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Suisse. Naturellement.

Shape & gaits 2.0 – four seasons of objectively measuring young Swiss horses in the field

Dr. Annik Gmel

30.03.2023

www.agroscope.ch I gutes Essen, gesunde Umwelt

Universität Bern | Universität Zürich
vetsuisse-fakultät

Universität Zürich
Vetsuisse-Fakultät, Departement für Pferde

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Why objective measurements?

Scores:

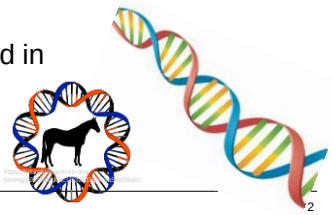
- Low to medium heritability of traits (Burren et al. 2015)
- Breed specific, small sample sizes
- Subjective (Gmel et al. 2020)
- Distributions not good, tendency towards optimum (Burren et al. 2015, Pfammatter 2017)

https://www.spiegel.de/sport/fussball/videobeweis-in-der-bundesliga-absoluter-mafia-a-1176998.html

https://www.sportbuzzer.de/artikel/videobeweis-bundesliga-2018-19-schiedsrichter-fehlentscheidungen-dfb-bilanz-var/

New objective data for:

- Support of the judges (for training and in cases of disputes)
- Genetic and genomic studies



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Two parts

- Conformation
- Gait quality

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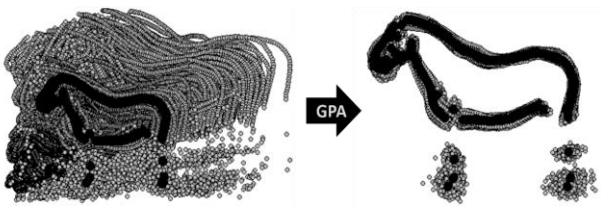
Horse shape space

animal
The use of novel phenotyping methods for validation of equine conformation scoring results
T. Druml*, M. Dobretsberger and G. Brem
(Received 27 August 2014; Accepted 9 December 2014)

- Photographs from the side
- Outline and anatomical landmarks
- Objective measures of joint angles and shape variation



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Database

- Currently, we have data from:
  - >500 FM
  - 226 Lipizzaner
  - 73 Warmblood (CH)
  - 32 Shagya Arabians
  - 28 Purebred Arabians
  - 19 Pura Raza Español

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Results

- Genome-wide associations for poll angle in FM and Lipizzaner horses

Genome-Wide Association Studies Based on Equine Joint Angle Measurements Reveal New QTL Affecting the Conformation of Horses

by Annik Imogen Gmel [1,2,*], Thomas Druml [3], Rudolf von Niederhäusern [1], Tosso Leeb [2] and Markus Neuditschko [1]

- Genome-wide associations for type (heavy-light) and back shape (kyphosis-lordosis) in Lipizzaner horses *(under peer review)*

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Current FM analyses – pedigree-based heritabilities

Angle	Heritability	Repeatability
Poll	0.37	0.98
Neck-shoulderblade	0.20	0.94
Shoulder	0.18	0.81
Elbow	0.20	0.86
Carpus	0.13	0.43
Fetlock front	0.29	0.65
Hip	0.23	0.90
Stifle	0.08	0.88
Hock	0.16	0.82
Fetlock hind	0.19	0.77

Open Access Article

Estimates of Genetic Parameters for Shape Space Data in Franches-Montagnes Horses

by Annik Imogen Gmel [1,2,*], Alexander Burren [3] and Markus Neuditschko [1]

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Some heritabilities higher when measuring… some not

Judged trait	h²	Measured trait	h²
Shoulder incline	0.09	Shoulder joint angle	0.18
Front limb (back-at-the-knee – over-at-the-knee)	0.14	Carpal joint angle	0.27
Croup incline	0.20	Hip joint angle	0.20
Hock angle	0.19	Hock joint angle	0.16

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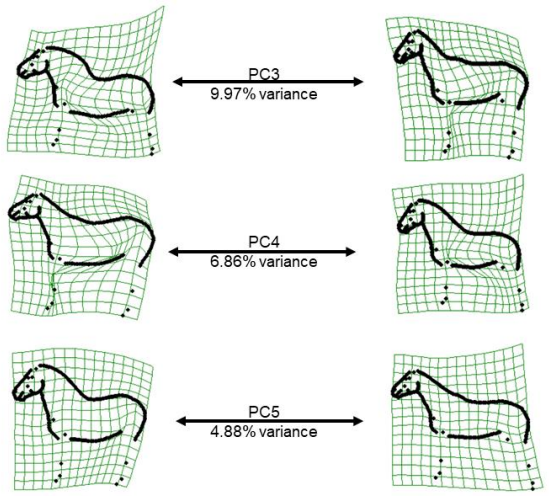
Current FM analyses – pedigree-based heritabilities

- High heritability for heavy – light type



h^2=0.36

h^2=0.29

h^2=0.37

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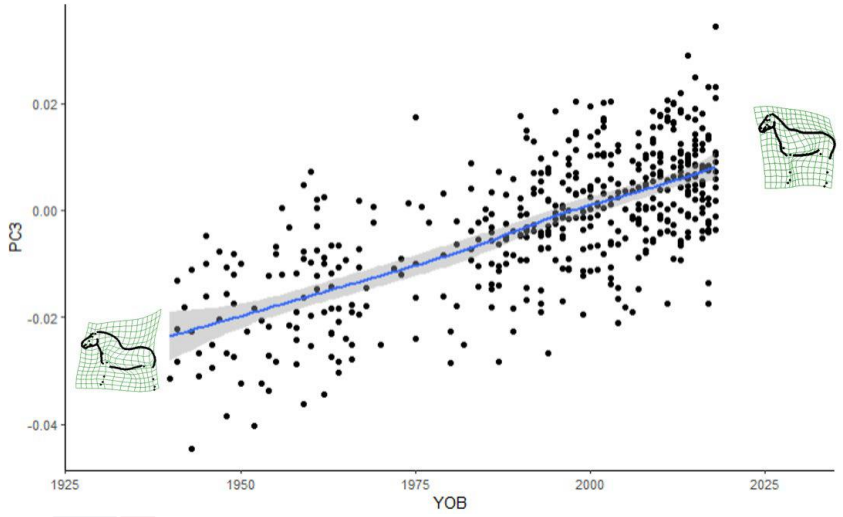
Loss of heavy type in the FM over time



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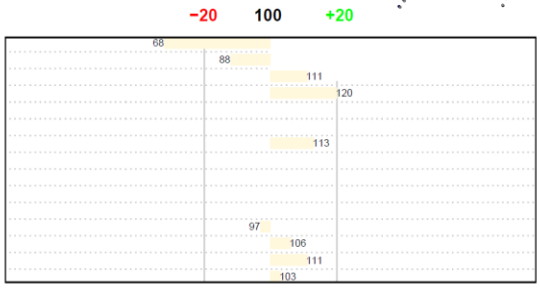
New visualisation for breeders

- Index
- Mean = 100, standard deviation = 20

INDEX SHAPE

Stockmass/Hauteur au garrot
Nackenwinkel/Angle de la nuque
Schultergelenkswinkel/Angle de l'épaule
Karpalgelenkswinkel seitlich/Angle du carpe vue latérale
Karpalgelenkswinkel L frontal/Angle du carpe G frontal
Karpalgelenkswinkel R frontal/Angle du carpe D frontal
Vorderes Fesselgelenk seitlich/Pâturon antérieur vue latérale
Vorderes Fesselgelenk L frontal/Pâturon antérieur G vue frontale
Vorderes Fesselgelenk R frontal/Pâturon antérieur D vue frontale
Hufwinkel L frontal/Angle du sabot G frontal
Hufwinkel R frontal/Angle du sabot D frontal
Hüftgelenkswinkel/Angle de la hanche
Sprunggelenkswinkel/Angle du jarret
Hinteres Fesselgelenk seitlich/Pâturon postérieur vue latérale
PC4 – Halsmuskulatur/PC4 – Muscles de l'encolure



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Conclusions from shape data

- Good posture of the horse during the photograph is necessary
- Time between taking the photograph and getting the feedack to the breeders
  - Automation of the landmark settings should be feasible but exceeds our mandate
- Heritabilities for some joint angles and type are better than when judged

➢It could be possible to take pictures of all horses presented at the field tests for the breeding value estimation

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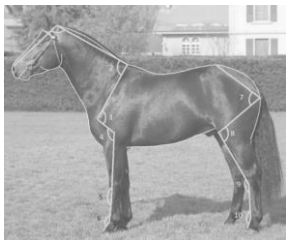
Two parts

- Körperbau / Conformation
- Gänge / Allures



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Different phases

- Determine measurable parameters
- Determine the optimal field conditions
- Mesure as many horses as possible
- Analyse external effects (speed, size)
- Genome-wide association studies

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Summary 2020-2023

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2020	2021	2022	2023
• **15** stallions • **19** mares • **21** geldings	• **17** stallions • **44** mares • **42** geldings	• **17** stallions • **28** mares • **17** geldings	• ***18*** *stallions* • ***13*** *mares* • ***24*** *geldings*

2020	2021	2022	2023
• **14** mares • **7** geldings	• **12** mares • **7** geldings		

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First comparisons FM vs WB

- At walk, WB had more protraction of the forelimbs, and longer strides than FM (better ground coverage)

	FM	WB	Significance
Speed m/s	1.66±0.11	1.73±0.07	***
Stride length m	1.77±0.12	1.99±0.11	***
Forelimb protraction	32.42±2.38	34.51±1.52	***
Forelimb retraction	41.68±3.02	38.65±3.00	***
Hind limb protraction	27.60±2.11	28.51±1.82	*

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First comparisons FM vs WB

- At trot, FM had more protraction and longer suspension duration than WB. WB still had longer strides

	FM	WB	Significance
Stride length	2.96±0.29	3.27±0.34	***
Forelimb protraction	27.59±3.21	24.86±3.34	***
Hind limb retraction	24.88±3.13	23.62±3.84	*
Suspension duration (s)	0.039±0.026	0.006±0.030	***

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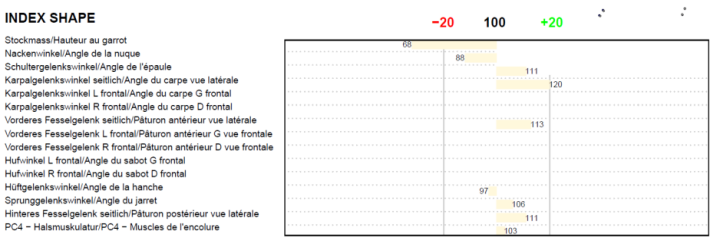
Difficulties

- Long delay between measurements and feedback to the breeders
- Potential improvement with a larger database
- Missing automation



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Usefulness for breeders and breeding organisations

- Objective measurements, medium heritabilities
- Costs for the breeders low as project was financed externally
- Feedback for every horse

- Breeders found it particularly positive that the young horses had a «training presentation» by our handlers

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Discussion

- Shape and gaits 2.0 is a stepping stone towards objective measurements in the field
- Hard to integrate EquiMoves® directly in a field test, but possible for station tests and stallion licensing
- Markerless tracking is the next step for the objective measurement of horses at breeding shows
- Relation between sensor data and markerless tracking essential to improve algorithms

Mathis Laboratory
of adaptive motor control

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Future plans

- Genome-wide association studies on shape data of the FM and of all breeds combined
- Estimates of heritability and genome-wide analysis on our EquiMoves data

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Thank you to the team!

- Supervisors: Mike Weishaupt, Markus Neuditschko
- Technical support: Filipe Bragança
- Engineer: Eyrún Halla Haraldsdóttir
- Handlers: Jérémie Korpès, Christian Gerber, Ludovic Taillard, Hervé Sapin

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