

Health and Psychopathology

- Pathology
- Pathogen
- Lactoferrin
- Defenses
- Virulence
- Maternal-fetal conflict
- Theory of mind

What is Pathology?

- Pathology is a dysfunctional state of an organism or a part thereof, compromising normal, adaptive, evolved functioning.
- The prototype is a *fracture*: a structure is broken, and it therefore cannot do what it was designed by selection to do.

Whose adaptations may harm us?

- Predators
- Pathogens & Parasites
- Infectious agents like TB, syphilis
- Other people
 - Allies with imperfectly consonant interests
 - maternal-fetal "conflict"
 - mates who shirk
 - Antagonists with no shared interests
 - competitors
 - psychopaths
 - exploiters, e.g. thieves and rapists

Causes of Disease

- Defenses
- Infection
- Novel Environments
- Genes
- Design Compromises
- Evolutionary Legacies

Defenses

- Coughing
- Sneezing
- Fever
- Iron "deficiency"
- Pregnancy sickness
- Some pathogens exploit defenses in order to spread

Fever

- When lizards are infected with pathogens, they will move along a temperature gradient to keep their body temperature about 2 degrees Celsius warmer than normal.
- Body temperature is still regulated during fever, rats placed in a too-warm room will use cooling mechanisms to lower their body temperature to fever level.

Iron Deficiency

- Doctors used to give iron supplements to patients with infection because they had anemia.
- Human milk protein is 20% lactoferrin, an iron-binding molecule. Cow milk has only 2%. Breast-fed babies have fewer infections than bottle-fed babies.
- Lactoferrin is concentrated in tears, saliva and at wounds.
- Leukocyte endogenous mediator sequesters iron during infection. Iron absorption by the gut decreases. Even food preferences may change.

More Evidence

- Zulu men drink beer from iron pots and have frequent amoebic infections.
- Masai seldom (<10%) have amoebic infections, but when given iron supplements, 88% of Masai soon developed an amoebic infection.
- A group of Somali nomads given iron supplements had a 38% infection rate, compared to 8% in a non-supplemented group.

Defenses Against Infection

- Hygiene to prevent contact
- Skin as a barrier
- Pain and malaise
- Expulsion
 - Sneezing, coughing, urination, diarrhea, vomiting, menstruation?
- Immune system
- Repair mechanisms
 - selection has caused repair according to how useful it would have been in the EEA

Pathogens' Counter-Defenses

- Pathogens in sheep's clothing
 - Rabies mimics neurotransmitters
 - Cowpox mimics hormones
- Changing disguises
 - The trypanosome that causes African sleeping sickness has over 1000 different antigenic coats and changes every 9 days. It takes about 10 days to build up antibodies.
- Disguise as the host

Other Pathogen Adaptations

- Attack host defenses (HIV)
- Manipulate host behaviour
 - Rabies
 - Ants on grass eaten by sheep
 - Snails on rocks eaten by birds
- Dispersal and virulence

The Evolution of Virulence

- Virulence is the harmfulness of a pathogen.
- Some pathogens have very severe effects (smallpox, AIDS, malaria) whereas others only produce mild effects (common cold virus).
- Ewald (1993) argued that there are 3 main evolutionary reasons for these differing levels of virulence.
 - Mode of transmission
 - Survivability
 - Human behaviours

Mode of Transmission

- If a host's illness impairs transmission, then the parasite should evolve to have milder effects so that the host can move around.
- If the host's disability does not inhibit transmission then pathogens could evolve greater virulence.
- For example, rhinoviruses that cause the common cold are easily spread by sneezing and so they do not disable their hosts.
- When a pathogen is transported by a vector (an organism that transmits an infectious agent like a mosquito) it can disable the host and still spread easily.
- It thus can be highly virulent to the victim but not to the vector (e.g. malaria, yellow fever, typhus).

Survivability

- There are exceptions to the previous rule when a pathogen can survive for long periods outside of the host.
- For example the smallpox virus can live for 10 years in the environment and is particularly virile.

Human Behaviours

- Human activities influence virulence. When drinking water systems were created this enabled pathogens to spread more easily.
- They could increase in virulence as the immobility of their host had little importance to their survival.
- Cholera epidemics in India in the 1950's and 1960's were drastically reduced when the water supplies were purified - a less virulent form of cholera overtook the more virulent type.
- In nearby Bangladesh where water supplies were not purified, the most virulent form of cholera out-reproduced the less virulent form.

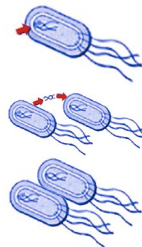
Human Behaviours

- Hospitals may create cultural vectors by adopting poor hygiene.
- Such vectors create increasing virulence in the form of antibiotic-resistant bacteria.
- Around 1 in 20 hospitalised patients in the USA acquire an infection before leaving hospital, and this leads to 4 million infections and thousands of deaths.
- Increasing sexual partners created highly virulent forms of HIV but as sexual practices became safer, HIV has become less virulent.

Antibiotic Resistant Bacteria

Bacteria can acquire genes for resistance in three ways:

1. Mutation - drug-resistant tuberculosis
2. Transformation - penicillin-resistant gonorrhoea
3. Plasmids - Shigella in Guatemala



How to Stop Antibiotic-Resistance

- Take ALL of your antibiotics
- Use "narrow-spectrum" antibiotics
- Use common antibiotics first
- Improve infection control in hospitals
- Use new drugs with different antimicrobial mechanisms
- Reduce widespread use in farm animals and agriculture
- Reduce unnecessary household use

Novel Environments

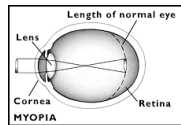
- We don't eat what we evolved to eat
 - Excess - fat, sugar and refined carbohydrates
 - Inadequacy - vitamins and minerals
- Addictions
 - We did not have as many or as refined addictive substances in the past.
- Our social lives are vastly different
 - Modern patterns of work
 - Living away from family

Wisdom Teeth

- Many people can not keep their wisdom teeth because of inadequate jaw space
- Exercise causes bone growth
- Our modern diet does not include as many difficult-to-chew foods

Myopia

- Myopia (nearsightedness) is a result of the eyeball growing too long.
- Myopia is highly heritable and fairly common (25%) in modern societies
- Myopia is almost non-existent in hunter-gatherer societies.
- Myopia is a result of both modern environment and genetic susceptibility



Myopia

- In an Inuit population in Alaska, only 1% of people had myopia in the early 1900's.
- By the 1950's, nearly half the people were myopic.
- This coincided with the introduction of lighting, reading and television.

Why are there Harmful Genes?

- Interaction with novel environments
 - Myopia
 - High blood pressure in African Americans?
- Heterozygote advantage
 - Sickle-cell anemia and malaria
 - Tay-Sachs and tuberculosis
- Mutations
 - Gene influencing muscular dystrophy is very large
- Late effects
 - Huntington's disease

Reducing Miscarriage

- The miscarriage rate is estimated to be from 60 to 90% of all fertilized eggs.
- Childhood-onset diabetes is caused by a gene called DR3.
- If only one parent has one copy of DR3, what proportion of offspring should have the allele?
- 66% of babies in such a situation have DR3, indicating that it reduces miscarriages.

Design Compromises and Evolutionary Legacies

- We can not begin over, adaptations are built upon the existing organism.
- Choking would be eliminated by putting the nostrils in the neck.
- The “blind-spot” is not a problem for squid because their eyes evolved differently.
- The female pelvis is used for both walking and birthing.

Maternal-Fetal Conflict

- Disease can happen because of the arms-race between people and pathogens.
- There is also an arms race between mothers and fetuses.
- If the fetus’ needs conflict with the mother’s, even by a small amount, the conditions are set for an arms-race.

Maintenance of Pregnancy

- Human chorionic gonadotropin (hGC) is required to maintain pregnancy
- Embryos start to secrete hCG even before implantation
- The placenta takes over later
- Fetuses with an ability to increase their chance of gestation will be selected for
- Mothers who terminate the gestation of a poor quality fetus will be selected for

Gestational Diabetes

- Mothers decrease their fasting blood glucose levels in early pregnancy and increase insulin production in later pregnancy
- Fetuses secrete human placental lactogen, which increases insulin resistance
- If the fetus’ response is too extreme or the mother can not produce enough insulin, she show signs of diabetes

Pre-eclampsia

- Pre-eclampsia occurs in the second half of pregnancy
- Symptoms are high blood pressure, swelling and proteinurea
- The fetus “wants” more blood than the mother “wants” to give, so the fetus has adaptations to raise maternal blood pressure
- Pre-eclampsia is associated with poor attachment of the placenta

Psychopathologies

- Many psychopathologies can be understood as:
 - Functioning of a normal adaptation in an abnormal environment
 - Defect of a “module”
 - Extreme of a polygenic adaptive trait

Anxiety

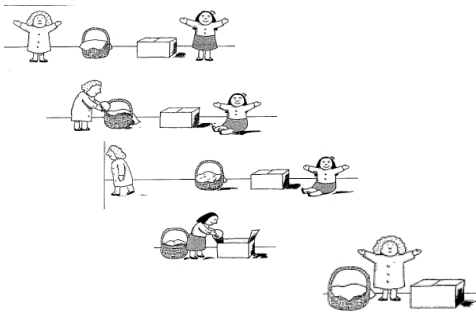
- Anxiety is adaptive in many contexts
- Guppies experiment
 - Timid - 40%
 - Ordinary - 15%
 - Bold - 0%
- Anxiety disorders
- Hypophobics
- What might be the consequences of widespread use of anti-anxiety drugs?

Classic Symptoms of Autism

- social and communication skills impoverished
- apparent lack of social awareness
- prefer to do solitary activities
- child's play lacks pretense
- Are these people lacking an ability to understand the perspective of another person?
- They do understand that others have desires and goals.
- They do correctly interpret the direction of eye gaze.
- They do not seem to appreciate shared attention: they don't show things to others or point to direct another's attention to something, although they do point, etc., to get others to do something for them.
- They do not seem to model others' mental representations.

(Baron-Cohen 1996)

The Sally-Ann Test



Postpartum Depression (PPD)

- Minor PPD is *relatively common*, transitory, and not severe.
- Major PPD is *rare*, longer-lasting and severe.
- Psychosis with hallucinations & delusions is *very rare*.
- Symptoms: Depressed mood, lack of interest in any activities, major change in weight, insomnia or hypersomnia, fatigue, inability to concentrate, recurrent thoughts of death.
- Have thoughts and anxieties about harming their child, less responsive to infant cues, less emotionally engaged.
- Reliable correlates of PPD:
 - Marital problems and lack of social support
 - Infant problems including pregnancy and delivery problems
 - Prior history of depression or emotional problems

(Hagen 1999)

Depression

- Some theorists have posited that depression functions to stop someone from continuing on a futile course of action
- Primates who lose a status contest often show symptoms resembling depression