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[Archived] Child Development and the Emotional Circuits of Mammalian Brains

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Introduction and Subject

Do little babies feel pain when they are circumcised without anesthetics? Despite ambiguous 20th century medical opinion, the answer is, of course they do. It is now quite clear that all mammals experience their emotions within the *subcortical* circuitries of their intensely affective brains. The evidence comes from hundreds of brain stimulation studies in other animals, where "rewarding" and "punishing" effects are readily obtained from subcortical brain emotional systems that are homologous in all mammals, with essentially no places where such effects can be obtained from higher brain areas.[1,2,3] Primal affective feelings are part and parcel of our inherited mammalian emotional action apparatus, which strongly influence learning and the growth of the neocortical cognitive apparatus.

Thus, the lessons from other mammals, where essential causal neuroscientific work can be done, apply to our children. Their intense affective nature, especially during the earliest years, is a consequence of evolutionarily in-built emotional functions. For instance, crying, even if not precipitated by physical pain, reflects psychological pain, whether hunger-related or from

separation-distress (starting at about age 6 months). Before infants speak, their affective experiences can be reasonably deciphered from their emotional actions, especially their diverse emotional vocalizations, homologous with those of other mammals.[4]

Problems and Research Context

The experience of pain corresponds to shrieking and crying, similar in all mammals. When we artificially activate such brain circuits, including ones that generate RAGE and FEAR, animals rapidly turn off stimulation. Likewise for joy. When humans feel joy they laugh; other animals also make laughing-type sounds when they play or are tickled. They learn to self-stimulate PLAY facilitating systems that generate such happy sounds, and the same goes for brain circuits that generate foraging (SEEKING), sexual (LUST) and maternal (CARE) behaviours.[1,3] (Please note that capitalizations are used as a nomenclature convention to highlight their primary-process status – also known as "unconditioned stimuli and responses" in behavioural learning-system parlance.)

Cross-species animal work has now revealed brain mechanisms that human have but can't be studied in ethically-conceivable human research. The lessons from affective neuroscience are quite clear. All our primary-process affects – emotional arousals, but also valenced sensory (e.g., pain and taste) and homeostatic feelings (e.g., hunger and thirst) – arise from subcortical brain systems mediated by evolutionarily ancient neural circuits and neurochemistries, concentrated very medially and very far down in the brain, namely very ancient brain areas. Animal research has also revealed universal secondary-process emotional learning mechanisms, which transpires in subcortical *basal ganglia* (e.g., *amygdala*, *nucleus accumbens*, etc.) richly connected to neocortex. It is the tertiary-processes of the BrainMind – capacities for thoughts, ideas and ruminations – that require extensive neocortical tissues that are essentially *tabula rasa*, at birth. Most functions of our visual cortex are fundamentally programmed by experiences.

Cortical "modularity" emerges through learning, making early emotional development critical for the quality of higher mental abilities. An understanding of such evolutionary/developmental levels of cognitive emergence have direct implications for child rearing practices: Optimize positive effects and minimize negative ones, with plenty of challenges for children to manage with their rapidly maturing higher mental powers. Many paths are auspicious, many are not, depending on local cultural and ecological demands, but reasonable advice, rich with emotional intelligence, is available.[5] A good example is to be found in language development. Infants love the emotional melodic-musical intonation of *motherese*. The first goal of language acquisition is to be positively

engaged with the melodic contours of your native language. Propositional meanings follow affective engagements.

Recent Research Results

The basic affective circuits of mammalian brains

There are at least seven primal types of emotional systems in all mammalian brains (see Panksepp,[1] for fuller anatomical, neurochemical and behavioural descriptions of these systems). All systems are situated subcortically, and consist of large transverse networks that interconnect ancient central midbrain regions such as the periaqueductal gray and ventral tegmental area, with various basal ganglia nuclei, such as amygdala and nucleus accumbens, which are well connected to cingulate, insular, orbitofrontal and medial frontal old-type cortices, via pathways that run through both the hypothalamus and thalamus. Each system has abundant descending and ascending components that work together to coordinate instinctual emotional behaviours, autonomic bodily changes and raw feelings. These systems come to be activated and regulated by higher brain mechanisms through learning. The seven systems that currently have abundant evidence are as follows:

1. The SEEKING/Desire System. This general-purpose appetitive motivational system is essential for all other emotional systems to operate effectively. Thus it is the grand-daddy of them all, generating an urge to explore and engage with the world, with eager curiosity and interest, yielding abundant spontaneous learning, which can become habit structures (in basal ganglia) and knowledge structures (in the neocortex). SEEKING allows animals and humans to find and eagerly anticipate all kinds of resources needed for survival, including water, food and warmth, but also creativity and playful engagements that promote development of various skills including those related to LUST and CARE. Pathologically, this system mediates all addictions to artificial drugs (e.g., cocaine and heroin) and natural compulsions (gambling, obsessive sexuality, etc). SEEKING circuitry has been called the “brain reward/pleasure system,” but this one promotes euphoria accompanying enthusiastic engagements with the world. Children need many opportunities to exercise the power of this exploratory system.
2. The RAGE/Anger System. When SEEKING is thwarted, RAGE/anger/aggression is aroused (e.g., just restrain a baby for a short time). All children have many encounters with this system throughout development. The goal should be to help children regulate this power of

the mind and minimize its influence on personality development.

3. The FEAR/Anxiety System. FEAR circuitry helps all mammals to reduce pain and likelihood of destruction. It promotes uptight freezing when danger is far away and precipitous flight when near. This system conditions rapidly to promote traumatic disorders as well as other psychiatric problems. Children need to learn how to cope with vicissitudes detected by this system in age-appropriate ways and in fundamentally secure environments.
4. Male and Female Typical LUST/Sexual Systems. These are imprinted within infant brains during early development (second trimester, in humans), promoting forms of childhood sexuality and "brought to life" in adolescence as massive sex hormone secretions from testes, ovaries and adrenals, promote sexual readiness in female- and male-typical ways, under the guidance of differential brain chemistries, especially *oxytocin and vasopressin*. Since brain and bodily sex characteristics are independently organized, there are abundant opportunities for cross-gender role identities. Sensitive parents should find ways for children not to feel guilty about who they have become, to minimize diverse personality problems in adulthood.
5. The CARE/Maternal Nurturance System. Brain evolution insured that mammalian parents (usually mothers) take care of offspring enthusiastically and psychological "can-do" strength, that fathers can learn. Also, young children seem to have a natural affinity to exhibit nurturing behaviours, reflected in a love of animals and certain toys, like dolls. CARE arousal is surely important for some variants of love, and deserve to be nourished and cultivated in children.
6. The PANIC/Separation-Distress System. All young mammals depend on maternal care for survival. Mother's CARE systems synergize with children's emotional responses, especially intensely when they get lost – their separation cries promptly stir PANIC in mothers, motivating reunion. If separation-distress is sustained for too long, no matter what age, depressive affect is promoted. This affective network is regulated via brain *opioids*, oxytocin, and *prolactin* systems, which provide social comfort, promoting attachments formation. Without a secure neuro-affective base early in life, children tend to grow into insecure adults, who are more likely to have depression and various insecurity problems, such as borderline personality disorders.
7. The PLAY/Rough-and-Rumble, Physical Social-Engagement System. Young children, like most immature mammals, have robust urges for physical play, which naturally lead to chasing,

romping and wrestling, accompanied routinely by joyous shrieking and laughter. Social PLAY networks have been well-studied in animals, and they promote adaptive socialization, acquisition of many social skills not genetically coded within the brain. Social play can reduce adult irritability (RAGE) and promote pro-social attitudes via learning and epigenetic moldings of other emotional systems. This emotional power-house, closely linked to SEEKING, deserves cultivation and attention by parents and society in order to reduce mental health problems such as childhood ADHD and adult depression.

Conclusion and Implications

These basic emotional systems are intrinsic value systems that inform animals how they are faring in the quest to survive. They guide learning and maturation of cortical executive processes. The implications of such ancestral tools for living and learning have enormous implications for early child development.[6]

References

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