The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning

Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Evolution of the Lecture

• Attachment is a construct reflecting a quality of relationship
  • It is identified by specific behaviors and physiological processes in the presence and absence of the attached figure
  • It is made up of components, each of which has a neurological underpinning
  • There is not a one-to-one correspondence between the construct of attachment and a neurological process/system/network

Evolution of the Lecture

• In general, there is not a one-to-one correspondence between a behavioral system and underlying neurological system
• Neurological systems mediating a complex behavior can change over maturation
• Similar behaviors between individuals can be mediated by different neurological systems and similar neural activation can result in different behaviors
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Evolution of the Lecture

- Knowledge of the neurological underpinnings of components of attachment leads to hypotheses and speculation.
- Speculation is vital and interesting to propel scientific inquiry.
- There is some writing connecting interpersonal relationships to neurology in which the speculation makes leaps that are too great for expectations, claims or conclusions.
- Our thought processes based on logic may have nothing to do with neurological processes.

Brain Systems

- Anatomic
- Physiologic
- Cellular
- Cytarchitectonic
- Electrophysiologic
- Neurochemical
- Vascular
- Metabolic
- White Matter

Influences on Brain Systems

- Anatomic
- Physiologic
- Cellular
- Cytarchitectonic
- Electrophysiologic
- Neurochemical
- Vascular
- Metabolic
- White Matter
Evolution of the Lecture

- I wanted to incorporate the theme of the conference into the lecture.
- Therefore, let’s consider the roles of foundational components of attachment toward child development, learning, and therapist connections to others.

Empathy, Compassion, Altruism & Attachment

- Educator to Child to Educator
- Parent to Child to Parent
- Educator to Parent to Educator
- Educator to Team Colleagues (teacher, additional therapists…) to Educator

*This is so little to think about, you can put your minds on auto-pilot.*

Empathy

- Definition: The natural ability to share, understand and respond to the affective states of another (Decety & Michalska)
- Contributes to:
  - Maintaining survival of offspring
  - Maintain well-being of offspring: alleviate distress
  - Moral development & sensitivity
  - Altruism & prosocial behavior
  - Inhibit aggression
  - Intersubjectivity, attachment, social competence and relationship development
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning  
Association of Educational Therapists Annual Conference  
Warren D. Rosen, Ph.D.  
22 October 2015

Components of Empathy

• Affective resonance
  ➢ Visceral emotional representation of internal sensation – emotional contagion, vicariously sharing the emotional state of another person
  ➢ Matching emotional response – facial expression, body posture, autonomic arousal, self-reported emotional state
  ➢ Compatible & compassionate response
  □ Sympathy: A sorrowful or concerned emotional response to another person’s distress or need (de Waal, 2008)

Deary & Michaux, 2012

Components of Empathy

• Affective resonance
  ➢ Behavioral emotional representation of non-verbal expressions - mimicry
  ➢ Affective resonance alone does not give an individual a sense of why the other person is holding these feelings. Emotional contagion & empathy
  ➢ Perspective-taking and theory of mind not essential underpinning for sympathetic concern or compassion (Walsh, 2012). BUT, sympathy can be derived from cognitive perspective taking without emotional resonance (Eisenberg et al., 2012)

Deary & Michaux, 2012

Components of Empathy

Perceiving Emotional Signals

• Children need to learn to
  ➢ Attend to
  ➢ Recognize
  ➢ Assess and interpret the meaning and significance/relevance of emotional signals
    □ Connect cues to relevant memories, contextual knowledge, motivational significance & subjective feelings
  ➢ These abilities are both neurologically and socially mediated.

Price & Pollak, 2007
Components of Empathy

Emotion Perception & Processing

- Emotion perception requires interoceptive awareness – ability to detect physiological responses.
- Individuals with high detection of physiological responses perceive inner emotions as more intense.
- Individuals with low threshold detection of physiological responses have deficits in detecting feelings states & in making emotional attributions.

Components of Empathy

Social Cognitive Development

- Understanding that the emotions of self and other can differ
  ➢ Cognitive perspective-taking
  ➢ The explicit mental representation of another person’s feelings as holding triggers or intentions, and perhaps intentional communication, mental state attribution
  ➢ Understanding that another person’s emotions can be intentionally communicated, camouflaged, dampened, heightened
  ➢ Mentalizing: Attribute non-communicated dynamics such as desires, intentions, beliefs.
  ➢ Self-reflection
  ➢ Appraisal of others: Theory of Mind

Components of Empathy

Development

- Emotional regulation and mental flexibility — emphasized by Decety & Michalska, 2012
  ➢ Emotional regulation: ability to respond to demands of an experience that is: commensurate with the experience and is socially appropriate in that context
  ➢ Emotional and cognitive flexibility to delay or color the emotional expression as needed
  ➢ These processes allow us to develop and deliver empathic responses mismatchingly fitting the 1) other individual’s reactions, 2) the context, & 3) our own desired image — apply our judgment to our hypothesized network of integrated components

Decety & Michalska, 2012
Empathy vs. Sympathy

- Display of sympathy often takes the form of compassion and sadness for the other
- Display of empathy resonates with the other’s emotion, not the emotion we would have in her/his place
- If child is angry, frustrated, impatient, fearful, these are the emotions with which to empathize

Neurology of Empathy

- The brain systems underlying the processes, visceral resonance and social cognition, must become progressively interconnected with development
  - Simultaneous resonance activation
  - Neural communication

Multi-Systemic Neurophysiology

- Neural circuitry operates simultaneously in serial and parallel fashion, not a linear chain of events.
- Each emotional process feeds forward and backward.
  - Stimulus activates associations and memories
  - Stimulus influences responses.
  - Stimulus fine-tunes associations and memories
  - Stimulus influences future selective attention and perception to subsequent emotional stimuli
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Neurology and Neuropsychology of Empathy Development
- Affective arousal and rapid appraisal
  - Amygdala
  - Sensori-perceptual cortex
  - Hypothalamus (produces oxytocin)
  - Hippocampus
  - Orbito-frontal cortex

Limbic System Internal to Cortex

Insula is Interior to the Temporal and Frontal Lobes
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Prefrontal Cortex

Amygdala

- Directs our attention to affectively salient stimuli
  - Unconditioned: For individual survival and species survival
  - Conditioned: Through pairing with past events, becomes an emotional trigger. Memory mediates the emotional response. The brain has learned.
- Especially sensitive to reading facial expressions of emotion
  - Registers “fearful” faces even if so brief, that there is no memory of them.
- “Trigger” is not a property of the stimulus – it is a brain mechanism that detects the emotionally relevant stimulus.

Emotional Stimulus-Response Pathways

LeDoux, 1996
Inherently Emotional Stimuli and the Amygdala

- For “normally” developing children, the following stimuli are inherently emotionally relevant, and activate the amygdala:
  - Facial expressions
  - Vocal expressions
  - Postural expressions
- Amygdala abnormalities have been found in children with autism.
- Amygdala and hippocampus abnormalities have been found in children with Fragile X and Turner Syndrome.

Amygdala

- Draws on and prompts further sensory and perceptual processing of potentially relevant stimuli, especially novel, unfamiliar, surprising, emotionally-ambiguous (and therefore potentially threatening) stimuli.
- Draws arousal to give “impulse” for reaction and further processing

Amygdala

- Amygdala receives afferents from every step of sensory processing
  - Thalamus
  - Primary and secondary sensory areas
  - Association cortices
  - Hippocampus
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

**Amygdala**

- Amygdala has projections to:
  - Hypothalamus (which controls release of hormones)
  - Brainstem nuclei (which mediates fight-flight motor responses and visceromotor responses such as heart rate and blood pressure).
- Amygdala contributes to mobilizing autonomic, neurochemical and behavioral reactions/responses.

**GABA: inhibits receiving neurons**

- Vasopressin: couple bonding, may trigger male aggression to sexual rivals

**Opioids**

- Soothes, reduces pain, moderates stress (e.g., endorphins)

**Dopamine**

- Central to rewards, attention, approach behaviors

**Estrogen**

- Promotes nurturance toward children, closeness, bonding & love in couples, ♀ ♂

**Acetylcholine**

- Alert wakefulness & learning

**Cortisol**

- Adrenal glands release during stress, stimulates

**Neurochemicals Central to Emotional Communication**

- Primary Neurotransmitters
  - Glutamate: excites receiving neurons
  - GABA: inhibits receiving neurons

- Neuropeptides: building blocks of neuromodulators
  - Opioids: soothes, reduces pain, moderates stress (e.g., endorphins)
  - Oxytocin: promotes nurturance toward children, closeness, bonding & love in couples, ♀ ♂
  - Vasopressin: couple bonding, may trigger male aggression to sexual rivals

- Others
  - Cortisol: adrenal glands release during stress, stimulates amygdala & inhibits hippocampus
  - Estrogen: ♀ low estrogen ▮♀ low mood, low libido, reduced memory; ♀ high estrogen/low testosterone ⇒ irritability; Andropause and Irritable Male Syndrome
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning

Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Tempero-Limbic System

- Hippocampus
  - Explicit memory about the emotional system
  - Later similar event evokes conscious recollections

- Amygdala
  - Implicit (unconscious) emotional memories
  - Later similar event evokes similar (autonomic) responses

Insula

- Insula mediates:
  - Interceptive awareness (e.g., heartbeat, pain, warmth)
  - Conscious awareness of visceral/emotional state
  - Social-emotions (e.g., disgust, norm violations, empathy, orgasms)

Learning of Emotional Significance of Stimuli

- Amygdala is also involved in learning of emotionally significant stimuli, explicit memories
  - Fear conditioning
  - Vicarious learning

- Hippocampus is involved in learning emotionally significant contexts, and can prime the amygdala to be on the “lookout.”

- Orbitofrontal Cortex allocates attention to emotional stimuli, and updates the value of the stimulus.
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Neurology of Empathy

- Evolutionarily and neurologically, empathy toward others’ different emotions have different value.
- Neurological underpinnings
- Responses & reactions to others’ fear and distress vital to maintain the life/health of the child, the survival of the species.

Neurology of Empathy

- Fear and pain:
  - Signals the individual to seek safety and healing
  - Signals others to help relieve their distress
  - Infants resonate with others’ distress – experienced as self-distress.
  - The neural circuitry that is triggered in one’s own pain is triggered in resonating with another person’s pain or even imagining another person’s pain
  - Going through toddler years, come to differentiate self from other

Positive Empathy

- Empathic happiness – resonating with another’s happiness brings forth feelings of goodwill, tenderness (vs. envy)
- Empathic cheerfulness – Proactive use of positive emotion to relieve the other person’s distress (can be to make other feel better or make self feel better)
- Joint attention and affective social referencing

Light & Zahn-Waxler, 2012
Empathy - Development
- In non-human primates and infants
- Not just motoric imitation in infants
- Extrinsic rewards not needed: oxytocin and dopamine in the act of helping and in the reduced distress of other, even not one’s own infant, intrinsically rewarding. (Foster attachment)
- In both chimpanzees and human infants, both help irrespective of anticipated external reward, even when the recipient is unfamiliar and even when effort is required (Warneken et al., 2007).
- Empathy and response felt to others beyond one’s children and genetically-linked family – primates and humans
- Language not needed – Infants show facial and vocal consoling, soothing expression in concern. This is not congruent resonance, but response to it.

Empathy Development: Neurology
- Bottom-up processing of affective communication:
  - Affective resonance and arousal, implicit and intuitive, are shown in infancy
  - Sensori-perceptual: Reading faces and interpreting vocal tone
  - Sensori-motor: Imitation of faces – not necessarily conscious
    - Partly mediated by mirror neurons, sensori-motor neurons in the premotor, motor, somatosensory and parietal cortex

Empathy Development: Neurology
- Bottom-up processing of affective communication
  - Emotional: Affective arousal and discrimination
    - Pleasant vs. unpleasant
    - Attracting vs. aversive
    - Threatening vs. nurturing
  - Balance between resonance-personal distress and empathic concern prompts avoidance vs. approach
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Empathy Development: Neurology

- Top-down cognitive appraisal processing:
  - The perceiver’s motivations, intentions, attitudes influence the empathic process and response
  - The perceiver assesses the perceived’s background that influences his/her emotional expression
  - With cognitive development, empathic and altruistic motivation becomes independent from the parent-child context, and progressively complex

Empathy Development: Neurology

- Children between 18 and 25 months can sympathize with a victim even when the victim does not give off emotional cues
  - There are some facets of affective perspective-taking that is not built on:
    - Emotional resonance/contagion
    - Mimicry
  - By 4 years, children come to understand that an emotion a person has about an event depends on that person’s perception, experience, beliefs and desires about the event

Neuropsychology of Empathy Development

- Early emotion understanding skills predict peer popularity, sophistication in understanding feelings, and “moral sensibility” in defending peers from bullies
- Early mind reading skills predict connection in communicating with peers and to frequency in role play
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning

Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Neurology of underlying pain
Perception of another person’s pain
Imagination of another person’s pain

- Somatosensory cortex
- Insula
- Cingulate cortex
- Supplementary motor area
- Periaqueductal gray area – mediates heightened arousal, attention, reaction to potentially threatening stimulus

Decety, 2012

Neurology of underlying pain
Perception of another person’s pain
Imagination of another person’s pain

- When the pain is intentionally caused by another person
  - Cognitive mediation is added!
    - Pre-frontal cortex
    - Orbito-frontal cortex
    - Tempero-parietal juncture

Neurology & Neuropsychology of Empathy Development

- With development of cognition, theory of mind, theory of emotional dynamics, human nature and relationship development
  - "Mentalizing and relating mental perspective and emotional state:" Can draw inference based on understanding of the other person’s personality, belief structure, goals, their joint relationship, contextual cues, and complex interpersonal emotions such as pride, shame, embarrassment. Social meta-cognition.
Neurology & Neuropsychology of Empathy Development

- With development of cognition, theory of mind, theory of emotional dynamics, human nature and relationship development
  > Developing communication between prefrontal cortex, temporo-parietal junction (mostly right), & temporal poles (PET scan, event-related potential, fMRI)

Neurology & Neuropsychology of Empathy Development

- Perception of another person’s pain
  > The toddler and younger child: mostly amygdala, insula, supplementary motor area
  > With development, pre-frontal cortex was recruited
    ◆ Subjective feelings of pain reduced
    ◆ If older individuals reported more pain (into adulthood), they showed increased activation of the amygdala.

Decety & Michalska, 2010

Neurology & Neuropsychology of Empathy Development

- Empathy for others’ pain:
  > Development from visceral resonance of another’s pain and affective charge related to the paining stimulus (amygdala) to
  > Evaluative response (pre-frontal cortex and its communication from the amygdala) incorporating context and assessment of intention & motivation, possession of social knowledge allow selective and modulated responding...
  > Evaluative response which can incorporate feelings of envy, self-interest, social inhibition (bystander detachment)

Warnken & Tomasello, 2009
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

---

**Emotional/Behavioral Regulation**

- Management of emotional/behavioral responses is highly related to executive functioning of prefrontal lobe: making judgments, planning/executing responses, inhibiting inappropriate/selfish responses, promoting empathy & social cooperation
- For emotional & behavioral regulation, dopamine pathways related to executive functioning of prefrontal lobe: making judgments, planning/executing responses, inhibiting social cooperation

---

**Empathy and Oxytocin Release**

**Part I**

- Questionnaires regarding emotionality
- Blood drawn – measure oxytocin level
  - 1. Emotional Video, then rate emotions, followed by game for pay
  - 2. Emotional Video alone, then rate emotions
  - 3. Neutral Video, then rate emotions, followed by game for pay
- Blood drawn

Barraza & Zak, 2009

---

**Empathy and Oxytocin Release**

**Part I**

- Results
  - 1. No significant increase or decrease in oxytocin (perhaps time lag after game before blood draw; short half life)
  - 2. Significant increase in oxytocin
  - 3. Significant decrease in oxytocin
  - Both groups who watched the emotional video reported greater empathy elicited, but not other characteristics, than those who watched the control video
  - Viewing the emotional video raised oxytocin by an average of 47% over baseline level compared to neutral video.

Barraza & Zak, 2009
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative 
Behaviors and Children’s Learning 
Association of Educational Therapists Annual Conference 
Warren D. Rosen, Ph.D. 
22 October 2015

Empathy and Oxytocin Release
Part I

Empathy and distress jointly (not individually) were correlated with change in oxytocin level, but not with ACTH, cortisol, progesterone, estradiol.

Barthas & Zak, 2009

A Neurological/Neuropsychological Transactional Process

- Empathic disposition, not as broad or personality-defining as temperament, is relatively pervasive across the lifetime (see Light & Waxler, 2012). But like other neuropsychological processes, is not immutable.
  - Social/familial response styles influence the feeling and communication of empathy
  - Social/familial response styles influence the neurological pathways of one’s empathy system
  - One’s empathic processes influence others around, which in turn can alter their responding to the individual

Socioemotional Self-Regulation

- Operations to moderate include up-regulating or down-regulating processing and responding.
- The ability to reduce emotional intensity
  - Decrease amygdala activation
  - Increase prefrontal activation
  - Can be automatic and unconscious
  - Can be proactive and preventive
- The ability to intensify or prolong emotional feeling and reaction
Derailments of Empathy
Autism, Asperger’s and Nonverbal Learning Disability

- Low threshold/failure to register the perceptual input and its meaning
  - Failure to register mild or subtle emotion expression
  - Failure to understand the meaning of mixed emotional communication
- Failure to imitate action and interpret the intent of the action
- Failure to interpret emotional and mental states of others
- Great difficulty integrating the multiple cues into cohesive meaning

Derailments of Empathy
Autism, Asperger’s and Nonverbal Learning Disability

- Great empathy when a bold, obvious cue is registered, often by a more “primitive” being: baby’s cry, animal’s distress.
- Even so, might not have the impetus, courage, or skill to express felt compassion to the person in pain/distress

Derailments of Empathy
Right Hemisphere Lesion: Neuroaffective Impact on Interpersonal Capabilities

- Poor ability to read & respond to subtle, complex or discrepant emotional expression
- Neutral emotional expression
- Insufficient intersubjectivity & empathy
- Poor integration of feelings
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

**Derailment of Empathy**
**Emotion Perception and Processing**
- People with impaired feeling awareness – ability to understand and think about emotions – have impaired ability to identify emotions in themselves and others.
- People with alexithymia have exaggerated interoceptive awareness and impaired feeling awareness.

**Derailsments of Empathy**
**Emotion Perception and Processing**
- People with alexithymia showed altered activation of brain systems in response to emotional stimuli, right hemisphere and white matter abnormalities.
- People who practice mindfulness meditation show larger gray matter volume in the right anterior insula (Hoelzel, 2008).

**Derailments of Empathy**
- Prenatal testosterone has been shown to be linked with lower levels of empathy in preschool boys and girls (Chapman et al., 2006).
Derailments of Empathy
Callous Unemotional

- Sociopathy, Callous unemotional traits, Aggression without feelings of guilt, lack of remorse of compassion, ability to use and manipulate other people
  - Reduced personal feelings of fear
  - Reduced recognition of others’ facial fear expressions
    (Marsh & Blair, 2008)
  - Reduced emotional arousal to others’ fear

Marsh et al, 2008

Derailments of Empathy
Callous Unemotional

- Sociopathy, Callous unemotional traits, Aggression without feelings of guilt, lack of remorse of compassion, ability to use and manipulate other people
  - Reduced activation of amygdala & amygdala pre-frontal connections
  - Therefore, reduced empathic feeling and responding to fearful others, induced by self or by other stimuli

Marsh et al, 2008

Derailments of Empathy
Conduct Disorder

- Aggressive conduct disorder in children (not necessarily callous unemotional sociopathy)
- Neurological circuitry of pain was triggered when watching another in pain
- When watching a person subject to intentional pain, pre-frontal cortex (processing, evaluation, judgment) and connections between pre-frontal cortex and amygdala not triggered as much as in control children

Decety et al., 2009
**Derailments of Empathy**

- **Aggressive conduct disorder in children**
- **When watching a person subject to pain, the greater the frequency of aggressive acts, and the higher the self-ratings in daring and sadism, the greater the amygdala activation**
  - Counter-intuitive?
  - Decety et al. wonder: excitement or enjoyment in response to others’ pain, Schadenfreude, hearty laughing at another’s pain or humiliation? 
  
  Decety et al., 2009

---

**Derailments of Empathy**

**Empathic Over-Arousal, Emotional Under-regulation**

- Excessive levels of empathic arousal and poor emotional regulation
  - Over-reactive empathy
    - Empathic distress, one’s own emotions (through emotional resonance) are prominent and overwhelming, overtaking empathic concern. Can motivate a person to make the other person feel better or alternatively avoid.
  - Over-reactive sympathy – patronizing (“I care too much”)
  - Vicarious trauma
  - Compassion fatigue

---

**Derailments of Empathy**

**Emotion Perception Affected by Emotional Experience Maltreatment**

- Children exposed to maltreatment
  - Perceive angry facial expressions as more salient than other facial expressions
  - Possessed broader boundaries surrounding expressions as “angry” than non-abused children
  - Required less visual information to detect anger in a facial expression than non-abused children

See Seth Pollak
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning

Association of Educational Therapists Annual Conference

Warren D. Rosen, Ph.D.

22 October 2015

### Derailments of Empathy

**Emotion Perception & Attention Affected by Emotional Experience**

- Maltreated children showed differential cognitive ERPs between angry vs. happy faces, and between angry vs. happy voices, while non-abused children showed equal ERP amplitudes (Pollak).
- Maltreated children allocate more neurological attentional resources to their mothers’ angry voices than did non-abused peers (Pollak).

### Stress Reaction

- A child with an overactive trigger mechanism
  - Vigilant to potential threats
  - Threat detected causes excessive release of stress hormones – cortisol especially
    - Cortisol impairs memory, including emotional memory
  - Anxiety interferes with detection of other relevant stimuli
  - Anxiety interferes with cognitive processing

### Empathy – The Trigger to Altruism

- Altruism: Prosocial behavior based on sympathy and/or moral values (Eisenberg et al., 2006)
- Prosocial behavior emerges in the 2nd year of life (Zahn-Waxler et al., 1992)
- Data suggest that another person’s fear is the clearest trigger from empathy to sympathetic concern and altruism
- Ability to recognize another person’s feelings of fear predicts compassionate and altruistic responses

Marsh, 2012
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative 
Behaviors and Children’s Learning 
Association of Educational Therapists Annual Conference 
Warren D. Rosen, Ph.D. 
22 October 2015

Altruism - Evolution
- Maintenance of offspring, family, community
  - Increase the probability of healthy offspring
- In an experiment, chimpanzees would exchange more Token A for food when the token would bring food for another chimp also, than Token B when the token would bring food only for oneself (Horner, 2011). Selfless giving

Altruism
- Pfaff (2015): The drive toward and experience of sex, and the experience of motherhood (parenthood) underlie the development of compassionate behavior and altruism.
- We have learned from sex and parenting to love intimacy and empathy toward altruistic, prosocial behavior.
- Pfaff (2015): One needs an emotionally-loaded ethical switch, the consideration of consequences that propels development of compassionate behavior and altruism.

Altruism
- From infancy, we learning about the rewarding feelings of prosocial behavior, receiving and giving.
- Altruistic acts prolong our lives and those of others and bring to fruition our yearning to connect and be with others.
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Neurology of Altruism

- Neurological and hormonal prompts toward altruistic behavior overlap considerably with mechanisms engaged when showing maternal behavior toward one’s infant.
- Pre-optic area neurons (in front of hypothalamus) trigger maternal caretaking behavior and suppress anxiety. They promote approach.

Neurology of Altruism

- Hormones: High estrogen (postpartum), low progesterone, high prolactin promote maternal caretaking
- Opioid peptide Oxytocin is believed to trigger Dopamine.
  Dopamine and Serotonin provide rewarding feelings, reduce anxiety, promote maternal behavior

Altruism

- True motives may be hidden, even to oneself!
  ➢ To receive a future favor
  ➢ To gild one’s image
  ➢ Decline to perform an antisocial act
  ➢ To avoid being ostracized
  ➢ To manage a situation
  ➢ To gain a good feeling in the doing
Attachment: The Strange Situation

- Parent and infant are alone in room: infant explores.
- Stranger enters, converses with parent, approaches infant.
- Parent leaves inconspicuously.
- First separation: Stranger focuses on infant
- First reunion: Parent greets/comforts infant, then leaves again.
- Second separation: Infant is alone. Then stranger enters and focuses on infant.
- Second reunion: Parent enters, greets infant, and picks up infant; stranger leaves inconspicuously.

Attachment: The Strange Situation

- Four aspects of the child's behavior are observed:
- The amount of exploration (e.g. playing with new toys) the child engages in throughout.
- The child's reactions to the departure of its caregiver.
- The stranger anxiety (when the baby is alone with the stranger).
- The child's reunion behavior with its caregiver.

Attachment Assessment

- Attachment relationships are defined by (in assessment) and characterized by:
  - Separation distress when attached figure leaves
  - Physiological soothing in presence of attached figure and stressful event
Attachment

- Attachment behavior shown in: seeking/gaining close proximity to attachment figure, especially at times of emotional stress.
  - Proximity/reassurance serves as interpersonally transmitted emotional regulation
    - Alleviates distress
    - Promotes a sense of security

Styles of Attachment

- Secure
- Anxious – Preoccupied
- Fearful-Avoidant
- Dismissive-Avoidant

- *Beginning fMRI studies are examining activation of neurological systems related to the four above styles.*

Attachment Interpersonal Regulation of Emotion

- The infant/toddler/child regulates emotion by presence of the attached figure
- Later, the attached figure is present as a mental representation (internal working model), which serves as regulatory – this representation is purportedly developed based on availability & efficacy of attachment figure in soothing and bringing safety in the face of threats.
- Purported to set anticipation about availability and helpfulness of others
Interpersonal Regulation of Emotion

- By 2 – 3 months, parent’s animated, mirroring choreography with happy infant maintains the baby’s positive emotional state
- Anticipatory soothing: By 6 months of age, a distressed infant will be soothed when hearing parent’s approaching footsteps
- Parents distract (shift the attention of) infants from negative emotion

Attachment Development

- Bonding and attachment occur during period of rapid neural development underlying learning, circuit establishment and pruning: Likely sensitive period for attachment
- Attachment develops from close proximity to familiarity to attached: attain pleasure, attain security, probable different underlying neural systems

Attachment Development

- Infant must survive depending on caregiver, no matter the quality of the caregiver’s emotional responsivity
- Strong attachment develops by 6 months, with precursors beforehand. Bond may develop in utero based on scent and voice
- Infant develops a strong bond to caregiver, even if insecure, anxious, strongly ambivalent, and distinguishes between caregiver and others – able to distinguish within hours after birth!
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning

Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Secure Attachment - Benefits
- Secure caregiver-infant attachment
  - Higher perceived availability of attachment figure – even in adolescence
  - Higher self-esteem & self-reliance
  - More effective self-regulation of impulses and emotions
  - Higher tolerance for distress
  - Enhanced friendships
  - Less loneliness

Secure Attachment - Benefits
- Enhanced capacity for intimacy and self-disclosure in adulthood
- More readily seeks help
- Higher perceived social support (including at school)
- Greater sense of mastery in the world
- Less frequent externalizing symptoms: oppositional, defiant, misconduct, aggression, drug abuse
- Less frequent internalization symptoms: anxiety, depression

Emotion Regulation
Parent-Child Choreography
- Parent judgment-influenced responses to children’s emotions:
  - Empathic/Sympathetic responses with constructive feedback & solutions, and sharing of their own problem-solving validate feelings, support the child, assist emotional coping & foster solutions
Emotion Regulation
Parent-Child Choreography

- Parent judgment-influenced responses to children’s emotions:
  - Denigrating, critical, dismissive, disdainful or overly empathic/identifying responses trigger stress response, exacerbate negative emotions, prompt feeling of incompetence, injure the relationship, and have negative effect on peer friendship capabilities

Neurology of Attachment

- Fear-inducing threats and social soothing
- Hypothalamus mediates the emotion-regulatory effects of social soothing, the major training for self-soothing.
- Hypothalamus synthesizes oxytocin and vasopressin, which are secreted during maternal bonding and pair bonding.

Neurology of Attachment

- Incentive motivation, acquisition of the rewarding stimulus - attainment of pleasure by proximity to the attached figure.
  - Dopamine system – produced in the ventral tegmental area and substantia nigra, projected to many networks
  - Dopamine propels goal-directed behavior
  - Primary pleasure and conditioned pleasure
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning

Association of Educational Therapists Annual Conference

Warren D. Rosen, Ph.D.

22 October 2015

Neurology of Attachment

- Hypothalamus mediates cortisol release in the hypothalamic-pituitary-adrenal axis.
- Hypothalamus receives input from amygdala, hippocampus and prefrontal cortex, structures that respond to social behavior, personal and social emotion, stress, and attachment dynamics.
- Can synthesize corticotrophin-releasing hormone, which during threat, triggers release of ACTH in the pituitary, which triggers cortisol, epinephrine and norepinephrine.
- Hypothalamus can synthesize oxytocin and vasopressin.

Neurology of Attachment

- Amygdala and hippocampus both contribute to consolidation of the connections between attached figure and the emotionally-colored situation (such as academics) into memory.
- Hippocampus mediates formation, storage and consolidation of the connections between internal sensory/emotional states and spatial, environmental context.

Attachment Emotional Regulation

- Parental love:
  - Great pleasure
  - Longing for closeness
  - Desire for nurture
  - Instinct to protect
- Correlated with centers rich in oxytocin and dopamine
- These patterns seem to change neurologically over the course of the child’s development.
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning
Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Neurology of Attachment
Emotion Regulation
• fMRI of mothers in response to their own vs. familiar children’s faces, & infant cries vs. background noise activate brain regions rich in oxytocin (Bartels & Zeki, 2004; Loup et al, 1991, Strathearn & McClure, 2002)
  > Oxytocin promotes milk ejection during lactation, physical proximity & nurturance from mother to infant, social memories formed in amygdala, reduced anxiety to promote bonding

Neurology of Attachment
Emotion Regulation
• fMRI of mothers in response to their own, familiar & unknown infants’ faces in photos showed activation in areas with dopaminergic projections (Strathearn & McClure, 2002)
  > Dopamine facilitates stimulus-reward learning in the brain (with reductions associated with AD/HD, drug addiction, compulsive gambling, obesity).
  > In animal studies, seen to enhance social attachment

Derailments of Attachment
Interpersonal Regulation of Neurology of Emotion
• Children who experienced neglect and deprivation in an orphanage showed
  > Lower levels of vasopressin
  > Reduced oxytocin responses to physical contact with caregivers
• … compared to children raised fully in a family
  (Wismer-Fries et al., 2005)
Derailments of Attachment
Mood and Behavior Regulation

- Insecure patterns of attachment (with maltreatment, rejection, disorganized (non-contingent) responding to infant or emotional unavailability) yield higher rates of
  - Anxiety disorders
  - Aggression
  - Conduct Disorder
  - Other forms of psychopathology

Attachment Prefrontal Cortex

- Mediates emotion, emotion regulation, motivation
- Appraise the emotions affiliated with sensory input/interpretation, determine approach-avoid to stimulus (threat cue), automatic or conditioned, or to attached figure
- Connections with amygdala, hippocampus, hypothalamus and the dopaminergic projection system (nucleus accumbens and ventral tegmental area – VTA)

Attachment Interpersonal Regulation of Neurology of Emotion

- Data suggest (Coan et al., 2006) that a spouse can attenuate threat (anticipated pain) in neural activity, and that even a warm stranger’s comforting presence can do this compared to threat when alone – down-regulation in cingulate cortex, nucleus accumbens, dorsolateral prefrontal cortex, and superior colliculus.
Attachment
Interpersonal Regulation of Neurology of Emotion

- Coan et al., 2006 study suggests: In the presence of a close, trusted other, we might not rely on ourselves alone (neurologically) to downshift emotion in a threat situation; the relationship is incorporated into the emotion regulation strategy.
- Suggests: Our perception of threat change over time in a trusted relationship.

Attachment and Learning in Children

- Attachment TO learning?
- Attachment figures’ coordinated efforts with child toward learning?
- Attachment to teacher (educational therapist) and learning?

Attachment TO Learning?

- Attachment connotes a trusting relationship, undergirded by oxytocin.
- The brain-systems associated with attachment would not be naturally triggered by the learning process or the material to be learned.
  - Proximity to learning process and materials do not enhance chances for living and procreation
  - (THOUGH, learning in hunting & gathering can enhance longevity and connectedness)
- Better construct = Engagement, which CAN have emotional underpinnings.
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning

Attachment and Learning

- Can secure attachment relationships foster learning?
- Might oxytocin and accompanying neurology generalize through conditioning to the learning situation?

Data, Scenarios & Discussion

Educational Therapist Response Pattern

- What is your response (internal and external) to children’s emotions?
  - Does it depend on the particular expressed emotion?
  - Does it depend on the child’s manner or frequency of expressing it?
  - What is your proximate goal? Your ultimate goal?
  - Does sympathy seem like coddling?
  - Does sympathy cause you distress?
  - How does the child react to your empathy?
The Connections Among Neurophysiological and Neuropsychological Processes Underlying Affiliative Behaviors and Children’s Learning

Association of Educational Therapists Annual Conference
Warren D. Rosen, Ph.D.
22 October 2015

Educational Therapist

• What is the effect of a child’s emotionality on you?
  ➢ Which emotions and what types of displays “press your buttons”?
  ➢ How do you react outwardly (don’t presume that the child cannot sense your reactions).
  ➢ How do you work on this?
  ➢ How does your attachment system interplay with that of the child?

• Help child label emotions – labeling alone promotes understanding/processing and reduces the intensity of the internal sensation.
• Identify your tolerance for a child’s negative feelings.

Educational Therapist

• If we coach a child on reducing emotional behavior,
  ➢ We must communicate that we do not mean that emotions are wrong, inappropriate or not legitimate
  ➢ Communicate that emotions are helpful to us, and well-expressed emotions are helpful to our relationships.