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Understanding the Neurobiology of Complex Trauma

Building a framework for effective practice with the children, young people we work with.

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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.



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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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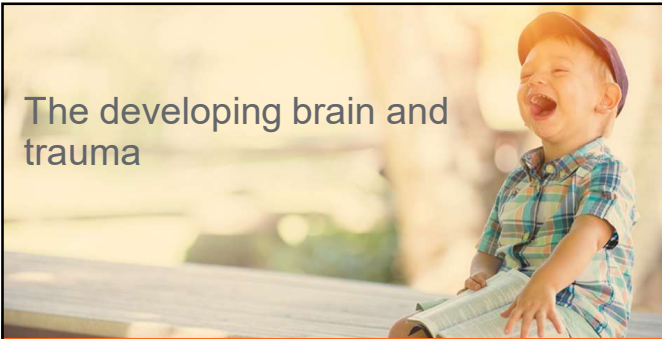

Learning outcomes

- ✓ 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 for the children and young people using your service.



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The developing brain and trauma



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What is 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
- evokes a physiological and psychological set of responses based on fear or avoidance

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What is Developmental Trauma?

Occurs when the fetus in utero, baby, child or adolescent experiences trauma, from abuse and neglect including domestic violence, during key stages of development. It happens in the context of relationship.

Simple	Intergenerational
Complex	Transgenerational
Developmental	Historical

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Trauma impacts

Trauma can impact all elements of children's development: brain, body, memory, learning, behaviour, emotions, relationships.

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Holding the child at the centre...

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Sequential brain development – building blocks

- 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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Neuronal connections

- The neural system has the ability for one neuron to communicate with up to 10,000 other neurons
- The newborn brain has approximately 100 billion neurons

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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**

6 weeks gestation | Newborn | 3 Months | 15 Months | 2 Years | 6 Years

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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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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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The brain stem under stress and trauma

- may experience fast or slower heart rate
- shortness of breath or breathing difficulties
- sleep disturbances and unsettledness
- sucking and swallowing and digestion difficulties
- may feel hot or cold or not notice changes in temperature

Image source: Shutterstock


What do you notice?

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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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The cerebellum under stress and trauma

- Difficulties coordinating cognitive processes such as planning & working memory
- difficulty in maintaining posture & balance
- difficulty in undertaking tasks that require balance
- lack of awareness of their body in space
- difficulty with voluntary movement tasks – walking or writing




Image source: Shutterstock

What do you notice and what can you do?

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Strategies for transforming – brainstem & cerebellum: RHYTHM, BREATH, MOVEMENT


- include soothing and calming activities, safe containment
- movement based activities
 - include activities that have a rhythmic, repetitive element
 - include activities that have a balancing element & gross & fine motor skills
- breath based activities
- conduct a sensory audit – ie: is it too hot or too cold, too noisy?
- include proprioceptive and interoceptive awareness and activities

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Diencephalon - sorting & sending centre

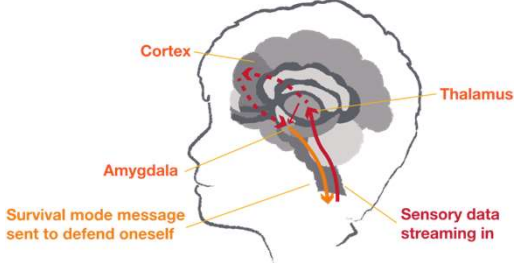
- This area of the brain develops mainly after birth
- It sorts out messages coming into the brain and sends them
- It uses hormones to send signals to body
- Hormonal signals tell your body what it needs, eg. food, water, love



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Sensory information response sequence



Cortex
Thalamus
Amygdala
Survival mode message sent to defend oneself
Sensory data streaming in

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The diencephalon under stress and trauma

- becomes overwhelmed and cannot sort the information
- is unable to send information to the memory and thinking parts of the brain – that pathway shuts down
- it alerts the amygdala which sets of a sensory information response sequence




Image source: Shutterstock

What do you notice?

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Strategies for transforming – diencephalon

- conduct a sensory audit
- provide calm, positive sensory experiences
- provide regular and predictable brain and body breaks
- Provide routine and prompts to support body systems and tuning in



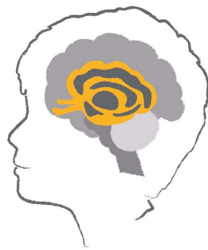
What might help during transitions, beginnings and endings?



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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

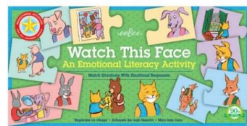


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Building Capacity – Limbic System

1. Co-regulating strong emotions
Validate emotion, cues for proximity/space, engage senses, prosody, rhythm & breathing
2. Enhancing positive emotions
May need help to name & express
3. Promoting emotional literacy
Teach during moments of calm

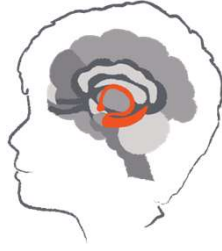


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Hippocampus – Brain’s historian

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



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The hippocampus under stress and trauma

- Reduction of hippocampal volume up to 25% as a result of high levels of cortisol
- Can't place memories in time or place – flooding & flashbacks
- Working memory, retention and recall (retrieval) capacity is severely impacted
- Narrative/autobiographical memory is affected



Image source: Shutterstock

What do you notice?

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Strategies for transforming – Hippocampus


- Repetition
 - Reminders
 - Review
 - Reinforce
- *Calming the brainstem, quietening the amygdala and boosting the cerebellum will all help the hippocampus to function more effectively*



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Amygdala – smoke alarm

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



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The amygdala under stress and trauma

- can be over active or under active
- can evoke reminders and flashbacks of the trauma (awakenings)
- will have difficulty in emotional regulation
- will have difficulty in reading facial expressions
- Constantly 'firing' – can hijack the cortex (thinking goes offline)




Image source: Shutterstock

What do you notice and what can you do?

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Strategies for transforming – Amygdala

- Manage own reactions (stay calm & present)
- Don't rely on reason/thinking to reduce an escalation
- Regular outbreath activities
- Provide opportunities for rest and recovery
- Environmental audit (noise, smell, colour, person, situation).

Re-entry to the classroom should be a safe and positive transition whenever possible.




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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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Cortical areas under stress and trauma

Unable to:

- use foresight and anticipation, focus or sustain attention
- plan, organise or prioritise or make decisions well
- reflect or have self-awareness
- be enthusiastic, motivated or persist with activities
- use impulse control




Image source: Shutterstock


What do you notice and what can you do?

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Strategies for transforming – cortical areas

- **Safety and stability are essential pre-requisites for cortical access**
- problem solving activities and strategies
- Support to map and plan activities
- games - card games – boards games – strategy games
- voluntary movement activities – table top drumming, clapping etc
- thinking and choice games – “Would you rather?”
- Mindfulness activities



A cartoon character with a red shirt and blue pants is shown in a thinking pose, with a speech bubble containing the word 'Hmm'.


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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



A 3D illustration of a human brain, showing the left and right hemispheres.

Right Hemisphere

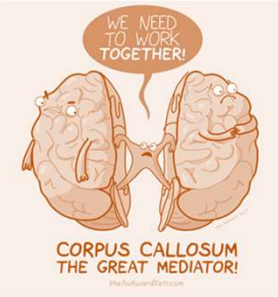
- In the present moment
- Eye contact
- Facial expression
- Tone of voice
- Posture
- Gesture
- Intensity
- Is mute
- Grasps the whole

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Corpus Callosum

Integration is the key to well-being and occurs vertically and laterally within the brain. The brain develops through the creation of neural pathways which connect different regions of the brain together. Neuronal connections are strengthened best when an individual repeats an experience over and over. If the experience is not repeated, the connection will disappear. To master a motor activity for example, a child is required to repeat and repeat a running motion and in the practice of it, becomes more precise and faster.



A cartoon illustration of two brain hemispheres with faces, connected by the corpus callosum. A speech bubble above them says 'WE NEED TO WORK TOGETHER!'. Below the illustration, it says 'CORPUS CALLOSUM THE GREAT MEDIATOR!'.

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Trauma and the Brain

Hypothalamus
Links the nervous system to the endocrine system via the pituitary gland. It synthesizes and secretes hormones to control body temperature, hunger, thirst, fatigue, sleep, and circadian cycles.

Prefrontal cortex
Responsible for executive functions, such as judgement, reasoning, and self awareness. Final part of the brain to mature in one's mid 20s.

Amygdala
Survival response centre within the limbic lobe that becomes enlarged and more sensitive the more it is activated through responding to threats

Hippocampus
Consolidates memory by providing the context/ sequential data for episodic memories. Goes offline if trauma overwhelms and disrupts cortex.

Corpus Callosum
Bridge between the 2 hemispheres. Chronic stress can damage and thin down this bundle of neurons

Thalamus
Sensory receptor within the diencephalon. Receives and passes on sensory data to be further processed by other areas of the brain

Cerebellum
Balance and coordination, motor skills may be impacted by trauma

Image source: GCMCF 2020

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Strategies for building healthy brain development

Brainstem & Diencephalon	Basic survival & sensory processing	Pacification or stimulation. Activities in the child's preferred sensory modality
Cerebellum	Coordination of movement	Using music, rhyme and movement activities
Limbic	Emotional processing	Building relational connection through plays, animals, games
Cortex	Thinking processes	Linking experiences and sensations to words and descriptions
Prefrontal cortex	Analytical and abstract thinking	Challenges and safe risk taking activities

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Lateral Brain development

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Strategies for healing...Desktop drumming



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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. Introception (awareness of basic primary functions – hunger, toileting, breathing)



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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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Body based Practice basics

- **Regulate child:** down regulate and up regulate to maintain attention and alertness for learning
- **Work Bottom-Up:** "Physicalize:" find a way to address child's issues through movement, rhythm, activities and gestures that integrate emotions and cognitions/beliefs
- **Use props:** pillows, therapy balls, body socks, fidget toys, throwing balls, rope, blankets, etc.
- **Emphasize strengths:** Positive reinforcement, acknowledge
- **Atmosphere of play,** fun, non-coercive, child in charge
- **Challenge child's window of tolerance** appropriate for his/her developmental stage
- **Do your best to assure success:** provide appropriate challenges at which the child can succeed rather than fail.

Sensorimotor Psychotherapy Institute 2012

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Holding the child at the centre



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TRAUMA



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Trauma impacts

Arousal Memory Attention Relationships

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Arousal - Affect dysregulation

Extremes of affect state:

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

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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

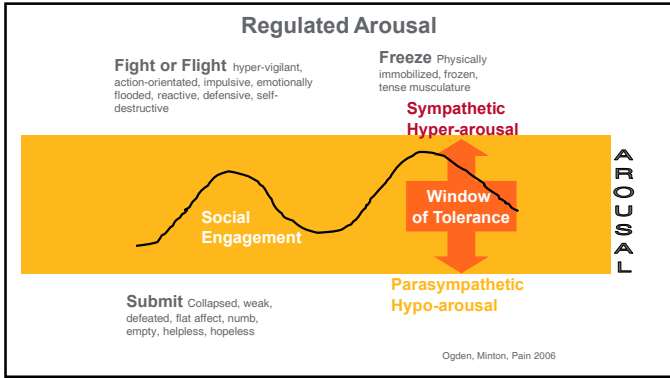
KEY:
— irregular curve
— normal curve

cortisol

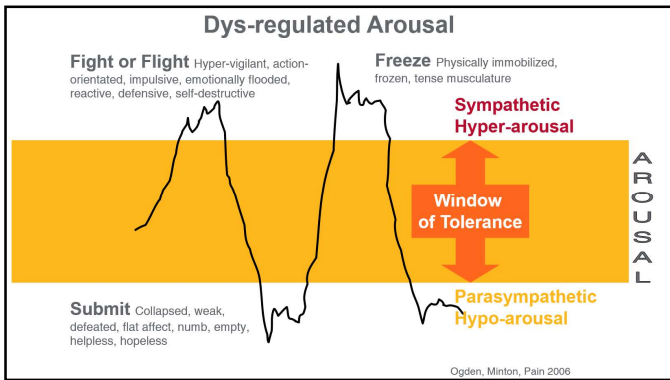
morning midday evening

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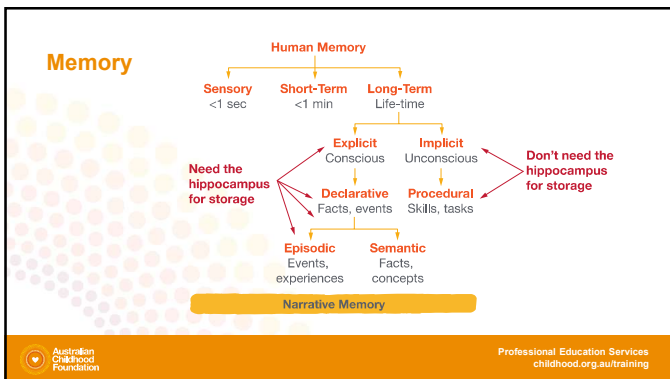
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Encoding memory

Implicit Procedural Memory

- Non-verbal
- Separate fragments
- Emotional/sensational
- Outside conscious awareness

Explicit Memory

- Develops at 2-3 years of age
- Consciously retrieved
- Eg. Autobiographical story

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Encoding traumatic memories

Implicit Procedural Memory

- Non-verbal
- Separate fragments
- Emotional/sensational
- Outside conscious awareness

Explicit Memory

- Develops at 2-3 years of age
- Consciously retrieved
- Explicit memory systems can become shut down when trauma is present

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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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Holding the child at the centre...



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Trauma-consistent presentations

- Poor sensory integration – hyper or hypo-sensitivities to one or more sensory inputs (thalamus)
- Coordination or gross motor difficulties (cerebellum)
- Weight or growth concerns, appetite issues, teething delays, sleep issues (hypothalamus)
- Executive function difficulties; impulse control, problem solving, paying attention, planning, judgement (prefrontal cortex)
- Difficulty naming and regulating emotions (corpus callosum, L-R integration)

Discuss



What presentations have you observed in the children and young people you work with?


How does a trauma-lens help you understand these presentations?



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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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Neuroception

- “The removal of threat is not the same as the presence of safety” (Porges, 2014)
- We need to help children who have experienced trauma detect more features of safety in their environment.



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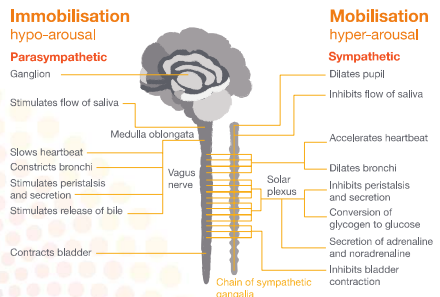
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Strategies for healing - Creating safety



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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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Behavioural Functions	Body Functions
 <p>Social Engagement Soothing and calming Indicates safety</p>	<ul style="list-style-type: none"> * Lowers or raises vocalization pitch * Regulates middle ear muscles to perceive human voice * Changes facial expressivity * Head turning * Tears and eyelids * Slows or speeds heart rate
 <p>Mobilization Fight or Flight Active Freeze Moderate to extreme danger</p>	<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>Immobilization Collapse or submission Death feigning Increased pain threshold Conserves metabolic resources Life threatening situations</p>	<p>Hypo- arousal</p> <ul style="list-style-type: none"> * Slows heart rate * Constricts bronchi * Stimulates gastrointestinal function

Evolution

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I need safe and attuned RELATIONSHIPS



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Relationships are key

- Relationships are the key way we learn to engage with the world around us
- They are key to our survival, throughout the lifespan
- The quality of relational right – brain to right brain interactions in childhood influence our development in all areas of life



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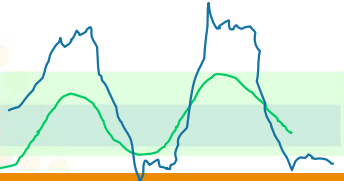
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Interpersonal Regulation

- When people are in relationship, the ability of one to regulate him/herself, affects the other's ability to regulate
- The child's arousal shapes, are shaped by, calming and engaging relationships

Child's movement in her/his window of tolerance

Movement in my window of tolerance



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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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Still face



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Meaning making

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.

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

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Meaning making

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

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

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Self Concept: Internal working models

	Positive internal working model	Negative internal working model
View of self	I am lovable I am worthy	I am unlovable I am unworthy
View of the world and relationships	Others are responsive Others are loving Others are interested in me Others are available to me The world is relatively safe	Others are unavailable Others are neglectful Others are rejecting Others are unresponsive The world is unsafe

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Trauma response patterns

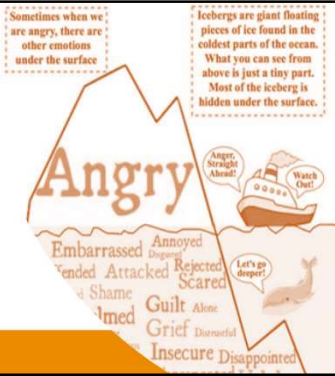
- To cope with trauma children use initial adaptive responses to survive
- This is reasonable as a once off occurrence, but, if they continue they can become maladaptive patterns of behaviour
- These responses will be different for an individual child at different developmental stages
- Often a combination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

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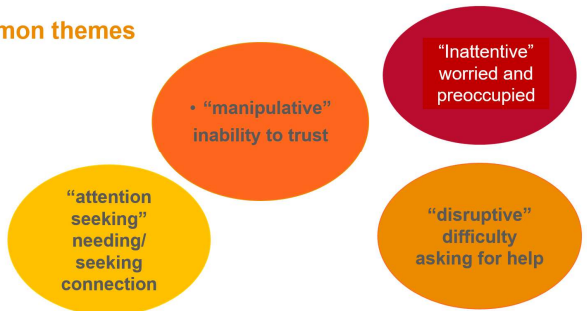
Behavioural – narratives of trauma

- 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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Holding the child at the centre...



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