

# Roots of Empathy

## RESEARCH SYMPOSIUM

Toronto, Canada

MAY 16-17, 2019

## PROCEEDINGS



Roots of Empathy  
Racines de l'empathie

[www.rootsofempathy.org](http://www.rootsofempathy.org)

## Introduction

The 2019 Roots of Empathy Symposium, set in the spectacular Globe and Mail Centre overlooking Toronto, brought together renowned international neuroscientists for two days of learning and connection. The neuroscientists addressed a wide ranging number of topics including epigenetics, altruism, self regulation, the impact of digital technology, perspectives on empathy, the connection between sleep and emotional processing and the importance of human touch.

Dr. Susan Greenfield, Ph.D., UK, opened the symposium with her keynote address “Empathy: A Neuroscientific Perspective”. Dr. Greenfield described how the digital world could be transforming the 21<sup>st</sup> century mind given that human brains adapt from birth to the environment. Dr. Abigail Marsh, Ph.D., US, talked about behavioral and brain imaging research aimed at understanding the roots of extraordinary altruism. Dr. Jean Clinton, M.D., Canada, along with Dr. Tiffany Field, Ph.D., US, provided compelling insight into the extraordinary power of human touch. Dr. Valeria Gazzola, Ph.D., Netherlands, Dr. Frances Champagne, Ph.D., US, Dr. Margot Taylor, Ph.D., Canada, and Rebecca Spencer, Ph.D., US, shared the latest research on how brain mechanisms help us to value the suffering of others, epigenetics and the connections between early experiences and later life challenges, the neuroscience of touch, attachment behaviour, theory of mind and how children process emotional facial expressions, and the importance of sleep for emotional memory in early childhood.

Every presentation struck a chord as shown by the energetic question and answer periods following each speaker. A highlight on the second day was hearing from students who have experienced Roots of Empathy, each of whom gave a heartfelt and powerful account of how they were changed. They brought tears to eyes and the house to its feet!

As Roots of Empathy reaches more children around the world with its empathy-based programs, research plays an increasingly important role for the organization and for others who support children. We would like to thank Beiersdorf/Nivea for its generous support of the 2019 Roots of Empathy Symposium, and thank you to our media partner, the Globe and Mail, for hosting the symposium in its beautiful Globe and Mail Centre, with the extra treat of participants being able to connect over lunch and breaks on the rooftop deck. Finally, we would like to extend very special thanks to both our Roots of Empathy Board Chair, the Honourable Christy Clark and to Board member, CBC broadcast journalist Mary Ito for emceeding the two day event.



*Mary Gordon*  
Founder/President



*Mary Ito*  
Board Member



*Christy Clark*  
Chair, Board of Directors





# Empathy: A neuroscience perspective

## SUSAN GREENFIELD, PhD

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Empathy is central to human civilization and human beings. A neuroscience perspective on empathy provides an understanding of the basis of human identity and empathy, and the issues of the impact of digital technology. This perspective also gives us strategies to reduce the negative impacts of digital tech on identity and by extension empathy.



Susan Greenfield

## The basics of neuroscience

Humans have a profound ability to adapt to their environment, and this has allowed us to occupy more ecological niches than any other species on the planet.

What shapes the individual to allow this adaptation to the environment? What process makes us so individual and unique? Even identical twins with the same genes will have unique patterns of connections within their brains. The brain displays plasticity; this ability to form unique connections between the neurons of the brain is the basis of the human mind. This forging of new connections and strengthening of existing connections is present throughout life, regulated by interactions with the environment.

Even as adults, plasticity can affect the physical structure of the brain. A well-known study of London taxi drivers, who are required to demonstrate an encyclopedic knowledge of the streets of London, showed structural change in the hippocampus compared to normal controls. The more you use a part of your brain, the more it will grow and strengthen. This same phenomenon is seen in musicians, mathematicians, and athletes.

Even in normal individuals, structural changes can be seen in the brain within 7 days of learning something new. For humans, this is an evolutionary birthright. With brain cells, just as with muscle cells, the concept of “use it or lose it” applies.

Experimental work with rats shows that environment plays a role in brain development. Rats housed in an enriched environment, compared to those in a standard environment, grew branches in their neurons that increase the surface area of the cell, providing space to facilitate more connections with other neurons.

*“The biological basis of the mind is the personalization of the brain through unique dynamic configurations of neuronal connections, driven by unique experiences.”*

Connections give deeper meaning over time. Consider a gold ring. To a young child, a ring has no meaning but may have an appeal based on sensory properties alone. Over time, the child will develop connections that a ring can go on a finger, and that a shiny gold ring goes on a certain finger after certain events and that a particular ring can hold memories and values. The connections that have been formed have liberated the evaluation of the ring from purely sensory terms, and it can now be evaluated in terms of cognitive sense. Meaning becomes personalized and is not apparent from just the object alone.

The converse is seen in dementia. Dementia dismantles the personal connections that give meaning to the world, and the person with dementia slowly becomes more like a child and then an infant and is forced to evaluate the world by sensory input alone, without the checks and balances of the cognitive connections. The loss of these connections can be seen as losing the essence of yourself. Without cognitive connections, we are forced to literally take things at face value.

Every human has a unique interpretation and view, with the present informed by their past. This beginning, middle and end echoes in one's life story, and it is the essence of thought that has a beginning, middle and end. The more experiences that one has, the more individual one becomes, and this is all down to the connections in your brain cells.

## The digital world

The impact of technology in the 21<sup>st</sup> century is unprecedented. Consider the proliferation of mobile phones. If we accept that every interaction with the environment changes and shapes you, then there is much potential for problems in the digital world.

Older people can be considered as "digital immigrants". We have already led lives with real memories, real friends and experiences. We may embrace the new digital world, but it will always embellish our real world. A child born now can face the full cognitive impact of digital technology. Even infants are exposed to digital screens and statistics show that 20% of 16-24 year olds spend 7 hours a day online.

For previous generations, technology enriched the real lives of people doing things with real friends, dating, working, eating, and doing all of these things together. These technologies supplemented the real life, they did not supplant real life. Now, many of these same activities can be done without interacting with another human, by interacting with a screen. How can this not have an impact on how one sees the world and interacts with other people?

Technology is changing the way we think and feel – a mind change comparable to climate change. This is unprecedented, global, controversial and multi-faceted. Some concerning statistics:

- 81% of people admit to interrupting conversation, mealtime or playtime to check their social media
- 73% of people believe their use of electronic devices has contributed to stress in their life
- 61% of people have felt jealous, depressed, sad or annoyed after checking updates on their social media accounts

An under-functioning prefrontal cortex is known to be involved in screen addiction. Could it be that we have gone from cognitive to sensory, and with too much dopamine, are we going back to raw sensation? A balance is needed in the human brain between cognitive and sensory. Screens provide sensory input, stimulating dopamine release and minimizing the input of the prefrontal cortex.

There is evidence for a world driven by external stimulation and its high arousal. Millennials asked to stay still for 6-15 minutes preferred to do mundane external tasks or even self-administer electric shocks over being left alone with their thoughts.

The digital world is also leading to reduced interpersonal skills; eye contact, body language, voice, physical contact and pheromones are important and none are available on Facebook. Interpersonal skills have already been developed by older persons, but not by the young. This has led to the concept of virtual autism in young people with a lot of screen time. Fortunately, this is easily reversible by removing screens and exposing children to real life interaction with other children in for example, a summer camp scenario.

There is also concern that we will have a fragile identity due to dependence on external input rather than a rich internal world. Sharing personal information online provides positive feedback and reduces perceived loneliness, but without the feedback of negative body language. This can lead to a cycle of compromised privacy and vulnerability to bullying and increased loneliness.

### Two basic modes for the human brain

#### 'MEANINGLESS' Prefrontal Under-function?

- Strong feelings
- Sensory
- Here-and-now
- External stimuli dominant
- Little 'meaning'
- Reduced sense of self
- No time-space
- Infants and children
- More **DOPAMINE**

#### 'MEANINGFUL' Prefrontal Activation?

- Thinking dominates
- Cognitive
- Past / present / future
- Internal stimuli dominant
- Personalised 'meaning'
- Strong sense of self
- Clear time-space reference
- Adults
- Less **DOPAMINE**

It is necessary to develop an inner narrative and a real identity. Consider the endless possibilities of children at play in real life. This is important because one is rehearsing a life story, developing a strong inner narrative with a beginning, a middle, and an end.

A digital screen is driven by someone else's imagination, and the constant sensory stimulation comes at the expense of the inner narrative and sense of confidence and identity.

### Combatting the digital impact

To combat the negative impact of the digital world, it is important to generate a life story and remind them of their life story. How can this be done?

- Avoid multitasking – multitasking is very poor for the brain
- Do things in sequence with linearity
- Play music – music is sequencing in action
- Physical exercise – exercise also has a sequence, and is known to encourage neurogenesis and is correlated with academic performance
- Cooking has a sequence – a beginning, a middle and an end
- Eating – when you eat with others you are interacting and acting out a sequence
- Reading – gives a temporal framework and enhances your attention span

The key takeaway is that we need a life narrative where the present links in a sequence between the past and the future. These are not expensive or unusual activities, and they should be a counter-balance to the digital activities we all do.

We need to put a premium on identity – not on digital activities or external identity, but a private inner world that is curated by you and you alone. By respecting and promoting this individuality, we will also promote empathy.

## The neuroscience of touch

### JEAN CLINTON, MD

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McMaster University  
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### TIFFANY M. FIELD, PhD

*Professor, Departments of Pediatrics,  
Psychology, and Psychiatry  
Director of the Touch Research Institute  
University of Miami School of Medicine  
Miami, FL, USA*



*Jean Clinton*

Why are emotions called feelings? This speaks to the essential nature of touch. Touch is one of the most critical ways of learning about the world and our sense of touch plays a fundamental role in daily life. Neuroscience studies have confirmed the necessity of touch as a powerful form of non-verbal communication. We need to ask ourselves, if touch is so essential to humans – why have we moved away from it in our schools and lives?

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*“Touch is permeated throughout the Roots of Empathy program.”*

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The skin acts as our connection with the outside world and is the largest organ of the body. Touch is the only sense we have that puts us in direct contact with another object or person. Skin sensors pick up all of the different types of messages however these sensors are not evenly distributed in the brain. There is tremendous variation for different parts of the body with the lips and hands being extremely sensitive. Both studies with primates and real-world experience in orphanages have taught us that when the young are deprived of touch, they do not develop properly.

Dr. Tiffany Field has done ground-breaking research on premature infants and found touch, in the form of massage, improves outcomes with increased weight gain and earlier discharge from the neonatal intensive care unit.

Touch has also been shown to have an impact on the immune system. By moving the skin, NK cells that play a major role in bacterial and viral infection control, are increased. Conversely, substance P, a peptide that increases nerve sensitivity to pain, is decreased with massage therapy.

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*“Empathy is facilitated by touch.”*

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### **Empathy and touch**

Dr. Tiffany Field explained that empathy is facilitated by touch/physical affection and this facilitates relationships. Massage has been shown to improve child and parent interactions. Couples who have more touching have better pregnancy outcomes and relationships.

A group of researchers studied several basketball teams in the pregame season and observed how much touching the teams did – high fives, pats on the shoulder, etc. They found that winning teams have more touch between players compared to the losing teams.

In a similar vein, Dr. Field said research has found that people who are touched by their waiter leave a bigger tip and patients who are touched by their doctors have better outcomes.

Preterm children who were touched were discharged 6 days earlier than those who were not touched. An astonishing 119 studies have replicated this work. The preterm babies who were touched also gained almost 50% more weight and 8-9 months later were still gaining weight and growing at a faster rate.

### **Relational poverty and lack of touch**

If children are not connecting with other children, very few deep connections are made. When comparing touch in children from the US to children in France, French children experienced more physical affection from one another and parents/teachers and displayed less physical and verbal aggression. Some educational institutes have a policy that teachers shouldn't touch the children and this can have negative outcomes.

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*“The power of touch is a crucial social glue.”*

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The power of touch is a crucial social glue. Are we losing that social glue because of a decrease in touch? We know the relational landscape is undergoing change. Children have fewer emotional, social interactions with people. Physical contact maps track how many physical contacts children have per day. Children coming to me as a child psychiatrist will have a less healthy contact map with fewer contacts in a day.

Poverty of relationships is modernity's paradox. Talking to educators about relationships and connections has to be part of the double helix of education with the base pairs being relationships and touch.



## How embodied stimulation might help us care about others

### VALERIA GAZZOLA, MD

*Co-Founder & Co-Director, Social Brain Lab  
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*Valeria Gazzola*

In our everyday life, when people's behavior makes us angry and upset, we rarely respond with a violent physical act. Why do we hold ourselves back from violent acts despite our anger? Our ability to share the emotions of others may play a critical role.

This phenomenon is associated with mirror neurons. A brain imaging study for instance asked participants to perform simple actions and to observe the same actions being performed. The results showed much overlap in the parts of the brain that were activated when the participants were performing the actions and when they observed the actions being performed.

There is a strong connection between the motor and somatosensory systems. Studies have found similar brain activity in the somatosensory cortices of study participants who are being touched compared to when watching someone being touched. Similar results have been found with emotions.

Hence, neuroscience shows that witnessing the action and emotions of others triggers brain activity in the regions involved in performing the same action, and experiencing the same sensation, and emotion – as though it were happening to you. This is called embodiment of the observed state – you map the states of others onto your own body.

When we observe pain in other people, as long as the source of the pain is physical, the somatosensory cortex is activated. In a study using pairs, one person volunteered to receive a small electric shock and their counterpart observed them. When given the opportunity to help their counterpart there was a direct correlation between how strongly the observer activated their own somatosensory cortex and how much help they offered, and altering this mapping of other people's pain onto one's own somatosensory cortex using TMS altered how much people help. This is evidence of a possible connection between the somatosensory cortex, embodiment and prosocial motivation.

There are many individual differences between people as well. This can be measured through perspective taking questionnaires. What we see in the brain, is that people that report being more empathic show more embodiment brain activity – they recruit their own actions, sensations and emotions more strongly than people reporting less empathy. Your ability to feel empathy is associated with your ability to embody the states of others. Fairness is a contributing factor as well. Activity in the insula and anterior cingulate cortex activity is reduced when observing the pain of someone we perceive to have behaved unjustly.

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*“Your ability to feel empathy is based on your ability to embody the states of others.”*

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People with psychopathy are typically thought to lack empathy. If embodiment is a foundation of care, then we have hypothesized that those with psychopathy that lack care should also lack embodied brain activity. Psychopaths were asked to observe other people's emotional actions as well as experiencing them themselves while in an fMRI scanner to test this theory.

When measuring the brain activity of psychopaths we measured reduced motor, somatosensory and emotional sharing in their brain. They appeared to embody the pains of others less. When psychopaths were asked to actively empathize with the person they were observing, brain activity however was the same as that of the control. Psychopaths therefore do not lack the ability for empathy but the lack the spontaneous propensity for it. This can be applied to those without psychopathy as

well: when asked to actively empathize there is far more embodied brain activity in all people than when we are asked to simply analyze a situation. Empathy is a choice.

*“This opens up the potential that we can train and increase our own empathy in order to care for others accordingly.”*

When we are with people, we use mirror neurons ourselves to have a direct, intuitive perception of what the other senses and feels. This vicarious state helps us to perceive what the other does and participates in our decision making in whether we want to help the other person or not. This is not black and white but rather is a fluid system that is susceptible to environment, our genetic makeup and our life experiences. This opens up the potential that we can train and increase our own empathy in order to care for others accordingly.

## Dynamic epigenetic pathways in the developing brain

### FRANCES CHAMPAGNE, PhD

*Professor, Department of Psychology  
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Austin, TX*

Experiences occurring during the prenatal and postnatal period set the stage for later life, including our physical and emotional health. Over the past decade, there has been increasing recognition of the role of epigenetic variation in these developmental effects – our genome is responsive to the conditions of life. This epigenetic variation serves as a form of developmental plasticity. Genotype influences phenotype but there is also an interplay between genes and environment. Effectively, studying genes isn't enough, we need to understand the trajectories a gene has undergone to understand phenotypic expression.



*Frances Champagne*

*“Epigenetics offers to describe the dialogue between the genes and the environment.”*

Genes can be turned off and on through epigenetic changes and are dynamic and modifiable. Epigenetics now refers to the specific biology of the gene with a focus on DNA methylation, now recognized as the on/off switch. A good example of epigenetic variability are monozygotic twins who, despite being genetically identical, are epigenetically different. Variation emerges across the lifespan and the environment is the epigenetic on/off switch.

### Prenatal and infancy epigenetics

Prenatal stress and hormones can disrupt and affect fetal development and infant outcomes. Longitudinal studies have shown that perceived stress by the mother is a predictor of epigenetic effects in the infant. Postnatal maternal distress can lead to epigenetic variations in the infant as well. Additionally, there can be multigenerational impact for health and disease with parents' and grandparents' experiences affecting the children.



Mothers can experience high testosterone levels for reasons such as pre-eclampsia and stress. High testosterone levels *in utero* are associated with decreased cognition and less social brain aptitude. The placental enzymes normally buffer the fetus from high stress hormones but higher levels of perceived stress lead to higher levels of hormone exposure to the fetus and shutting down of the regulatory enzymes. Perception of stress is a powerful force in shaping our biology.

### Epigenetics and aging

This is a new area of epigenetics which is a marker in your epigenome that tells us how well you are aging biologically. This is “age accumulation” and does not always match with chronological age. Stress, disease and prematurity can accelerate epigenetic age. Through intervention programs we can restore our biology to a more positive outcome.

*“There is much more to the story than just the genes we inherit.”*

### What factors induce epigenetic variation?

Multigenerational exposure can be transmitted across generations via oocyte, prenatal environment and hormonal exposure in the uterus. Sperm can cause epigenetic variation as well increasing speculation that multigenerational effects can be passed down to subsequent generations. Epigenetics offers to describe the dialogue between the genes and the environment. There is room for trajectory change and to think more broadly about inheritance. There is much more to the story than just the genes we inherit.

## The altruistic brain

### ABIGAIL MARSH, MD

*Director, Laboratory on Social and  
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Altruism is often explained in terms of two mechanisms that root altruism in self-interest. Kin selection, which is the desire to help your own kin, and reciprocal altruism, which is the desire to help your own group. When altruism is anonymous and selfless, it fails to be explained as solely related to self-interest.

Altruistic acts are more likely to result from genuine care or concern for others, and have long been a puzzle for scientists.

In an effort to understand the processes in the brain which are responsible for care-based altruism, I began studying children who exhibit psychopathic traits. Psychopathy can be described as a lack of care or concern for others (and thus people who are psychopathic show very little care-based altruism). In children, there is no DSM equivalent to psychopathy but the most relevant diagnosis is “Conduct Disorder with limited prosocial emotions”. Children with this diagnosis are at very high risk for developing psychopathy.

Psychopathy is a highly heritable developmental disorder. The most commonly identified feature is dysfunction in the amygdala which is necessary for learning about and experiencing fear. In neurotypical children, the prospect of punishment or threat creates a fear-based response. Children with psychopathy do not experience fear as strongly as other children, which is why they do not respond to punishment.



*Abigail Marsh*

Importantly, because children with psychopathic traits don't experience fear strongly, they also have trouble empathizing with other people's fear. We traced this deficit to the amygdala. In a brain imaging study, adolescents with psychopathy did not exhibit any amygdala response to others' fearful expressions. We observed a direct correlation was found between a decrease in amygdala activity and increase in psychopathic traits. This suggests that amygdala responses' to signs of other people's distress are an essential part of care and concern for others.

My research on extraordinary altruists, who are the polar opposite of those with psychopathy, has also provided valuable information about the origins of the capacity to care. These people are the opposite of psychopathic individuals: instead of exhibiting extreme antisocial behaviour, they exhibit extreme pro social behaviour. This may result from extraordinary altruists, in contrast to a control group, showing heightened amygdala activity in response to others' fear as well as having a 30% higher amygdala volume.

*“Extraordinary altruists feel care for strangers as much as they feel care for their own children.”*

Care based altruism can also be linked to ancient brain systems that evolved to support parental care. In a study conducted on primate species the best predictor of altruism among adults is alloparental care of offspring, i.e. the care of others' babies. The ability to overcome one's own fear in order to care for another is the essence of parental care and is linked very closely to the amygdala. Importantly, we have found that people respond to fearful expressions similarly to how they respond to an infant's face.

Studies in rats show that altruistic care in the face of danger relies on oxytocin receptors in the amygdala. This connection may explain why altruists respond to other people's fear the way that they do. In a study measuring white matter tracts in human brains to measure connections between PAG and the amygdala, altruists had far greater connections than controls when being shown fearful expressions.

Not all people have the same capacity for care and compassion. There is a neurobiological basis for altruism just as much as there is for psychopathy. Psychopathic and altruistic traits are not distributed normally and fall on more of a spectrum. Extraordinary altruists feel care for strangers as much as they feel care for people close to them. Altruists feel more self-other overlap with strangers and map the pain and fear of others very similarly to the way they map their own. But these tendencies are not at all fixed or “hard-wired.” My research has shown that most people may have the capacity to expand our circle of care out past people who are close to us and to include strangers as well.



*13 year old Roots of Empathy graduates share authentic reflections of their experience with Roots of Empathy and respond to questions, resulting in audience cheers, tears and a standing ovation.*

## Social cognitive abilities in childhood and the underlying brain processes

### MARGOT TAYLOR, PhD

*Director of Functional Neuroimaging*

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Social-cognitive ability – understanding the mental states of others and awareness and understanding of emotions, and self-regulation – is critical for children's success in school and life. It is a long developmental process but key to shaping learning and academic performance. We know that social cognitive functions in the brain rely on strong reciprocal connections, but what we don't know is how the development/maturation of these underlying neural substrates affects both how children acquire these skills and how competent they are at them. I will summarize a number of our brain imaging studies that are crucial for us to understand if and how children are at risk for social and cognitive difficulties (such as children born very preterm or children with autism). Brain circuitry is a complicated system with information moving between different regions. Some areas are busier than others, and minor disruptions can affect the whole network.



*Margot Taylor*

*“The attachment system is important for infants’ survival and social development.”*

Happy faces are the first to be recognized by emotion processing in a child's development. Angry faces are recognized after further maturation however, and for those with social cognitive difficulties such as Autism Spectrum Disorder (ASD), emotional face recognition can be difficult. An emotion processing study looked at 108 people of varying ages, where participants were shown either a happy or angry face side by side with a scrambled version of the same face and asked to select the scrambled version. The brain can't ignore emotional faces, as emotional processing is automatic or implicit. There is significantly different activity in the brain when recognizing different emotions.

The same task was performed with participants with autism. There has been a recent focus on atypical brain function and connectivity, underlying the cognitive and social difficulties of autism. There was atypical connectivity in key processing regions, but no differences in young children with ASD with processing of angry faces. There was a consistent positivity bias in the ASD group. In teenagers aged 12-15 yrs there was decreased connectivity in those with autism when responding to angry faces. Recognizing emotional faces improves with age regardless of their development, with those with ASD developing more slowly. The same task was run with very preterm-born children. For angry faces, full term children showed greater connectivity than very preterm children and this increased from 6-8 years. By 8 years old, the preterm children had caught up to the full term children in emotion processing. Both very preterm and ASD children are at high risk for social cognitive difficulties in social situations.

### Attachment behaviour studies

The attachment system is important for infants' survival and social development. The core regions of attachment are in the deep grey matter of the brain, the striatum, particularly the caudate and putamen. Connectivity between these structures was examined in the resting state of normal 10 year old boys who showed secure or insecure attachment. Attachment security was assessed using the separation anxiety test (SAT). Those who were securely attached could speak confidently

about their feelings and were confident that, if needed, their caregiver would help them. Those who were insecurely attached had more sporadic support from caregivers, and tended to avoid talking about their feelings.

Children with secure attachment showed increased functional activity. Attachment security can be measured with brain connectivity and relates to behavioural differences in attachment to typically developing (TD) children. Distinct patterns of brain activity were seen, with the securely attached children having the activation in this attachment network. This may explain why attachment has life-long effects on social and emotional development.

### Theory of mind

Theory of mind (ToM) is a skill that emerges in early childhood and allows understanding of the behaviour of others and is a key skill for empathy. When testing ToM, inhibition is very important. You need to inhibit what you know to be true to understand what another believes to be true. In children (7-12 yrs) processing this task takes longer, however, the majority of the same brain network is being used. Very preterm and ASD children were able to perform the task as well as the TD children but utilized different regions of the brain, suggesting alternate processing strategy.

The final task was a social attribution task. Participants viewed videos of shapes moving and were asked to identify if the shapes were moving randomly or interacting and to describe the scenario. In the fMRI, adults, full term (FT) and very preterm (VPT) 8 year olds had similar brain activation patterns, despite behavioural differences. The greater sensitivity of MEG, however, showed that FT children had greater connectivity in the ToM network than VPT children.

In conclusion, empathy scaffolds on social cognitive abilities which show protracted behaviour development over childhood and involve complex brain networks. Assessments of brain function provide a fuller understanding of social cognition and provide a means to help children who face challenges in these domains.

## Sleep on it! How children process emotions in their sleep

### REBECCA SPENCER, MD

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We spend more than a quarter of our adult lives sleeping. From infancy to childhood, an even greater amount of time is spent sleeping. While this may seem to be a rather unproductive use of time the brain is active during sleep. Recent research has exposed numerous functions of sleep on cognitive and emotional well-being. My research explores emotion processing during sleep and how sleep contributes to the critical emotion processing that takes place in childhood.



*Rebecca Spencer*

### Sleep protects memories

There are two major stages of memory, encoding and recalling. Encoding is the process of actively learning and recalling is the ability to reiterate the information given. A third stage exists that falls between encoding and recalling. This stage, called consolidation, is when memories are processed. Memory consolidation is enhanced by sleep. In a study testing word recall ability, the group who stayed awake for 12 hours after learning a set of word pairs performed significantly worse than the group who had a full night's sleep.



## Sleep and memory in children

Sleep changes across the lifespan. In children there is a high amount of sleep with rich sleep stages coupled with many learning experiences throughout the day. Naps are very similar to overnight sleep and provide the same sleep stages. I believe naps serve many benefits for children learning in a preschool setting. However, I have observed many preschools removing naps from the day to day schedule.

We used a visual-spatial test to investigate the relationship between sleep and memory recall in preschoolers. When children learned the task before a nap, they remembered more later that afternoon than when they stayed awake between learning and recall.

## Sleep processes emotions

Sleep has also proven effective with emotion processing. Sleep reduces the emotional load making children less emotionally reactive following sleep. Using a dot probe test, children were shown either a neutral or an emotional face with a dot hidden behind one of them. Half of the group was tested after a nap and half without. If emotions are being effectively processed the reaction time to both of the faces should be the same however, if there is an emotional attention bias then reaction time will be faster towards the emotional face. Children who stayed awake had emotional bias towards the emotional faces however those who napped were less emotionally reactive.

In this study, we found that the nap benefit was greater for the habitual nappers suggesting that they need naps more than non-habitual nappers in order to maintain emotional stability. Non-habitual nappers performed with the same level of low emotional reactivity regardless of whether they had napped.

### Key points: Sleep and emotional processing in children

#### Sleep supports emotion processing

- Enhanced emotional memory
- Reduced emotional attention bias
- Increased inhibitory control

#### Naps and overnight sleep can serve these functions

- Young, less mature children need distributed sleep

*“This work points to a role of protecting and promoting sleep health as a target for improving emotional development.”*

Children who have grown out of naps have matured their brains enough to not need a nap for effective emotion processing and exhibit inhibitory control. Inhibitory control is the ability to inhibit prepotent responses and is critical to education. It allows children to withhold disruptive or inappropriate behaviour as well as to withhold prior tendencies to exhibit new learning and is improved with sleep.

In conclusion, this work points to a role of protecting and promoting sleep health as a target for improving emotional development. Sleep supports memory processing. It leads to enhanced emotional memory and reduced emotional attention biases. Sleep also leads to increased inhibitory control which allows for more appropriate behaviour in the classroom. Both naps and overnight sleep can serve these functions with naps for younger children as well as an appropriate amount of overnight sleep for older children.



Roots of Empathy  

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