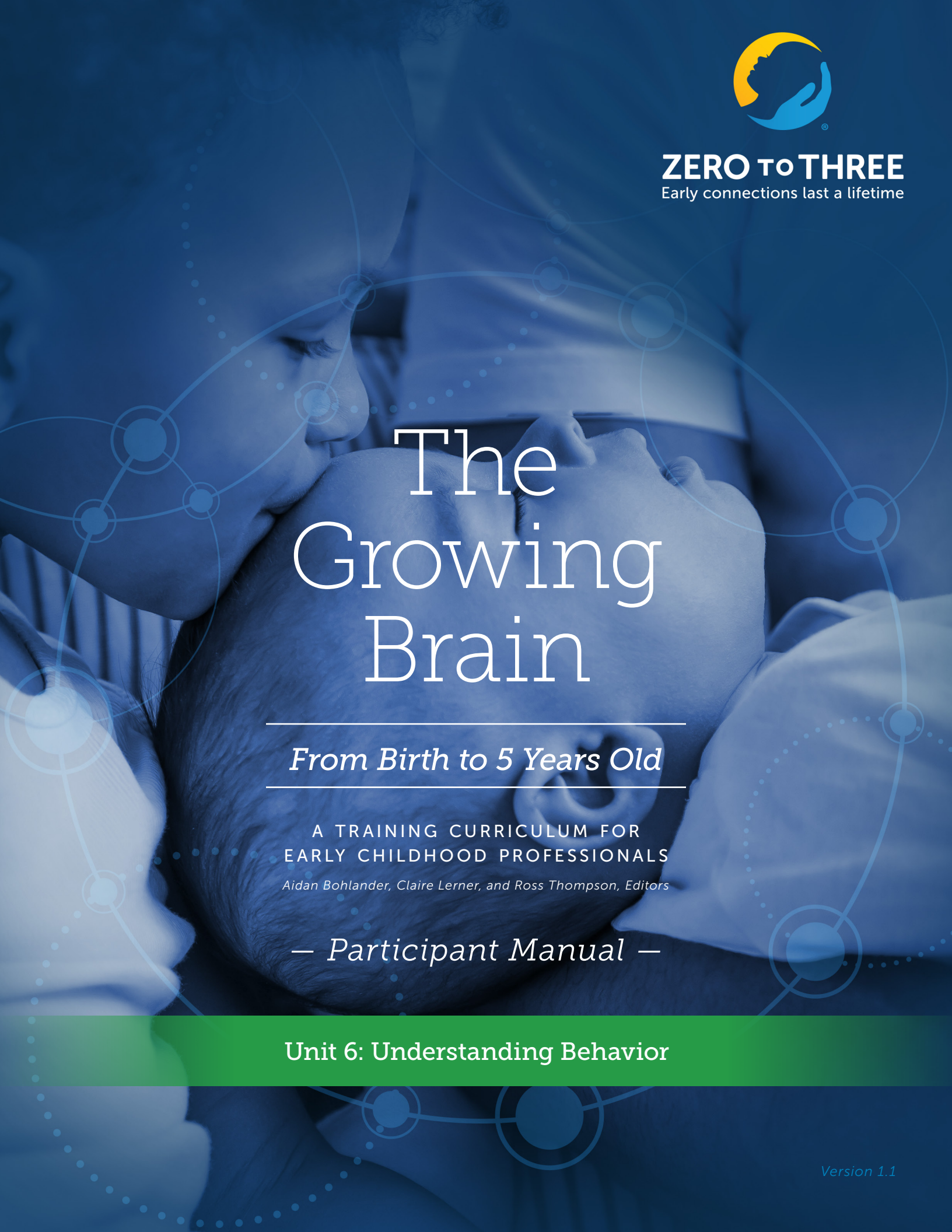

ZERO TO THREE
Early connections last a lifetime

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 6: Understanding Behavior

Version 1.1

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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 young¬est 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 6

This section of the participant manual is comprised of important content and reflections related to Unit 6, Understanding Behavior 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 6 covers:

- how different parts of the brain and its networks influence children's behavior and communication;
- how behavioral expression is influenced by several factors including physical development, temperament, and environmental factors;
- how challenging behavior in very young children can evoke strong emotional reactions for all involved; and
- the importance of responding to children's behavior in a sensitive, supportive, and nurturing fashion.

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.

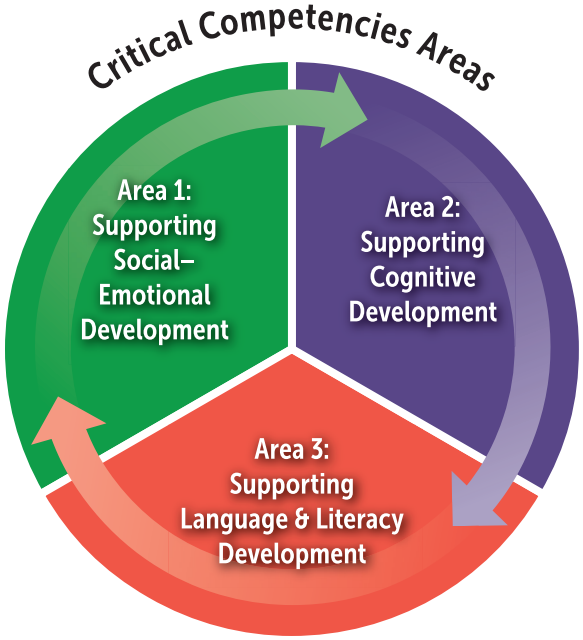
Unit 1: The Growing Brain: The Basics	3 hours
Unit 2: The Growing Brain: The Factors Affecting Brain Growth and Development	3 hours
Unit 3: The Growing Brain: Communication and Language Development	3 hours
Unit 4: The Growing Brain: Cognition and Executive Function	3 hours
Unit 5: The Growing Brain: 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 6

Understanding Behavior

Goal: To understand how children's behavior is influenced by the brain

Objectives

1: Understand Basic Brain Anatomy

2: Understand the Connection Between the Various Areas of the Brain and How These Connections Are Expressed Through Behavior

3: Understand the Key Factors That Influence Behavior

4: Understand the Root Causes of Challenging Behavior and Effective Strategies for Helping Children With These Difficulties

Tuning in to Your Triggers

What is your gut reaction?

Your responses to challenging behaviors are affected by what is going on in your brain.

What are you feeling in your body?

What are you feeling in your mind?

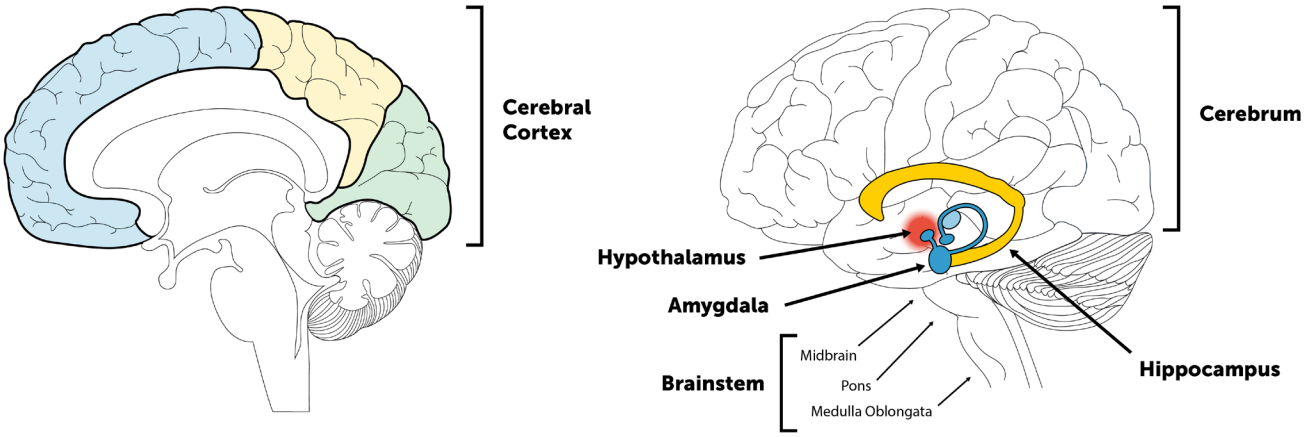
How might you respond differently?

1 Understand Basic Brain Anatomy

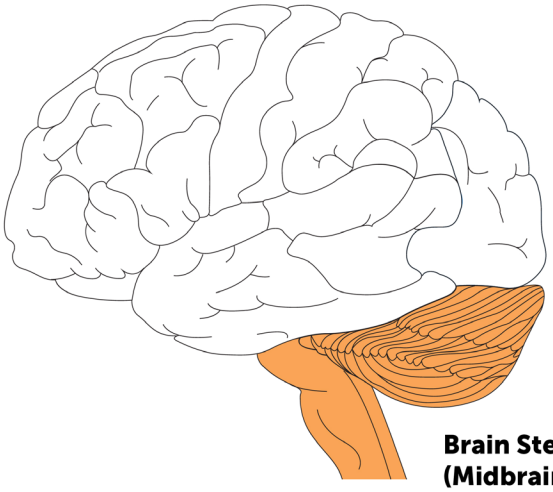
Overview of Brain Anatomy

The easiest way to get to know the brain and its effect on behavior is to learn about some of the main structures and how they relate to the brain's functions. The larger areas of the brain that affect behavior include:

- the **brain stem,**
- the **limbic system,**
- the **cerebral cortex.**



Understanding Behavior



Brain Stem
(Midbrain + Hindbrain)
Lower order functions

Overview of Brain Anatomy: Brain Stem

The brain stem is made up of the **midbrain** and **hindbrain.** It connects the **spinal cord** to the **forebrain,** or upper brain. It receives input from the body and sends input back to the body to regulate basic processes.

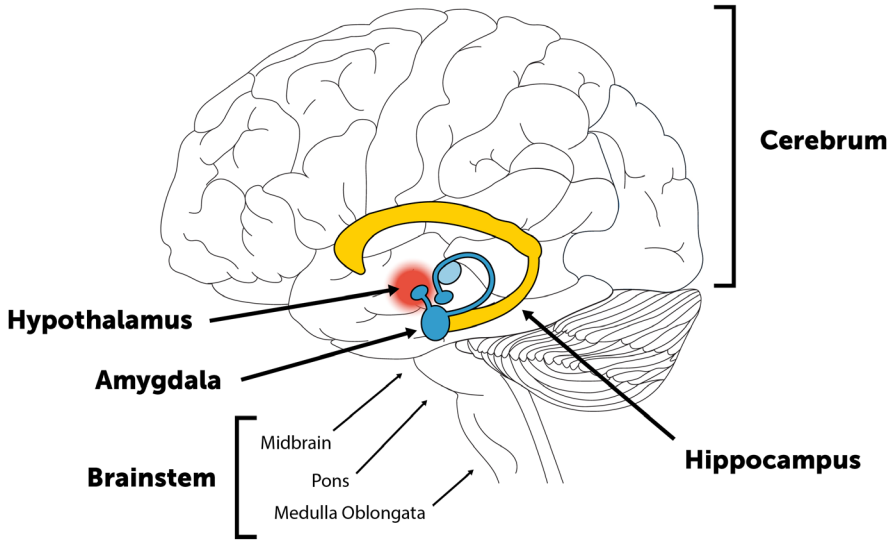
Think About It: The brain stem is partly responsible for our "fight, flight, or freeze" response when we are experiencing stress (Siegel, 2010).

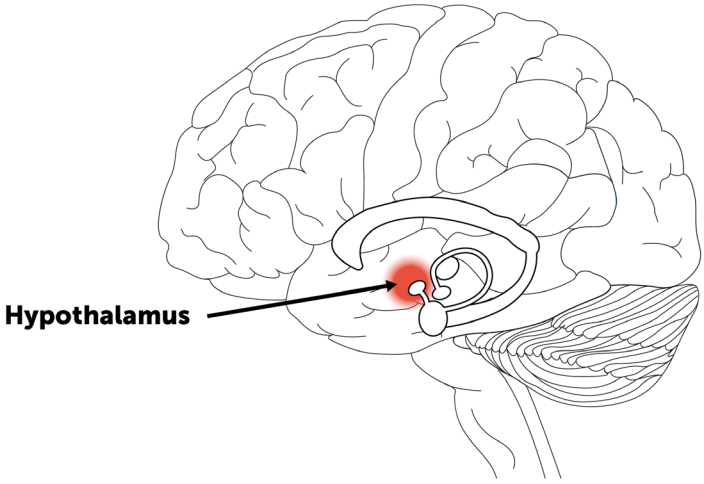
Understanding Behavior

Overview of Brain Anatomy: Limbic System

The limbic system spans the forebrain and midbrain and is located just beneath the **cerebrum,** the major region of the forebrain. The limbic system is responsible for our emotions as well as many higher mental functions, such as the formation of memories.

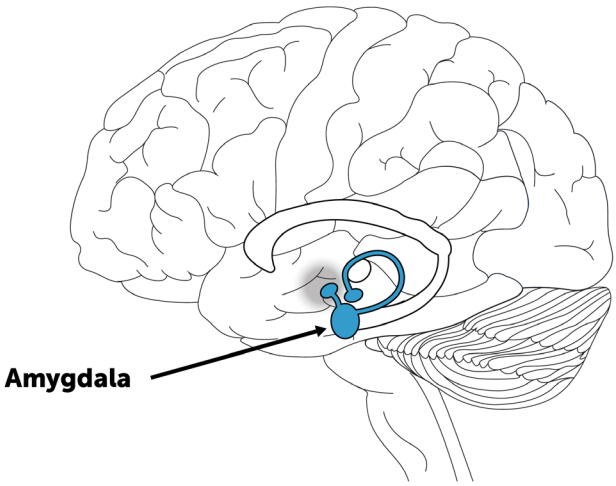
The limbic system matures over time. Three of its structures include: the **hypothalamus,** the **amygdala,** and the **hippocampus.**





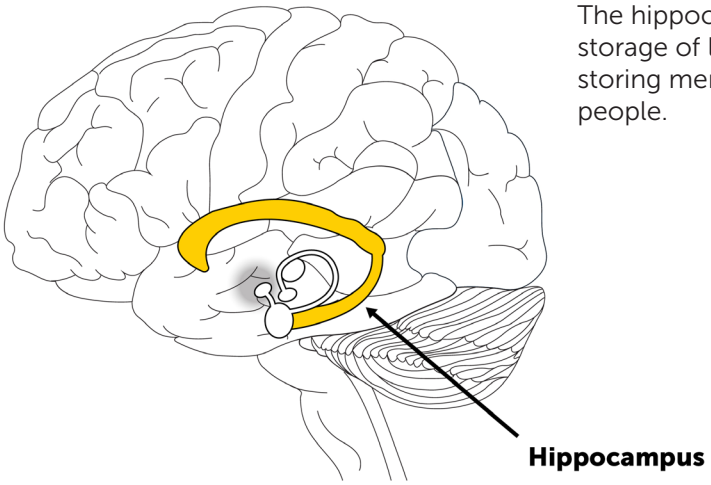
Overview of Brain Anatomy: Hypothalamus

The hypothalamus is the structure responsible for controlling our body temperature, thirst, hunger, sleep, circadian rhythm, moods and emotions, stress reactions, and the production of many of the body's essential hormones that help control different cells and organs (Society for Neuroscience, 2016).



Overview of Brain Anatomy: Amygdala

The amygdala is a small almond-shaped structure located close to the hippocampus, in the frontal portion of the temporal lobe. It is well known for its importance in analyzing the emotional significance of events, perceiving emotion, and expressing emotion.



Overview of Brain Anatomy: Hippocampus

The hippocampus is responsible for the storage of long-term memories, as well as for storing memories of the location of objects or people.

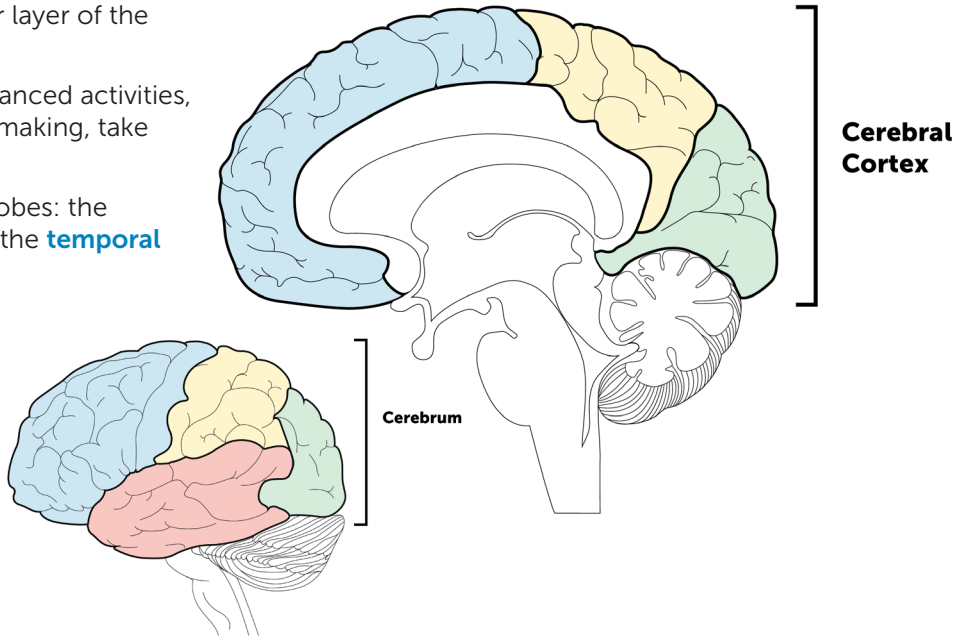
Understanding Behavior

Overview of Brain Anatomy: Cerebral Cortex

The cerebral cortex is the outer layer of the cerebrum.

It is where the brain's most advanced activities, such as planning and decision making, take place.

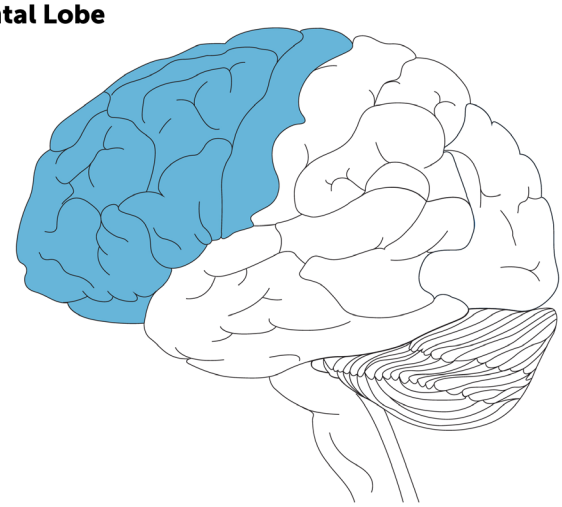
It is divided into four different lobes: the **frontal lobe,** the **parietal lobe,** the **temporal lobe,** and the **occipital lobe.**



Think About It: The cerebral cortex is not fully developed until a person is in his or her mid-20s (Society for Neuroscience, 2016).

➡ Discuss the four parts of the cerebral cortex and their functions. Jot down below what each lobe is responsible for.

Frontal Lobe



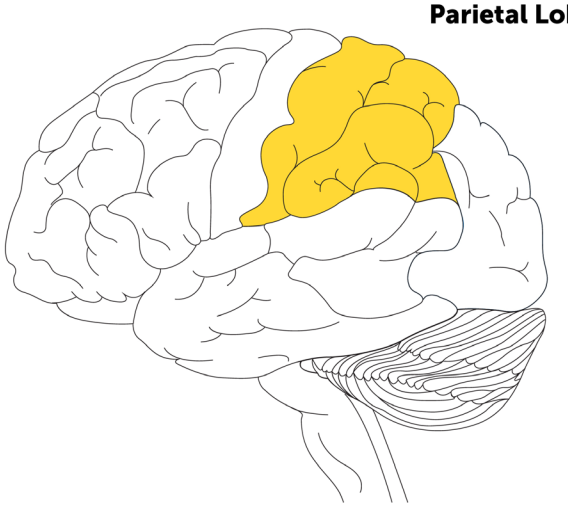
Overview of Brain Anatomy: The Frontal Lobe

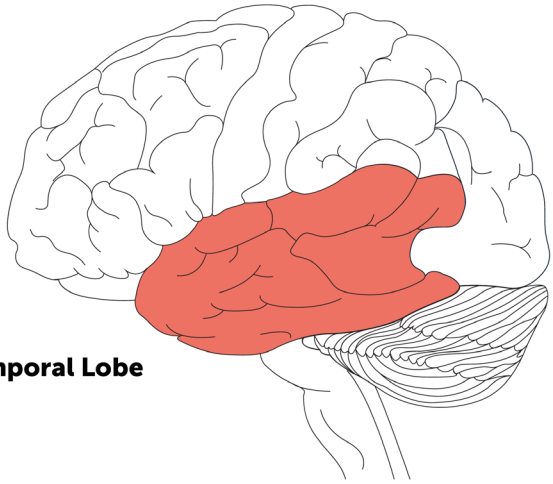
Discuss the functions and responsibility of the frontal lobe.

Overview of Brain Anatomy: The Parietal Lobe

Discuss the functions and responsibility of the parietal lobe.

Parietal Lobe





Temporal Lobe

Overview of Brain Anatomy: The Temporal Lobe

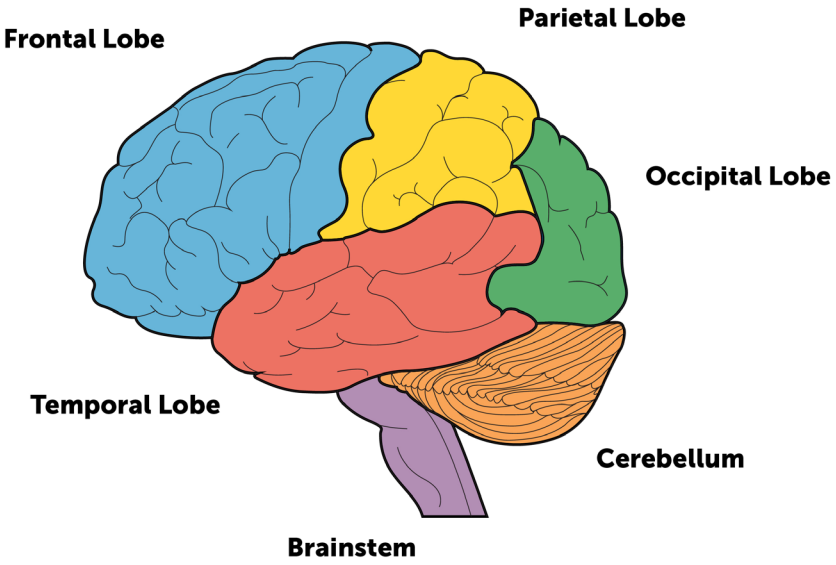
Discuss the functions and responsibility of the temporal lobe.

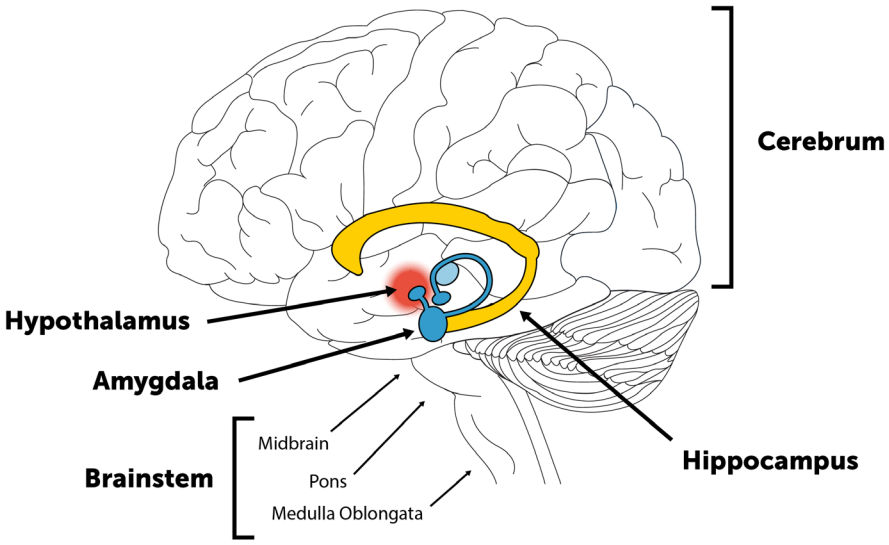
Overview of Brain Anatomy: The Occipital Lobe

Discuss the functions and responsibility of the occipital lobe.

Occipital Lobe

Summary of Brain Anatomy: Behavior and the Brain





➡ Give an everyday example of how the various areas of the brain can work together.

2 Understand the Connection Between the Various Areas of the Brain and How These Connections Are Expressed Through Behavior

For a worksheet about behavior skills and glossary of brain structures, see handouts 6.1 and 6.2 at the end of this chapter. Use the space below for notes.

3 Understand the Key Factors That Influence Behavior

All Behavior Has Meaning

All behavior is driven by the brain, but how these behaviors get expressed is influenced by three key factors that shape how children process and react to the experiences they have in the world:

- where they are developmentally,
- their **temperament,**
- environmental factors.

Effectively helping children depends on understanding the root cause of their behavior.

Think About It: Understanding the root cause of a child's behavior is like detective work—you need to sort through clues about the reasons for this child's behavior from all that you know and can observe about the child.

Development

Knowing where a child is on the developmental ladder provides important data in figuring out behavior.

Consider:

- What is a child capable of in all domains: cognitive, language/communications, social–emotional, and physical?
- How do the child's skills and abilities affect his behavior?

Development of Self-Control/Self-Regulation

Many of the challenges parents and providers are dealing with in the early years have to do with the development of self-control, also known as self-regulation.

- Record the definitions of self-regulation and executive functions, giving examples.

Self-Regulation	

Executive Functions	

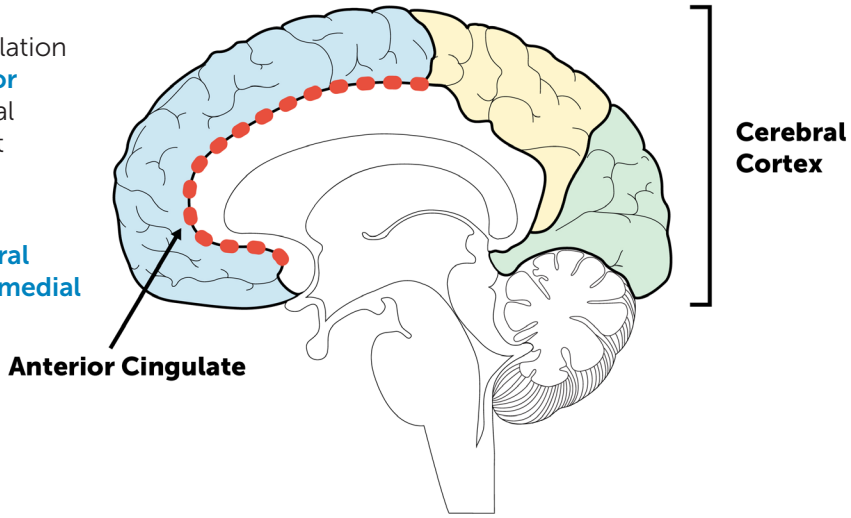
- When you think of self-control, what kinds of images or scenarios come to mind?

Understanding Behavior

The Brain's Role in the Development of Self-Regulation

Critical to the development of self-regulation is the part of the brain called the **anterior cingulate,** which lies between the frontal lobe of the cerebral cortex and adjacent emotion-related brain regions.

Also important for self-regulation and executive functioning are the **dorsolateral prefrontal cortex (DPC)** and the **ventromedial prefrontal cortex (VMPC).**



Temperament

Temperament accounts for how children approach the world—how they take in and respond to their experiences.

Temperament is brain based. It isn't something children choose or parents create.

Think About It: Research clearly shows that "differences in early childhood temperament—ranging from being extremely outgoing and adventurous to being painfully shy and easily upset by anything new or unusual—are grounded in one's biological makeup" (National Scientific Council on the Developing Child, 2004, p. 2).

Temperament Traits

Researchers Stella and Chess (1956) defined temperament according to nine categories.

1. Activity Level: how active a child is generally, from constant motion to more sedentary.

2. Distractibility: how easily a child's attention is drawn away from a task at hand.

3. Intensity: the degree of reaction, whether positive or negative, to a stimulus.

4. Regularity: the predictability of biological functions such as eating and sleeping.

5. Sensory threshold: how sensitive a child is to physical stimuli.

6. Approach/withdrawal: how a child reacts to new situations or people.

7. Adaptability: how easily a child adapts to transitions and changes.

8. Persistence: how frustrated a child becomes when faced with a challenging task.

9. Mood: the tendency to approach the world in a primarily positive or negative way.

To complement the categories above, see handout 6.4 at the end of this chapter.

Understanding Behavior

Temperament Shapes Behavior

➡ What are two behaviors that you see in your classrooms that may be influenced by temperament?

Think About It: With regard to temperament and behavior:

- Research shows that temperament traits are brain based.
- Temperament provides a foundation for personality.
- Just as experience shapes the growing brain, it also shapes temperament.

There is no right or wrong, good or bad temperament. It is all about the **goodness of fit**.
SE-1 SE-2

The Importance of a Child's Sensory Threshold

All children process sensory information through primary sensory cortices associated with each sense. For example, sounds are detected by the ear and are processed in the temporal lobe. Visual information is detected by the eye and is processed in the primary visual cortex. This sensory information then gets distributed to other parts of the brain via the **thalamus.** How this sensory information gets processed is different for every child and results in different behavioral outcomes.

Think About It: Tuning in to how the children in your care are responding to sensory input is very important for understanding the root cause of some of the behaviors you see.

Environmental Factors/Context

Children's experiences in the world have a significant effect on their ability to self-regulate. The most foundational factor in this is the quality of early **attachment.** When parents follow children's lead, tune in to and respond sensitively to their cues, and support children's growing autonomy, children develop self-control strategies.

Think About It: The level of security of attachment predicts self-control 6 years later (Olson, Bates, & Bayles, 1990). Children with secure attachments perform better on attention and self-control tasks (Bernier, Carlson, Deschenes, & Matt-Gagne, 2012).

➡ Give examples of environmental factors that affect self-regulation and describe their potential impact.

Impact of Change

A significant change in a child's life often creates a sense of insecurity, sadness, fear, or anger that can cause the child to become clingy, withdrawn, or more easily distracted. She also may show greater frustration and distress and have a harder time recovering from meltdowns. Children may also become anxious and overactive or aggressive.

Think About It: When children experience ongoing stress, the **cortisol** levels in their brains are elevated, which can alter the functioning of brain structures and make it harder for them to maintain self-control.

4 Understand the Root Causes of Challenging Behavior and Effective Strategies for Helping Children with These Difficulties

For a worksheet on the meaning of behavior, see handout 6.5 at the end of this chapter.

Managing Challenging Behavior

Here are some important guiding principles that are critical to effectively manage challenging behaviors:

- Recognize and believe that children aren't being "bad" on purpose. SE-5

- Feelings aren't the problem; it's what children do with feelings that can become problematic (ZERO TO THREE, 2016b).

Responsibility/Role of Provider

A key responsibility of providers is to help young children navigate the tide of strong emotions and desires they experience in ways that are prosocial and will help them thrive.

The first step in helping children develop strong problem-solving and coping skills is managing our own emotions as adults.

Think About It: Tuning in to our own emotions and reactions is the critical first step to maintaining our own self-control and using our own coping skills.

Know Your Triggers

➡ As a caregiver, take a moment and think about your emotional triggers. Use the space provided below to journal about behaviors that push your buttons.

Know Your Triggers

➡ Now take a moment to think about what helps you calm down. List them below.

Think About It: Self-awareness is one of your greatest assets in nurturing young children's healthy development.

Understanding Behavior

Staying Calm and Nonreactive

"Don't just do something, stand there." (Jeree Pawl)

Staying calm is critical because highly charged emotional reactions can be obstacles to helping children calm down and thereby learn important coping skills. By contrast, when we keep calm, we can begin to observe and problem solve. SE-3

Calming Strategies

- List calming strategies to practice during challenging moments.

Heading Off Challenging Behaviors

Consider the following strategies for facing challenging behaviors. Jot down notes in the space provided.

1. Establish close, open communication with parents. SE-3

2. Look for patterns in children's reactions throughout the day and then make adaptations accordingly. SE-5 C-2 C-4

3. Adapt the environment and structure of the classroom to minimize challenges. SE-2 SE-3

Approach to Dealing With Challenging Behaviors

Here are some guiding principles that can help you remain present and loving while positively guiding children's behavior. Use the space provided to jot down some notes.

➡ Stay Calm:

➡ Have a Plan:

- Validate the child's feelings: SE-3
- Set the limit: SE-5
- Allow space for recovery: SE-4
- Debrief when the child is calm: SE-5

Understanding Behavior

Putting it into Practice

➡ What are some approaches to addressing challenging behaviors?

When to Consider Further Assessment

It is important to consider when it is time to take a closer look at a child's behavior, to assess whether there is something foundational going on that might require intervention. Consider further assessment when:

- you notice a marked change in a child's behavior,
- the behavior is interfering in a child's ability to learn, develop healthy relationships, and function effectively in the classroom.

It is important to have a list of local resources that provide developmental and behavioral services such as psychologists; social workers; occupational, speech, and physical therapists; and early intervention programs.

Let's Review! Key Messages:

- Various areas of the brain are involved in young children's behavior communicating through networks shaped by the child's experiences.
- How behaviors get expressed is influenced by several key factors—development, temperament, and environment—that shape how children process and react to the experiences they have in the world.
- Challenging behavior in very young children can evoke strong emotional reactions for those involved.
- It is important to observe and try to understand the meaning of behaviors and respond in a sensitive, supportive, and nurturing fashion.

Think About It:
A _____ is like a _____ because...

Notes

References

Aksan, N., & Kochanska, G. (2004). Links between systems of inhibition from infancy to preschool years. *Child Development, 75*, 1477–1490.

Bernier, A., Carlson, S. M., Deschenes, M., & Matte-Gagne, C. (2012). Social factors in the development of early executive functioning: A closer look at the caregiving environment. *Developmental Science, 15,* 12–24. doi: 10.1111/j.1467-7687.2011.01093.x.

Callaghan, B. L., & Tottenham N. (2016). The neuro-environmental loop of plasticity: A cross-species analysis of parental effects on emotion circuitry development following typical and adverse caregiving. *Neuropsychopharmacology, 41*(1), 163–176.

Diamond, A. (2006). The early development of executive functions. In E. Bialystok & F. I. M. Craik (Eds.), *Lifespan cognition: Mechanisms of change* (pp. 70–95). New York, NY: Oxford University Press.

Eisenberg, N., Fabes, R. A., Shepard, S. A., Guthrie, I. K., Murphy, B. C., & Reiser, M. (1999). Parental reactions to children's negative emotions: Longitudinal relations to quality of children's social functioning. *Child Development, 70*(2), 513–534.

Howse, R. B., Lange, G., Farran, D. C., & Boyles, C. (2003). Motivational and self-regulation as predictors of achievement in economically disadvantaged young children. *Journal of Experimental Education, 71*, 151–174.

Kross, E., Bruehlman-Senecal, E., Park, J., Burson, A., Dougherty, A., Shablack, H., ...Ayduk, O. (2014). Self-talk as a regulatory mechanism: How you do it matters. *Journal of Personality and Social Psychology, 106*(2), 304–324.

Lengua, L. J., Honorado, E., & Bush, N. R. (2007). Contextual risk and parenting as predictors of effortful control and social competence in preschool children. *Journal of Applied Developmental Psychology, 28*, 40–55.

Lerner, C., & Dombro, A. (2005). *Bringing up baby: Three steps to making good decisions in your child's first years.* Washington, DC: ZERO TO THREE.

Luu, P., & Tucker, D. M. (2002). Self-regulation and the executive functions: Electrophysiological clues. In A. Zani & A. M. Preverbio (Eds.), *The cognitive electrophysiology of mind and brain* (pp. 199–223). San Diego, CA: Academic Press.

National Scientific Council on the Developing Child. (2004). *Children's emotional development is built into the architecture of their brains: Working paper no. 2*. Retrieved from http://developingchild.harvard.edu/resources/childrens-emotional-development-is-built-into-the-architecture-of-their-brains

National Scientific Council on the Developing Child. (2010). *Early experiences can alter gene expression and affect long-term development: Working paper no. 10*. Retrieved from http://developingchild.harvard.edu/resources/early-experiences-can-alter-gene-expression-and-affect-long-term-development

Olson, S. L., Bates, J. E., & Bayles, K. (1990). Early antecedents of childhood impulsivity: The role of parent-child interaction, cognitive competence, and temperament. *Journal of Abnormal Child Psychology, 18*(3), 317–334.

Posner, M. I., & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology, 12,* 427–441.

Prencipe, A., & Zelazo, P. D. (2005). Development of affective decision making for self and other: Evidence for the integration of first- and third-person perspectives. *Psychological Science, 16,* 501–505.

Rifkin-Graboi, A., Kong, L., Sim, L. W., Sanmugam, S., Broekman, B. F. P., Chen, H., . . . Qiu, A. (2015). Maternal sensitivity, infant limbic structure volume and functional connectivity: A preliminary study. *Translational Psychiatry*, *5*(10), e668. http://doi.org/10.1038/tp.2015.133

Rothbart, M. K., Derryberry, D., & Hershey, K. (2000). Stability of temperament in childhood: Laboratory infant assessment to parent report at seven years. In V. J. Molfese & D. L. Molfese (Eds.), *Temperament and personality development across the life span* (pp. 85–119). Mahwah, NJ: Erlbaum.

Shackman, J., Wismer Fries, A. B., & Pollak, S. D. (2008). Environmental influences on brain-behavioral development: Evidence from child abuse and neglect. In C. A. Nelson & M. Luciana (Eds.), *Handbook of developmental cognitive neuroscience* (2nd ed., pp. 869–881). Cambridge, MA: MIT Press.

Siegel, D. J. (2010). *Mindsight: The new science of personal transformation.* New York, NY: Bantam Books.

Society for Neuroscience. (2016). *Brain facts: A primer on the brain and nervous system*. Washington, DC: Author.

Sutton, S., & Davidson, R. (1997). Prefrontal brain asymmetry: A biological substrate of the behavioral approach and inhibition systems. *Psychological Science, 8,* 204–210.

Thomas, A., & Chess, S. (1956). An approach to the study of sources of individual differences in child behavior. *Journal of Clinical and Experimental Psychopathology*, *18*(4), 347–357.

Thompson, R. A. (2009). Doing what doesn't come naturally. *ZERO TO THREE*, *30*(2), 33–39.

Thompson, R. A. (2014). Stress and child development. *The Future of Children*, *24*(1), 41–59.

Zelazo, P. D., & Cunningham, W. A. (2007). Executive function: Mechanisms underlying emotion regulation. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 135–158). New York, NY: Guilford Press.

ZERO TO THREE. (2016a). *Challenging behaviors*. Retrieved from https://www.zerotothree.org/early-development/challenging-behaviors

ZERO TO THREE. (2016b). *I said I want the red bowl! Responding to toddler's irrational behavior.* Retrieved from https://www.zerotothree.org/resources/325-i-said-i-want-the-red-bowl-responding-to-toddlers-irrational-behavior

ZERO TO THREE. (2016c). *Temperament tools.* Retrieved from https://www.zerotothree.org/early-development/temperament

ZERO TO THREE. (2016d). *Toddlers and biting: Finding the right response.* Retrieved from https://www.zerotothree.org/resources/232-toddlers-and-biting-finding-the-right-response

ZERO TO THREE, (2016e). *Toddlers and self-control: A survival guide for parents.* Retrieved from https://www.zerotothree.org/resources/1603-toddlers-and-self-control-a-survival-guide-for-parents

Handout 6.1

Behavior Skills and the Brain Worksheet

For each behavior listed on the left, fill in the specific area(s) of the brain associated with that behavior in the right-hand column.

Areas of the brain: Brain stem, hypothalamus, amygdala, hippocampus, frontal lobe, parietal lobe, temporal lobe, occipital lobe

BIRTH–9 MONTHS	AREA OF THE BRAIN
1. Strong heartbeat	1.
2. Cries to indicate need/wants	2.
3. Responds to familiar faces	3.
9–18 MONTHS	**AREA OF THE BRAIN**
1. Begins to say "no"	1.
2. Separation anxiety	2.
3. Points to common objects	3.
18–36 MONTHS	**AREA OF THE BRAIN**
1. Asserts independence	1.
2. Plays "pretend" with other children	2.
3. Show fears of objects (monsters, dark)	3.
36–60 MONTHS	**AREA OF THE BRAIN**
1. Shows empathy toward other children	1.
2. Takes turns and shares	2.
3. Begins to understand right from wrong	3.

Handout 6.2

Glossary of Brain Structures

Amygdala: The brain structure responsible for analyzing the emotional significance of events, and perceiving and expressing emotion (e.g., happy, sad, scared). The amygdala is present at birth but undergoes significant structural and functional development across infancy and early childhood (Callaghan & Tottenham, 2016; Society for Neuroscience, 2016). When you experience highly charged emotional reactions, such as seeing a dog that is running toward you, looking like he may bite you, it is your amygdala that is being activated.

Brain stem: The brain structure that connects the spinal cord to the forebrain, or upper brain. The brain stem receives input from the body and sends input back to the body to regulate basic processes such as the functioning of our heart and lungs. The brain stem controls reflexes and involuntary processes like breathing and heart rate. The brain stem is partly responsible for our "fight, flight, or freeze" response when we are experiencing stress (Siegel, 2010).

Frontal lobe: One of four lobes of the cerebral cortex, used to make decisions, such as what to eat and drink, as well as for critical thinking. This is where personality is formed and where we carry out higher mental processes such as planning.

Hippocampus: The brain structure responsible for the storage of long-term memories as well as for the memory of the location of objects or people. The hippocampus develops gradually during our early years and continues to grow new connections throughout our lives (Siegel, 2010; Society for Neuroscience, 2016). We would not be able to remember where we parked our car in a parking lot without the work of the hippocampus.

Hypothalamus: The brain structure responsible for controlling our body temperature, thirst, hunger, sleep, circadian rhythm (our sleep/wake cycle), moods and emotions, stress reactions, and the production of many of the body's essential hormones that help control different cells and organs (Society for Neuroscience, 2016).

Occipital lobe: One of four lobes of the cerebral cortex, the occipital lobe enables us to correctly understand what our eyes are seeing. It works very fast to process the rapid information we are taking in through our eyes. Just as the temporal lobe makes sense of auditory information, the occipital lobe makes sense of visual information so that we are able to understand it. If our occipital lobe were impaired or injured we would not be able to correctly process visual signals (Society for Neuroscience, 2016).

Parietal lobe: One of four lobes of the cerebral cortex, the parietal lobe processes sensory information such as taste, temperature, and touch. This processing happens almost instantaneously. A person would not be able to feel sensations of touch and temperature and would even be partially or completely unaware of his own body if the parietal lobe were damaged.

Temporal lobe: One of four lobes of the cerebral cortex, the temporal lobe is responsible for hearing and selective listening. It receives sensory information such as sounds and speech from the ears. It is also key to being able to *comprehend,* or understand, meaningful speech. This lobe makes sense of all the different sounds being transmitted from the sensory receptors of the ears.

Handout 6.4

Identifying Temperament

Activity Level

Very low — In constant motion

Distractibility

Very easily distractible — Very focused

Intensity of Emotional Reaction

Low reactor — Big reactor

Regularity of Biological Functions

Very irregular — Very regular

Sensory Threshold

Low threshold — High threshold

Approach/Withdrawal

Very cautious — Jumps right in

Adaptability

Adapts easily to change — Change is very difficult

Persistence

Frustrates very easily — Very persistent

Mood

Very negative — Very positive

Adapted from Lerner & Dombro, 2005.

Handout 6.5

The Meaning of Behavior

Behavior	Development	Temperament	Environment
A 9-month-old gets very distressed in situations outside the home—the grocery store, mall, play groups. She cries and is very clingy to her parents/caregiver.			
An 18-month-old has severe tantrums every time he doesn't get what he wants, sometimes banging his head on the floor, throwing objects, and biting.			
A 2½-year-old gets very upset when it's time to make a transition from one activity to another. When something doesn't go her way, she tantrums and gets physically out of control, sometimes biting.			
A 3-year-old does well when engaged in a structured activity, but during free play he wanders aimlessly around the room and sometimes engages in inappropriate behavior, such as running around or throwing toys out of baskets.			

Behavior	Development	Temperament	Environment
A 3½-year-old gets frustrated very easily and breaks down as soon as he faces a challenge. He also doesn't join in his peers' imaginative play. When he does interact with peers, he mostly copies what they are doing. He also has become very silly and class-clownish, using potty talk or pulling down his pants to get his peers to pay attention and laugh.			
A 4-year-old gets very emotional if he doesn't get something he wants. He gets red in the face, on the verge of tears, and usually screams. He also has a hard time playing interactively with peers, needing to control everything, lacking flexibility. When he is building something with blocks and another child tries to join and help organize the blocks into a different design, he gets very upset.			
A 4½-year-old had previously separated fairly easily from his parents but has suddenly begun to get very upset when dropped off. When other children's parents come into the class for special events, he is sometimes so distressed he vomits.			

Handout 6.6

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 & Cunningham, 2007). 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).
- **Attachment:** The enduring bond that children form with their regular caregivers based on the experiences they have with those primary adults in their lives beginning in their early years. Classical attachment theory sets forth that our early relationships with our caregivers influence our expectations of relationships throughout our lives.
- **Bottom brain functions:** This is a term used to refer to the brainstem and structures in the temporal lobes; most important, the amygdala, hypothalamus, and other structures of the limbic system (Ochsner et al., 2009).
- **Brain stem:** The part of the brain made up of the hindbrain and midbrain. Its functions include those needed for daily living, such as controlling breathing, heart rhythm, blood sugar levels, sleep/wake patterns, alertness, motor control, eye movement.
- **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).
- **Cerebrum:** The largest part of the brain, which is responsible for higher order, more complex functions than our brainstem, including thinking, perceiving, planning, and processing language.
- **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.
- **Cortisol:** A hormone produced to help the body prepare for and respond to stressful conditions (Thompson, 2014).
- **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).
- **Forebrain:** The forward or front part of the brain. It includes the cerebrum—the largest part of the brain—which is responsible for higher order, more complex functions like thinking, perceiving, planning, and processing language.
- **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.
- **Goodness of fit:** The compatibility in temperament between caregiver and child.

- **Hindbrain:** The part of the brain located at the base of the brain near the spine. It includes the cerebellum, pons, and the medulla oblongata. It is intact and well developed at birth (Society for Neuroscience, 2016). The hindbrain is responsible for the basic functions for human life. It controls breathing, heart rhythm, and blood sugar levels (Society for Neuroscience, 2016).
- **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).
- **Hypothalamus:** The hypothalamus is the structure responsible for controlling our body temperature, thirst, hunger, sleep, circadian rhythm (sleep/wake cycle), moods, and the production of many of the body's essential hormones that help control different cells and organs (Society for Neuroscience, 2016).
- **Limbic system:** A complex set of structures that lies on both sides of the thalamus, just under the cerebrum. It includes the hypothalamus, the hippocampus, the amygdala, and several other nearby areas. It is primarily responsible for our emotional life. It controls the basic emotions (e.g., fear, pleasure, and anger) and drives (e.g., hunger, sex, dominance, and care of offspring). It also plays a major role in the formation of memories.
- **Midbrain:** The midbrain is located between the hindbrain and forebrain. Its functions include eye movement, hearing, motor control, sleep/wake patterns, alertness, and temperature regulation. The midbrain and hindbrain together are often called the "brain stem."
- **Nervous system:** The nervous system consists of the brain, spinal cord, and a complex network of neurons that extend throughout the body. The nervous system is responsible for sending, receiving, and interpreting information from all parts of the body. The nervous system monitors and coordinates internal organ function and responds to changes in the external environment. The nervous system is made up of two parts: the central nervous system and the peripheral nervous system (Society for Neuroscience, 2016).
- **Neurohormones:** Hormones that trigger a relaxation response in the body (Society for Neuroscience, 2016).
- **Neuron:** A nerve cell used to pass messages across the nervous system.
- **Occipital lobe:** The function of the occipital lobe is to process visual information, such as shapes and colors (Society for Neuroscience, 2016).
- **Orbitofrontal cortex:** A prefrontal cortex region in the frontal lobes that is involved in cognitive processing of decision making.
- **Parietal lobe:** The parietal lobe is one of four lobes of the cerebral cortex. The parietal lobe's functions include sensory processing, such as knowing where your body is in space and how you see print or objects in relation to one another. The parietal lobe also regulates attention, or how well a person is able to tune in and focus on a thought or action. Another important function of the parietal lobe is being able to learn and recall words to communicate at appropriate times (Society for Neuroscience, 2016).
- **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.
- **Scaffolding:** Providing just enough structure or support for a child to manage a task on her own.
- **Self-regulation:** The ability to exert control over one's attention, emotion, thinking, and behavior. It is used interchangeably with self-control.
- **Spinal cord:** The part of the central nervous system that receives information from the skin, joints, and muscles. It also carries all the nerves that control all of our movements. Via the spinal cord, our brains receive information from our ears, eyes, nose, mouth, and the rest of our bodies.
- **Sustained attention:** The ability to focus and maintain attention even in the face of distractions.
- **Temperament:** Temperament describes how children approach the world—how they take in, process, and react to their experiences in the world.

- **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.
- **Thalamus:** The thalamus relays sensory impulses from receptors in various parts of the body to the cerebral cortex. A sensory impulse travels from the body surface toward the thalamus, which receives it as a sensation. This sensation is then passed on to the cerebral cortex. The thalamus serves as a kind of "gate," filtering which information from various channels is allowed to be relayed by it for processing.
- **Top brain functions:** The brain areas associated with higher forms of cognition—most notably, the parietal and frontal lobes—and especially the prefrontal cortex (Ochsner et al., 2009).
- **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.

Behavior and the Brain: Managing Challenging Behaviors

Did You Know?

All behavior has meaning. Children's actions are important communications and are efforts to cope with the challenges they face. Young children aren't misbehaving on purpose.

- **Understanding the reasons behind their behavior makes it easier for both you and your child to cope.** Is the tantrum due to fear of a new situation or because the child is overwhelmed by too much stimulation around him? The reason for a behavior provides critical information about what kind of support your child needs and how to best respond.
- **Children have very little self-control before 3 years old.** Young children are largely driven by emotion, not logic. The parts of the brain that enable children to think about their feelings and plan how to respond to them are just starting to develop, so even preschoolers' ability for self-control is limited.
- **Different kids respond to the world in different ways**. Every child has a unique temperament—his or her own way of experiencing and approaching the world. Some children rush into new experiences without looking back, and others need time and support to feel comfortable in unfamiliar situations. This is not the result of something you did or something your child did. It's brain based.
- **Changes in a child's world can cause changes in behavior.** A move, the loss of a person or beloved pet, the birth of a new sibling, or a change in child care arrangements can all affect a child's behavior.

Managing Challenging Behaviors

Stay or get calm. Your mood is contagious. If you get angry, your child is more likely to get agitated and worked up. The calmer you are, the more likely it is that your child will calm more quickly, and the more likely you are to be able to carefully observe what is happening and consider how best to respond.

Have a plan. Think about how you will respond to situations that come up often; for example, not wanting to leave the playground or get ready for bed. Below are some strategies to include in your plan:

- **Let your child know you understand her feelings.** Remember, it's not the feelings that are the problem, it is what kids do with their feelings. Helping children become aware of their feelings helps them to ultimately learn to control them. Give them the words that show you understand: "You are so mad that I turned the TV off. You love your show, and you don't like when it ends. I totally understand that feeling. It's ok to be mad."
- **Set the limit calmly and clearly, with as few words as possible.** Say: "But it's not okay to hit me. That's against our family rule that we don't hurt people with words or actions." (It helps to make everything about rules, which are concrete and not personal. They apply to everyone. Always be sure to state the value behind the rule.) It's also important to be matter-of-fact. When you avoid shaming your child or showing annoyance or anger, your child is much more likely to take in what you are saying.
- **Offer acceptable choices, whenever possible.** Say, "You can hit this pillow or stomp your feet to get the mad out. Which would you like?" This teaches children acceptable ways to express their feelings and gives them some sense of control.
- **Allow space for your child to get himself back together.** Have a safe space in your home where kids can go to calm down. This strategy is meant to provide comfort, not punishment. Once a limit is set—the focus is on helping your child get calm.
- **Wait to talk about what happened until after the child is calm.** Children can't process and learn when they are overwhelmed. They need to be calm before they are able to think, reason, and problem solve.