University of New England

Optimizing Breeding Programs

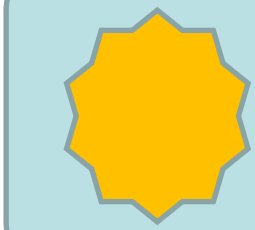
Effect of Reproductive Technologies and Measurement

Aspects that need to be balanced:

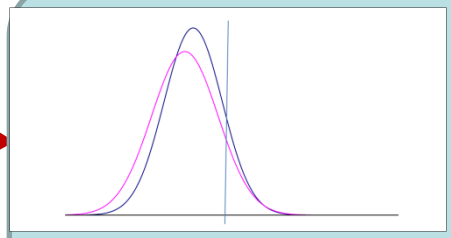
$$\frac{i_m r_{IAm} + i_f r_{IAf}}{L_m + L_f} \sigma_A$$

- Selection accuracy versus generation interval
  - Short generation intervals are good for fast progress, but young breeding animals have lower EBV accuracy
- Selection accuracy versus selection intensity
  - Money available for testing (either performance or DNA) can be used to test a few animals accurately, or to test more animals with lower accuracy. For example, testing fewer young bulls but giving them more test progeny.
- Selection intensity versus generation interval
  - Selecting fewer animals for breeding each year and keeping those longer
- Selection intensity versus inbreeding
- The relative emphasis in selection for multiple traits
- Cost versus benefits

Aspects that need to be balanced

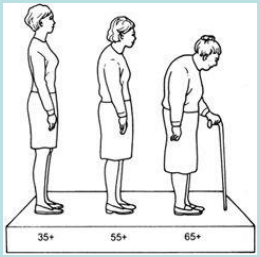


Selection accuracy



Selection intensity

$$\frac{i_m r_{IAm} + i_f r_{IAf}}{L_m + L_f} \sigma_A$$

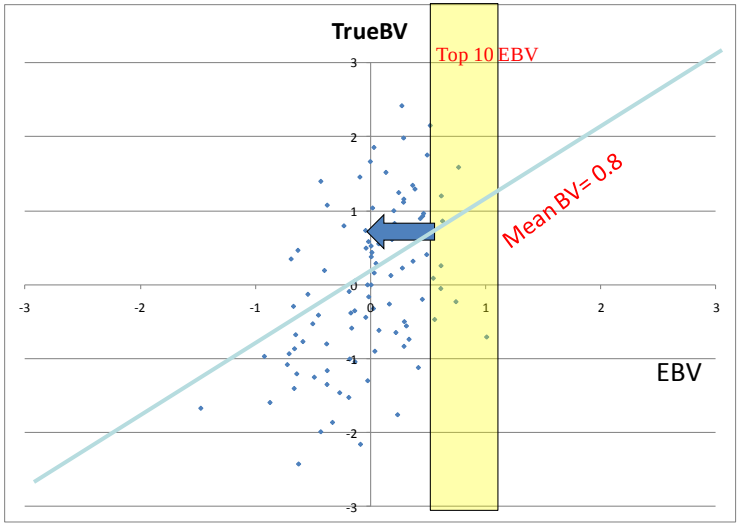


Generation Interval

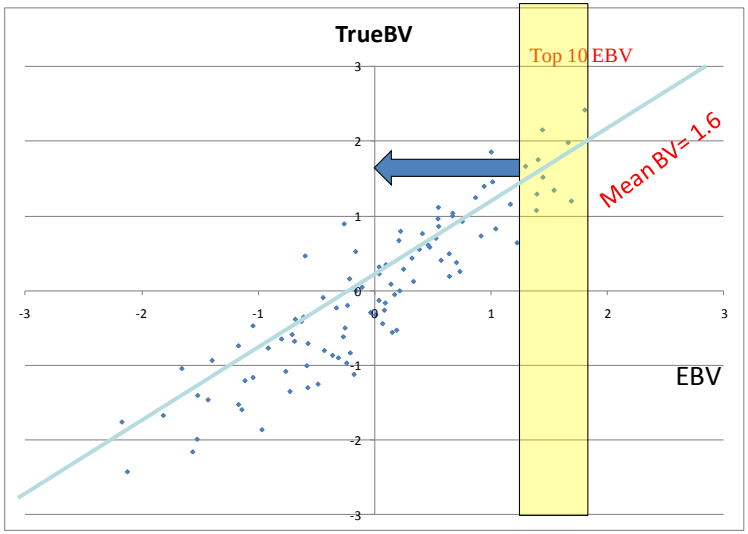
Inbreeding

Multiple traits

Cost Benefit



Accuracy = 45%

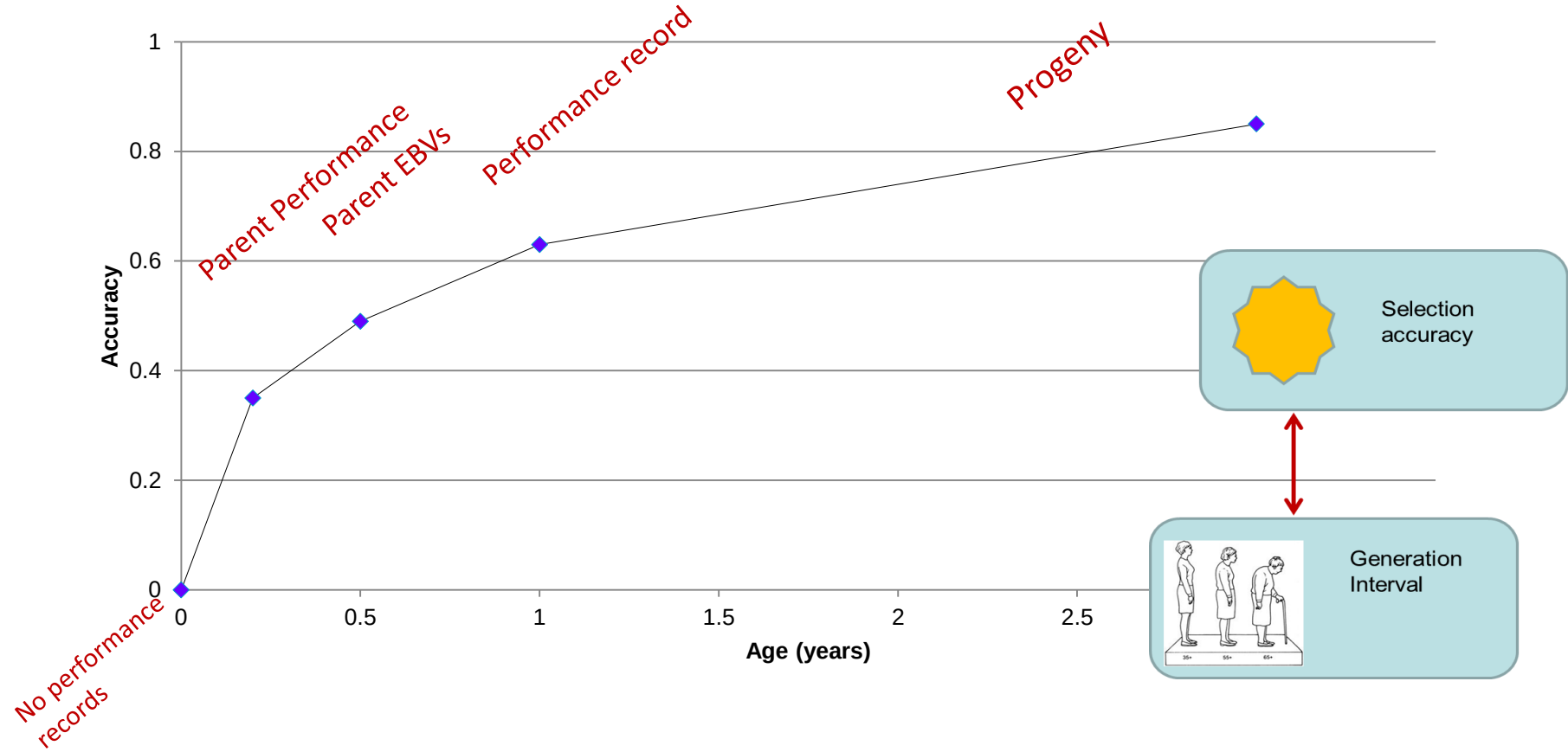


Selection accuracy

the more accuracy, the more response

Accuracy of predicting a breeding value

- increases as an animal gets older

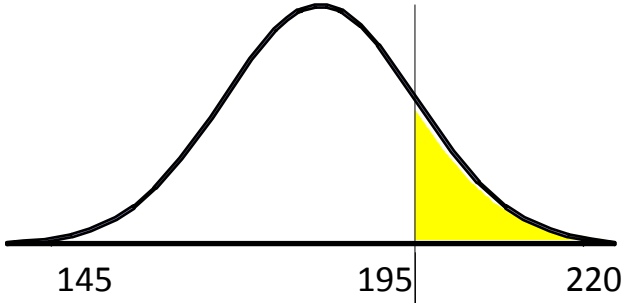


Assumed heritability = 25%

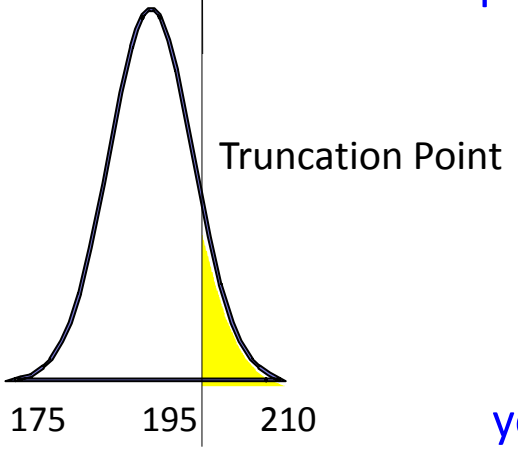
Need to balance accuracy and generation interval!

BLUP helps selecting between old and young bulls

- EBVs can be compared directly over age classes
- Selection on BLUP EBVs optimizes generation interval

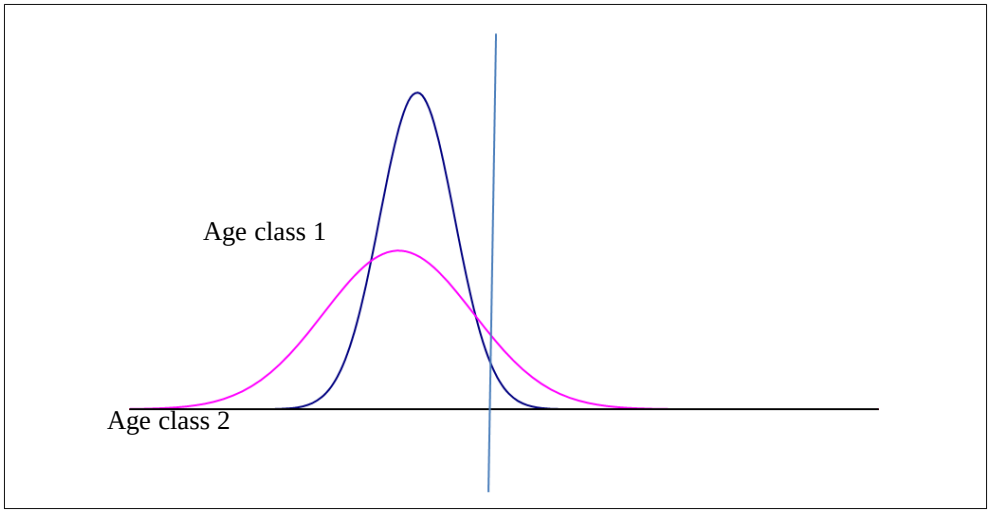


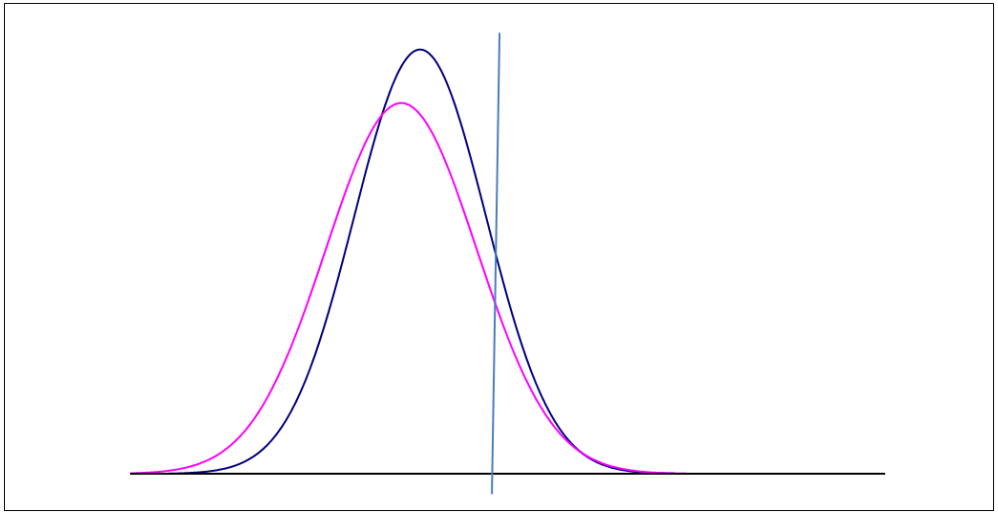
proven sires



young sires

Optimizing age structure





Accuracy changes with age class !

Without genomic selection

ageclass	N in group	mean	SD	Nr Selected
1	50	10.20	0.4	2.7
2	50	10.00	0.8	7.3

Accuracy

With genomic selection

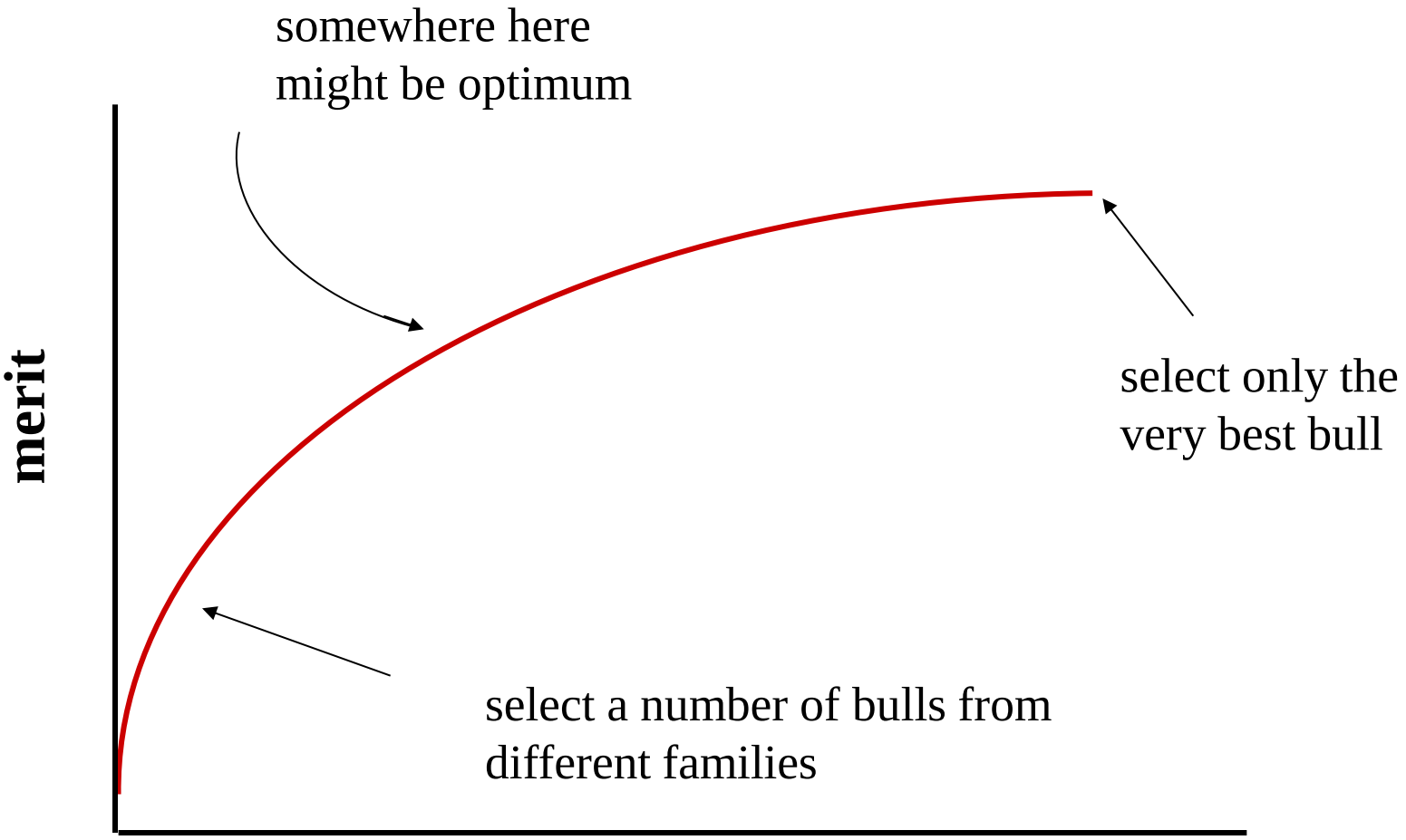
ageclass	N in group	mean	SD	Nr Selected
1	50	10.20	0.7	5.4
2	50	10.00	0.8	4.6

Best to select on EBV, irrespective of accuracy /genotyped or not / age

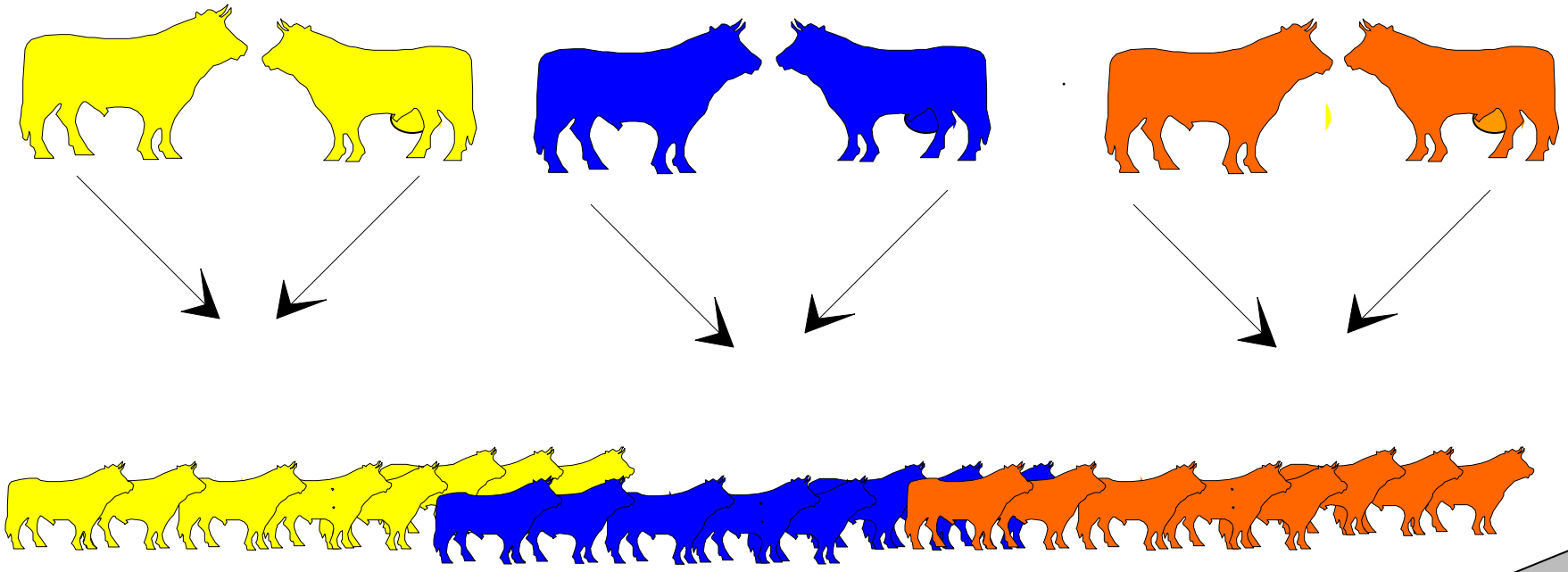
	birth year	genotyped	progeny	EBV	acc
Kevin	2009	Y	0	+124	71
Tony	2005	N	345	+119	97
Bob	2009	N	0	+117	63
John	2008	N	45	+113	85
Paul	2006	N	1087	+112	99
Geoff	2009	Y	0	+106	40
Malcolm	2007	N	67	+105	89

Balancing inbreeding and merit

This graph will look different for each population



Between versus within family selection



Own information (performance or *genotype*):

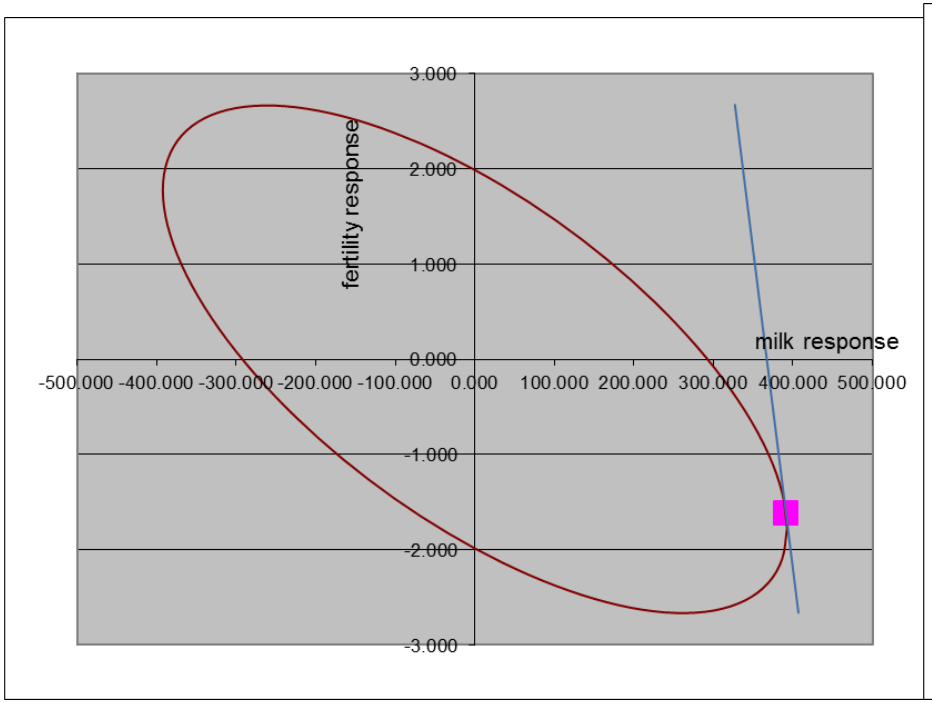
More variation within families

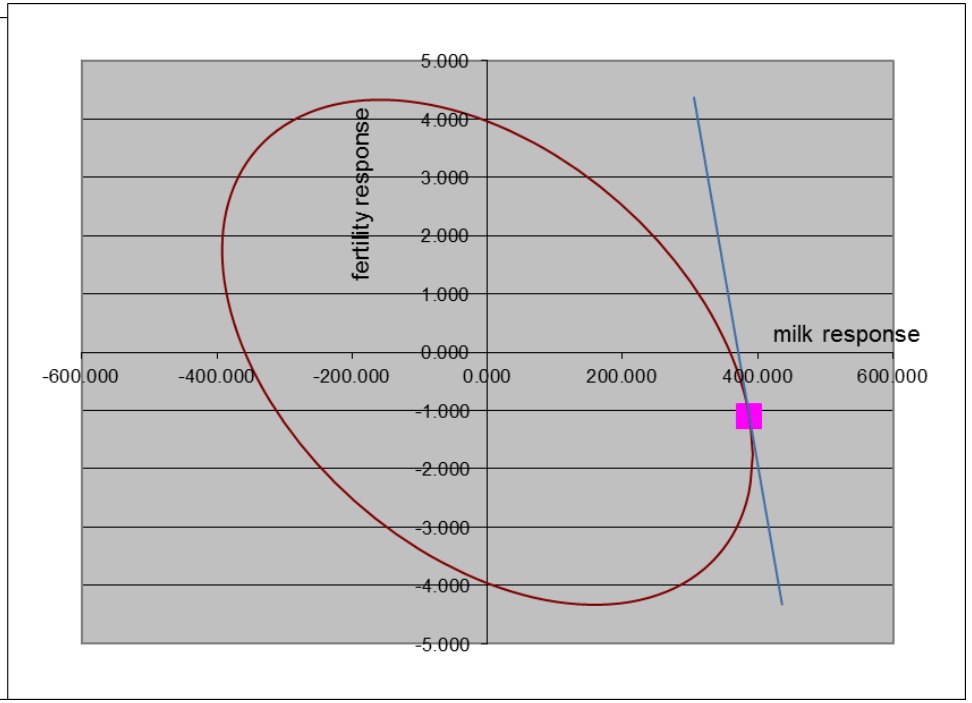
More within-family selection – ***less inbreeding***

Advantage of genomic selection

Balancing Traits, weights and information

Multiple traits

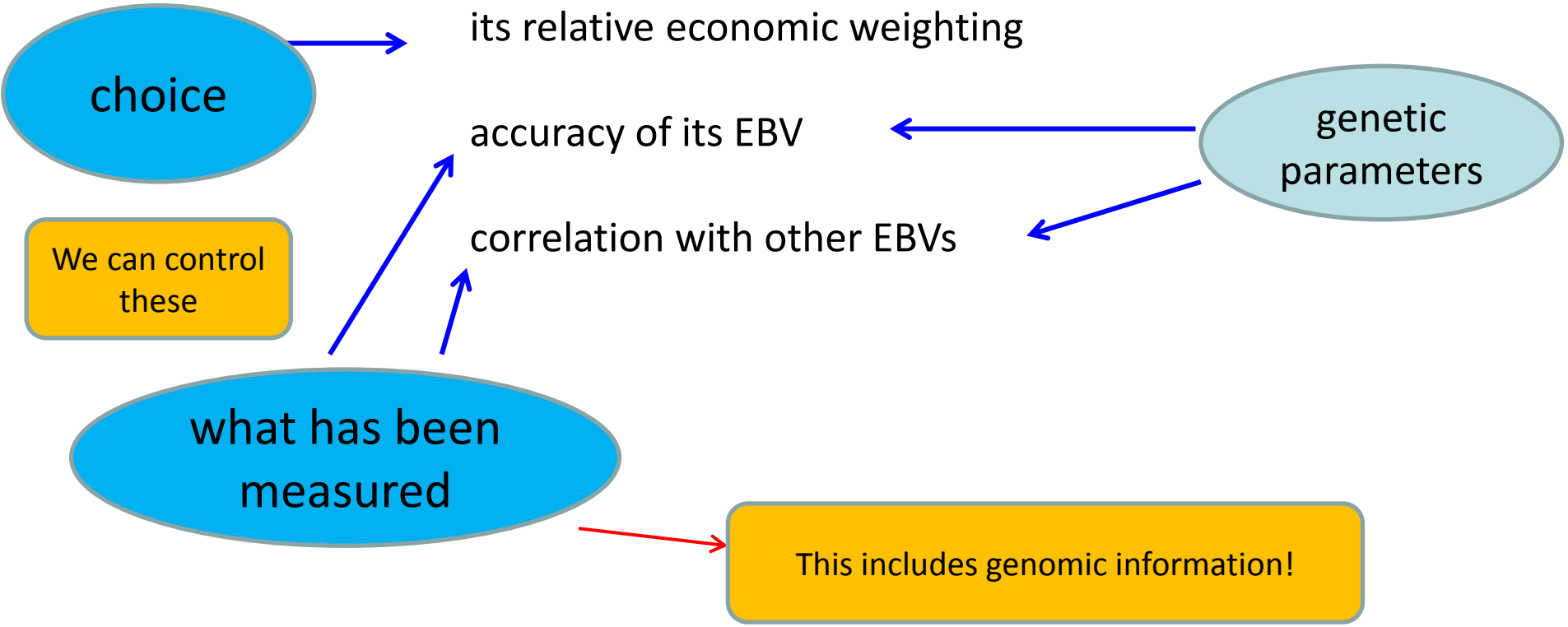




Usually push the traits that have more information/higher EBV accuracy
→ Balance may change with genomic information on 'hard to measure traits'

Importance of Trait measurement

1 The ultimate response of a trait will depend on:



Evaluating Breeding programs

- Deterministic vs Stochastic Simulation
- Optimization strategies