HERITABILITY

— Pasternak

The proportion of phenotypic variance due to genetic variance. It is denoted as (h^2 or H^2) where h stands for heritability. Heritability is = Genetic Variance.

$$\text{Variance (V)} = S^2 = \frac{\Sigma (x_1 - x)^2}{n-1}$$

S^2 = Square of Standard Deviation (S.D) is taken as variance

- Out of all individuals of a population showing variance, how much is due to genetic factor variance.
- Normally, in human genetics we use Broad Sense Heritability. in plant and animal genetics " Narrow " ".
- Proportion of h^2 = Proportion of genetic factors

  normally h^2 = 0 – 1 i.e. heritability is measured in terms of 0–1.

If in a study h is >1 = MZ experienced more environmental influences than DZ. (Both genetic & env. has more imp role) than genetic factors.

If h^2 shows negative value = Genetic-environmental interaction has a significant contribution.

In uterus (before birth), competition b/w MZ twin usually lead to inhibition of one twin.

This is example of negative heritability.

It is measured as

Variance : (σ^2) $\frac{\Sigma(X-\bar{X})^2}{N-1}$

PARTITIONING OF HERITABILITY:

All this phenotypic variance is denoted as (V_P)

genotypic variance V_G

environmental variance V_E

$V_P = V_G + V_E$ Total phenotypic variance is sum ... and ~~vari~~ environmental variance

~~$h^2 = \frac{V_G}{V_P}$~~ Heritability $(h^2) = \frac{V_G}{V_P}$ ~~in humans, Broad se...~~

(I) BROAD-SENSE HERITABILITY (h^2_B)

In humans Broad Sense Heritability i.e. $h^2_B = \frac{V_G}{V_P}$ = V...

Snustad & Simmons

The actual difference in Broad Sense and Narrow sense is determined by V_G. Since genes have the additive ... in ~~V_G, this ratio~~ broad sense, Value of V_G becomes ... as compared to narrow sense where less no. genes a... under consideration for calculating value of V_G

In general value of V_G is calculated by –

$V_G = V_A + V_I$

V_A = Additive effect of gen...

V_I = Interaction of genes (epista... Interlocus interaction)

$\therefore V_P = V_A + V_I + V_E$

Interaction could give +ve/-... effect which also is conside...

The role of ~~interlocus~~ intralocus Dominant ~~Interlocus~~ allele interaction (V_D) Variance.

$$V_P = V_A + V_I + V_E + V_D$$

→ Broad Sense heritability because here we consider all kinds of interactions possible.

(II) NARROW-SENSE HERITABILITY (h^2_N)

Only additive effect is considered.

$V_G = V_A$

$$V_P = V_A + V_E$$

h^2_B

$$h^2_B \quad \frac{V_G}{V_P} = \frac{V_A + V_I + V_E + V_D}{V_G + V_E}$$

$$h^2_N = \frac{V_G}{V_P} \quad \frac{V_A}{V_G + V_E}$$

In humans, enviromental influence is very important.

Partitioning of E – ① V_c ② V_E

E – ① V_c (V_{common}) = Common environmental variance shared

② V_E ($V_{specific\ environment}$) = Individual specific environment (not shared)

$$VE = V_c + V_E$$

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Phenotype – Genotype = Enviroment (Geneticist definition)

Conjoint Twins or ~~Sciamic~~ Twins : Siamise

- When bifurkation occurs at later stages of embryonic development and improper separation results.
- Earlier the splitting, more the chances of being different by character in MZ twins and vice-versa. Environmental sharing may differ and accordingly the effect i.e. phenotypic difference.

ADOPTION STUDY

① General adoption – any sibling is adopted away.

② Twin adoption – one of the Twin member is adopted away

Adoption In normal rearing

Biological parents = Genes + Environment

In Scientific adoption (within a week of birth)

Biological parent ⇒ Genes

↕ separate

Foster parent ⇒ Environment

NOTE: Parent give genes ~~or It~~ only. It is the only environment which selects the gene for expression. Thus ~~the~~ a child should be given good env.

- Parental negativity – Providing of bad env lead to expression of bad gene and then then stepwise ting effect. This negative env provided by parent may make a person criminal. But if positive env is provided, bad gene wouldn't get expressed and child will become good.

~~History of Adopt~~

1. Twin study By Galton 1876
2. Adoption studies started much later
3. Jensen (1969) on IQ

Percentage of IQ $= \frac{\text{Mental age}}{\text{Actual age}} \times 100$

Mental age is decided by doing IQ test

4. Socioeconomic and ethical ~~and~~ or environment plays imp role determining IQ.
5. Jensen started study of IQ level in black & white peo... IQ studied were done).

   Blacks have 15 points (100pts max.) less IQ than wh...

~~6. The~~

6. Thomas J. Bouchard (1979–1990) → Did twin study and also twin adoption study and he studied globally (twins from countries).

Minnesota Twin study (Twin Adoption study)

Genetic co-relation (r) or Heritability of IQ (B) → Broad sense. → This IQ study is ... stage (21 years o...

MZ	reared Together	=	0.86
MZ	reared apart	=	0.72
DZ	reared together	=	0.5 (what a maximum could be expe...)
DZ	reared apart	=	0.5
Siblings	reared together	=	0.5
Foster parent and adopted child		=	0.0
Unrelated individuals		=	0.0

NOTE: Early environment sharing play major role.

→ **Denmark: Schizophrenia Study –**

14,427 adopted persons

aged 20–40 years (after this age, severe persons may die...)

Out of these adoptions 47% of whom were diagnosed as ch...

47 Schizophrenic adoptees / 14,427	47 Controlled adoptees / 14,427

	Schizophrenic among biological relatives	Schizophrenic among ad... relatives
In case of 47 schizophrenic adoptees	① 44/279 (15.8%) Gene pool — very high; out of 279 relatives 44 had it	② 2/111 (1.8%) Gene pool — low; out of 111 genetic relatives, only ...
In case of 47 normal controlled adoptees	③ 5/134 (3.7%)	④ 2/117 (1.7%)

②, ③ & ④ are comparable bit ① is very high. This revealed the gene sharing.

Conclusion: Gene sharing is more important than environmental influences.