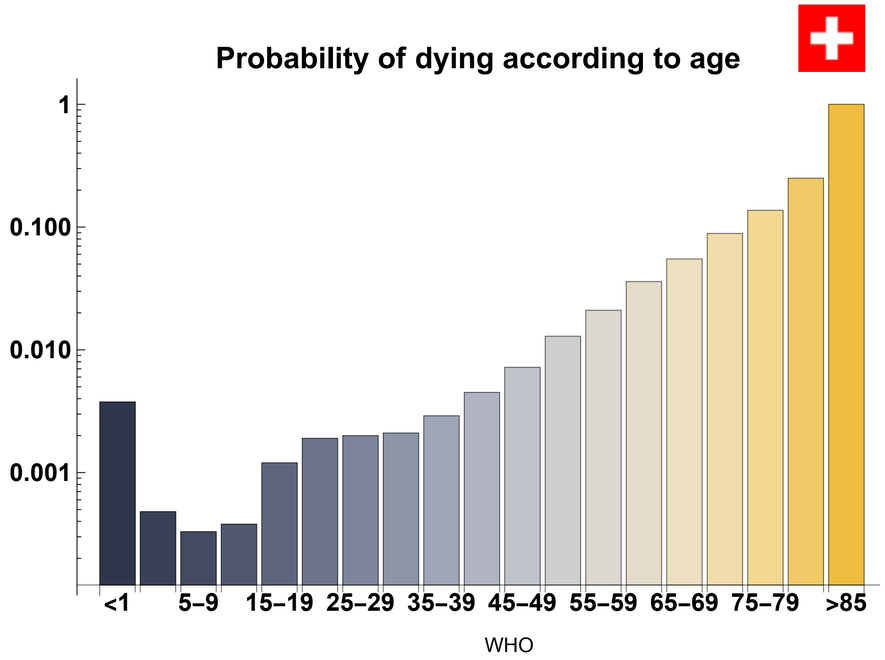
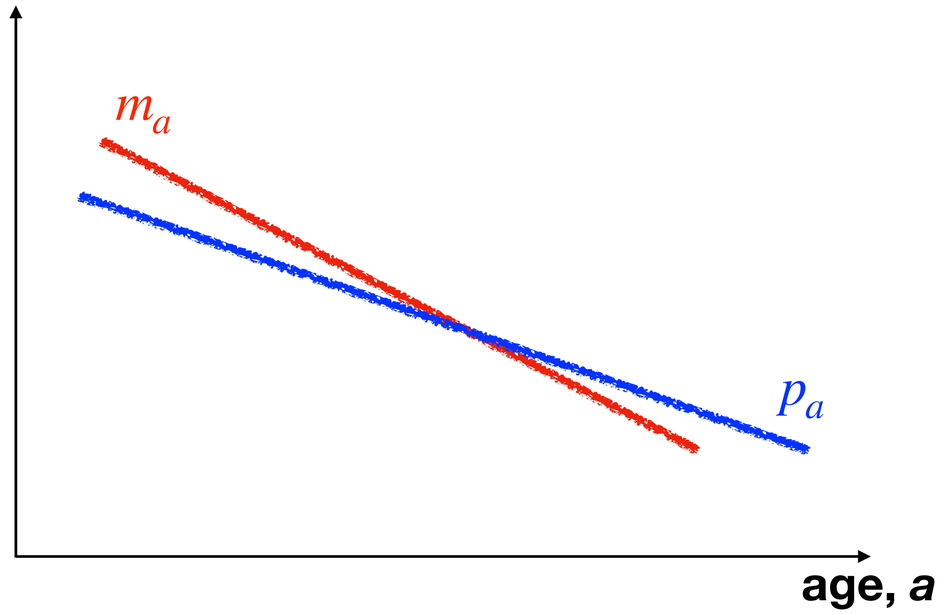
Evolution of ageing

Recap on ageing

- Gradual deterioration of function.
- Decrease in survival rate and/or fecundity with age.





Strength of selection on age specific traits

Hamilton 1966

$$R_0(y,x) = \sum_{a=1}^{\infty} l_a(y,x) m_a(y,x)$$

$$l_a(y,x) = p_0(y,x) p_1(y,x) \ldots p_{a-1}(y,x)$$

$$s(x) = \left. \frac{\partial R_0(y,x)}{\partial y} \right|_{y=x}$$

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reproductive value of age *a*, i.e. expected number of offspring given survival till age *a*

$$= \quad v_{a+1}(x) = \sum_{b=a+1}^{\infty} \frac{l_b(x)}{l_{a+1}(x)} m_b(x)$$

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selection on survival proportional to reproductive value

Strength of selection decreases with age

Gray squirrel exemple (with fecundity scaled so that $R_0 = 1$)

Age *a* (years)	p_a	m_a	f_a
0	0.25		
1	0.46	1.15	0.32
2	0.77	2.05	0.57
3	0.65	2.05	0.57
4	0.67	2.05	0.57
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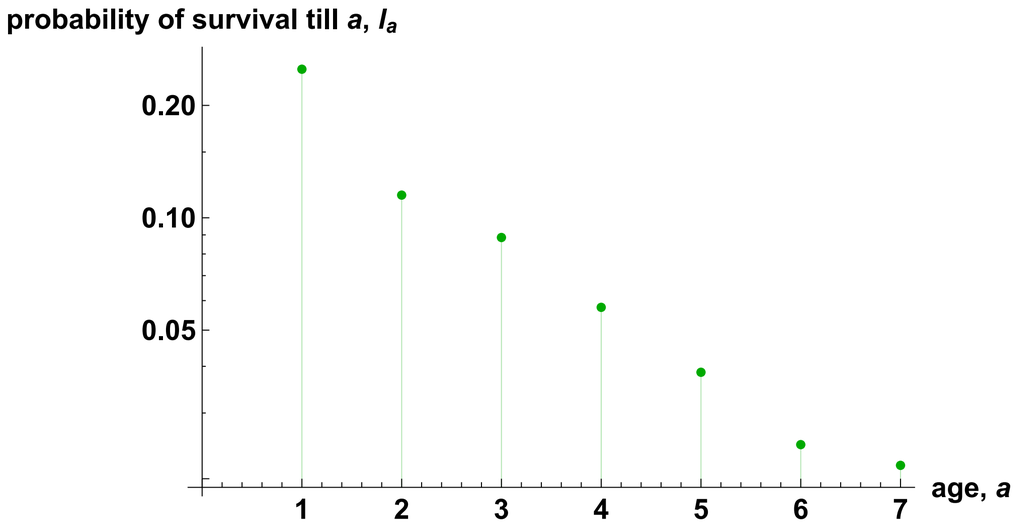

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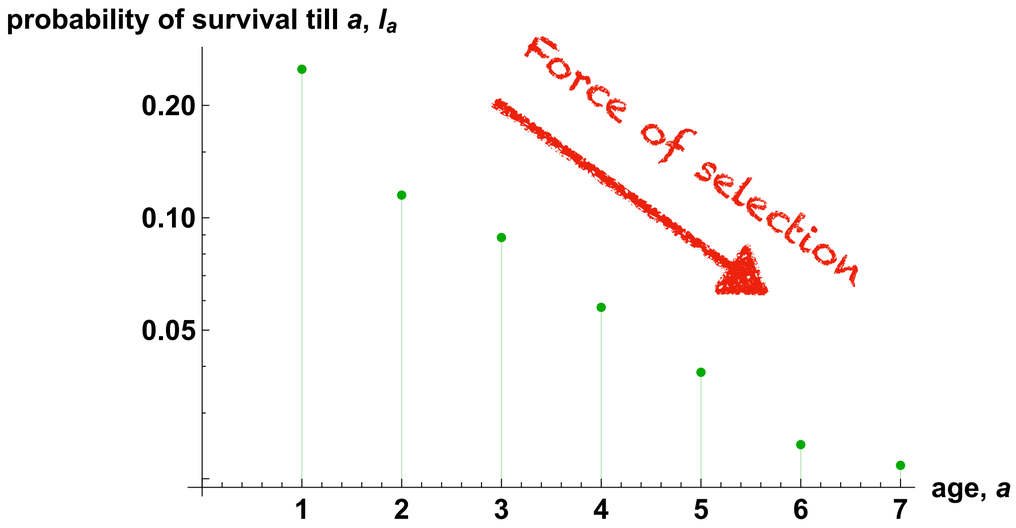

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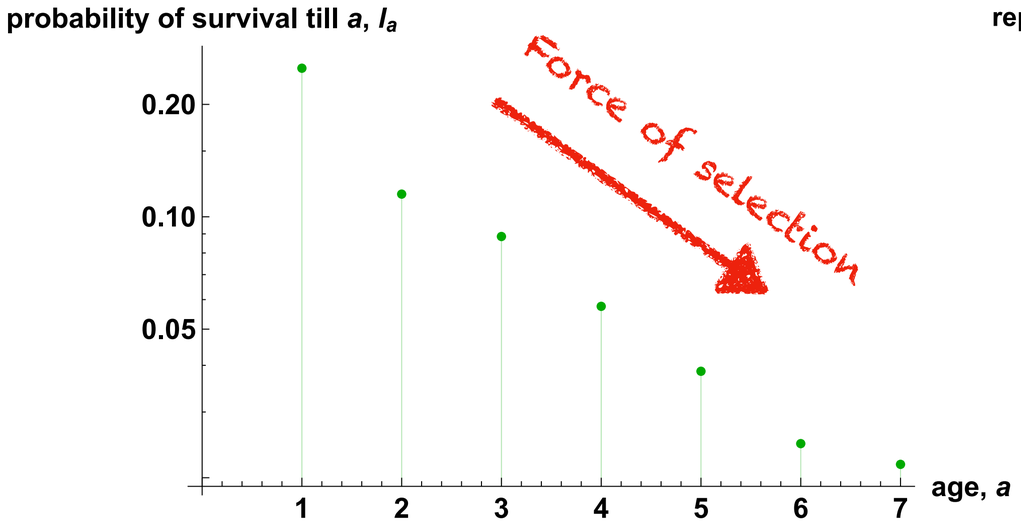
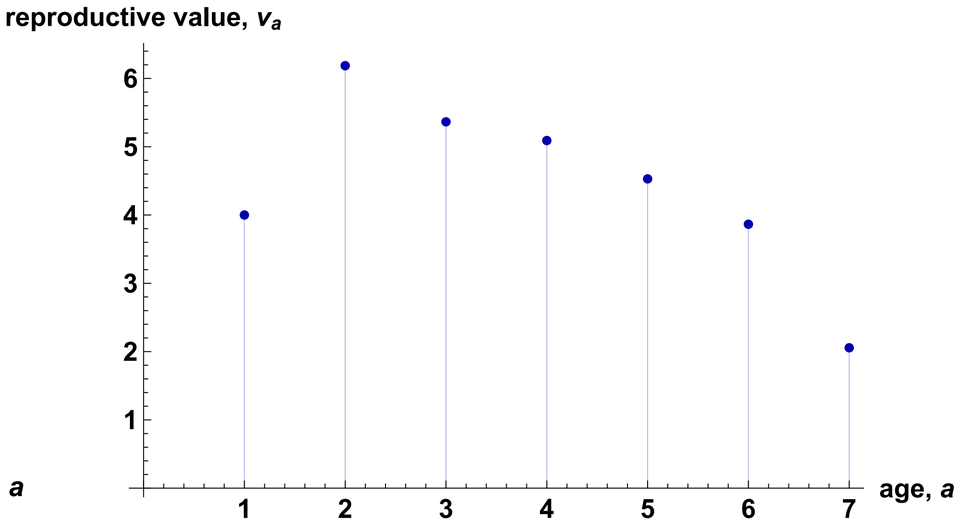




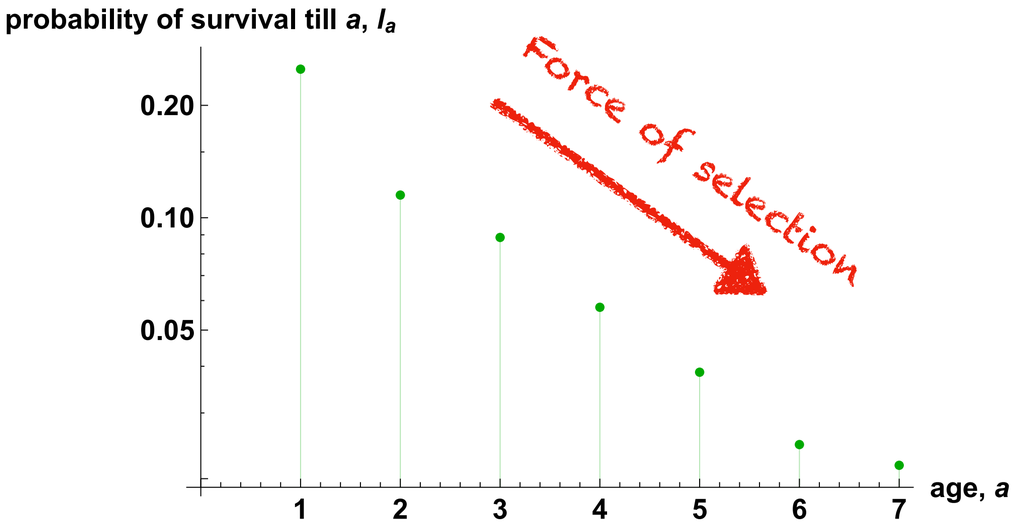
selection on fecundity decreases with age

selection on survival biased towards ages with greatest perspective of reproduction

Mutation accumulation

Medawar 1952

- Deleterious, late-acting mutations accumulate with little resistance as selection weakens with age of action.
- Causes a reduction in vital rates with age.



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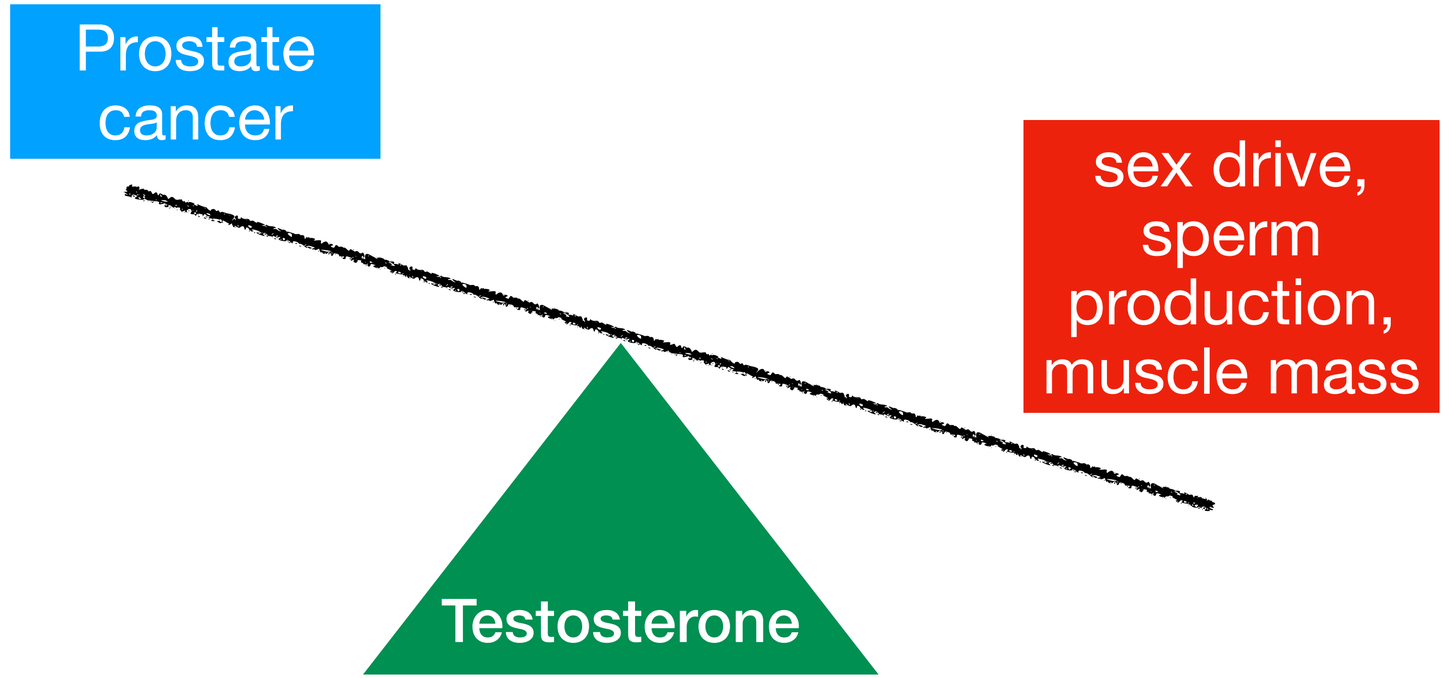

Disposable soma theory

Kirkwood 1977

- A mechanism for trade-off and antagonistic pleiotropy.

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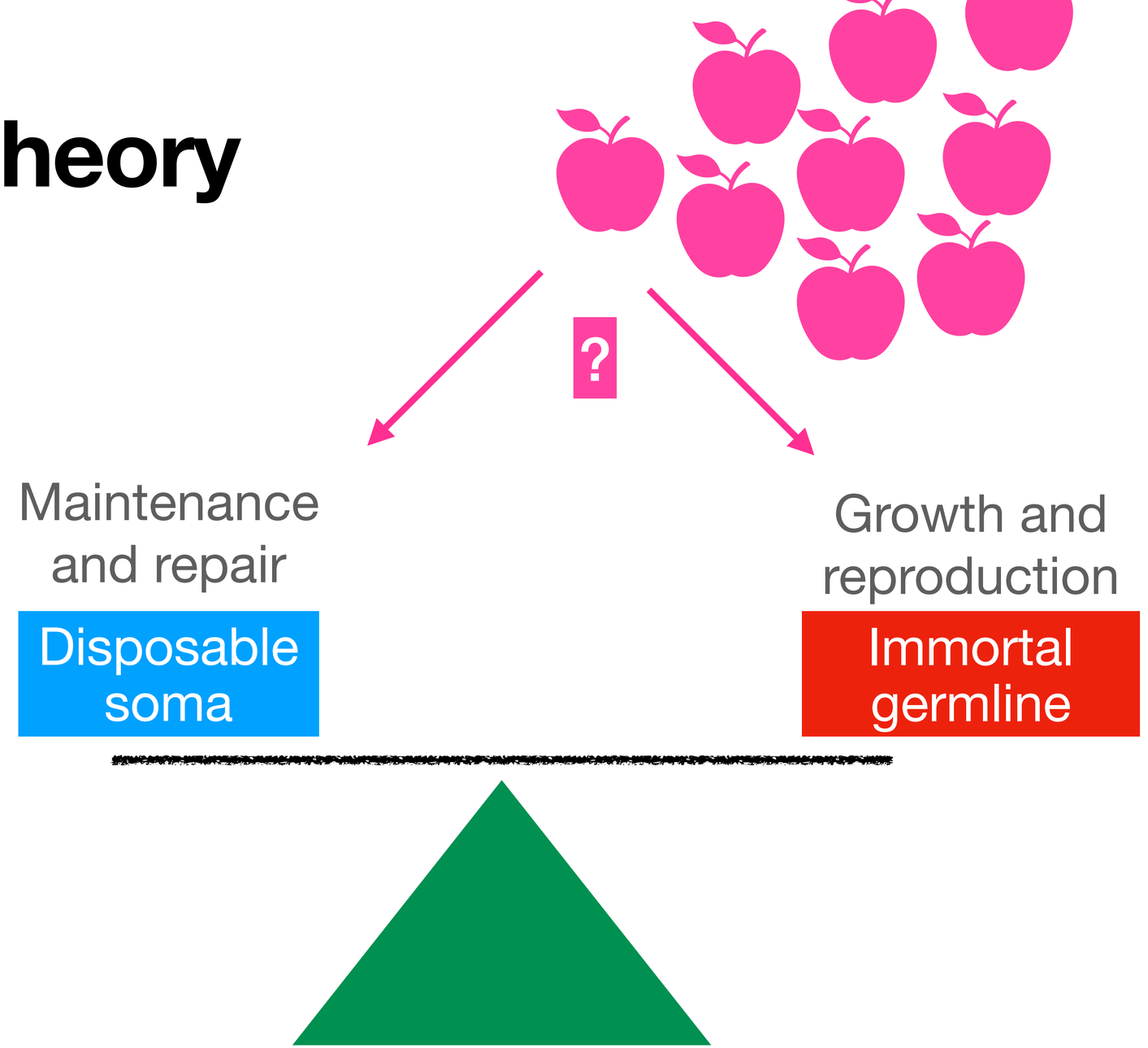

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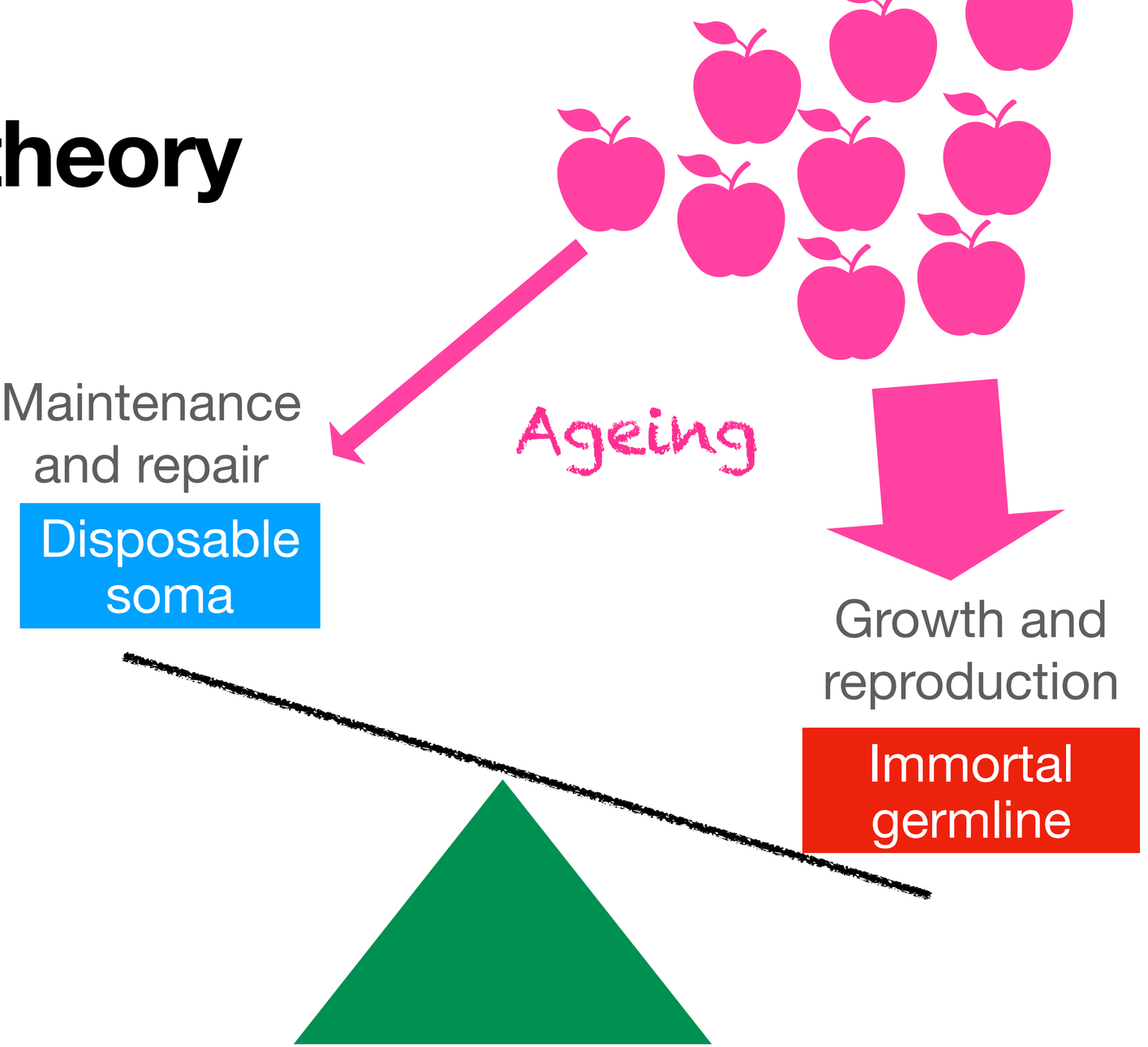

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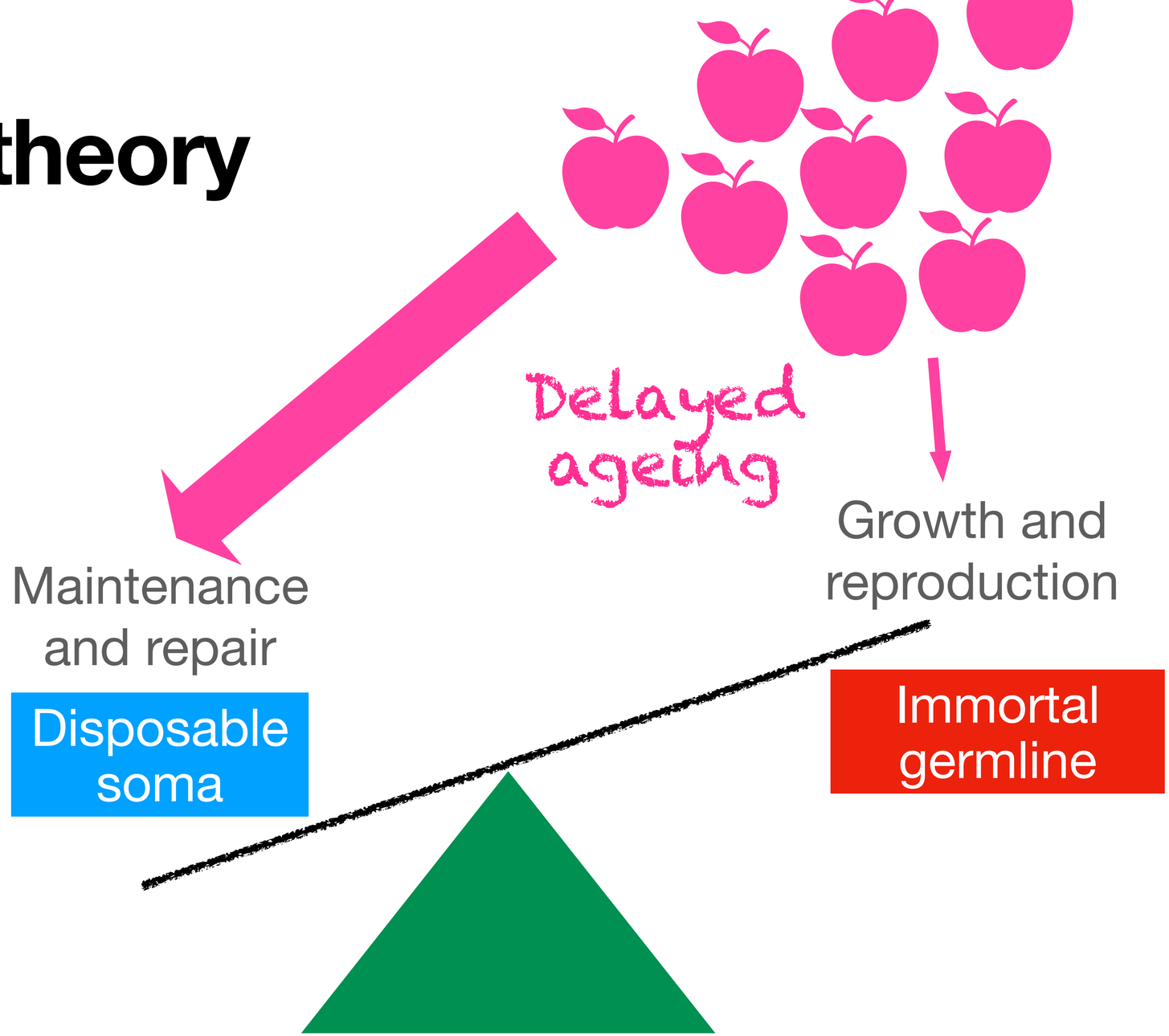

Summary

- Strength of selection on traits with age-specific effects declines with age (proportional to probability of surviving till relevant age)
- Selection on traits influencing age-specific survival also proportional to reproductive value
- Two non-exclusive theories for ageing:
  - Mutation accumulation (selection too weak to purge detrimental mutations with late effects)
  - Antagonistic pleiotropy (favours early effects at the expense of later effects)