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Swedish University of Agricultural Sciences



Linear profiling in SWB – new breeding values and genetic background

Åsa Viklund, Emma Thorén Hellsten, Sofia Mikko, Susanne Eriksson



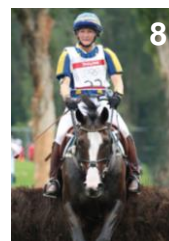
Swedish Warmblood



“Internationally competitive horses in dressage,
show jumping or eventing”

65,000 horses

4,400 covered mares (2017)



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Introduction of linear profiling

2013

Young horse test for 3-year-olds ($\approx 40\%$)

2014

Young horse test for 4- and 5-year-olds

Foal inspections

Stallion performance test

Mares for conformation grading



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Scientific background

Scientific results published in November 2017

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ORIGINAL ARTICLE

WILEY *Journal of Animal Breeding and Genetics*

Genetic analyses of linear profiling data on 3-year-old Swedish Warmblood horses

Å. Viklund | S. Eriksson

Department of Animal Breeding and Genetics, Swedish University of Agricultural Sciences, Uppsala, Sweden

Summary

A linear profiling protocol was introduced in 2013 at tests for 3-year-old Swedish Warmblood horses. In this protocol, tests are subjectively described on a scale

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Scientific results in short

Heritabilities

Conformation (21 traits)

0.10 hock joint from behind - 0.52 for shape of the neck

Movements (21 traits)

0.08 energy in walk - 0.54 elasticity in trot

Jumping (14 traits)

0.05 ability to focus on the assignment - 0.57 scope

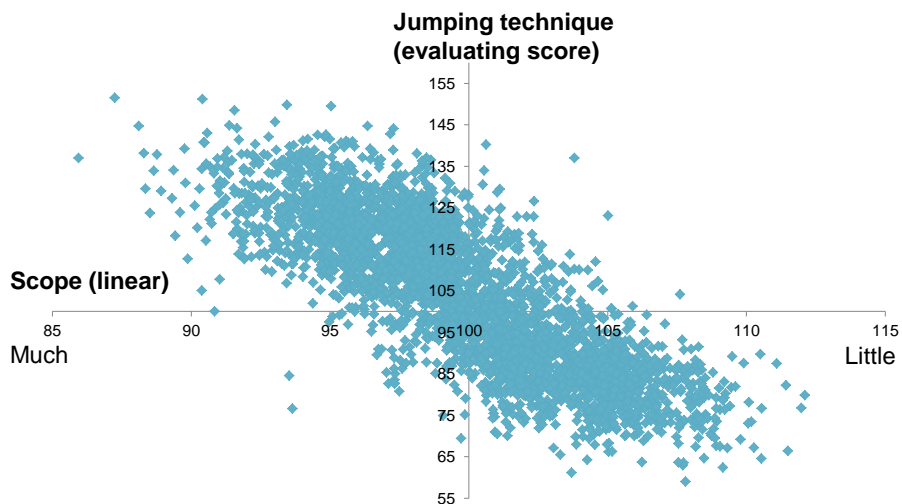
Genetic correlations

very strong between corresponding traits

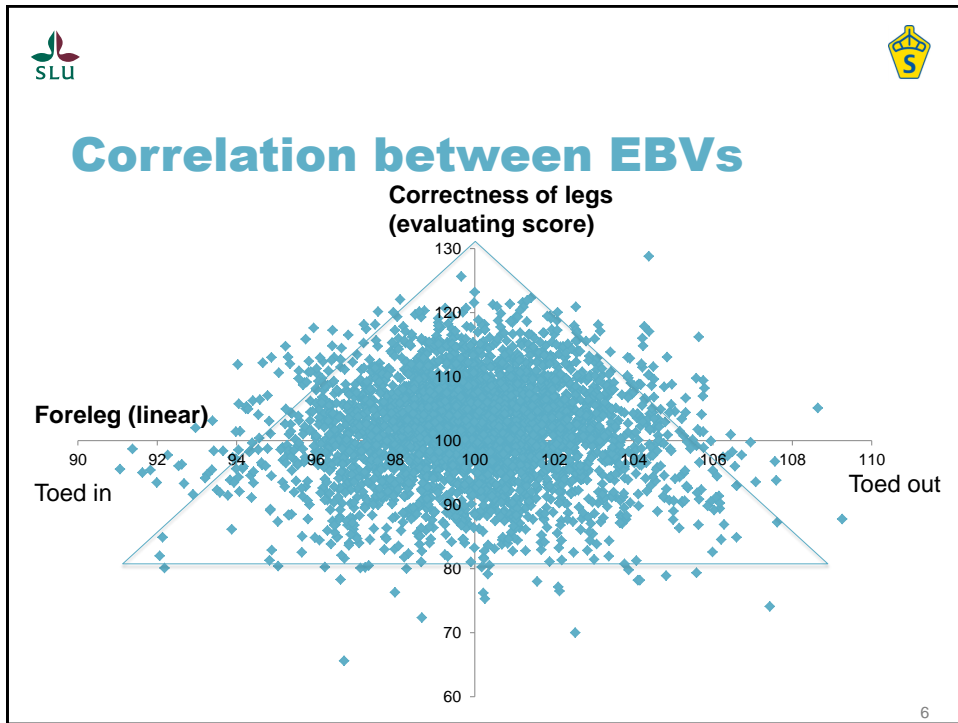
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Correlation between EBVs



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Scientific results in short

Heritabilities
 Conformation (21 traits)
 0.10 hock joint from

Conclusion:
 Linear information suitable for genetic evaluation and can be a useful tool for breeders

Genetic correlations
 ... assignment - 0.57 scope
 very strong between corresponding traits

SLU and a yellow crown icon are in the top corners. A small number '7' is in the bottom right corner.



New breeding values

2017 March

- Stallions - minimum 10 offspring with linear assessment (but at least 15 offspring at young horse test)

2018 January

- Stallions - minimum 10 offspring with linear assessment
- Mares – with own linear assessment

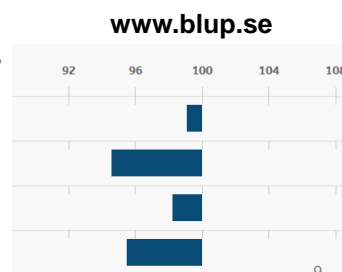
$$y_{ijk} = \text{sex}_i + \text{event}_j + \text{horse}_k + \text{residual}_{ijk}$$

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New breeding values

- Based on young horse test for 3-year-olds (4,000 horses)
- 50 traits (conformation, movements, jumping)
- **100** = average of all assessed horses
- Genetic standard deviation of 4 units
- Same direction of scale as protocol
- Accuracy – low, moderate and high



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On-going activities

Add information in breeding value estimations from:

- Young horse test for 4- and 5-year-old horses
- Performance test for stallions

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Genome-wide Association Study (GWAS) of Young Horse Test Traits in SWB Horses



Aim

To find genomic regions associated with conformation and performance traits in Swedish Warmblood (SWB)



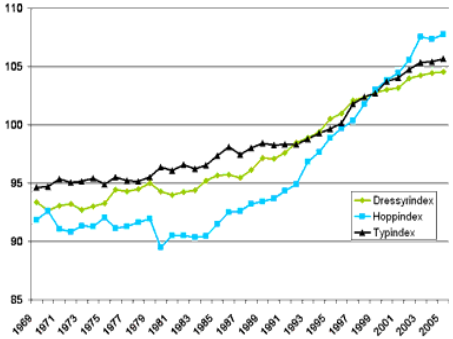
Contact Q 1203 och Arnold Assarsson. Photo: Maria Håkansson.

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Background

- SWB selected for show jumping **and** dressage traits.
- Weak positive genetic correlations previously estimated between jumping and dressage traits.
- Breeders focus increasingly on one discipline rather than both.
- Still, some stallions have high EBVs for both disciplines.

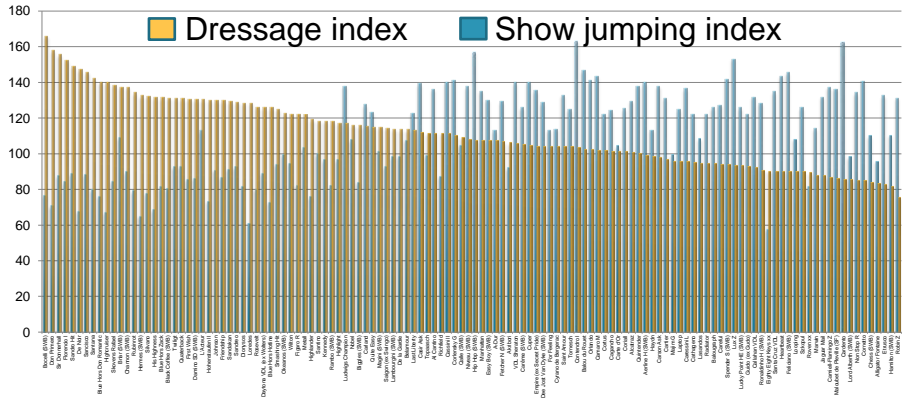


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SWB stallions by dressage EBVs

■ Dressage index ■ Show jumping index



Stallions with ≥ 10 offspring born 2006-2009

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Material and methods



- 380 horses tested as 3-year-olds 2013-2014, hair samples
- Total of 97 young horse test traits
 - Height at withers
 - 8 traditional evaluating scores
 - 2 summarized traits: show jumping and dressage talent
 - 57 linearly scored traits
 - 29 deviations scored as 0/1
- Genotyped using the equine 670K SNP-chip (Affymetrix)

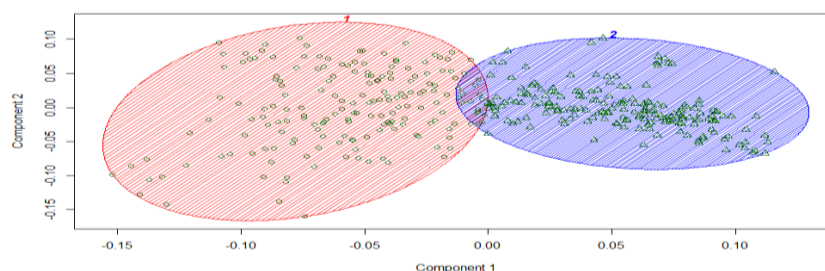
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Two main clusters

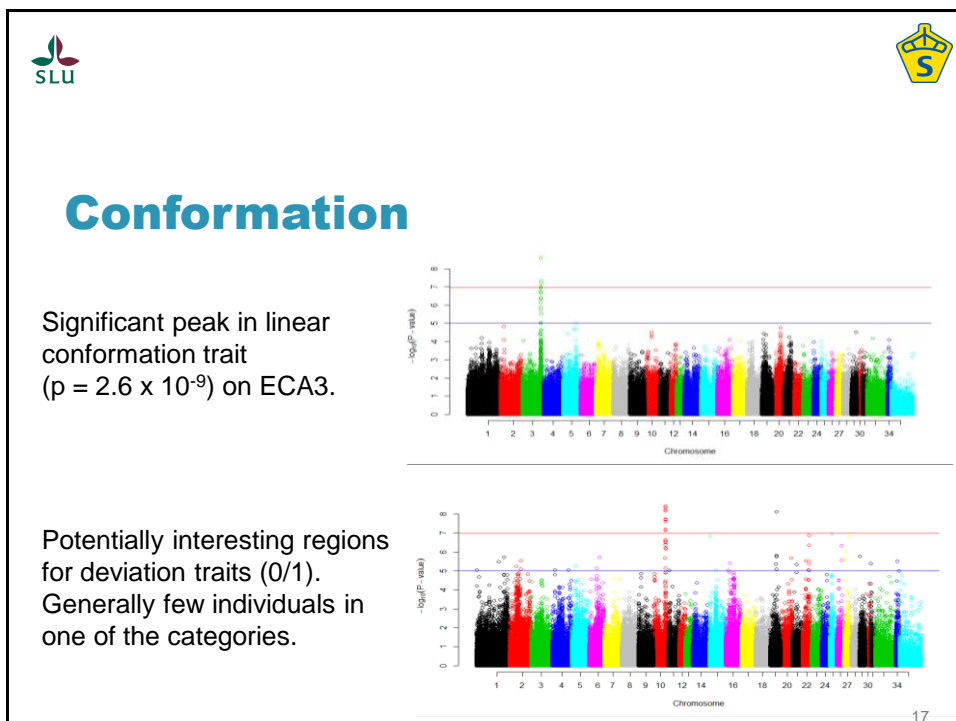
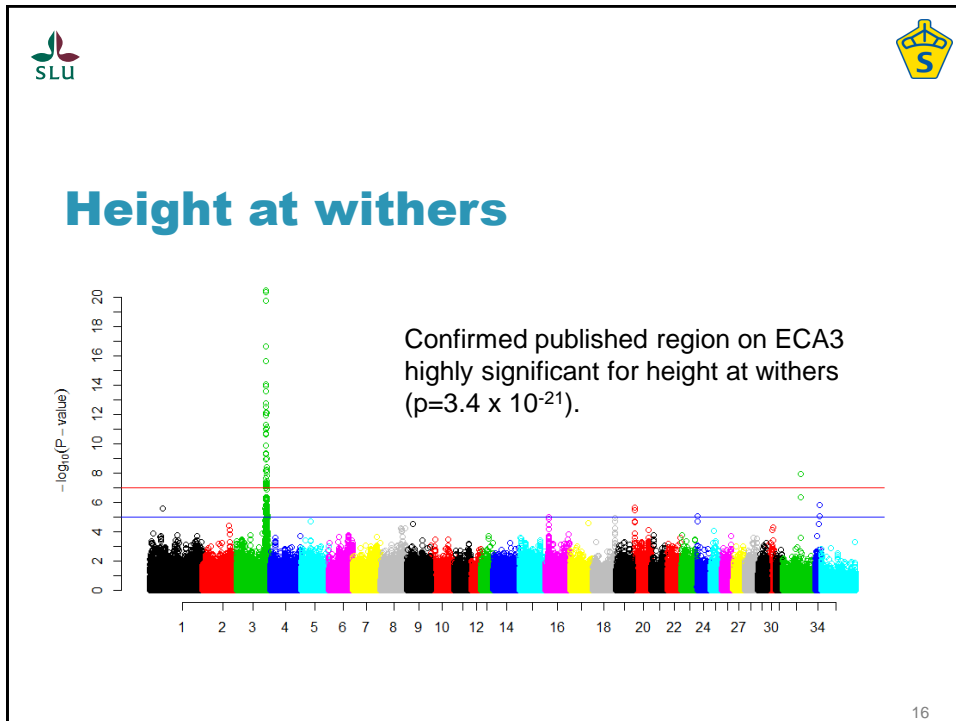
EBV (dressage) = 97
EBV (**show jumping**) = 123

EBV (**dressage**) = 117
EBV (show jumping) = 84



These two components explain 100 % of the point variability.

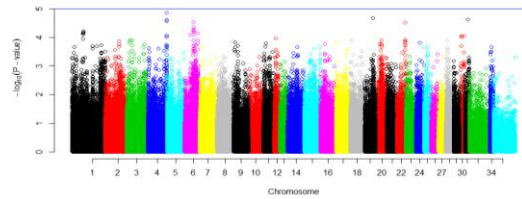
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Movements

Only few suggestive associations for movement traits in spite of high heritabilities ($p=1.3 \times 10^{-6}$).



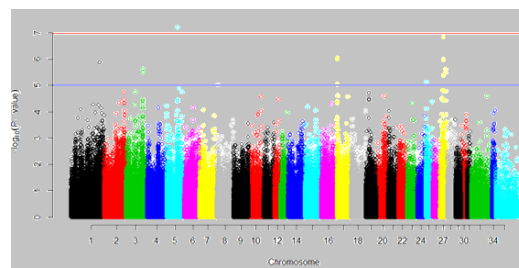
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Jumping technique

No significant association found in full data set ($N=378$) or in dressage cluster.

But potentially interesting association(s) in show jumping cluster only for linear jumping trait ($N=189$, $p = 6.4 \times 10^{-8}$).



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Conclusions

- Increasing focus towards *either* show jumping *or* dressage among SWB-breeders.
- With 380 horses and 670K SNP-chip genome-wide assoc. for 'normally distributed' traits could be detected.
- A highly significant genome-wide association was confirmed for height at ECA3.
- Significant SNP associations were found for conformation traits.
- Within one of two clusters, significant association was found for linear jumping traits.

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Acknowledgement

- Swedish Warmblood Association
- Swedish-Norwegian Foundation for Equine Research



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