General theory of love //outline

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- Brain
    - Reptilian
        - Low level functions: breathing, heartbeat, swallowing, etc
        - Function is involuntary
        - If it is offline = you're dead //human - yes, person - no
        - No emotional processing features //reptiles have no emotions
    - Limbic
        - Limbus = edge //Latin
        - Function is involuntary
        - Structure = hippocampus, amygdala, septum, cingulate gyrus, perirhinal, perihipocampal
        - Mammals have an orientation towards offspring (care, protection, etc). In contrast, reptiles have none (lay egg and move on, watch how one of your kind dies and feel nothing, etc)
            - Separation cry
            - Play
        - Input
            - External: vision, smell, sound
            - Internal: body temperature, blood pressure, heart rate, digestive process
        - The limbic brain processes these streams of input and tweaks physiology, to optimize the body for the current state of the outside world
        - Effects
            - Visible instantly: sweating, breathing, heart rate
            - Long lasting and subtle: endocrine system changes, metabolism, immunity
            - It also sends feedback to the neocortex (i.e. some of it input comes from the limbic brain), influencing: tone of speech, strategic operations, action planning
            - Face muscles - the only muscles in the body that are connected directly to the skin; controlled by the limbic brain, with practically no "filtering" at other layers - therefore controlling facial expressions is very difficult/impossible (at least not out of the box, at least not without training)
    - Neocortex (Latin = bark),
        - Humans = their neocortex is the largest of the three parts
        - Function is voluntary
        - Readiness wave = neuro-activity that precedes an action (ex: before you move an arm, a readiness wave indicates that a motion is about to take place)
        - It can be seen as the source of "will"
        - Motor, visual, audio - damage one, and a corresponding feature is offline/buggy
        - Tasks - abstraction, future planning, writing, language, symbols parsing, etc
        - "Skill points" are reusable; ex: better visualizing of what-ifs = improve rock-throwing skills, as well as improve chess skill. This is a mega-feature!
        - Neocortic cells have a different structure and composition, and are more advanced than the ones in the limbic and reptilian brain - so the separation is not arbitrary.
        - Neocortex's activity is regulated by the paralimbic area, from which it evolved. Therefore, emotional life can be influenced, but not commanded.
        - The notion of words and symbols exists only in the neocortex; poetry and various flavours of art are "best effort" attempts to express feelings, but they represent just subsets or approximations, because there is no 1:1 mapping between what happens in the other areas and our vocabulary. [unless you know many words and can express subtle differences - this is very hard]

    - Modularity
        - Remove neocortex of a hamster - she can still take care of her offspring
        - Remove/damage limbic area - ignore presence of peers, take their food, no play
        - Remove reptilian brain - death

    - Emotions
        - the root of everything we do, ex:
            - Fear, shame, disgust, guilt - keep distance in society
            - Fascination, passion, devotion - stay closer to other people
            - Greed, ambition - economics
            - Vengefulness, reverence - justice
        - Bias towards praising logic and analysis vs intuition and feeling - because intellect gave us many things, offers a quick ROI.
            - Humans tend to associate importance with durability (since we're tool-making animals, we have this bias). Since emotions spawn quickly and fade quickly as well - they are perceived [incorrectly] as unimportant.
        - Emotions offer enhanced survival features
        - Universal
            - intraspecies - humans use the same emotions, they can be identified regardless of culture, race, education, age, sex, etc. As long as the limbic brain is online, one can correctly parse emotions.
            - Interspecies - mammals also have limbic brains, they can manifest emotions that can be read by humans (and vice versa).
        - Hardcoded - a blind baby (who has never seen a face) will smile when interacting

- pleasurably with their mother
  - Animals (mammals) feel too - they have a developed limbic brain. Reptiles don't, since they don't have the right hardware.
  - Fear is probably the oldest emotion - avoid trouble, run away when in danger.
  - Disgust - another oldie, avoid gelatinous blobs that smell bad or look yucky :-)
  - Some emotions require neocortical abstraction, so only humans have them (ex: the beauty of a formula, FOSS zealots, religion, appreciating elegance of an API, etc)
  - Feeling - when a neural excitation exceeds a certain threshold
  - Mood - a persisting background feeling
  - Irritable mood - residual feeling, the result of being irritated a while ago (consciously you're over it, but it keeps running in a background process). If something happens when you're in this state, the threshold of excitation is reached much easier, because of the residual feeling.
    Further, the neocortex can replay scenes in our mind without actually having the action take place - thus the limbic brain's wiring for a certain feeling can be fed with input even after the real stimuli is gone.
  - Extreme cases - depression, manic depression; the brain stays locked in a state for a long period of time. Getting it unstuck is difficult/impossible
  - Inborn emotionality is undeniable
    - □ Some babies are criers, others are placid
    - □ Some reach for new toys, others shrink away
    - □ Some are easy to sooth, others are inconsolable
  - The reptilian brain's high level features determine the type of temperament (i.e. reptilian brain's primitive emotional features are the foundation upon which the high-level emotional features are developed)
  - Worry - the reptilian brain sets the default value to "average"
    - □ Modern culture idealizes heroes whose worry is nonexistent (Bruce Willis, Arnold Schwarzenegger :-)
    - □ Many of our low-anxiety ancestors were bitten by snakes and fell of trees :-) Their deaths shifted the gene pool towards higher degrees of trepidation.
    - □ Children with reduced levels of *worry* are more likely to become criminals; criminality is partially heritable
    - □ Anxiety deters people from high-risk acts.
    - □ The result of the mixture of some genes from the pool is that some people are at the extremes.
    - □ Will cannot undo temperament
    - □ But it can influence it
  - All mammals have dreams during sleep. Echidnas are the only mammals that do not have dreams, but they have all the other features provided by the limbic brain's hardware
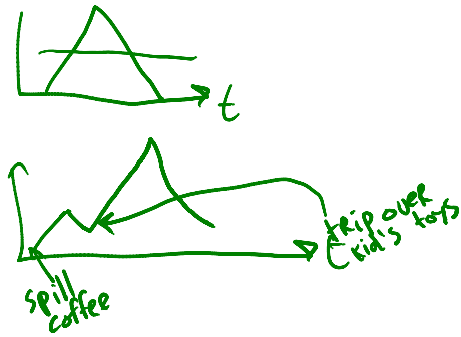
  - Asperger's syndrome (Hans Asperger, Vienne, 1940) - cannot parse other people's emotions, have troubles expressing their own.

- ○ Language
  - Prosodia - add emotional charge to symbolic representations
  - Aprosodia - poorly implemented or absent prosodia
  - Left temporal cortex
    - □ Wernicke - speech to symbols and thoughts; damage in this area renders one unable to understand what others are telling them.
      - ◆ But they can express themselves without a problem
      - ◆ If a message is passed to them in a different form (ex: text), they can parse it
    - □ Broca - thoughts to speech; damage to this area makes a person unable to talk
      - ◆ But they can understand what others are telling them
  - Right temporal cortex
    - □ Emotional speech parser - damage to this area makes a person unable to understand the emotional metadata attached to speech //"thanks dad :-(" vs "thanks dad! :-)"
    - □ Emotional speech generator - if damaged, they cannot deliver emotional nuances
  - Email is a serious source of aprosodia, but people try to compensate that with smilies ;-)

- ○ Babies have an intrinsic appetite for faces
  - Look longer at novel objects, look less at familiar ones
  - Babies just a few days old can distinguish emotional expressions
  - *Visual cliff* experiment - when unsure, the baby checks mom's facial expression and decides whether to continue crawling [over the edge, on transparent glass] or not. If mom looks worried - they don't do it; if mom looks confident and happy - they go for it.
  - Realtime feedback - babies feel comfortable when interacting with their mothers via video-cameras and screens; since communication is realtime, they can observe mom's reaction to their actions. If they are shown just a pic of their mother (i.e. non-interactive static picture), or a video recording (dynamic, but still non-interactive) - they are distracted
  - They are good at this because their limbic brains contain innate knowledge, which is inter-human and inter-mammal compatible.
  - The limbic brain enables us to analyze the internal state of other mammals.
  - Limbic resonance - two mammals sync their states. For example, a reptile (with no limbic brain) will see a threat and run away. A mammal, on the other hand, will also pass this info along to their peers - thus helping the others escape too. [this is why looking in someone's eyes gives us pretty good info about their internal state]
  - Absence of limbic resonance is disturbing for a mammal. Try looking in the eyes of a

[handwritten diagram, top right: a curve over axis labeled "t"; a second curve with labels "spill coffee" and "trip over kid's toys"]

crocodile or a shark - you won't see anything :-)
- Due to limbic resonance, feelings are contagious, while ideas [produced by the neocortex] are not. Don't be surprised if a high-tech idea generated by one person is not instantly understood by those around them.
- Movie theaters are a more joyful experience, not because of the screen or the better sound, but because of the *crowd* around - which acts as a catalyst in limbic resonance.

Attachment theory - it applies to humans and mammals; the nature of the parent-child bond affects how the child will behave in their future relationships
- *Insecure avoidant* - A bond produces distress if the mother is absent when the child is frightened or in pain; later - mom's absence leaves them indifferent, they ignore her upon return.
- *Secure* - stable bonds are developed if mom is always there, providing feedback reliably and consistently; later - mom's absence makes them upset, but they are instantly joyful when she returns;
- *Insecure ambivalent* - inconsistent and unpredictable maternal behaviour makes babies clutch to their mothers when they are together; in mom's absence the baby gets very lonely, remaining inconsolable after their reunion.
- Mom's presence is necessary because children cannot objectively evaluate what happens to them. For example, if a baby fell on the grass, it will look at mom's reaction - if she is calm, it means that everything is OK; if she is worried, then something went wrong. The point is that the baby's pain-sensors are not properly calibrated, they can't figure out whether what happened is good news or bad news. If mom is not around to evaluate, they will be anxious.

Separation and reactions to it
- *Protest* - short; explore the surroundings, examine the faces of those who are around, look for familiar objects, etc.
  - Increased motor activity
  - Increased vocalization
  - Heart rate++
  - Body temperature++
  - Catecholamines++, increase alertness, be more vigilent
  - Coristol++, stress hormone //ex: stare at the ceiling while(1)
  The protest is over as soon as you're reunited.
- *Despair* - long; protests morph into despair, given enough time
  - Decreased
    - □ Motor activity
    - □ Socialization
    - □ Play
    - □ Vocalization
    - □ Food/water intake
    - □ Heart rate--
    - □ Body temperature--
    - □ Body weight--
    - □ Growth hormone--
    - □ O2 consumption--
    - □ REM sleep--
    - □ Cellular immunity--
  - Increased
    - □ Sleep arousal
    - □ Irregular heartbeat
  - Generic
    - □ Slouched posture
    - □ Sad facial expression
- Mom's presence control's the baby's biofunctions;
- There is a strong correlation between different maternal regulators and parameters of the infant system. Table from page#82]
- Therefore replacing the mother doesn't really do the trick; ex: if you keep the baby warm using a radiator, or provide milk via an automatic mechanism - some parameters will be normal, while others will continue to be messed up.
- When separated, older children lose their stability more slowly; adults - even slower.

Limbic regulation - synchronize with the limbic system of another person.
A human body operates like an open loop, i.e. its behaviour is affected not only by internal states, but also by external factors and the states of the systems it interacts with. [teoria sistemelor :-]

- Babies rely heavily on limbic regulation, outsourcing many decision-making points to their mothers
  - Breathing bear vs static Winnie-Pooh experiment
  - Mom's presence reference in the previous point
- With time babies learn how to internally deal with many scenarios, thus the reliance on external factors is reduced
- However, humans are social animals and they require a source of stabilization outside of themselves

- This is a consequence of the *open-loop* design
  - People cannot be stable on their own.
  - Not should or should not, but *cannot*.
- Our society promotes individualism, but total self-sufficiency is in contradiction with the architecture of our core system
- Stability means finding people who regulate you well and staying with them.

Isolation syndrome
- Monkeys raised alone cannot socialize with normal ones, being consistently rejected
- They are unable to mate
- Artificially impregnated females are indifferent to their offspring
- Ordinary monkeys break off a conflict after dominance was settled, while those grown in isolation usually fight to their death
- Self-mutilation usually happens with those who grew in isolation (bite their own arms, hit head against wall...)

The point is that a mammal brain is *not preprogrammed*, so without limbic regulation at the right time - neurodevelopment is incoherent

Neurotransmitters
- *Serotonin* - anti-depressant; for some people it can reduce the pain of loss
- *Opiates* - pain reliever
  - Self-inflicted wounds - sometimes people harm themselves (razor cuts, cigarette burns, etc) to cause the body to release opiates. This alleviates not only physical-layer pain, but also logical-layer pain
  - The limbic brain has more opium receptors than any other brain area
- *Oxytocin* - attachment
  - More of it - stronger attachment
  - Less - weaker attachment, more sexual promiscuity
  - Oxytocin levels rise dramatically when women are about to give birth

Memory
- TODO Korsakoff's syndrome - living only in "now" ??
- Explicit - conscious reflection
- Implicit - ex: the guy who thought he could not knit, but he could - it was in his muscle memory; he was simply unaware of it //Korsakoff's syndrome
  - This memory relies on low-level patterns that we are able to identify in various objects even if we do not understand them, ex:
    - Korinawa, hitoko, mitaki, Toyama Tokanawa - these sound like Japanese
    - Flitch, vlas and ptak - certainly not Japanese
    - Flachmatuch - sounds German
  - In the same fashion, the trained mind identifies improperly formed phrases or errors in calculations

- Interactions from childhood, attachment styles and other things influence our view on relationships. The knowledge is not explicit, but implicit. This can make us people who are confident and trust others, or people who think that love will always be outside of our reach.

Neural networks - the model was proposed by Donald Hebb
- Memories are made by strengthening the links between neurons that fire together
- A network that fires will also excite related networks, which usually fire along with it
- The excitement is propagated to other related networks :-)
- Inhibitive signals - a neural network will excite related neighbors and suppress the neighbors that are not related to it [logically]
- *Attractor* - a generic pattern that overwhelms the weaker patterns, allowing you to determine that some input means X, rather than something else. This deals with
  - Ambiguity
  - New patterns that were not dealt with before, but which can be detected by relying solely on past experience
- Attractors make it easy to read handwriting - it is different for each person, but the patterns are identifiable, even if that specific handwriting was never seen by you in the past
- Attractors make proofreading difficult, because our brain does its best to see the big picture, replacing *taht* with *that* on-the-fly
- Attractors help us see things that are not there, ex:
  - Kanisza triangle
  - The cat
- *Emotional attractor* - same thing, but used within the limbic brain; they are derived from emotional experience
- This is how sometimes in dealing with [new] people , we react emotionally as if we have met them in the past [and apply some stereotypes]. This distorts our judgment; any system that applies Hebbian processing behaves that way - it compresses experiences into compact neural-patterns; collisions are bound to happen (just like with hashes:-)
- Emotional attractors can influence the people around us, via limbic resonance (ex: act clumsily in the presence of an older sibling, even if you're an adult)
- Continuous exposure to one's limbic attractors activates and strengthens the same patterns within us, thus longstanding togetherness updates our internal states [rather permanently]

THE CAT

- *Limbic revision* - the power to update certain parts of the people we love [via repeated exposure to new attractors]. Progress is made in small increments and instant results are not to be expected.
- Who we are and what we become, partially depends on whom we love.

- Neural networks - they give you something at the output, but after that you cannot obtain meaningful details about the process itself, you can't know *why* the result is as it is.

- *Sympathetic reverberation* —when a certain emotion occurs, it will wake up distant memories attached to the same emotion; behaviour similar to that of neural networks.
  - Cheerful people automatically remember moments of joy
  - Depressed people - incidents of loss or despair
  - Severely depressed people's positive emotions can be suppressed by negative ones

- Good mothering can override a disadvantageous temperament
- Poor mothering can be detrimental too: infants of depressed mothers have a 4x probability to die (SIDS - sudden infant death syndrome, Mitchell et al, 1992)
- Proper limbic training is very important in the development of a baby
- Children of emotionally stable limbic parents are resilient to various run-time exceptions of life

- Attachment is not a critic
  - a child loves the mother's face, whether she is pretty or not
  - A child prefers the emotional patterns of their family, regardless of their objective merit, they become a prototype
  - The better the patterns of a potential mate match that prototype, the better the relationship will feel
- A relationship that deviates from one's prototype is the equivalent of limbic isolation. Loneliness outweighs most types of pain
- People prefer misery with a partner that matches the prototype, rather than a relationship with a better partner [their attachment mechanisms cannot detect]

  Happy relationships are a function of
  - Attachment
  - Implicit memory
  - Strong attractors

- Limbic attractors formed in childhood can be of various flavours, not just with mom and dad, but also with siblings, neighbors, nannies, etc.
- Children from multi-child families can form the impression that there is not enough X [love, wealth, happiness, resources] for everyone, so if you want something - you MUST take it ASAP.
- If parents with many children are advised to let the children resolve the disputes themselves [like in the real world] - children observe that justice is weak and that model will be applied elsewhere (ex: school playground)
- With age, emotional learning does not stop, but it slows down [since well-defined patterns are already established]; new lessons have to "battle" the old ones [that are supported by strong attractors].

  Limbic revision - revising old attractors by repeated exposure to new ones.