International Journal of Social Sciences
Citation: IJSS: **13**(02): 63-69, June 2024
DOI: 10.46852/2249-6637.02.2024.5

Review Paper

The Empathetic Eve: A Neurophilosophical Origin Story of Compassion

Curt Anderson

Department of Biological Sciences, Idaho State University, USA

Corresponding author: curtanderson@isu.edu (**ORCID ID:** 0000-0001-7249-9371)

Received: 12-03-2024 **Revised:** 06-05-2024 **Accepted:** 02-06-2024

ABSTRACT

Compassion is an evolutionary, moral force that is a necessary output of vertebrate evolution and that vertebrates, including humans, exhibit it as a result of suffering for oneself and others. It predates the Anthropocene, and is engrained in the emergent properties of the vertebrate brain, particularly through the evolution of the oxytocin pathway in the mesolimbic system. I suggest it can be cultivated and enhanced but is entrenched in our genetics and epigenetics as a response to help relieve suffering from oneself and others. Here, I present an origin story for the role of compassion across all species.

HIGHLIGHTS

- This proposes compassion is a phylogenetically basal condition that predates the Anthropocene, and prior to the vertebrates and basal to the invertebrates.
- There is a neurological basis for empathy and results in the output of the emergent properties of the brain.
- The concept of empathy and compassion as a theological component has independently evolved multiple times and not unique to humans.
- The Hippocratic Oath may well have been a preordained concept as a result of the evolution of the human brain.

Keywords: Compassion, oxytocin, evolution, neuroscience

> *No religion exists as a complete world unto itself. No person of faith is exempt from the powerful effects of the near presence of people of other ancient and new faith traditions. People of many faiths, evolving faiths, and seemingly no faith are our neighbors today, our colleagues and friends, our students. If we are to be Catholic today in a fully realized manner, we must be Catholic interreligiously; as theologians, we must also think interreligiously."*
>
> — **(Clooney, 2022).**

If we replace the word 'Catholic' with any chosen theological moniker, or better yet, replaced the word 'interreligiously' with the word compassion, we may be at the basis for an anthropological understanding of how the human mind was destined to evolve beneficence and caring. The origin story of the 'mind' is less relevant than the fundamental precept I propose exists as a primitive neural condition regardless of species. This suggests that caring for the survival of others predates the anthropological origins of theology, predates a 'higher being' and is the fundamentals of the evolution of the vertebrate brain.

How to cite this article: Anderson, C. (2024). The Empathetic Eve: A Neurophilosophical Origin Story of Compassion. *Int. J. Soc. Sci.*, **13**(02): 63-69.

Source of Support: None; **Conflict of Interest:** None

The compassion of medicine

Hippocrates of Kos (or Cos) is often considered the 'Father of Medicine', although history makes claims for Imhotep as being the 'God of Medicine' and the Greeks recognized Asclepiades as the 'hero and god of medicine'. None the less, Hippocrates spoke of healing as the work of a '*benevolent Nature*' (Bynum, 2001). While Galen took a good run at being a dominant influence on medical practice, his eventual non exemplary status and medical knowledge was replaced again with the ideology of the *Hippocratic corpus* and the philosophy of Hippocrates and his teachings. The Hippocratic Oath is still used by many medical schools across the world in various forms and refers to the causing no harm and penultimate beneficence.

> *"I swear by Apollo Physician, by Asclepius, by Health, by Panacea and by all the gods and goddesses, making them my witnesses, that I will carry out, according to my ability and judgment, this oath and this indenture."*

(Translated from the Hippocrates of Cos, Loeb Library, Harvard, 1923)

> *"Hippocrates, in the opening sentence of the oath, recognized the divine source of the power to heal… The sacredness of the oath, which involves the idea of a professional obligation, is indicated by his appealing to the gods by name as witnesses to his supreme purpose to hold aloft the highest standard."*

(AM Trawick in 1899 in front of the Tennessee State Medical Society).

I suggest the oath was preordained as a component of our genetic and epigenetic fundamentals, and our degree of compassion was a resultant experience of the necessity for compassion to uphold an evolutionary compulsion. I suggest that the neuronal reward system led human evolution into a sense of necessity and describe several examples of convergent evolution of vertebrates that requires the success of the species to have developed compassion. This proposed idea posits a global collective consciousness invoking into the community, the peoples, the nature, and the ecosystem.

Amongst this is the theory that the homologous mind encompasses a health care common origin story that is built around compassion. The term compassion is derived from the Latin origin '*com*' (with/together) and '*pati'* (to suffer); specifically, Latin for '*misericordia'*. Friccione (2011) argued that from the basal stem anapsids to the mammals, parental attachment and social engagement was an inevitable outcome of evolution, albeit from a Western Christian perspective. In other cases, it may be 'medicine for the heart', as in the Moroccan moving the spirit (the *ruh*) from the heart (*qalb*) to the body during the sanctity of prayer (MacPhee, 2003). Healing comes through prayer, not unlike a 'sickness of the heart' and through prayer comes self-compassion from the Quran. Nurse educators in Papua, New Guinea teach a '*biocommunicability*' through the invocation of ancestral 'relatives' to bridge the gap from the "hopeful synthesis between diverse indigenous cultures and the positive aspects of Western culture" (e.g. Christianity; Santos da Costa 2021; Andersen, 2023). Foucault compared this to "*the kind of relationship one ought to have with oneself"* (Foucault, 1985), and Jordan (2014) says concerning Foucault that '(religion is) *…an insistent example of speech with power over bodies"*. All of these are derivatives of caring for oneself and others.

The goal is not to skip a stone across a lake of philosophical, theological, or anthropological ideas of caring. It is to suggest that there is a common origin story, and that is in the emergent property of the human brain. Here I will present some basic pharmacology and neuroscience that compose what appears to be the origins of empathy and compassion, then a brief discussion of the philosophical origins of compassion with a brief introduction of three disparate views to illustrate a common origin.

The neuroscience of compassion

Most folks would argue that the reward system of the brain, or the mesolimbic system, is responsible for recognizing a desirable outcome (Lewis *et al.* 2021). Comprised of projections from the ventral tegmental area, the ventral striatum of the brain appears to play a prominent role in motivation and reward (e.g., Aosaki *et al.* 1994; Marche *et al.* 2017). Serotonin receptors in the ventral tegmentumand the mesolimbic pathway affects reward motivated behavior (Pratt *et al.* 2021) and

along with oxytocin are suggested to be combined as an important component of human affect and socialization (Bartz and Hollander, 2006; Heinrich and Domes, 2008).

Singer and Klimecki (2014) propose, during meditation, an increase in the 'compassion network', a group of primarily medial orbitofrontal cortex and striatum networks. This medial prefrontal cortex receives a direct connection from oxytocin onto receptors in this network suggests is produced in the hypothalamus and released from the posterior pituitary (Raam, 2020). This neurohypophysial hormone is ubiquitous amongst nearly all vertebrate groups and is found from lungfishes across to all anamniote groups, avians and mammals. I suggest this is the evolutionary and hormonal basis of compassion.

Oxytocin shows significant influence of the limbic system, particularly the amygdala (Landgraf and Neumann, 2004; Huber *et al.* 2005). Traditionally considered the 'hormone of pregnancy' by its role in lactation, milk ejection and uterine contraction, it has suggested for years to play a role in social organization within brain networks for motivation (for an excellent review, see Love, 2014, also, Rushworth *et al.* 2011; Baxter and Murray, 2002).

Originating from the paraventricular nucleus of the hypothalamus, Dale (1906) described oxytocin producing contractions of the uterus, spleen, the iris and internal anal sphincter from injections of what was originally identified as 'chrysotoxin', later '*our silly ergot extract*… (and*)' I am perilously near wild theorising*' (Dale, 1913). Paton and Watson (1912) identified it as a blood pressure lowering compound in birds and eventually it became 'oxytocin' from the Greek words meaning "swift birth." (Magon and Kalra, 2011, who referred to it as the 'love hormone' and the 'cuddle drug'). In a lovely symbiotic relationship, not only is oxytocin an evolutionarily conserved hormone (Akinrinade *et al.* 2023), but the gut microbe *Limosilactobacillusreuteri* 6475 promotes wound healing and social behavior in laboratory mice through oxytocin signaling (Poutahidis *et al.* 2013; Sgritta *et al.* 2019) and in fact is also suggested to be produced in the gut epithelium of mice, non-human primates and humans (Danho *et al.* 2023), promote 'emotional contagion' in zebrafish (Akinrinade, 2023; Ferreira, 2023) and Reddon and Swaney (2023) suggest that the basic mechanism for empathy is conserved among all vertebrates and is of an early evolutionary origin.

Few would argue that petting a friendly dog reduces 'stress' (however we define it, cognitively or physiologically) and the pharmacokinetics between a dog and owner are arguably difficult to ascertain (Marshall-Pescini *et al.* 2019), however, multiple studies have shown that pair bonding between mammals has been shown to suggest oxytocin plays a role in mother and infant bonding (Anaker and Beery, 2013; Coria-Avilia *et al.* 2014). I suggest that this also plays a role in patient-client relationships, whether in a pet owner or a human doctor-patient relationship and is engrained in our evolutionary origins and the inevitable foundation during the evolution of the nervous system. The revised Hippocratic oath of "*Above all, I must not play at God"*by Dr. Louis Lasagna in 1964 may just be at the root of the evolution of empathy and compassion.

A discussion of compassion

Charles Darwin referred to the origin of human nature and compassion in his 1871 text thusly: *…" This virtue [concern for lower animals], one of the noblest with which man is endowed, seems to arise incidentally from our sympathies becoming more tender and more widely diffused, until they extend to all sentient beings"* (abridged from Ekman, 2010). As an evolutionary biologist, I would argue vehemently against the term 'lower animals', as there are no such organisms in living systems, just animals who have retained primitive characteristics (wisdom teeth come to mind), however, compassion is a primitive characteristic that exists largely for the successful evolution of organisms. Darwin was not immune to the combining of compassion in medicine with the evolution of his concept of empathy. His father and grandfather (Erasmus Darwin, who defined the concept of the central pattern generator before the word synapse was born by Charles Sherrington in 1897) were both physicians and if it weren't for Thomas Huxley and Joseph Hooker, his colleagues and physicians, the 'Origin' might not have been published. Darwin admired Hooker as a friend to the point he wrote: '*But*

the truth is that I have so accustomed myself, partly from being quizzed by my non-naturalist relations, to expect opposition & even contempt, that I forgot for the moment that you are the one living soul from whom I have constantly received sympathy." (Darwin, 1858)

Goetz *et al.* (2010) suggests that compassion arose out of an evolutionary preponderance for reducing the suffering of offspring and thus is built in our genetic success. I suggest it also begins in the neuropharmacology of the brain. Oxytocin, while necessary for uterine contractions and milk ejection from the breast promotes pair bonding and a mechanism for reward in the mother (Thamer *et al.* 2011). This is a tremendous evolutionary promoter for the success of the species. Geangu *et al.* (2011) demonstrated that infants by the age of 6 months express and change in pupil diameter to positive and negative emotional experiences and is built in before the corticospinal tract is ready to produce walking. If Geotz's definition is correct, that compassion is a '*feeling that arises in witnessing another's suffering*' (see also, Lazarus, 1991), it existed extremely early on in development, and I suggest long before bipedalism became evolutionarily popular amongst Hominids. The Dalai Lamasuggests that *"The need to create and sustain complex social connections in child-rearing and other prehistory activities has seemingly given humans a predisposition for empathy, kindness, and compassion."* (Dalai Lama, 2023)

At risk of pretentiousness, I will humbly submit a very brief, quite likely incorrect, interpretation of three convergent origin stories. This is to suggest that empathy and medicinal practices is innate in the emergent properties of the evolution of the mammalian brain, in the fundamentals of Buddhism, the Navajo Diné and Indigenous health and wellbeing of the Aboriginal and Torres Strait Islander people. Together, I suggest that the tenement of compassion is of evolutionary origin.

A Buddhist philosophy

According to common folklore and from the Buddhist philosophy, following his enlightenment, Buddha's first sermon revolved around the 'Four Noble Truths'. This is a fundamental foundation of the many forms of Buddhism. To briefly paraphrase these (and there are many variations of this philosophy) are:

1. ***Dukkha***, not being at ease, searching for ideas and *the truth of suffering*
2. ***Samudaya***, searching for the cause, the origin, the recognition and *the truth of the cause of suffering*
3. ***Nirhodha***, searching for a cure for suffering and to not grasp the ephemeral hope that it does not really exist, but rather search for *the truth of the end of suffering*
4. ***Magga,*** searching for the path that frees us from suffering, and the philosophy of the Buddha who can provide the treatment and to live the doctrine and walk the path of health. *The truth of the path that frees us from suffering.*

Placed in a purely Western medicine philosophy, this is easy to relate to 2 and 3, but often the truth that one is suffering is a difficult task and the path to be free from both physical and spiritual health is seldom considered a part of standard pharmaceuticals. None the less, a search for a 'cure' is an important path to wellness.

A Diné philosophy

The Hózhó is a wellness philosophy and spiritual belief system of the Diné (Navajo) people, a set of principles that guides through thoughts, actions, behaviors and speech (Kahn-John, 2015). This approach has been applied to the a 'complex wellness philosophy' as an attempt to integrate Western medicine into indigenous wisdom.

Hózhó has been described as "*everything that a Navajo thinks as good—that is good as opposed to evil, favorable to man as opposed to unfavorable or doubtful*." (Wyman and Haile, 1970). To briefly and paraphrase, it could be thought of as:

1. Soft spoken, intelligent listeners with respect and yearning for elder knowledge (acceptance of seeking higher knowledge and the presence of where one is).
   - ❖ Human beings are whole systems integrated into organism of the cohort.
2. Appreciation for the discipline of self-study, planning for the future and a willing to search

(knowledge of the path and searching for the path to the truth).

- ❖ Human being can recognize the capacity for health and well-being.

3. Understanding of truth that combines the family, clan, tribe, community as the cure and to seek these in combination with all living creatures and nature.
   - ❖ Nature has restorative powers that can cure.
4. The truth of the path that frees us from suffering.
   - ❖ Relationship with self is viewed as most critical, requiring full understanding of the sacred nature of the collective body-mind-spirit.

The common truth, again, is a search for wellness for oneself, others, and a compassion for all living beings.

The 'Dreaming' philosophy

In 1899, the anthropologists Spencer and Gillen wrote of the aboriginal people of Australia as having relationship with all things and of their fundamental religious tenant, whether medicinal or socially was giving, as the '*status comes from sharing*' (Grieves, 2022). The relationship with their ancestors was to express ties to the land and to the others that share it, acquire knowledge from the ancestors and pass on this knowledge for human and non-human health for all plants and animals and a '*faithful sacred obligation to kin*' (Spencer and Gillen, 1899).

In 2017, the Commonwealth of Australia produced report on the national consultations concerning the cultural determinants of Indigenous people's health. In this report, it encompasses 'culture at the center of change', along with environmental health, individual wellbeing and "*Practising culture can involve a living relationship with ancestors, the spiritual dimension of existence, and connection to Country and language. Individual and community control over their physical environment, dignity and self-esteem, respect for Aboriginal and Torres Strait Islander people's rights and a perception of just and fair treatment are also important to social and emotional wellbeing".*

CONCLUSION

Three distinct, rather disparate ideals of human health. All evoke empathy and compassion, and all involve societal influences as an important component to health. All place the individual within a communal structure and compassion is at the anchor. Is it engrained as part of our evolution? These are but a few relatively random selections with obvious analogous, but convergent philosophies of compassion I suggest make the argument that are neurophilosophically homologous.

Descartes argues in 1641 in 'Meditations on the First Philosophy' "*if the soul and the body are two substances whose nature is different, this prevents them from being able to act on each other".* I suggest that the mind is an emergent product of the body. For example, Descartes argued that the pineal gland is the seat of the soul for '*no other animal has one' and 'no other animals possess a soul'.* Every vertebrate animal has a pineal and it is rather anthropocentric to assume humans are the only ones gifted with a 'soul'. Statuary of the Buddha show a 'third eye' (a key to beauty and enlightenment) slightly cranial to the bilateral eyes as do paintings of the Egyptian sun god Rah. All reptiles and amphibians have a parietal for amina in their skull directly cranial to the bilateral eyes. None of these groups to my knowledge had the slightest idea that the pineal gland (that projects into the foramina through the pineal stalk) is light sensitive and drives circadian rhythms, but these groups independently evolved the 'third eye' concept of enlightenment and beauty. A 'first mind' origin story? The concept of 'beauty' is not a scientific term, it is one of perception and thus ethereal in the 'mind' and is one of the wonderful problems with consciousness theory.

The mind is likely a result of the physical combinations of emergent properties of the brain, and the output of the brain is impossible to ultimately understand because of a fundamental first order problem of physical constraints. The emergent properties are malleable and subject to evolution, but the various philosophies are homologous in origin. I suggest it is engrained in our evolution, likely through the properties driven

by a physicalistic origin through mechanisms yet to be elucidated by the evolution of the hypophysial-pituitary axis, and our anthropological origins of compassion are neurologically originated.

Maybe Descartes was right. Maybe it is, '*cogito, ergo sum'*. However, I prefer, '*Ego sum, ergo misereor'*. 'I am, therefore I have compassion'.

REFERENCES

Aboriginal and Torres Strait Islander Mental Health and Suicide Prevention Advisory Group, 2016. *National Strategic Framework for Aboriginal and Torres Strait Islander Peoples' Mental Health and Social and Emotional Well-being 2017-2023* Commonwealth of Australia.

Anacker, A.M.J. and Beery, A.K. 2013. Life in groups: The roles of oxytocin in mammalian sociality. *Front. Behav. Neurosci.,* **7**: 185.

Andersen, B.A. 2023. Compassion or Corruption? Temporalities of Care and Nationhood in Papua New Guinean Nursing Education. *Med. Anthropol. Q.,* **37**: 42-58.

Akinrinade, I., Kareklas, K., Teles, M.C., Reis, T.K., Gliksberg, M., Petri, G., Levkowitz, G. and Oliveira, R.F. 2013. Evolutionarily conserved role of oxytocin in social fear contagion in zebrafish. *Science,* **379**(6638): 1232-1237.

Baxter, M.G. and Murray, E.A. 2002. The amygdala and reward. *Nat. Rev. Neurosci.,* **3**: 563–73.

Bartz, J.A. and Hollander E. Horm. 2006. The neuroscience of affiliation: forging links between basic and clinical research on neuropeptides and social behavior. *Behav.,* **50**(4): 518-28.

Bynum, W. 2001. Nature's helping hand. *Nature,* **414**: 21.

Chatzigiagkos, A., Alm, E.J. and Erdman, S.E. 2013. Microbial symbionts accelerate wound healing via the neuropeptide hormone oxytocin. *PloS One*, **8**(10).

Clooney, F.X. 2022. *Being Catholic Interreligiously*. https://hds.harvard.edu/news/2022/07/18/being-catholic-interreligiously (retreived Dec 10, 2023)

Commonwealth of Australia, Department of Health, 2017. *My Life My Lead - Opportunities for strengthening approaches to the social determinants and cultural determinants of Indigenous health: Report on the national consultations*.

Coria-Avila, G.A., Manzo, J., Garcia, L.I., Carrillo, P., Miquel, M. and Pfaus, J.G. 2014. Neurobiology of social attachments. *Neurosci. Biobehav. Rev.*, **43**: 173-82.

Dalai Lama (retrieved 2023). Compassion and Wellbeing: Evidence. The Centre for Compassion. https://www.dlccoxford.org/cbct

Dale, H.H. 1906. On some physiological actions of ergot. *The J. of Physiology,* **34**: 163–206.

Dale, H.H to Elliott, T.R. 1913. *GC/42*, Wellcome Library, London.

Danhof, H.A., Lee, J., Thapa, A., Britton, R.A. and Di Rienzi, S.C. 2003. Microbial stimulation of oxytocin release from the intestinal epithelium via secretin signaling. *Gut. Microbes.,* **15**(2).

Darwin, C. 1858 '*Darwin Correspondence Project'*. Letter to JD Hooker. Retrieved 25 November 2023. https://www.darwinproject.ac.uk/letter/DCP-LETT-2345.xml

Ekman, P. 2010. Darwin's Compassionate View of Human Nature. *JAMA.*, **303**(6): 557–558.

Ferreira, J. 2023. Key role for oxytocin in emotional contagion. *Lab Anim (NY)*, **52**(5): 101.

Fricchione, G. 2011. *Compassion and healing in medicine and society: on the nature and use of attachment solutions to separation challenges* Baltimore : Johns Hopkins University Press.

Foucault, M. 1985.*Volume 2 of the History of Sexuality*. New York: Vintage Books. Random House. Ch.1-3.

Geangu, E., Hauf, P., Bhardwaj, R. and Bentz, W. 2011. Infant pupil diameter changes in response to others' positive and negative emotions. *PLoS One,* **6**(11): Article e27132.

Gimpl, G. and Fahrenholz, F. 2001. The oxytocin receptor system: structure, function and regulation. *Phys. Rev.,* **81**(2): 629-683.

Grieves, V. 2002. *Aboriginal physiology*. Retrieved 10 Dec 2023 https://downloads.newcastle.edu.au/library/cultural%20collections/awaba/culture/wisdom

Heinrichs, M. and Domes, G. 2008. Neuropeptides and social behaviour: effects of oxytocin and vasopressin in humans. *Prog. Brain Res.,* **170**: 337-50.

Hicks, R.D. 1925. Extracted from Diogenes Laertius, *Lives of Eminent Philosophers*, trans. R. Hicks, vol. 2. Retrieved 10 Dec 2023 https://lexundria.com/epic_ep_pyth/0-33/hks

Hippocrates of Cos, *The Oath.* Retrieved 25 November 2023https://www.loebclassics.com/view/hippocrates_cos-oath/1923/pb_LCL147.299.xml

Jordan, M. 2014.https://stanfordpress.typepad.com/blog/2014/11/looking-for-religion-in-foucault.html

Rainer, L. and and Neumann, I.D. 2004. Vasopressin and oxytocin release within the brain: a dynamic concept of multiple and variable modes of neuropeptide communication, *Front. in Neuroendocrinology*, **25**(3–4): 150-176.

Lazarus, R.S. 1991. *Emotion and adaptation.* Oxford University Press.

Love, T.M. 2014. Oxytocin, motivation and the role of dopamine. *Pharmacol. Biochem. Behav.*, **119**: 49-60..

MacPhee, M. 2003. *Medicine for the Heart: The Embodiment of Faith in Morocco Medical Anthropology*, Taylor & Francis, NY.

Magon, N. and Kalra, S. 2011. *The orgasmic history of oxytocin: Love, lust, and labor*. *Indian J. Endocrinol. Metab.,* Suppl 3(Suppl3): S156-61.

Marshall-Pescini, S., Schaebs, F.S., Gaugg, A., Meinert, A., Deschner, T. and Range, F. 2019. The Role of Oxytocin in the Dog-Owner Relationship. *Animals (Basel),* **9**(10): 792.

Paton, D.N. and Watson, A. 1912. The actions of pituitrin, adrenalin and barium on the circulation of the bird. *J. Physiol.,* **44**: 413–24.

Petersen, M.A., Smith, M., Brogaard, D. and Hoeyer, K 2022. Subject in the Making: Technologies of the Self and Aspirations for a Good Life in Contemporary Denmark, *Med. Anthro.,* **41**(4): 431-445.

Poutahidis, T., Kearney, S.M., Levkovich, T., Qi, P., Varian, B.J., Lakritz, J.R., Ibrahim, Y.M.,

Sgritta, M., Dooling, S.W., Buffington, S.A., Momin, E.N., Francis, M.B., Britton, R.A. and Costa-Mattioli, M. 2002. Mechanisms underlying microbial-mediated changes in social behavior in mouse models of autism spectrum disorder. *Neuron.*, **101**(2): 246–259.

Pratt, W.E., Vaca-Tricerri, R., Blanchard, R.C., Thomas, R. Hopkins, and Ying, R. 2021.

Selective serotonin receptor stimulation of the ventral tegmentum differentially affects appetitive motivation for sugar on a progressive ratio schedule of reinforcement. *Behav. Brain Res.,* **403**: 113139.

Raam, T. 2020. Oxytocin-Sensitive Neurons in Prefrontal Cortex Gate Social Recognition Memory. *J. of Neuroscience,* **40**(6): 1194-1196.

Reddon, A.R. and Swaney, W.T. 2023. *Fellowship of the fin: Fish empathy and oxytocin*. Learn Behav. doi: 10.3758/s13420-023-00593-1. Epub ahead of print.

Rienzi, R. 2023. Microbial stimulation of oxytocin release from the intestinal epithelium viasecretin signaling, *Gut. Microbes.,* **15**: 2.

Rushworth, M.F., Noonan, M.P., Boorman, E.D., Walton, M.E. and Behrens, T.E. 200. Frontal cortex and reward-guided learning and decision-making. *Neuron.,* **70**: 1054–69.

Spencer, B. and Gillen, F.J. 1899. *The Native Tribes of Central Australia.* McMillan and Co., NY (ret 10 Dec). from: https://archive.org/details/nativetribescen01gillgoog/page/n5/mode/2up)

Tharner, A., Luijk, M.P., Raat, H., IJzendoorn, M.H., Bakermans-Kranenburg, M.J. Moll, H.A. *et al.* 2012. Breastfeeding and its relation to maternal sensitivity and infant attachment. *J of Developmental & Behavioral Pediatrics*, **33**(5): 396–404.