The Expression of Alternative Mating Strategies

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The Expression of Mating Strategies

Depends on the ***predictability*** of mating opportunities ***relative*** to individual life span.

Three Patterns of Phenotypic Expression

Mendelian Strategies
Developmental Strategies
Behavioral Strategies.

1. Mendelian Strategies

Mating strategies controlled by ***few loci*** of major effect, which segregate in populations according to Mendelian rules.

Genetic/Life History Example

α-, β- and γ-males in the marine isopod, *Paracerceis sculpta*

Mendelian Strategies

In these cases, ***specific allelic combinations*** produce morphologically and behaviorally distinct male phenotypes.

Mendelian Strategies Arise When

√ Sexual selection favors specialized mating phenotypes.

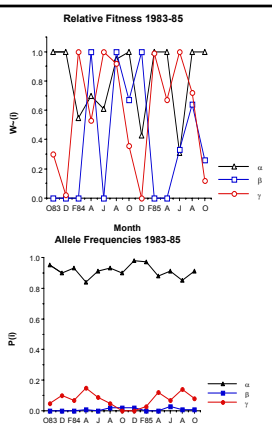
The relative mating success of each phenotype is ***unpredictable*** within male lifetimes.

Unpredictable Mating Success

A morph is, ***by chance***, well or poorly suited for securing mates in a given environment.

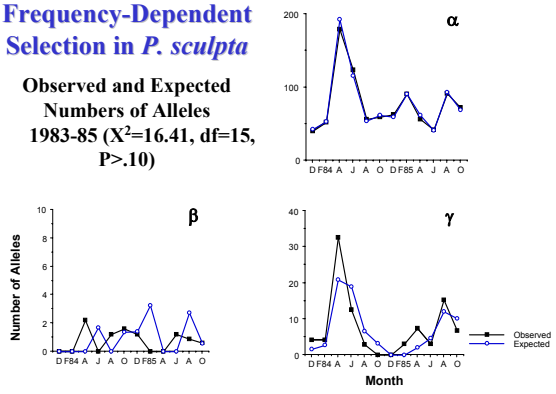
Its relative fitness, and its population frequency, ***rises or falls*** accordingly.

Variation in Frequency and Fitness Among *Ams* Alleles



Frequency-Dependent Selection in *P. sculpta*

Observed and Expected Numbers of Alleles 1983-85 (X^2=16.41, df=15, P>.10)

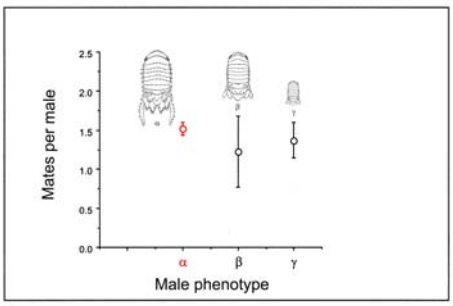


Equal Fitnesses

Over longer durations, different morphs are expected to persist in the population because their average fitnesses ***are equal***.

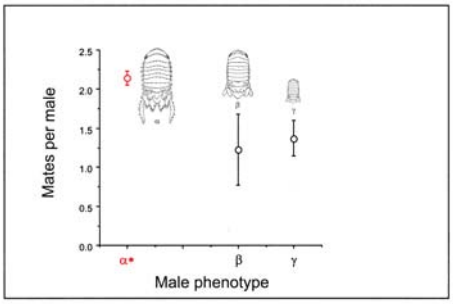
Equal Fitnesses Among Males

(N_α=452; N_β=20; N_γ=83)



Un-equal Fitnesses Among Males

(N_{α} = 452-131 = 321)



With Unpredictable Mating Success,

Phenotypic plasticity is ***unlikely*** to evolve.

Why?

Genes of major effect ***exclude*** genetic architectures that allow a variable response to environmental cues predicting mating success.

When cues are lacking, plasticity is ***unnecessary***.

2. Developmental Strategies

Discontinuous phenotypes produced by distinct developmental trajectories, which ***do not*** segregate in a Mendelian manner.

Developmental Strategies Arise When

√ Sexual selection favors specialized mating phenotypes.

The relative mating success of each phenotype is ***predictable*** within male lifetimes.

The time scale for change is ***long***.

Why?

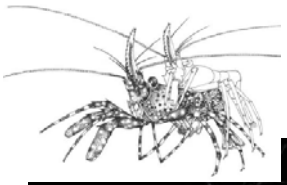
Phenotypic plasticity ***excludes*** genes of major effect when reliable cues predicting mating success ***are*** available.

When cues ***are*** available, the phenotypes produced by major genes are ***often incorrect***.

Which Cues?

In many species, the environmental cue to which males respond appears to be their own ***growth rate***.

In Some Species,



Slow growing males mature early as ***satellites***.

Males who cross a size threshold continue to grow and mature later as ***territorials***.

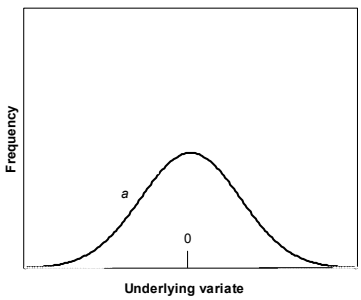
In Other Species,

Rapidly growing males become ***satellites***, and slower growers become ***territorials***.

This Pattern Is Consistent With

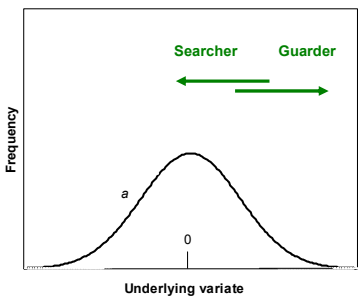
the observed expression of ***threshold characters***.

In Threshold Characters,



Genotypic AND phenotypic variation underlying characters (i.e., growth rate) are ***normally distributed***.

If Selection is Strong,



Distinct phenotypes are likely to evolve.

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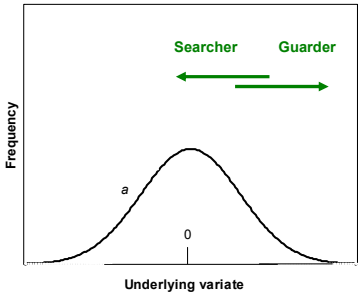
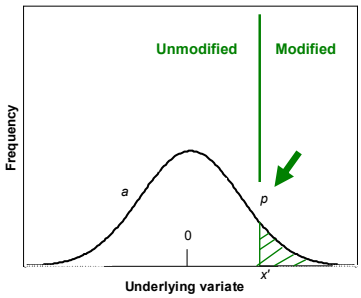


Distinct phenotypes are likely to evolve.

When environmental cues that predict success occur ***early in life***,

If Selection is Strong,

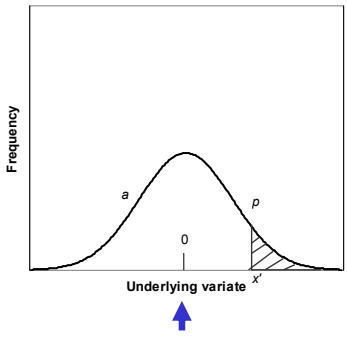


Distinct phenotypes are likely to evolve.

When environmental cues that predict success occur ***early in life***,

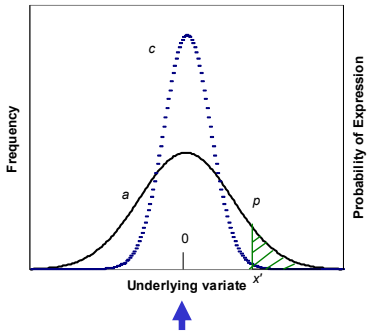
Expression is likely to be mediated by a ***developmental threshold***.

Genotype Influences the *Probability* of Trait Expression



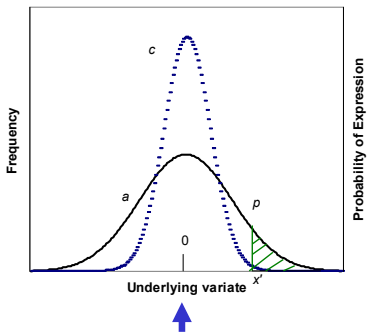
Each genotype (0) has its own ***probability distribution*** for trait expression.

Genotype Influences the *Probability* of Trait Expression



Each genotype (0) has its own ***probability distribution*** for trait expression.

But *Actual* Trait Expression,

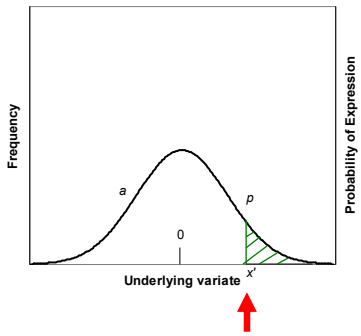


Depends on an ***interaction*** between genotype ***and*** environment;

GxE Interaction

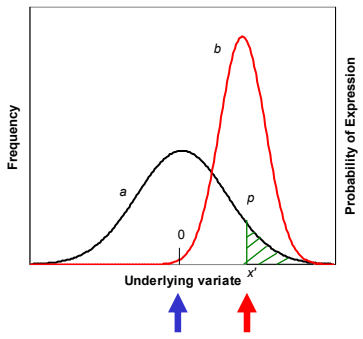
In a *Given* Environment,

Genotypes at or above the threshold are ***likely*** to express the trait (b);



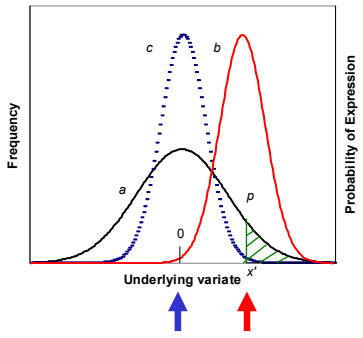
In a *Given* Environment,

Genotypes at or above the threshold are ***likely*** to express the trait (b);
Genotypes below the threshold ***seldom do*** (c).



In a *Given* Environment,

Genotypes at or above the threshold are ***likely*** to express the trait (b).
Genotypes below the threshold ***seldom do*** (c).

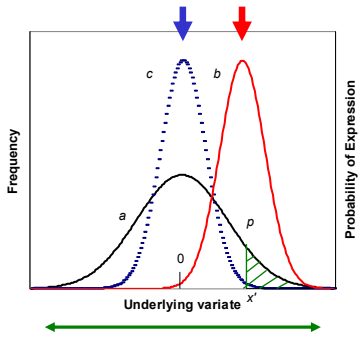


In a *Given* Environment,

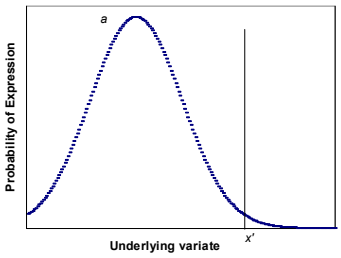
As a result of the ***distribution of genotypes*** (**a**) and their ***associated sensitivities***, i.e. their ***reaction norms*** (**b**, **c**)

The population appears ***dimorphic***.

Relative morph frequencies depend on the location of ***p***.



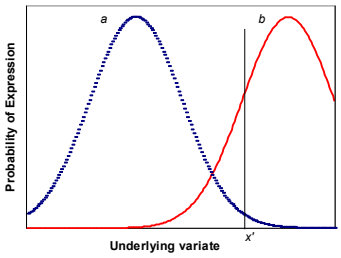
In a *Variable* Environment,



Genotype influences the ***probability of response*** to environmental cues.

Few genotypes express the trait at one environmental extreme (a);

In a *Variable* Environment,



Genotype influences the ***probability of response*** to environmental cues.

Few genotypes express the trait at one environmental extreme (a);

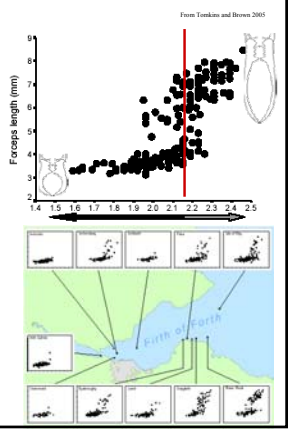
At the other extreme, ***nearly all*** genotypes become modified (b).

Relative Mating Success

For satellites and territorials, determines where the ***average male growth rate*** lies with respect to the ***body size threshold***.

Average fitnesses are ***equal***.

Inter-population variation is expected.



Genetic Architectures

Sensitive to environmental cues ***can*** allow males to express ***appropriate phenotypes*** in response to changing environments.

Provided That,

The cost of making the wrong choice is ***high***.

Circumstances favoring plasticity occur ***frequently***.

Are experienced by a ***large fraction*** of the population.

Phenotypic Plasticity is ***Unlikely*** When,

Selection is ***weak***.

Circumstances favoring plasticity are ***rare and highly contingent***.

Are experienced by ***few*** individuals in the population.

3. Behavioral Strategies

Discontinuous behavioral phenotypes expressed in response to changes in mating opportunities.

Are also known as "***tactics***."

Behavioral Example

Mate guarding tactics in stomatopods, *Gonodactylus bredini.*

Behavioral Strategies Arise When

√ Sexual selection favors specialized mating phenotypes.

The relative mating success of each phenotype is ***predictable*** within male lifetimes.

The time scale for change is ***short***.

Why?

Behavioral plasticity ***excludes*** major genes and developmental plasticity,

when reliable ***cues*** predicting mating success ***are available***,

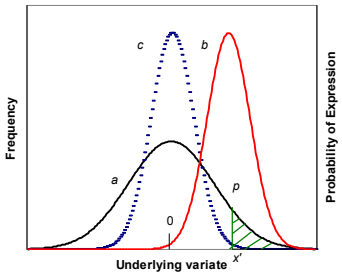
and mating opportunities ***change quickly***.

Genetic Architectures

Underlying behavioral plasticity appear to be ***similar*** to those of developmental strategies.

Genetic variation underlying quantitative traits influences the likelihood that individuals express a particular mating behavior.

The Behavioral Threshold Hypothesis Predicts:



Differential responsiveness to the ***same*** environmental cues among individuals within populations,

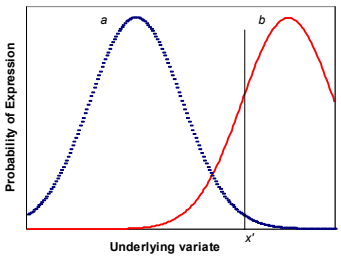
Due to ***genetic differences*** among males.

This May Explain Why,

Certain individuals in a population express one set of mating behaviors,

And under the same conditions, other individuals express another behavioral set.

The Behavioral Threshold Hypothesis *Also* Predicts:



Variable responses to ***different*** cue intensities among individuals within populations,

Due to ***genetic differences*** among males.

This May Explain Why,

Weak stimuli will induce ***few individuals*** to perform mate acquiring behaviors.

Strong stimuli, however will cause ***most individuals*** to attempt to mate.