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Understanding the Neurobiology of Complex Trauma

Building a framework for effective practice with children, young people and their network of relationships.

Virtual Classroom





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The Australian Childhood Foundation acknowledges the Aboriginal and Torres Strait Islander peoples as the traditional custodians of this land and waters. We pay our respects to their elders past and present and to their children who are the leaders of tomorrow. We acknowledge their history and living culture and the many thousands of years in which they have raised their children to be safe and strong.





2



Learning together online

- Participation welcome
- Cameras on
- Mute yourself when not talking
- Hands up or use the chat button if you have questions
- Please use headphones if children are in your training space
- Confidentiality



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Safety

The content of this training can evoke strong emotions and may trigger personal experiences of trauma.

Please be mindful of your own wellbeing during this training and if you need support please ask the facilitator.

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Learning outcomes

- ✓ Learn in detail about brain/body development through childhood and adolescence,
- ✓ Understand the ways that trauma shapes children and young people's states, needs and experiences,
- ✓ Develop creative and evidence based approaches and practice strategies to enable children and young people to communicate and transform their experiences of trauma,
- ✓ Build approaches that resource change across all environments in which children and young people live, learn and relate.

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Holding the child at the centre...

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BRAIN DEVELOPMENT



and the impacts of trauma




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Brain development

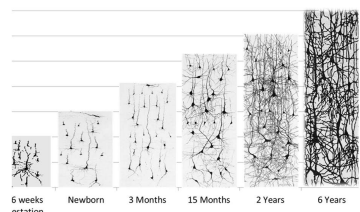
- The brain develops through a mix of genetics and environmental factors.
- Key to this development are relationships
- The brain develops sequentially from the bottom up


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Neuronal development



- Rapid growth occurs from birth to 6 years
- **Critical period** of development
- Healthy neuronal development occurs through **relationships, regulation, repetition**



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Neuronal development

- Early years – period of **rapid growth**
- Followed by onset of puberty in which **synaptic pruning and formation of new neurons** occurs.

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Sequential brain development – building blocks

- The Thinking brain**
3-5 Years
- The Emotions and Memory Brain**
Birth - 4 years
- The Movement Brain**
Birth – 2 years
- The survival brain**
Pre birth to 8 months

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Brainstem - basic life functions

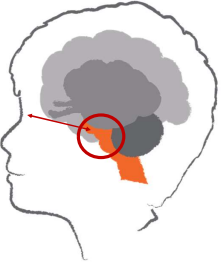
- Basic life functions
- First part of our brain to develop
- This is the most developed brain part at birth
- Responsible for our heart beat, breathing, sucking, temperature control, blood pressure

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Superior Colliculus

- Processes visual threats – looming objects identified by cells in the retina of the eye
- Retinal neuronal input received by Superior Colliculus which engages the body in **Avoidance and defensive behaviours**




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Cerebellum- movement and balance

- Helps us to know where our body is in space
- Helps us with our posture and balance
- Helps us not to fall over and to control our movements
- Has its own connective pathways between the 2 halves- cerebellar vermis

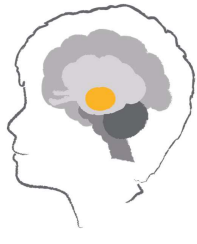


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Diencephalon - sorting & sending centre

- This area of the brain develops mainly after birth
- It sorts out messages coming into the brain and sends them
- It uses hormones to send signals to body
- Hormonal signals tell your body what it needs, eg. food, water, love




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Limbic lobe- emotional gateway

- The part of the brain that helps us attach an emotion to an experience or memory
- This part of the brain is particularly involved with the emotions of fear and anger
- Also heavily involved in attachment processes
- This area develops mainly after birth

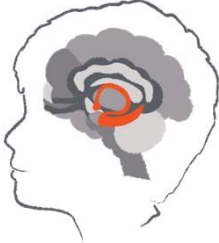


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Hippocampus – Brain’s historian

- Explicit memory system
- Develops approximately 2-3 years of age
- Provides context to memory and embeds long term memory

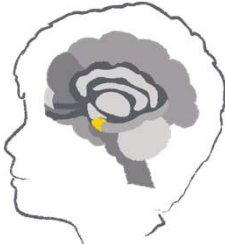


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Amygdala – smoke alarm

- Detects threat
- Develops from birth
- Learns by association
- Involved in implicit memory processes




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Cerebral cortex- complex thinking

- The largest part of the brain
- Associated with higher brain function such as thought and action
- Examples of functions:
 - Reasoning
 - Logic
 - Judgement
 - Voluntary movement




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The prefrontal cortex- executive function

- Responsible for executive functions, such as judgement, reasoning, and self awareness
- Final part of the brain to reach maturity in one's mid 20s
- Under reconstruction in adolescents from the age of approximately 12 years




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Medial prefrontal cortex

- Associated with perceptions of self and similar others
- Known as centre for mindfulness
- Involved in maternal bonding – the parent child dyad and inter-subjectivity



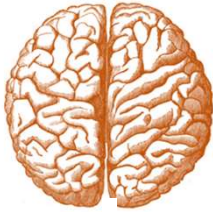
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Hemispheric integration

Left Hemisphere

- Evaluates language content
- Optimistic hemisphere
- Understands beginning, middle and end
- Learns from the past and expects the future
- Looks for patterns




Right Hemisphere

- In the present moment
- Eye contact
- Facial expression
- Tone of voice
- Posture
- Gesture
- Intensity
- Is mute
- Grasps the whole

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Corpus Callosum




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Early experiences shape the architecture of our brain

Threat and Neglect → Survival



Safety and Connection → Integration



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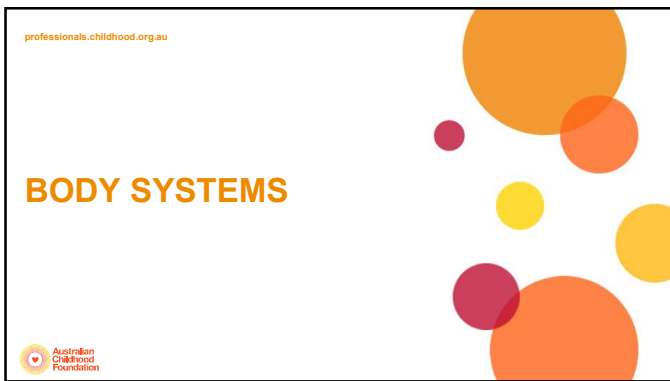
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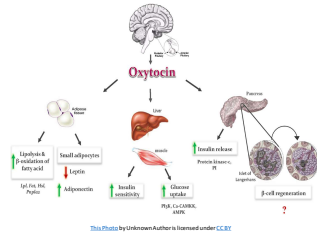


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Oxytocin

Role in regulating maternal care behaviours:

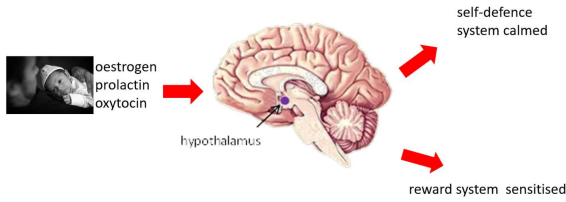
- Critical for maternal behaviour – motivates the parent to care for his/her infant
- In several mammalian species, facilitates physical proximity and nurturant care



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The Parental Approach System: the role of hormones

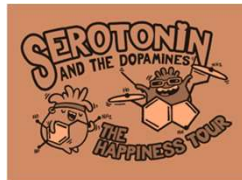


Dan Hughes

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Dopamine

- A neurotransmitter - plays a big part in **motivation and reward**
- 'Feel good' hormone – nearly all pleasurable experiences come from a release of dopamine – eating, sex, etc



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The role of Dopamine in mother-infant bonding

'A study group investigated the role of dopamine in mother-infant bonding and found that both mother-infant vocalization synchrony and maternal attunement were associated with higher dopamine concentration in brain structures connected to bonding'.



<https://www.medicalnewstoday.com/role-dopamine-mother-infant-bonding/>



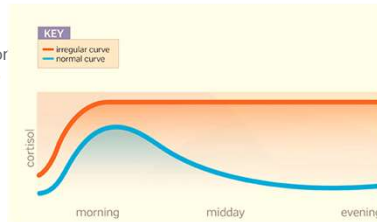
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Cortisol

Can help:

- your body respond to stress or danger – **fight, flight, freeze, submit response**
- increase your body's metabolism of glucose
- control your blood pressure
- reduce inflammation

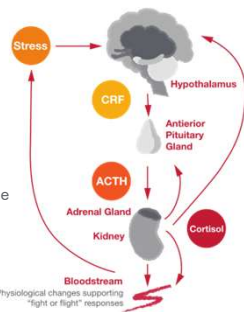


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Hypothalamic (Diencephalon) / Pituitary / Adrenal Axis

1. The hypothalamus secretes the hormone **corticotropin-releasing factor (CRF)**, which rouses the body.
2. CRF travels to the pituitary gland.
3. The pituitary gland secretes **adrenocorticotropic hormone (ACTH)**.
4. ACTH circulates in the bloodstream, traveling to the adrenal gland.
5. The adrenal gland releases **cortisol**, another hormone.
6. Cortisol stimulates many reactions in your body, including a rush of energy and alertness.



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8 senses

1. **Visual**
2. **Auditory**
3. **Olfactory** (smell)
4. **Gustatory** (taste)
5. **Tactile System** (touch)
6. **Vestibular** (sense of head movement in space)
7. **Proprioceptive** (sensations from muscles and joints of body)
8. **Interoception** (awareness of basic primary functions – hunger, toileting, breathing)

The diagram consists of seven circular icons arranged in two rows. The top row contains three icons: a blue eye labeled 'Vision', a green nose labeled 'Olfaction', and a red mouth labeled 'Gustation'. The bottom row contains four icons: a purple ear labeled 'Audition', an orange hand labeled 'Somatosensory', a pink figure labeled 'Vestibular', and a green figure labeled 'Proprioception'.

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Auditory - Ohm dad

A photograph showing a man from the side, leaning over and kissing a baby on the forehead. The baby is lying down, and the man's face is close to the baby's.

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Olfactory

A photograph of a baby sitting up, wrapped in a grey and white patterned blanket. The baby is looking towards the camera. The background is slightly blurred.

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Activities to support body awareness



Round – straight	Light – strong
Sit – stand	Under – over
Small – large	Yes – no
Freeze – melt	In – out
Push – pull	Tall – short
Wide – narrow	Loud – soft
Left – right	Up – down
Hot – cold	Happy – sad
Fast – slow	Fast slow

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TRAUMA



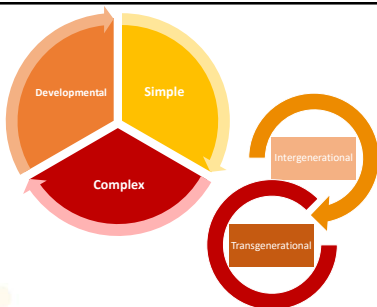
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Defining trauma

Any single, ongoing or cumulative experience which:

- is a response to a **perceived threat**, usually to survival
- **overwhelms** our capacity to cope
- feels/is **outside our control**
- often evokes a **physiological** and **psychological** set of responses based on fear or avoidance



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Trauma impacts

Trauma can impact all elements of adolescent's development: brain, body, memory, learning, behaviour, emotions, relationships and their view of themselves

Image source: ©ACF 2021

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Epigenetics

"The study of inheritable changes in gene function without the change in the DNA sequence"

Journal of Science

Chromosome, Chromatin, Histone, Histone Tail, Acetylation (epigenetic factors), DNA Inaccessible: gene inactive, DNA Accessible: gene active, Methyl Group (epigenetic factors), Methyl Group Binds only to Cytosine

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Epigenetics

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Sequential brain development – disrupted by trauma

	The Thinking brain 3-5 Years
	The Emotions and Memory Brain - Birth to 4 years
	The Movement Brain Birth – 2 years
	The survival brain Pre birth to 8 months

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Trauma impacts

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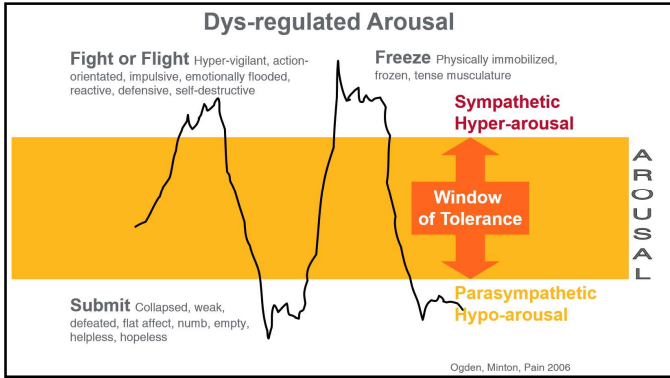
Arousal - Affect dysregulation

Extremes of affect state:

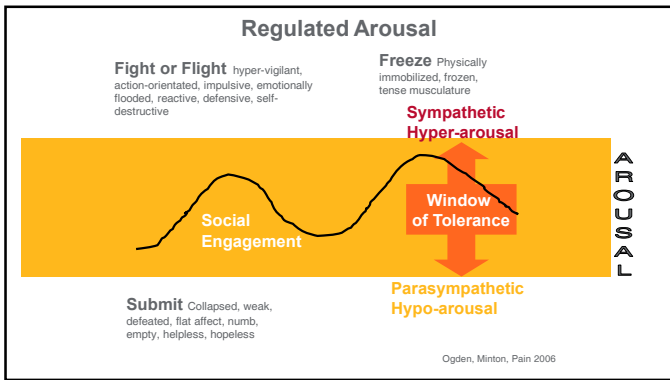
- **Terror** replaces fear
- **Despair** replaces sadness
- **Rage** replaces anger

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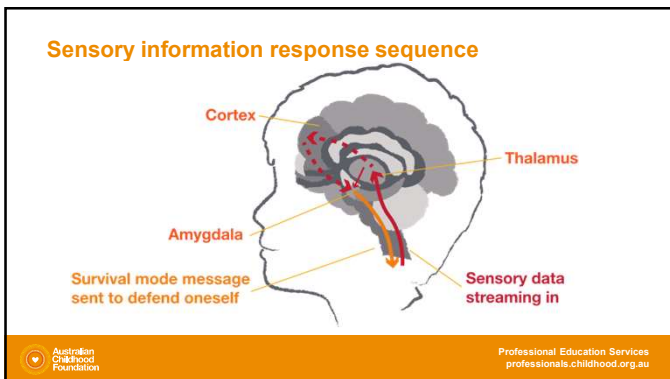
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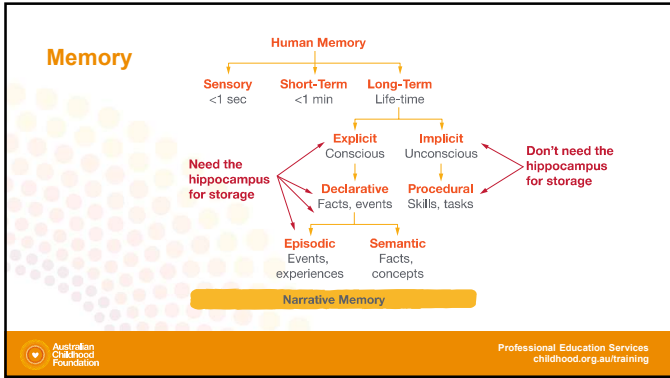
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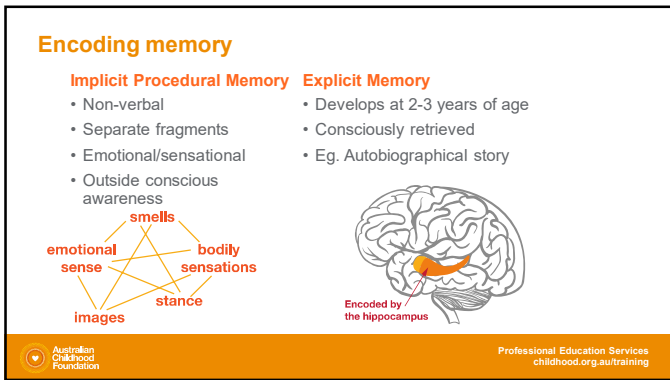
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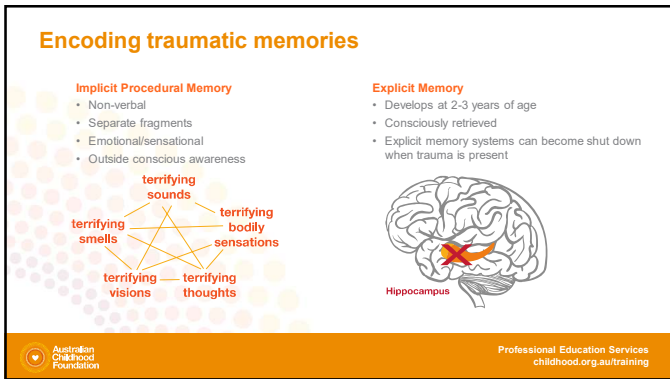
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Implicit memory




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Attention – impacts of trauma

- Affects sustained and focused attention
- Focus remains on the perceived threat
- Difficulty in focussing on task at hand, listening to instructions or following directions
- Shark music – always playing



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Working with attention issues

- **Check yourself** – your body language, tone of voice, facial expressions
- **Check the environment** – reduce overstimulation
- **Know the child** and their triggers
- **Use relationship** to help the child regulate – co-regulation
- **Provide sensory tools** that the child can ground with
- Try music, song, rhythm, to calm the brain stem and reduce bottom up hijacking by the survival brain

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Neuroplasticity



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I need to feel SAFE...



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Safety principles

Safety is embedded in our physiology
 Safety is a relational experience
 Child abuse is a deep violation of a child's sense of safety

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A hierarchical nervous system response

Safety

S= social engagement

S= mobilised play

S= immobilised for sexual intimacy

Danger

D= social engagement

D= mobilised fear responses to threat

D= immobilised responses to threat

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Immobilisation
hypo-arousal

Parasympathetic

- Ganglion
- Stimulates flow of saliva
- Slows heartbeat
- Constricts bronchi
- Stimulates peristalsis and secretion
- Stimulates release of bile
- Contracts bladder

Mobilisation
hyper-arousal

Sympathetic

- Dilates pupil
- Inhibits flow of saliva
- Accelerates heartbeat
- Dilates bronchi
- Inhibits peristalsis and secretion
- Conversion of glycogen to glucose
- Secretion of adrenaline and noradrenaline
- Inhibits bladder contraction

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Polyvagal Theory and Protective Responses

by Stephen Porges

Behavioural Functions	Body Functions
<p>Social Engagement</p> <ul style="list-style-type: none"> • Soothing and calming • Indicates safety 	<ul style="list-style-type: none"> • Lowers or raises vocalisation pitch • Regulates middle ear muscles to perceive human voice • Changes facial expressivity • Head turning • Tears and eyelids • Slows or speeds heart rate
<p>Mobilisation</p> <ul style="list-style-type: none"> • Fight or Flight • Active Freeze • Moderate or extreme danger 	<p>Hyper-arousal</p> <ul style="list-style-type: none"> • Increases heart rate • Sweat increases • Inhibits gastrointestinal function • Narrowing blood vessels - to slow blood flow to extremities • Release of adrenaline
<p>Immobilisation</p> <ul style="list-style-type: none"> • Collapse or submission • Death feigning • Increased pain threshold • Conserves metabolic resources • Life threatening situations 	<p>Hypo-arousal</p> <ul style="list-style-type: none"> • Slows heart rate • Constricts bronchi • Stimulates gastrointestinal function

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Regulated Arousal

Fight or Flight hyper-vigilant, action-orientated, impulsive, emotionally flooded, reactive, defensive, self-destructive

Freeze Physically immobilized, frozen, tense musculature

Sympathetic Hyper-arousal

Window of Tolerance

Submit Collapsed, weak, defeated, flat affect, numb, empty, helpless, hopeless

Parasympathetic Hypo-arousal

Ogden, Minton, Pain 2006

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Strategies for healing - Creating safety

Posture and gestures

Environment

Proximity

Tone of voice

Eye Contact

Facial expressions

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I need safe and attuned RELATIONSHIPS

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Activity

How can we create safety for the children, young people we are working with/caring for?




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The right hemisphere in infancy

• Normatively develops in an integrated fashion through healthy attuned, co-regulatory relationships in the primary years of life.



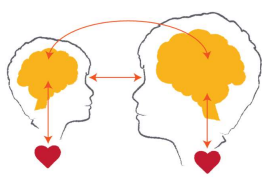
The diagram features a central orange infinity symbol. On the left loop, it is labeled 'Another's self experience'. On the right loop, it is labeled 'Self experience'. Between the loops, the text 'Connection' is written. Above the symbol are the terms 'Attunement' and 'Exploration'. Below the symbol are 'Responsiveness/Modulation' and 'Acknowledgement/Validation'. To the right of the symbol is 'Self regulation'.

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The right hemisphere in relationship

- These primary relationships contribute to:
- stored internal working models of primary relationships recorded in the right hemisphere
- the perception of emotion in self and others, enabling empathy and humour.



The diagram shows two human heads in profile facing each other. Inside each head is a brain. A double-headed red arrow connects the two brains. Below each brain is a red heart.

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The importance of you


- Relationships are the most important factor in our development and in healing from experiences of trauma
- Secure relationships are central to how a child experiences themselves and others



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Still face



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Rupture and repair

What you did is not ok, but you're still a good person and our relationship is still strong.'



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Relationship is the key!Brain systems that support parenting

Parental Approach System

- Get close to the child without becoming defensive.

Parental Reward System

- Enjoy interacting with the child.

Parental Child Reading System

- Understand the mind of the child.

Parental Meaning Making System

- Make sense of our experiences with the child and our social life.

Parental Executive System

- Regulate interpersonal conflicts between approach and avoidance, pro-social and defensive reactions.

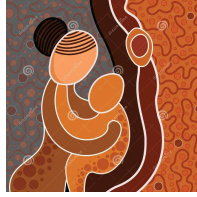
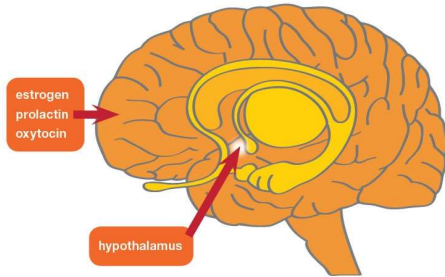


Image source: Dreamtime

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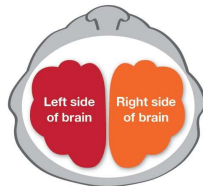
Approach System



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Early Adversity impacts our Parenting ability

The environment we grow up in can shape how we use our right and left brain systems of avoidance and approach. If we begin life exposed to insensitive caregiving our right brained harm avoidance system is likely to be used a lot. Instead of feeling protected and connected with our caregiver, we are more likely to need to shift into a defensive state of protest or collapse in order to try to protect ourselves.



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Reward System

1. We become a parent which generates hormones that talk to our hypothalamus.

2. Our hypothalamus releases oxytocin (the love hormone) which activates the reward system.

3. The reward system works by this area sending dopamine to the orbitofrontal cortex and the nucleus accumbens.

Hypothalamus

Orbitofrontal cortex plays a key role in processing rewarding experiences and helps us create positive parenting memories.

Nucleus accumbens

When the **Nucleus accumbens** is activated we become highly motivated to approach things that have led to reward in the past. It can become activated responding to expectations of positive interactions with our child.

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Child Reading System

Facial Expression
Tone of Voice
Body Language
Gestures

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Meaning Making System

Well-Connected Brain
Utilizing the front part of the brain

Stressed out Brain
Utilizing the more primitive middle region of the brain

Open Flexible and Adaptive

Closed and Rigid

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Blocked Executive System

Unprocessed trauma history

Experiencing chronic stress

Exposure to high levels of adversity in early life

Poor attachment with caregiver in early childhood

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Repairing the impacts of trauma

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Repairing the impacts of trauma

- Relational** (safe)
- Relevant** (developmentally-matched to the individual)
- Repetitive** (patterned)
- Rewarding** (pleasurable)
- Rhythmic** (resonant with neural patterns)
- Respectful** (of the child, family, and culture)

Bruce Perry, as cited by <https://attachmentdisorderhealing.com/developmental-trauma-3>

Image: hellovector.com

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Safety and listening the child

- Model attunement
- Ensure that the child is seen and kept in focus throughout the assessment and that account is always taken of the child's perspective
- Are they ready-how long can you sit and wait
- Validate what the child is feeling
- Check meaning
- Make sense of what is happening for the child
- What will have meaning



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PACE

- Playfulness
- Accepting
- Curious
- Empathetic



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PACE Helps

- The social engagement system come online
- Connect the prefrontal cortex (thinking brain) to the lower regions of the brain (emotional and survival brain)
- Calm the threat sensing amygdala by sending a message of safety.
- Connect children and their caregivers
- Aid the growth of regulation skills.
- Build the ability to reflect
- Develops the child make meaning of themselves, their stories and their behaviour.

PACE uses all 5 parent brain systems (approach, reward, child reading, meaning making and executive)

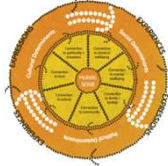


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Key considerations

- There is no magic wand!
- It takes time and patience: persistence and repetition is a must
- You matter in this work!
- Your relationship with the child is key
- Each child is individual which adds to the complexity
- Trial and error is common
- A titrated approach is important



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Respect diversity in cultures and child rearing practices while keeping child safety paramount

Respecting diversity should be taken to mean 'having the same aims for people's wellbeing and safety but finding different ways to achieve them' that are more appropriate to the person's different perspective.

- Being child-safe respects cultural difference:
- thinks about safety and wellbeing concepts from a cultural perspective
 - takes steps to develop cultural competence to respond in a culturally appropriate manner
 - takes guidance from experienced others (for example, seek advice from recognised Aboriginal or Torres Strait Islander organisations in regards to the needs of children from these backgrounds), and
 - approach family cultural contexts with sensitivity.

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I need to MAKE MEANING of my world

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Meaning making

How children understand and make meaning of their world often occurs through what is reflected back to them through their interactions with significant adults.

If adults respond to the child's behaviour in a punitive way, it reinforces negative schemas and stories that the child has developed about themselves.

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Trauma response patterns

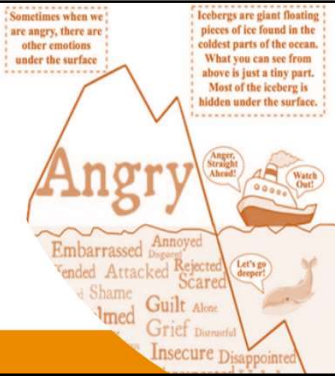
- To cope with trauma children use initial adaptive responses to survive
- This is reasonable as a once off occurrence, but, if they continue they can become maladaptive patterns of behaviour
- These responses will be different for an individual child at different developmental stages
- Often a combination of appropriate developmental behaviours and maladaptive patterns of behaviour emerge

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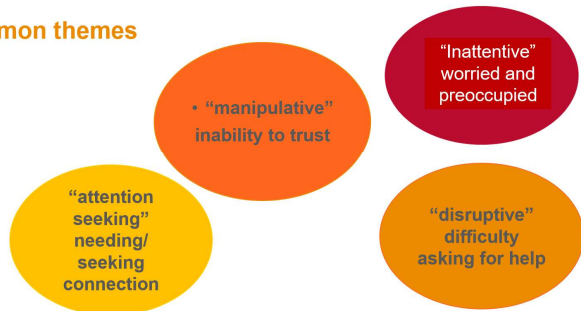
Behavioural – narratives of trauma

- Behaviour tells a story!
- Traumatized children’s behaviour can be difficult and complex for parents, teachers and carers to understand, manage and shape
- However, it is functional and almost always makes sense given their specific experiences of trauma
- Children’s behaviour is the manifestation of the impacts of trauma outlined in the previous sections



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Common themes



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Meaning making

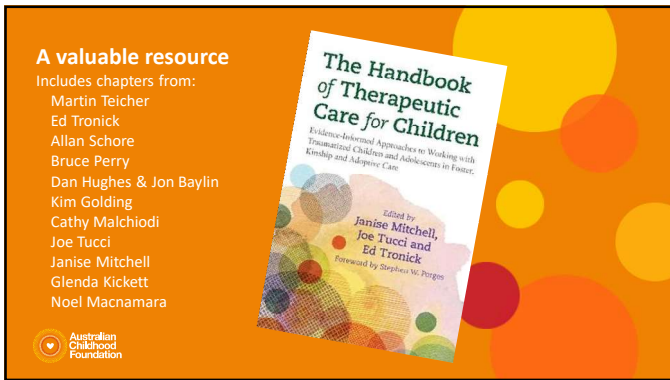
In making meaning we want the child to understand who they are despite their experiences of trauma

And for them to know they are ok, they are loved, they are accepted no matter what trauma symptoms are being expressed.

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References

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- *Deep Systems: The Psychotherapist's Essential Guide to the Brain* 2017
- NCBI: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4123787/>
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- What really is safety for traumatised children and young people? Joe Tucci, Jan 2019 ACF Prosody Blog
- Porges (2017) *The Pocket Guide to the Polyvagal Theory*, page 68, Norton
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