Lecture Handout 10

Relative risk (or "risk ratio" or "odds ratio" or RR): Relative risk is the ratio of the probability of an event occurring in a group exposed to an agent versus the risk of the event occurring in a non-exposed group.

For example, RR of getting a disease with one genotype versus another.

Relaxing the genetic assumptions:

Multiple alleles: basic selection model extended from 2 alleles.

Allele frequencies may not change monotonically; eg if one favorable allele is dominant and another favorable allele is recessive

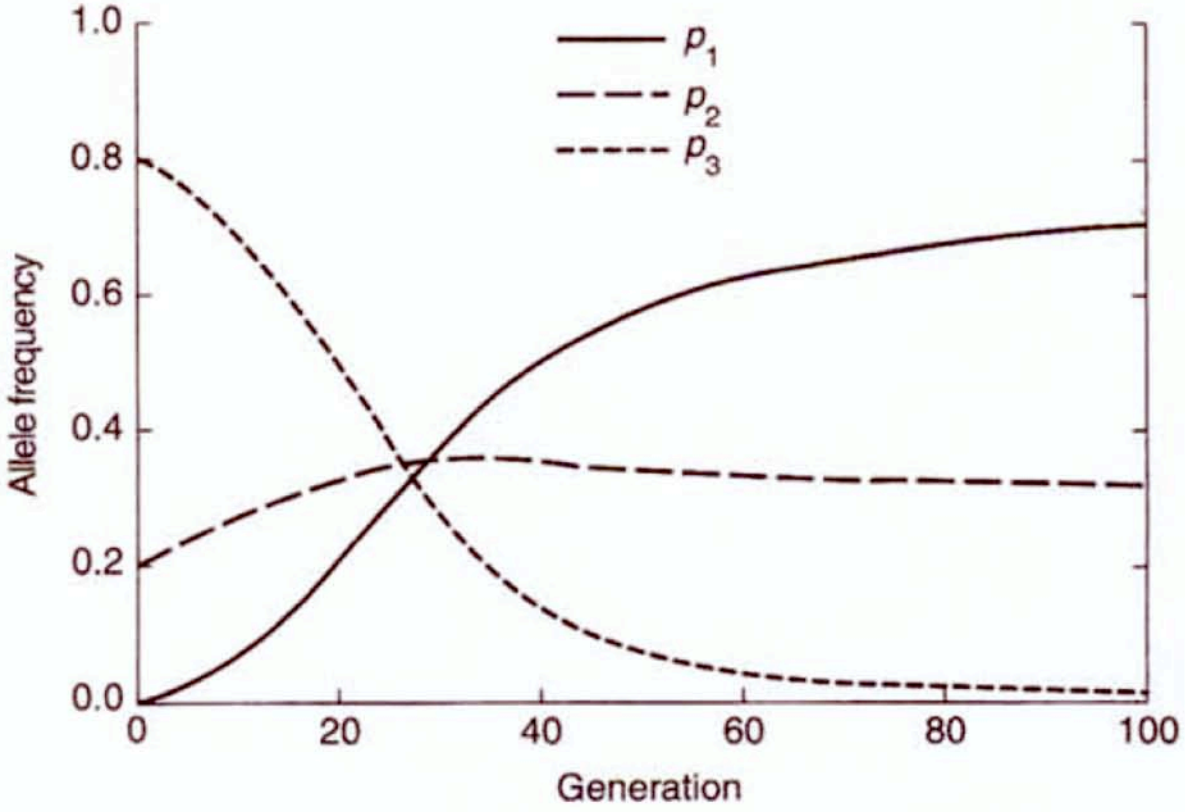


Figure 3.11. The change in allele frequency over time for a three-allele situation where both A_1 with a frequency of p_1 and A_2 with a frequency of p_2 are favorable alleles, but A_1 is dominant and A_2 is recessive to A_3 (row a of Table 3.16).

Relaxing the genetic assumptions:

X-linked genes or genes in haplo-diploid organisms

Lethal X-linked alleles: among adults, only females will carry the lethal allele as heterozygote X_1X_2. Hemizygous adult males cannot be X_2. Frequency of X_1X_2 females is reduced by half each generation.

X-linked genes or genes in haplo-diploid organisms

TABLE 3.17 Different fitness arrays used as examples of selection for X-linked or haplo-diploid genes.

	Females			*Males*	
Fitness arrays	A_1A_1	A_1A_2	A_2A_2	A_1	A_2
(a)	w_{11}	w_{12}	w_{22}	w_1	w_2
(b)	1	1	$1-s_f$	1	$1-s_m$
(c)	$1-s_1$	1	$1-s_2$	$1+s_m$	$1-s_m$
(d)	1.5	1.0	0.5	0.5	1.5

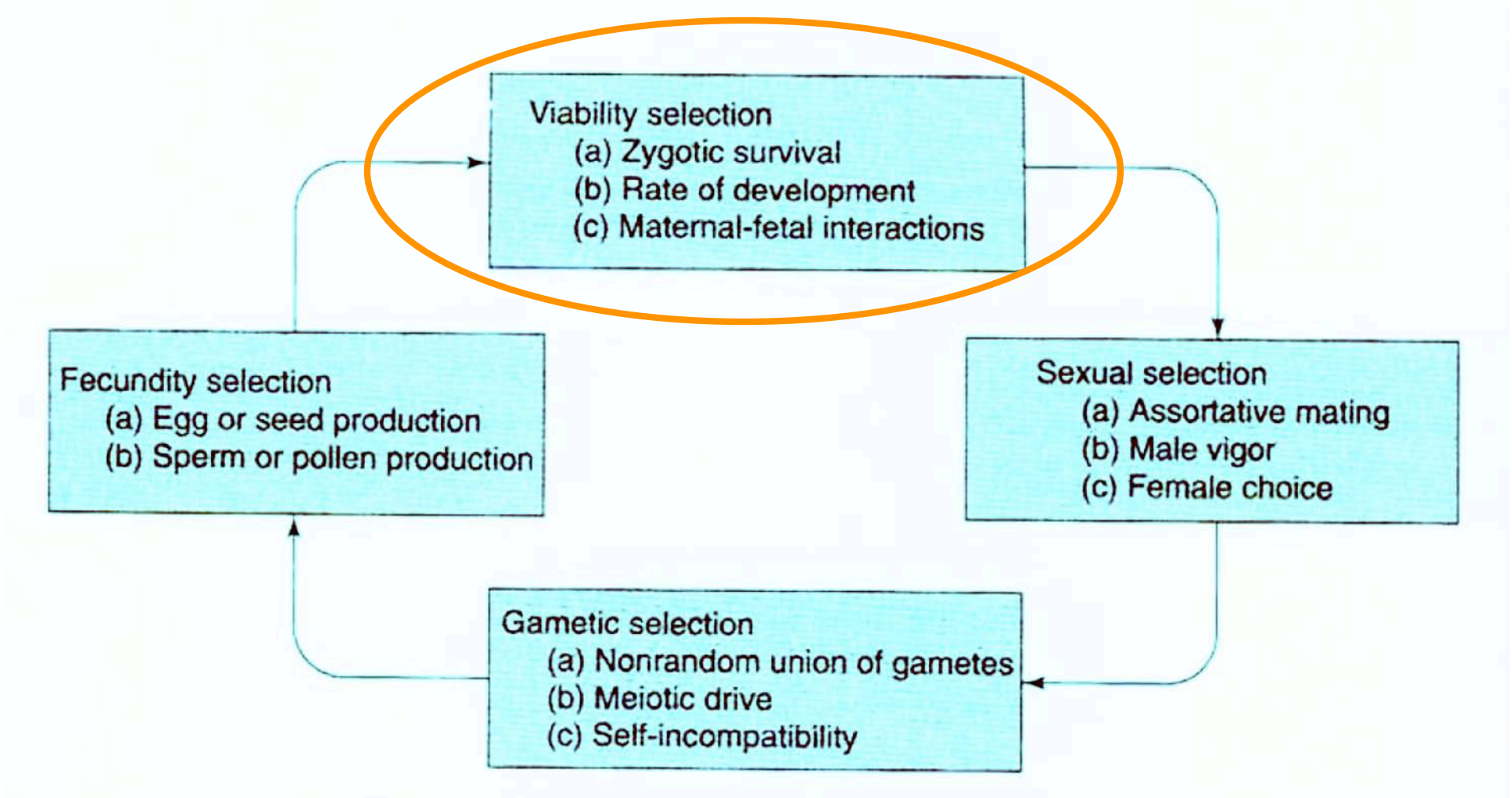
Selection: advanced topics (ch4)

Total amount of selection may be divided into four **fitness components**:

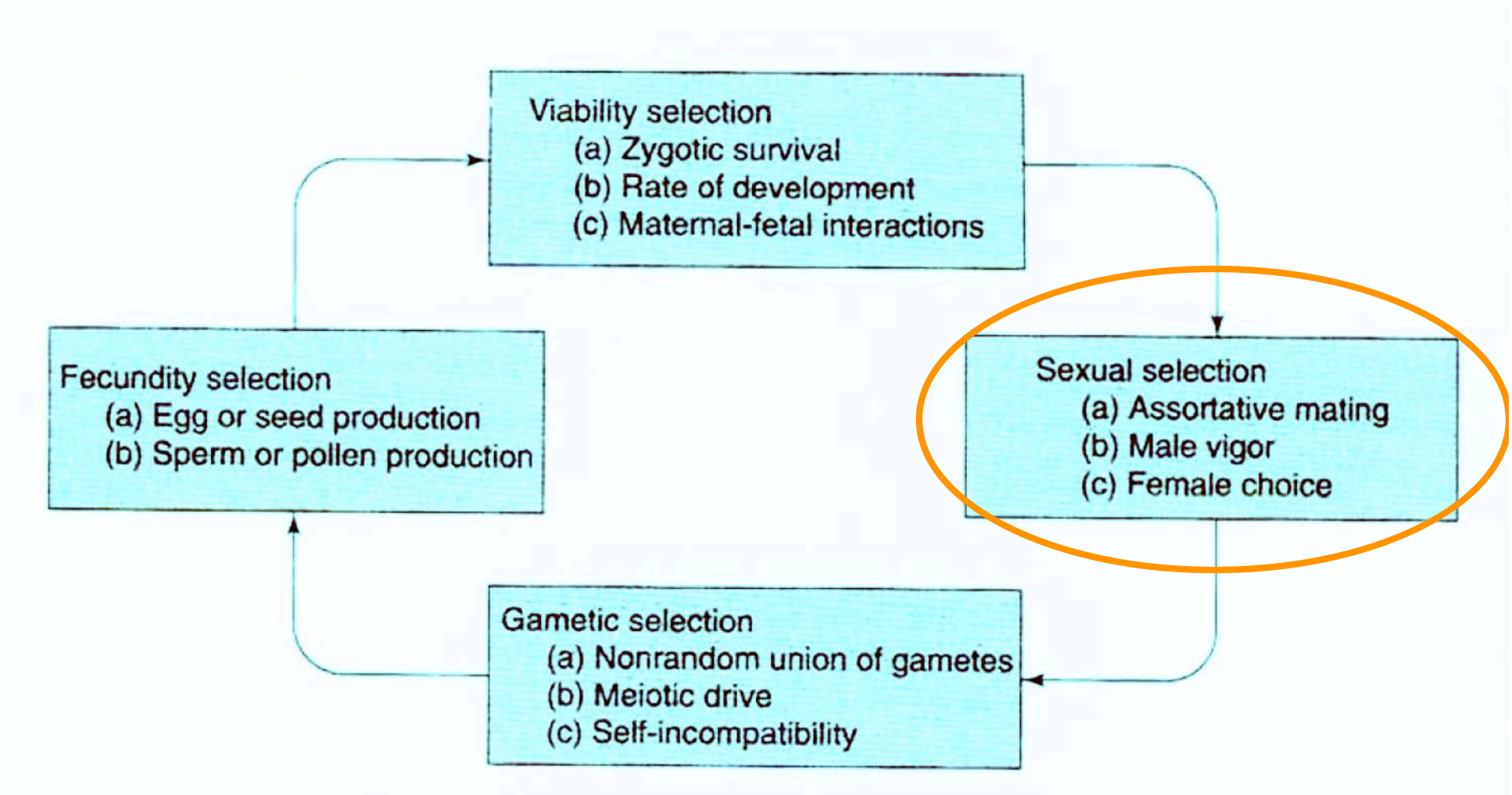
viability (zygotic), sexual, gametic and fecundity selection

(Basic Selection Model [ch 3] had assumed only that viability was affected)

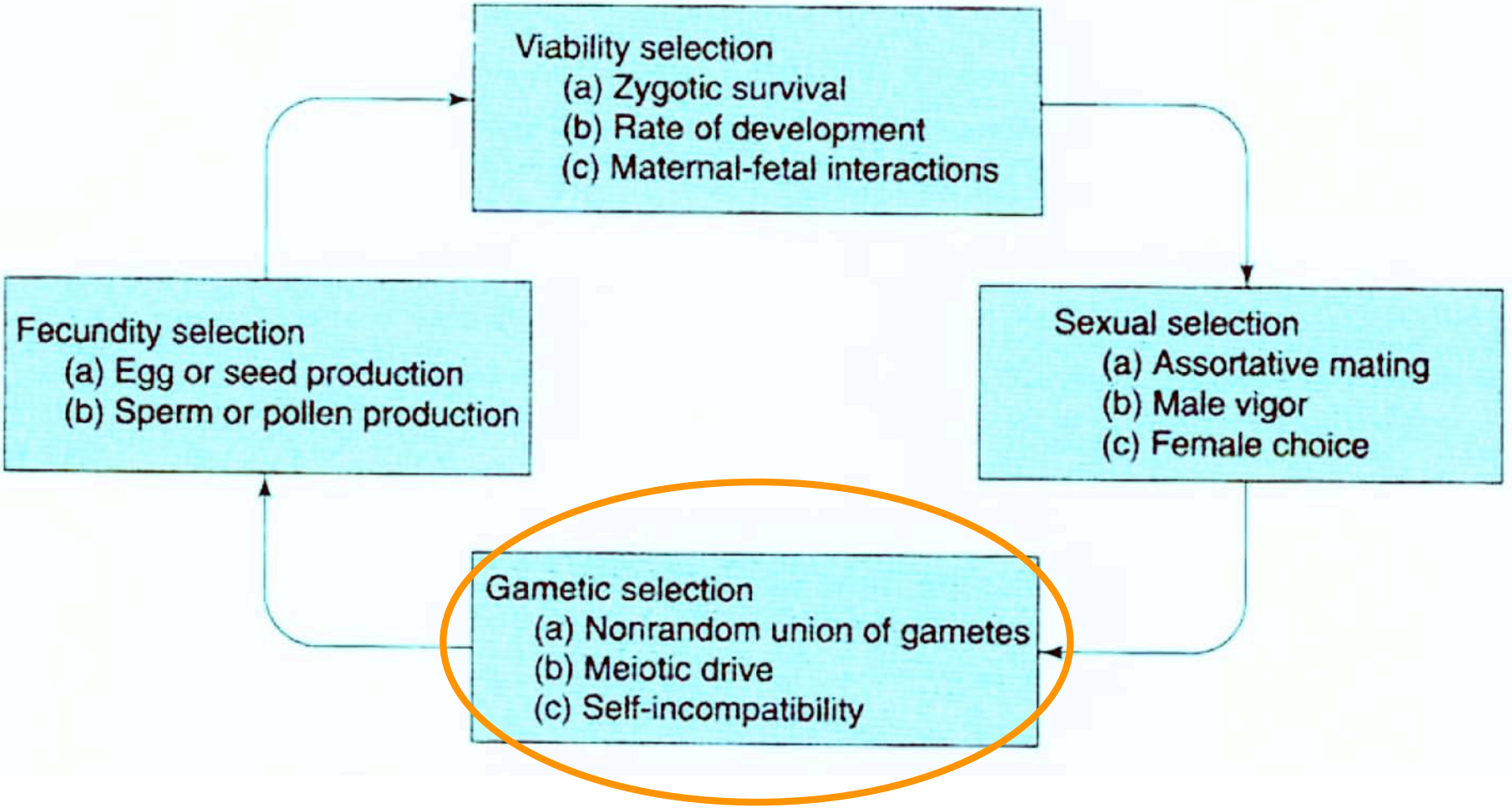
Viability selection: survival of different pre-adult stages



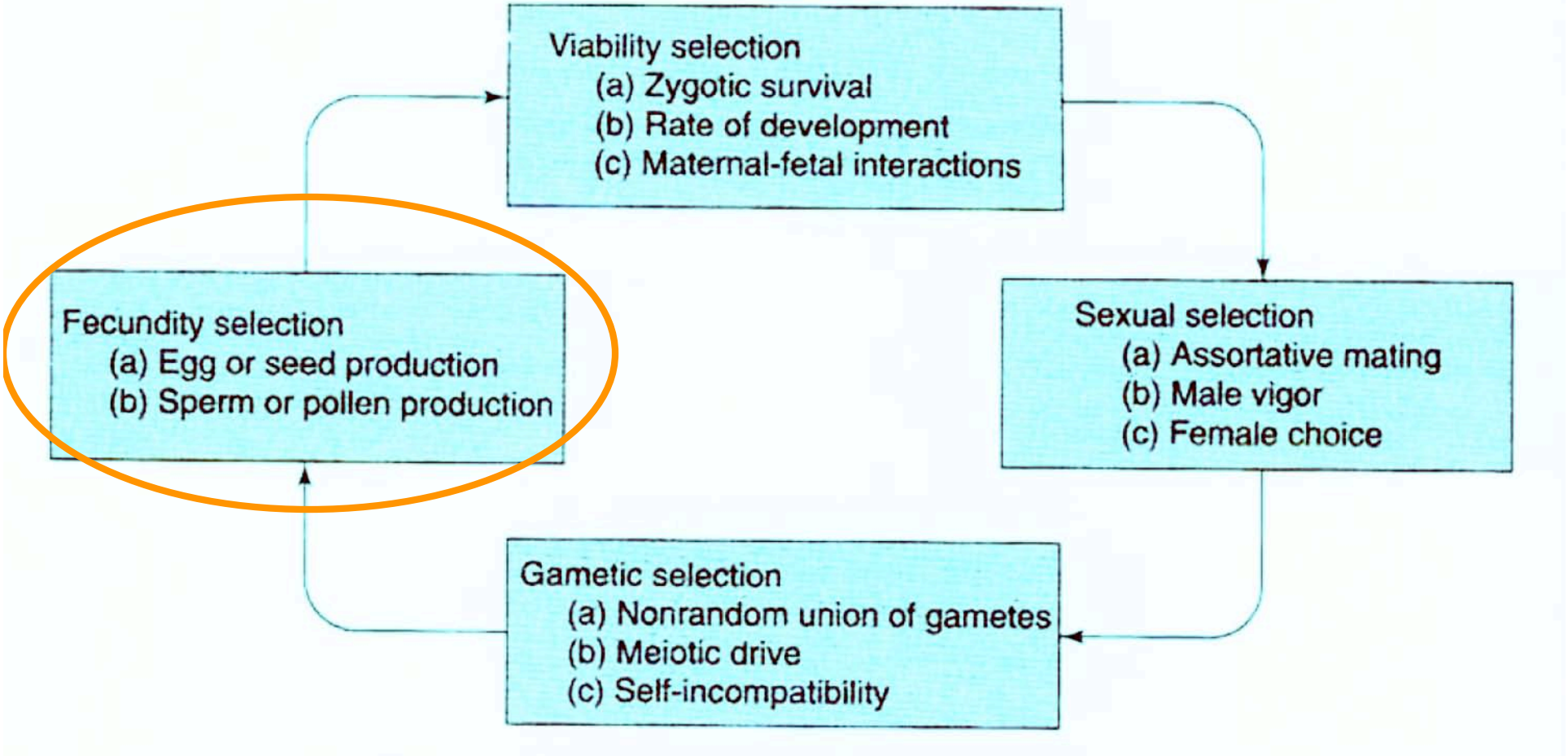
Sexual selection: some male or female genotypes favored for mating



Gametic selection: gametes from heterozygotes are not in equal proportions



Fecundity selection: one genotype is more fertile than another (usually among females).



Viability differences <u>in different life stages</u> may exist for genotypes at a locus

TABLE 4.1 Different viability in various life stages of a plant and the collapsed overall survival values for each genotype.

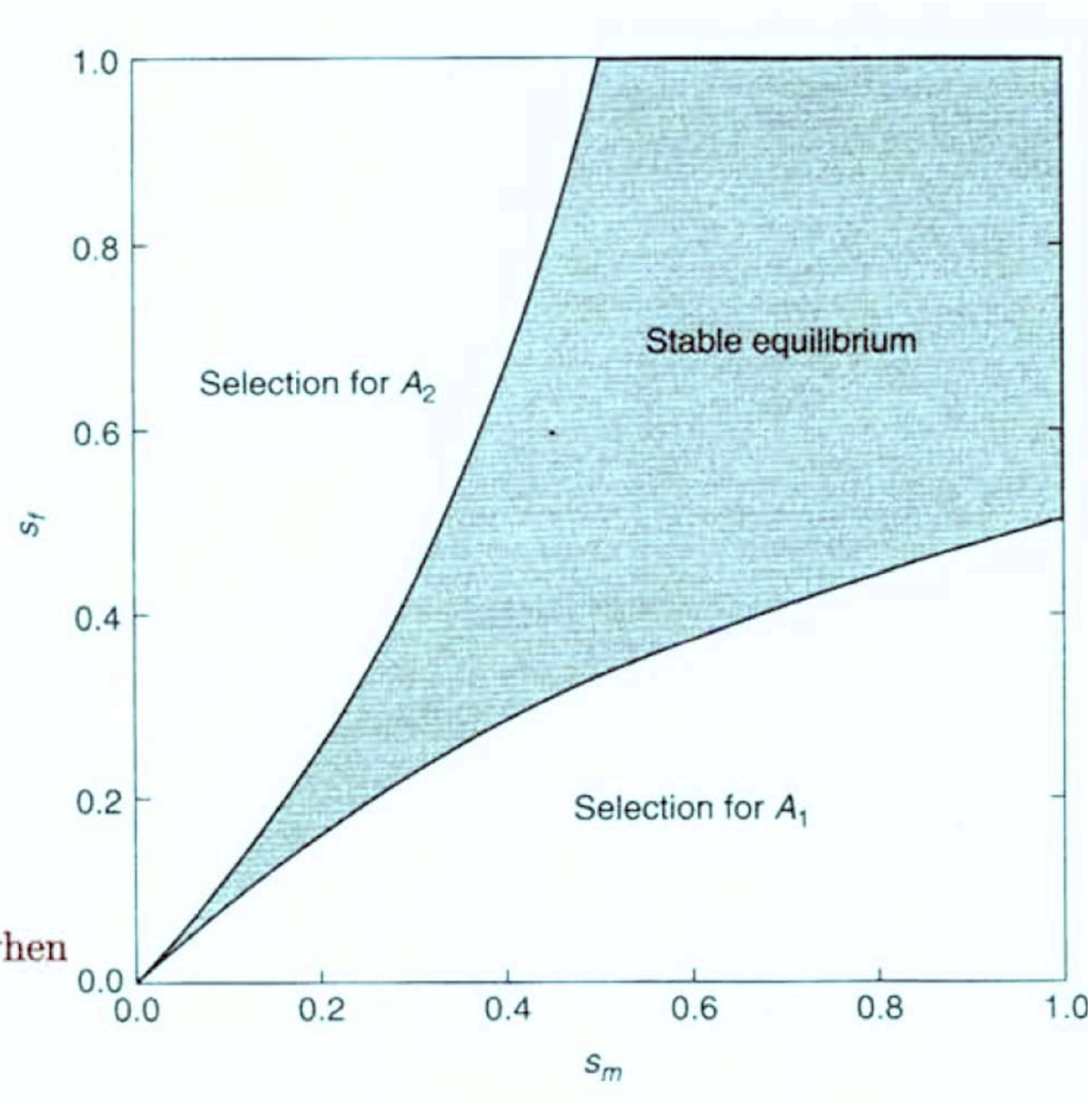
	Genotype		
Life stage	A_1A_1	A_1A_2	A_2A_2
Germination proportion (seed survival)	w_{11g}	w_{12g}	w_{22g}
Seedling survival	w_{11s}	w_{12s}	w_{22s}
Remaining pre-adult survival	w_{11p}	w_{12p}	w_{22p}
Overall survival or Relative viability	$w_{11g}w_{11s}w_{11p}$ or w_{11}	$w_{12g}w_{12s}w_{12p}$ or w_{12}	$w_{22g}w_{22s}w_{22p}$ or w_{22}

Viability differences <u>in the sexes</u> may exist for genotypes at a locus (note: this is NOT "sexual selection")

	Genotypes		
	A_1A_1	A_1A_2	A_2A_2
(a) **Relative fitness**			
Females	w_{f11}	w_{f12}	w_{f22}
Males	w_{m11}	w_{m12}	w_{m22}
Frequency before selection	$p_m p_f$	$p_m q_f + p_f q_m$	$q_m q_f$
Frequency after selection			
Females	$\frac{w_{f11} p_m p_f}{\overline{w}_f}$	$\frac{w_{f12}(p_m q_f + p_f q_m)}{\overline{w}_f}$	$\frac{w_{f22} q_m q_f}{\overline{w}_f}$
Males	$\frac{w_{m11} p_m p_f}{\overline{w}_m}$	$\frac{w_{m12}(p_m q_f + p_f q_m)}{\overline{w}_m}$	$\frac{w_{m22} q_m q_f}{\overline{w}_m}$
(b) **Relative fitness**			
Females	$1 - s_f$	$1 - \frac{1}{2}s_f$	1
Males	1	$1 - \frac{1}{2}s_m$	$1 - s_m$

Viability differences <u>in the sexes</u>:

Case of additive and opposite viability selection in the two sexes



This equilibrium exists only when

$$\frac{s_m}{1-s_m} > s_f > \frac{s_m}{1+s_m}$$

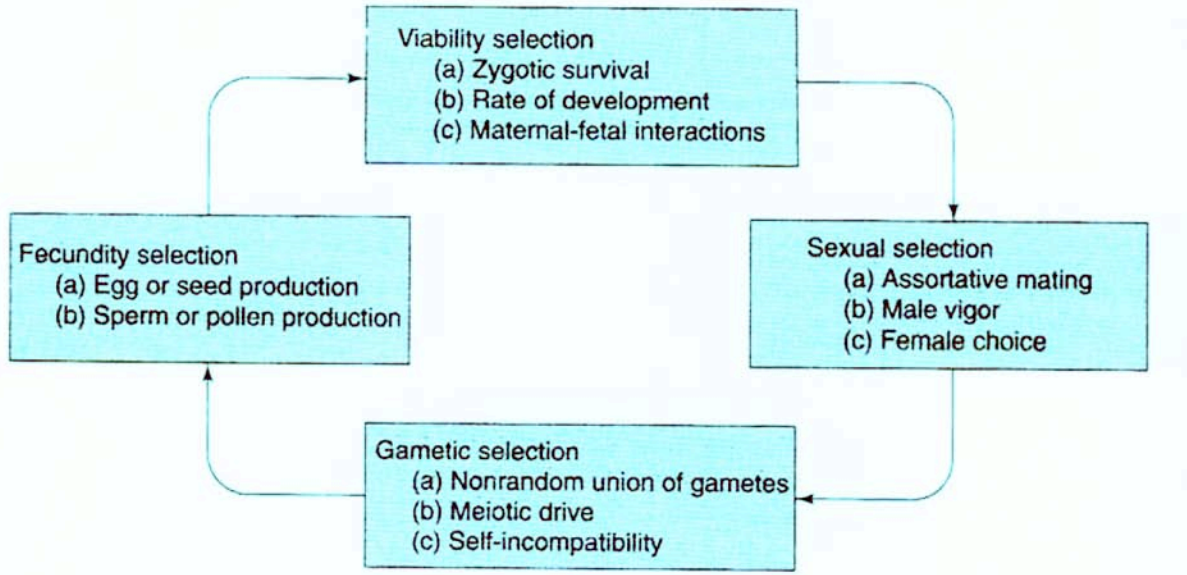
Viability differences due to maternal fetal interactions may exist for genotypes at a locus. Example: **Rh blood group system**.

Rhesus factor: Rh D antigen, present on surface of red blood cells. “Rh positive” if present in individual (ie genotype RR or Rr).

Fetal mortality occurs when mother is Rh negative (genotype rr) while fetus is Rh positive (so father is also Rh positive).

Antagonistic pleiotropy: negative correlation of two components of fitness; ie, a single locus affects multiple selection components in opposite directions.

May maintain genetic variation; May be important in evolution of senescence and understanding life history



Antagonistic pleiotropy: negative correlation of two components of fitness.

For example, senescence: alleles that increase fitness in younger organism contribute to decreased fitness in aged organisms.

In youth, testosterone has positive effects on male reproductive fitness but, later in life, there are negative effects such as increased susceptibility to prostate cancer.

Antagonistic pleitropy: negative correlation of two components of fitness

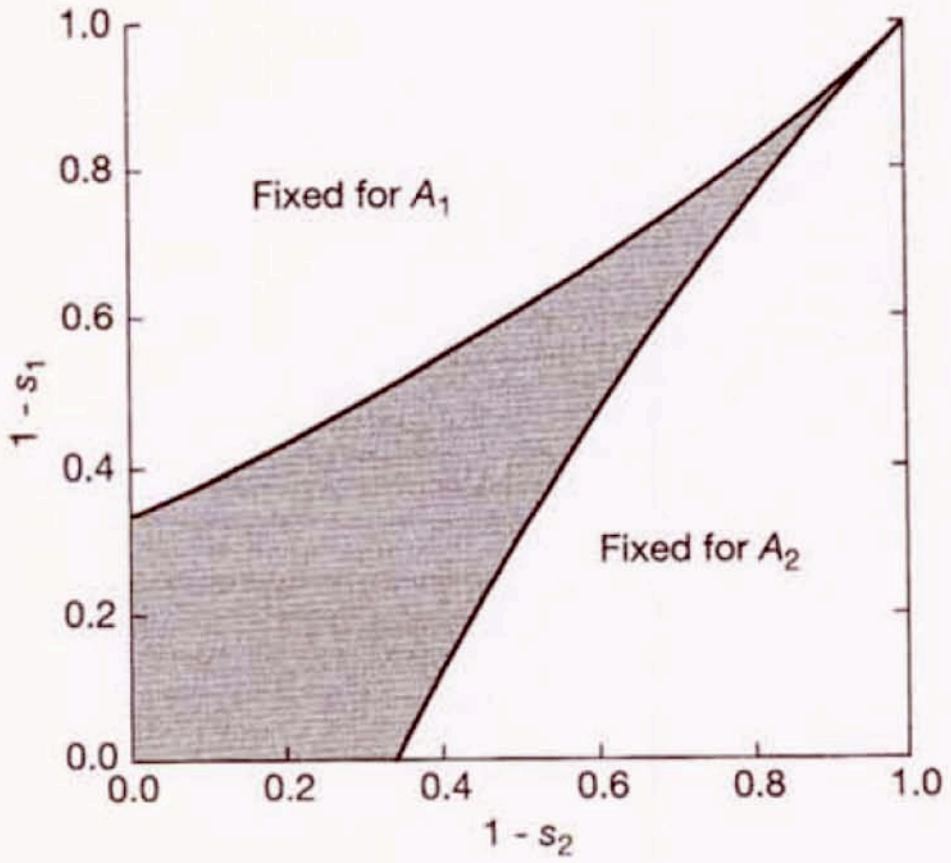


Figure 4.4. The region of polymorphism for antagonistic pleiotropy (shaded) when the relative viability of genotype A_2A_2 is $1-s_2$ and the relative reproduction of genotype A_1A_1 is $1-s_1$ and the level of dominance is $h = 0.5$.