain and its role in early development to their students. While early educators had long focused on the whole child, brain imaging brought a seismic shift in our understanding about biopsychosocial development. Now students in early childhood development, as well as faculty, fully appreciate the power of brain health and functioning and are eager to learn how they can best build the brainpower of the children they serve.

This new curriculum, *The Growing Brain (TGB)*, addresses the same vital areas that we covered: the structure and function of the brain; factors and experiences that can harm the growing brain, especially stress, and how to protect the brain from harm; and the connections between the brain, language development, and sensory functioning.

In the 9 years since we wrote our curriculum, much more has been discovered about the brain, especially regarding emotional regulation, the role of caregiving relationships, and the impact of trauma. Evidence that young children’s early experiences shape the actual architecture of the brain and how it functions has grown dramatically, and it has put a spotlight on the importance of the interface between the brain and the environment and on the centrality of human interaction and relationships in brain development. Accordingly, *TGB* focuses heavily on the growing field of “affective neuroscience”—the science of emotions and the brain—and how the earliest interactions shape lasting patterns of relatedness. The link between brain, body, and behavior is ever clearer. Unmediated adverse childhood experiences (ACEs) are linked with problems in adult physical and mental health in ways we might not have imagined. Synchrony in mother-infant behavioral interactions also has a significant influence on the growing brain, as this synchrony is mirrored physiologically in the child’s heart rate synchrony—heart to heart and brain to brain. This early synchrony relates to self-regulation in infancy and toddlerhood and even shapes the adolescent’s capacity for empathy. In this *TGB* curriculum, you will learn about the impact of disrupted synchrony and how factors such as maternal depression affect the child’s ability to read emotions. *TGB* also includes very important content on the impact of stress on the developing brain, which is heavily influenced by the availability of a caring adult to help mediate the stress—to provide protection and help make the experience manageable. One of the most powerful features of this curriculum is that it translates very complex concepts in a way that is digestible, is meaningful and relevant, and provides a range of interactive exercises that enable trainees to integrate and apply these concepts in their daily work supporting young children. In short, it engages trainees’ brainpower in active learning!

Further, while professionals must be critical consumers of neuroscience, how do we help parents absorb this new information from science and build their confidence in what *they know* about their child? How can we help protect and grow parents’ intuitive competence—a concept well-documented decades ago in studies of parenting? While brain and behavior research will continue to bring new discoveries, we are reminded of one of the most fundamental ideas of early care and education: the essential value of observation as a way of knowing. A child’s behavior is one of the best windows into brain functioning. Our role is to encourage parents, teachers, and other caregivers to pause, watch, and truly notice the child’s responses to his world—to see what this child can take in at this moment on this day. What experiences does he approach? What experiences does she pull away from—even a bit? What is too much input for him? What is too little for her? Where is the sweet spot—the space for moderate novelty in which the brain thrives?

The science of early development is an integrated science, and you are an integrated professional. Enjoy deepening your understanding of child development and the brain and sharing that knowledge with others!

Linda Gilkerson, PhD
Professor, Erikson Institute

Note for Participant Manual: Unit 4

This section of the participant manual is comprised of important content and reflections related to Unit 4, Cognition and Executive Function of *The Growing Brain*. All 7 Units are available separately from ZERO TO THREE, as well as available as a complete publication package. Please see the participant manual table of contents on page 3 for a list of all 7 Units.

We are proud of the participant manual as a way of enhancing participants' understanding of *The Growing Brain* as an interactive curriculum: it is a fully designed and functional workbook for learners to explore and exchange ideas. They can be purchased individually, or as a group purchase. Your learners can make the purchases or you can on their behalf.

Unit 4 covers:

- how children are driven to comprehend the world from day 1;
- how they learn best by following an adult lead;
- how executive functioning skills are comprised of a set of cognitive processes within the brain; and
- how children build confidence through interactions that help them persevere and overcome challenges.

The participant manual is available from the ZERO TO THREE bookstore as a digital download. This download is a single-use license for either you or your learners to print—in order to make best use of the workbook features.

Teaching *The Growing Brain: Birth to 5 Years Old*

The Growing Brain: From Birth to 5 Years Old is a 21-hour course. The following is a suggested time schedule for teaching each unit based on the field test. Times may vary from trainer to trainer and based on the needs of participants.

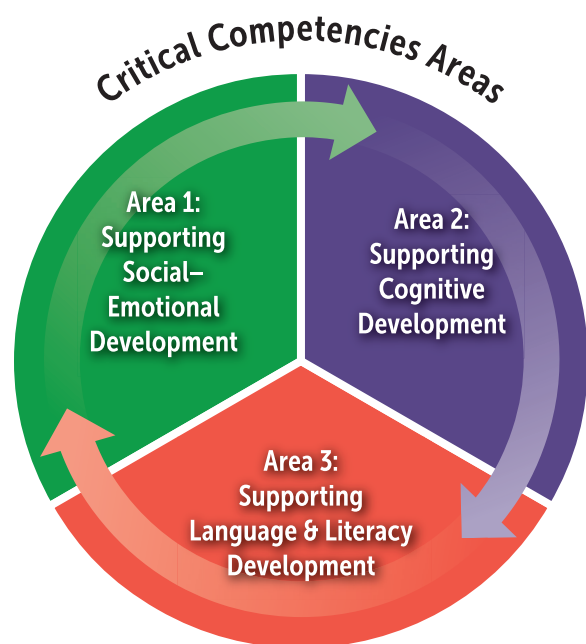
Unit 1: The Growing Brain: The Basics	3 hours
Unit 2: The Growing Brain: The Factors Affecting Brain Growth and Development	3 hours
Unit 3: The Growing Brain: Communication and Language Development	3 hours
Unit 4: The Growing Brain: Cognition and Executive Function	3 hours
Unit 5: The Growing Brain: Social-Emotional Development	3 hours
Unit 6: The Growing Brain: Understanding Behavior	3 hours
Unit 7: The Growing Brain: Everyday Play	3 hours

*Note: The 21 hours is training time and each unit includes only one 10-minute break. *Additional time must be scheduled for additional breaks of any kind.*

Critical Competencies Areas and Sub-Areas

The *ZERO TO THREE Critical Competencies for Infant-Toddler Educators™* define the specific evidence-based teaching methods and practices that support and nurture young children's social-emotional, cognitive, and language and literacy development and learning.

ZERO TO THREE has completed a crosswalk between the *ZERO TO THREE Critical Competencies for Infant-Toddler Educators™* and *The Growing Brain: From Birth to 5 Years Old* training curriculum. Significantly for learners, these two professional development curricula and resources now closely align and complement each other. For more information on the *Critical Competencies* and how you can use them to inform your professional development goals, visit www.zerotothree.org/criticalcompetencies.



Critical Competencies Sub-Areas

Area 1: Supporting Social-Emotional Development

- SE-1 Building Warm, Positive, and Nurturing Relationships
- SE-2 Providing Consistent and Responsive Caregiving
- SE-3 Supporting Emotional Expression and Regulation
- SE-4 Promoting Socialization
- SE-5 Guiding Behavior
- SE-6 Promoting Children's Sense of Identity and Belonging

Area 2: Supporting Cognitive Development

- C-1 Facilitating Exploration and Concept Development
- C-2 Building Meaningful Curriculum
- C-3 Promoting Imitation, Symbolic Representation, and Play
- C-4 Supporting Reasoning and Problem Solving

Area 3: Supporting Language & Literacy Development

- L&L-1 Promoting Communication Exchange
- L&L-2 Expanding Expressive and Receptive Language and Vocabulary
- L&L-3 Promoting Early Literacy

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Unit 4

Goal: To understand how young children develop cognitive and executive functions in relation to the developing brain

- Objectives**
- 1: Learn How Cognitive Development Unfolds
 - 2: Learn Ways to Support Cognitive Development in Young Children
 - 3: Learn About Executive Functioning and Its Critical Role in Cognitive and Overall Development
 - 4: Learn Ways to Support the Development of Executive Functions
-

1 Learn How Cognitive Development Unfolds

What Is Cognition?

➔ Write down the definition of **cognition** below:

The term **cognitive development** refers to the process of growth and change in intellectual/mental abilities such as thinking, reasoning, and understanding. It includes the acquisition and consolidation of knowledge.

Think About It: Cognition starts at birth. Babies come into the world with a natural drive to learn about how the world works. It is this intense curiosity that helps them develop the critical thinking skills necessary to be successful in school and in life.

Cognition and Executive Function

Cognitive Development From Birth to 12 Months

Babies learn by taking in information through their senses. In their first year, babies are learning very important concepts.

Give an example of a baby working through each of the following concepts.

➔ Cause and effect:

➔ Size and shape:

➔ Solve problems:

➔ Gravity:

➔ "Object permanence":

➔ People:

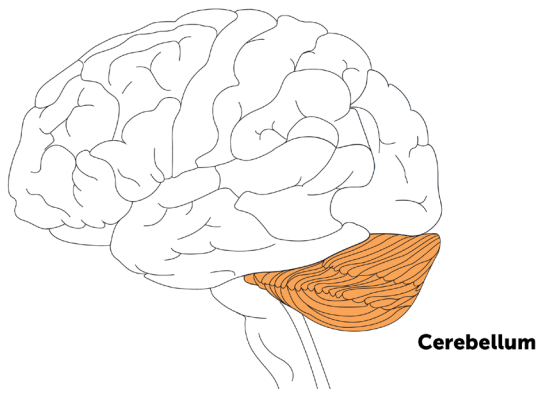


Development of Memory

During the first year, babies are developing what is known as **procedural memory** which is the unconscious memory of skills and how to do things, particularly the use of objects or movements of the body. Babies are also developing **explicit memory**, which is the kind of memory in which they are consciously aware of using recall of past experiences or recognizing that something is familiar.

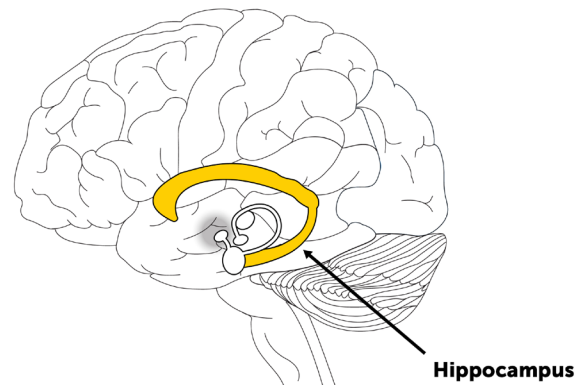
Procedural Memory

- Unconscious—how to do things
- Acquired through repetition and practice
- Stored in the cerebellum



Explicit Memory

- Conscious—recall of past experiences
- Encoded and stored by the hippocampus



➔ What are some ways babies let you know they are remembering things?

Cause and Effect and Understanding the Physical World

Babies develop a sense of how the world operates very early on. Many studies demonstrate that babies already have developed expectations about how objects work. One way babies figure out how things work is through cause and effect—experiencing that there are predictable responses to their actions—starting as early as 3 to 4 months old.

➔ What are some ways babies demonstrate they are learning about cause and effect?

Cognition and Executive Function



Categorizing

Young babies are also learning to categorize objects they encounter in the world around them, mostly according to their sensory understanding of these objects and their functions.

Babies are very clever in how they categorize. They notice similar features even among very different objects. Babies also show **cross-modal categorization** in the first year. In other words, they can use what they have learned about an object through one sense and apply it to their experience of the same object using another sense. Babies also pay special attention to human faces early in the first year.

➔ What are some ways babies show they are categorizing even in the first year?

What You Can Do to Nurture Early Thinking Skills

➔ What information and skills can babies learn by exploring baby toys?

➔ What are some ways to encourage the development of cognitive skills during the first year?

Cognitive Development From 12–24 Months

Toddlers are little scientists. They are eager to figure out how everything works, and they do this through “experiments” and using objects as tools. Toddlers’ growing physical skills allow them to explore objects more thoroughly; for instance, they figure out and sort which objects fit together, stack items and knock them down, and mix and dump materials such as water and sand.

What’s going on in the brain?

Growth in the **cerebral cortex** makes the development of new cognitive skills possible as the cerebral cortex plays a key role in memory, attention, perceptual awareness, thought, language, and consciousness.

➔ Write down some of the cognitive skills of toddlers below.

➔ What are some ways you have observed toddlers categorizing?

**Toddlers’ Growing Memory**

Toddlers can remember a great number of familiar people, places, things, and routines. As their memory grows, they begin to identify patterns in their lives and develop expectations about the world. Conversely, when there is a change in a daily routine or they are faced with a new, unfamiliar situation, toddlers may be fearful and need support to cope. **SE-2** **SE-3**

SE-4 **C-2** **C-3**

Their developing memories, thinking skills, and physical skills allow toddlers to apply their existing knowledge to solve increasingly complex problems. They can make and execute a plan of action.

➔ What are some ways children in this age group use their memories?

Cognition and Executive Function

Early Symbolic Play

As children near 2 years old, they begin to develop a critical cognitive skill called **symbolic thinking**. 🧠C-3

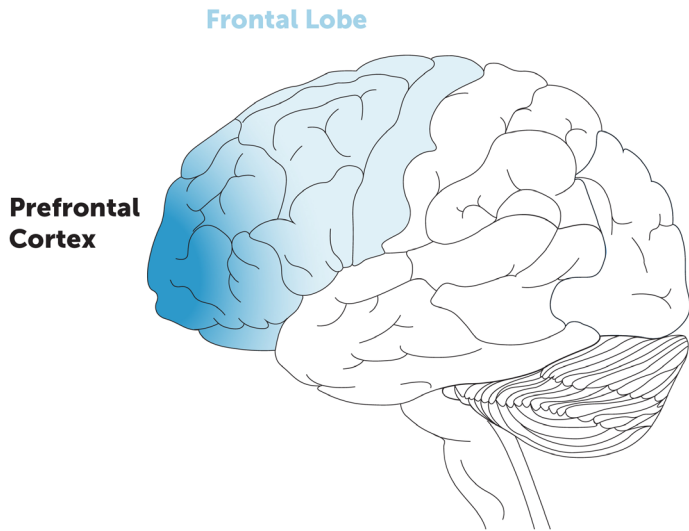
➔ Write down the definition for symbolic thinking.

➔ What are some ways you have observed children in this age group develop symbolic thinking?

Imitation and Early Understanding of People

Babies and toddlers learn a lot by imitating other people. Their growing memory skills are also revealed when you see toddlers use **deferred imitation**—repeating the action or sound after a delay of at least 24 hours—which can first be seen late in the first year. They also have an understanding about what other people are thinking—what their intentions are. 🧠C-3

Understanding that people have intentions, desires, goals, and emotions that affect their actions is an early step in developing what is known as **theory of mind**, which begins to flourish during the third and fourth years.



Cognitive Development From 24–36 Months

There is a big jump in children’s thinking skills in the third year due to the fact that the synaptic connections in the **prefrontal cortex** reach their peak—up to 200% of their adult level.

Children at this age can:

- use their memory of past events to interpret future events,
- have more **cognitive flexibility**,
- better understand cause and effect,
- have lots of new ideas but limited skills and self-control.

Growing Ability to Pretend

Children’s symbolic thinking skills grow rapidly between 24 and 36 months old. This growth allows for an increase in the use of their imagination through pretend play. 🎭C-3

➔ Write down ways to support symbolic thinking.





➔ What are some ways you see children in this age group growing in their ability to play pretend?

Cognition and Executive Function

UNIT 4



The Development of Logical Thinking Skills

Between 2½ and 3 years old, children begin to understand how things are logically connected. They use their increasing language skills to ask questions about what they see, hear, and experience in the world. Cognitive flexibility is also developing at this time.  

➔ Write down ways to support logical thinking.

➔ What are some ways you see children in this age group using cognitive flexibility?

Children See and Remember Patterns and Connect Ideas

By 3 years old, children can use their memories to apply past experiences to the present. This is evident when they laugh at funny things or when they remember that a peer is not coming to school because she is on vacation.  

➔ Write down ways to support this skill.

➔ What are some ways you see children in this age group noticing and remembering patterns?

Sorting and Categorizing

During this third year, children's ability to sort becomes more complex. They can categorize objects by their characteristics. They are also beginning to understand more complex concepts of time, space, size, and quantity.

➔ What are some ways you see children in this age group sorting and categorizing?



Theory of Mind



A major milestone that children master during this third year of life is the understanding that other people have their own thoughts and feelings. Scientists call this "**theory of mind.**" This development means that children are starting to develop empathy as they can put themselves in other people's shoes. 🔄SE-6

➔ What are some ways you see children in this age group beginning to understand that other people have thoughts, goals, and feelings that may be different from their own?

Cognition and Executive Function

UNIT 4

Cognitive Development From 3–5 Years Old

Preschoolers' memories are developed to the point that they remember specific details. Their imaginations are growing, and their pretend play becomes more complex and collaborative. They can solve abstract problems due to their increasing ability to organize and analyze information. Their stories also become more intricate, with a beginning, middle, and end.  

➔ Document the important concepts that help children 3–5 years old prepare for success in school.

2 Learn Ways to Support Cognitive Development in Young Children

Use Handout 4.1 to learn more advanced skills to support cognitive development in young children.

3 Learn About Executive Functioning and Its Critical Role in Cognitive and Overall Development

Executive Functioning

Executive functioning is a set of cognitive skills that controls impulses and filters out distractions. Cognitive processes involved in executive functioning include: *Note the definition of each below. We will review them later.*

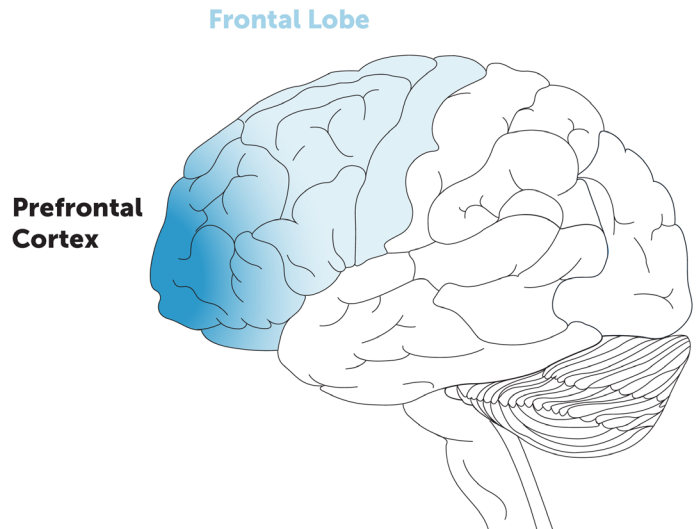
1. Inhibitory control:	
2. Sustained attention:	
3. Working memory:	
4. Cognitive flexibility:	

Think About It: Executive function skills are necessary for both strong cognitive and social skills. (Center on the Developing Child at Harvard University, 2011).

Cognition and Executive Function

Prefrontal Cortex

The prefrontal cortex plays a major role in planning and decision making and coordinates thoughts and actions to meet a goal.



➔ Document the role the parts of the prefrontal cortex play in executive functioning.

Anterior cingulate

Dorsolateral prefrontal cortex (DPC) and the Ventromedial prefrontal cortex (VMPC)




Think About It: Recent evidence (Glasser et al., 2016) suggests that there are more than 50 anatomically or functionally distinct parts of the prefrontal cortex.

Let's now think about the four features of executive functioning:

1. Inhibitory Control
2. Sustained Attention
3. Working Memory
4. Cognitive Flexibility and Perspective-Taking




1. Inhibitory Control

Inhibitory control allows children to manage their impulses and override urges to act out inappropriate behavior; for example, raising a hand when the teacher asks a question versus shouting out the answer (Davis, Bruce, Snyder, & Nelson, 2003). Children begin to develop inhibitory control between 3 and 4 years old as their prefrontal cortex becomes more developed, which helps them manage the expression of their feelings and plan how to act in ways that are more socially acceptable. Inhibitory control also includes the ability to delay gratification.   

➔ What are some ways to help children develop inhibitory control?



2. Sustained Attention

Sustained attention is the ability to maintain focused attention, even in the face of distractions. Distractions might include what is going on in the room—the sounds and activities going on around the child. Children can also be distracted by their own thoughts. The longer a child can focus on a task, the more persistent she is likely to be and, thus, the more success she is likely to experience. 

Cognition and Executive Function

UNIT 4

3. Working Memory

Working memory is the capacity to temporarily hold and manipulate information necessary to complete a task (Baddeley, 1992). Children need working memory skills to help them decide what information should be kept for a few minutes to complete a task or what should be stored long-term.

Think About It: Working memory can hold only a small chunk of information at a time. Then the brain has to quickly decide if it's going to hold on to that information to complete a task or move the information along to long-term memory.

4. Cognitive Flexibility and Perspective-Taking

Cognitive flexibility is the ability to adapt thinking when new information is provided. **Perspective-taking** is the ability to understand something from someone else's point of view (Diazgranados, Selman, & Dionne, 2015) and is an important part of cognitive flexibility.

Think About It: Children exhibit the ability to tune into other people's thoughts and feelings if their mothers talk about thoughts, wants, and feelings and provide explanations.

4

Learn Ways to Support the Development of Executive Functions

Use the Parent Handout at the end of this unit to learn important concepts related to executive functioning. [C-1](#) [C-2](#)

Let's Review! Key Messages:

- From day 1, children are driven to learn how the world works.
- They learn best when you follow their lead and use everyday experiences to teach important concepts.
- Executive functioning skills are a set of cognitive processes that are crucial for learning.
- Helping the children you serve see themselves as good learners builds their confidence, making it more likely that they will persevere through the challenges they encounter.

➔ What other key messages are you taking with you, in terms of how children are driven to learn how the world works?

Notes

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Handout 4.1

Supporting Cognitive Development

Concept	Birth to 12 Months Old	12–24 Months Old	24–36 Months Old	3–5 Years Old
Memory				
Problem solving				
Cause and effect				
Categorizing				
Understanding patterns				
Symbolic thinking				
Theory of mind/ social understanding				

Handout 4.2

Executive Functioning in Action

Strategies for Supporting	Inhibitory Control	Sustained Attention	Working Memory	Cognitive Flexibility and Perspective Taking
<p>Example of typical activity: <i>Two 3-year-olds playing with animal dress-up costumes (e.g., cat ears and tail)</i></p>	<p>As children become loud in their play ask them to use their indoor voices, or soft kitten noises. Model the tone of voice.</p>	<p>The teacher helps them continue to focus on the dramatic play by asking questions about what happens next.</p>	<p>The teacher asks what they learned about cats yesterday in story time (e.g., they like to drink milk).</p>	<p>The teacher asks what would happen if the cats saw a dog. How would the cats feel?</p>
<p>Typical Classroom Activity</p>				
<p>Typical Classroom Activity</p>				

Handout 4.3

Key Terms

- **Amygdala:** A structure located in the temporal lobe of the forebrain that perceives and evaluates a potentially threatening event or circumstance. Its functioning can be affected by an increase in stress-induced cortisol. The amygdala matures early in life and plays a critical role in the body's learned response to fear (National Scientific Council on the Developing Child, 2010; Society for Neuroscience, 2016).
- **Anterior cingulate:** This structure lies between the frontal lobe of the cerebral cortex and emotion-related brain regions. The anterior cingulate receives messages from many brain regions and coordinates all of the information to regulate both cognitive and emotional processes (Zelazo, Carlson, & Kesek, 2008). The anterior cingulate is involved in controlling behavior in challenging situations and making adjustments to behavior when a strategy is not working (Luu & Tucker, 2002).
- **Cerebellum:** The part of the brain at the back of the skull that is responsible for the coordination and regulation of muscular activity.
- **Cerebral cortex:** The outer layer of the cerebrum that consists of four lobes: frontal, parietal, occipital, and temporal. The four lobes of the cerebral cortex are responsible for the important functions of processing cognitive, emotional, behavioral, and sensory information (Society for Neuroscience, 2016).
- **Cognition:** The mental action or process of acquiring knowledge and understanding through thought, experience, and the senses.
- **Cognitive development:** The process of growth and change in intellectual/mental abilities such as thinking, reasoning, and understanding. It includes the acquisition and consolidation of knowledge.
- **Cognitive flexibility:** The ability to adjust when we acquire new information, allowing us to think creatively, catch mistakes and fix them, and gain a new perspective.
- **Cross-model categorization:** Applying what one has learned about an object through one sense and applying it to one's experience of the same object using another sense.
- **Deferred imitation:** Repeating an action or sound after a delay of at least 24 hours.
- **Dorsolateral prefrontal cortex:** One of the most sophisticated areas of the cerebral cortex involved in the planning, organization, and regulation of behavior.
- **Executive functioning:** A set of cognitive skills that controls impulses and filters out distractions. Executive functions allow children to focus their attention, organize information, put a plan into action, and also have a back-up plan if necessary (Diamond, 2006).
- **Explicit memory:** The kind of memory that entails conscious awareness of using recall of past experiences or recognizing that something is familiar.
- **Frontal lobe:** The frontal lobe of the cerebral cortex is located at the very top, front of the brain, and is the last part of the brain to develop fully.

Functions of the frontal lobe include (Society for Neuroscience, 2016):

- starting and coordinating motor movement;
 - higher order cognitive skills: thinking, planning, problem solving—all necessary for executive functioning; and
 - personality and emotional processing.
- **Hippocampus:** The hippocampus is responsible for the storage of long-term memories as well as for the memory of the location of objects or people (Society for Neuroscience, 2016).
 - **Implicit memory:** Memory that is stored and accessed unconsciously.
 - **Inhibitory control:** The ability to control impulses and filter out distractions.

- **Medial prefrontal cortex:** The area of the brain that is responsible for making associations between context, locations, events, and corresponding adaptive responses, particularly emotional responses. Accordingly, it is involved in both memory and decision-making due to the fact that almost all these tasks entail the ability to recall the best action or emotional response to specific events in a particular place and time.
- **Occipital lobe:** The function of the occipital lobe is to process visual information, such as shapes and colors (Society for Neuroscience, 2016).
- **Perspective taking:** The ability to see things from someone else's point of view.
- **Prefrontal cortex:** The front part of the frontal lobe. This region of the brain is widely considered the center of executive functions and is responsible for regulating thought, emotions, and actions.
- **Procedural memory:** The unconscious memory of skills and how to do things, particularly the use of objects or movements of the body, such as how to make a ball roll or how to get a toy to make a sound.
- **Self-regulation:** The ability to exert control over one's attention, emotion, thinking, and behavior. It is used interchangeably with self-control.
- **Superior temporal sulcus:** Situated in the temporal lobe, it processes cues about the direction of other people's attention.
- **Sustained attention:** The ability to focus and maintain attention even in the face of distractions.
- **Symbolic thinking:** A developmental milestone beginning around 18 months old, where children represent people, objects, ideas, or events with images, words, or in play. For example, holding a banana up to one's ear and mouth as though it were a phone.
- **Temporal lobe:** The temporal lobe has a variety of important functions, which include (Society for Neuroscience, 2016):
 - processing auditory information—such as hearing different pitches of sound,
 - language recognition—understanding what words mean,
 - storing visual memory—such as remembering a familiar face,
 - short-term and long-term memory—through a structure called the hippocampus, and
 - emotional responses—through a structure of the temporal lobe called the amygdala.
- **Theory of mind:** The understanding that others have their own thoughts and feelings that can be different from one's own thoughts and feelings.
- **Ventromedial prefrontal cortex:** A part of the prefrontal cortex that is involved in the inhibition of behavior (including emotions) and decision making.
- **Working memory:** The capacity to temporarily hold and manipulate information necessary to complete a task.

Supporting Early Cognitive Development

Babies are driven to figure out how the world works. You can support your child's learning by providing lots of opportunities to explore, by encouraging her curiosity, and by building her confidence.

Here's what you can do:

Birth to 12 months

In this first year, babies are learning very important early math and logic concepts. They learn about *cause and effect* when they push a button to make the toy car move. They learn about *size* and *shape* and how to solve problems when they figure out that one ball fits into the bucket but another one doesn't. They learn about *gravity* when they drop a spoon from the high chair and watch to see where it lands.

Encourage your child to explore objects and toys in different ways. Touching, banging, shaking, and rolling help children learn about how things work. Talk with your child about what he is doing. "You got the truck to move by pulling the string!"

Make everyday activities "teachable moments." For example, bath time can be a fun time for learning. Filling and dumping out cups help children learn about *empty* and *full*, and *in* and *out*.

12–24 months

Toddlers are like little scientists. They are eager to figure out how everything works. For example, they might throw a ball to the ground and see that it bounces, then throw a doll to see what it will do. Toddlers also imitate the things they see you do.

Follow your child's lead. Toddlers can learn almost any concept through their everyday activities. If your child loves to be active, she will learn about *fast* and *slow*, *up* and *down*, and *over* and *under* as she plays on the playground. If she prefers to explore with her hands, she will learn the same concepts and skills as she builds with blocks.

One more time! Toddlers like to repeat actions over and over again. This strengthens the connections in the brain that help children master new skills. Whether it's building a block tower or singing a song, doing it many times helps your child learn.

24–36 months

The ability to pretend marks a big leap in the development of thinking skills. When children pretend, it means that they understand symbols—that a block can become a car, a shoebox can become a home for stuffed animals, and, eventually, that a word stands for an object or an idea.

Encourage your child's growing imagination. It's important to allow your child to take the lead in your playtime. Let him be the "director." This helps him develop his own ideas. It also strengthens his thinking skills as he makes logical connections in his stories: "The dog has to go back in the house because it's raining." Offer him props to help him act out the stories he's creating.

Incorporate math games into your everyday routines. Count as you climb the stairs. Ask if there are enough crackers for everyone. Help your child put the socks in one pile and the shirts in another as you do laundry.

3–5 years

During this time, children are able to use reason and logic to solve lots of problems, like how to make a puzzle of several pieces fit together. Their imaginations are growing, and their pretend play becomes more complex. The stories they create have a beginning, middle, and end.

Build critical thinking skills. Ask questions about what you are seeing and experiencing together: "Where do you think the butterfly is flying to?" Wonder about things together: "I wonder how many legs are on that spider." "I wonder where else that puzzle piece might fit." "I wonder where the rain goes when it lands on the ground." This helps build strong thinking skills.

Build your child's creative thinking skills. The ability to use information in new ways to solve problems is a very important skill that helps children succeed in all aspects of life. For example, if your child puts his leg in the wrong opening while getting dressed, ask him what the problem might be and guide him to figure out which the correct hole is. You might hold up the pants so he can see the different openings and identify the correct one.