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Is It Possible to Define a European Total Merit Index?

(Presentation for the PROTEJE group)

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Introduction

- PROTEJE workgroup started in 2001
  - Initiative of European Holstein & Red Holstein Confederation (EHRC)
- Main objective:
  - To investigate the possibility of having one common list of bulls potentially useful for Europe
- Common European direction of selection
- Easier comparisons of bulls on the international market

Introduction

- Two main areas of work:
  - Single MACE trait lists
    $\Rightarrow$ combined proofs on a phantom country scale
    - Täubert, H., Z. Liu and F. Reinhardt. 2008. Predicting MACE breeding values on a phantom country scale. Interbull Bulletin 38:152-157.
  - A European Total Merit Index

  $\Rightarrow$ This presentation !

Material and Methods

- Official TMIs from 6 European countries or regions:
  - France (ISU), Germany (RZG), Walloon Region of Belgium (V€G), Italy (PFT), The Netherlands (NVI) and the Nordic countries (NTM)

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- Multiple regression
  - Of this draft on the currently available combined proofs (MACE proofs on a phantom country scale)

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  $\boxed{\Rightarrow \text{Index coefficients}}$

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	N	Min	Mean	SD	Max
ISU	81,165	-44.0	86.71	27.33	195.00
RZG	95,292	40.57	91.89	13.43	148.69
V€G	105,014	-936.00	-17.63	140.52	502.00
PFT	8,201	-2,273.00	0.64	787.30	2,795.00
NVI	120,717	-510.00	-94.71	83.45	297.00
NTM	7,490	-59.00	-13.25	11.81	35.00

Results (Shared Bulls)

- TMIs of shared 458 bulls:
  - France (ISU), Germany (RZG), Walloon Region of Belgium (V€G), Italy (PFT), The Netherlands (NVI) and the Nordic countries (NTM)

	N	Min	Mean	SD	Max
ISU	458	31.00	106.82	22.38	195.00
RZG	458	61.09	102.56	12.74	148.69
V€G	458	-335.00	112.26	120.59	502.00
PFT	458	-1,630.00	467.08	690.16	2,795.00
NVI	458	-282.00	-24.60	75.94	297.00
NTM	458	-50.00	-8.28	11.66	35.00

Results (Shared Bulls)

	Δ Mean (SD)	Δ SD (%)
ISU	+ 0.74	- 18 %
RZG	+ 0.79	- 5 %
V€G	+ 0.92	- 14 %
PFT	+ 0.59	- 12 %
NVI	+ 0.84	- 9 %
NTM	+ 0.42	- 1 %

- TMIs of shared 458 bulls:
  - France (ISU), Germany (RZG), Walloon Region of Belgium (V€G), Italy (PFT), The Netherlands (NVI) and the Nordic countries (NTM)
  - Differences between original and selected populations:
    - Changes 0.42 SD ⇔ 0.92 SD for means
    - Only -1% ⇔ -18% for SD of original SD
  - Selected population kept large part of original variability

Results (PCA)

- Correlation matrix among national TMIs from the 6 European countries or regions

	ISU	RZG	V€G	PFT	NVI
RZG	.89				
V€G	.82	.87			
PFT	.83	.83	.79		
NVI	.82	.90	.87	.78	
NTM	.79	.87	.79	.75	.85

- Principal components
  - 86% of variability of these 6 TMIs described by first principal component (Prin1) and
  - 5% by second principal component (Prin2)

Component Pattern

Component Pattern

Component 2 (4.761%)

PFT
ISU
RZG
VEG
NVI
NTM

Component 1 (85.76%)
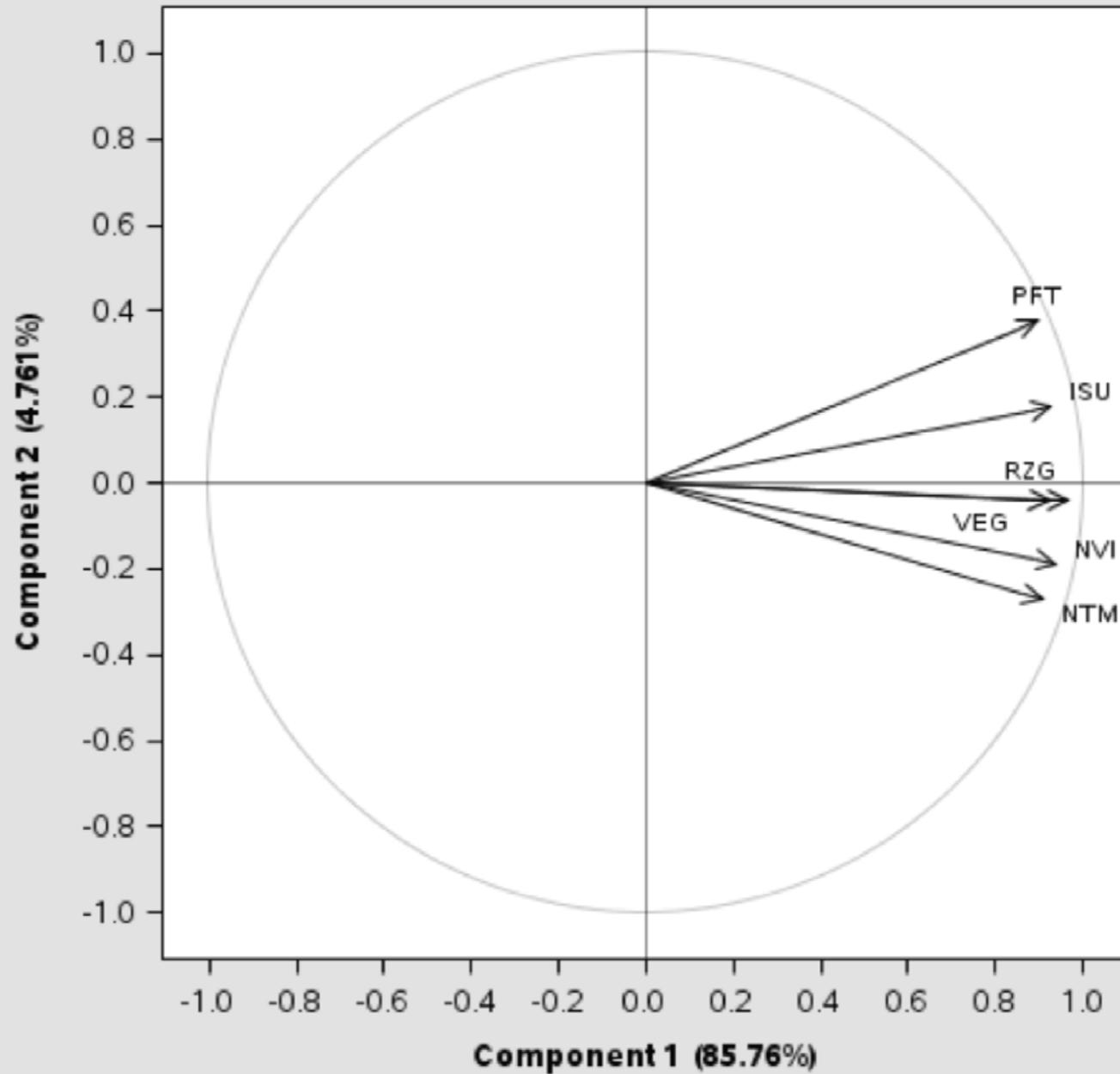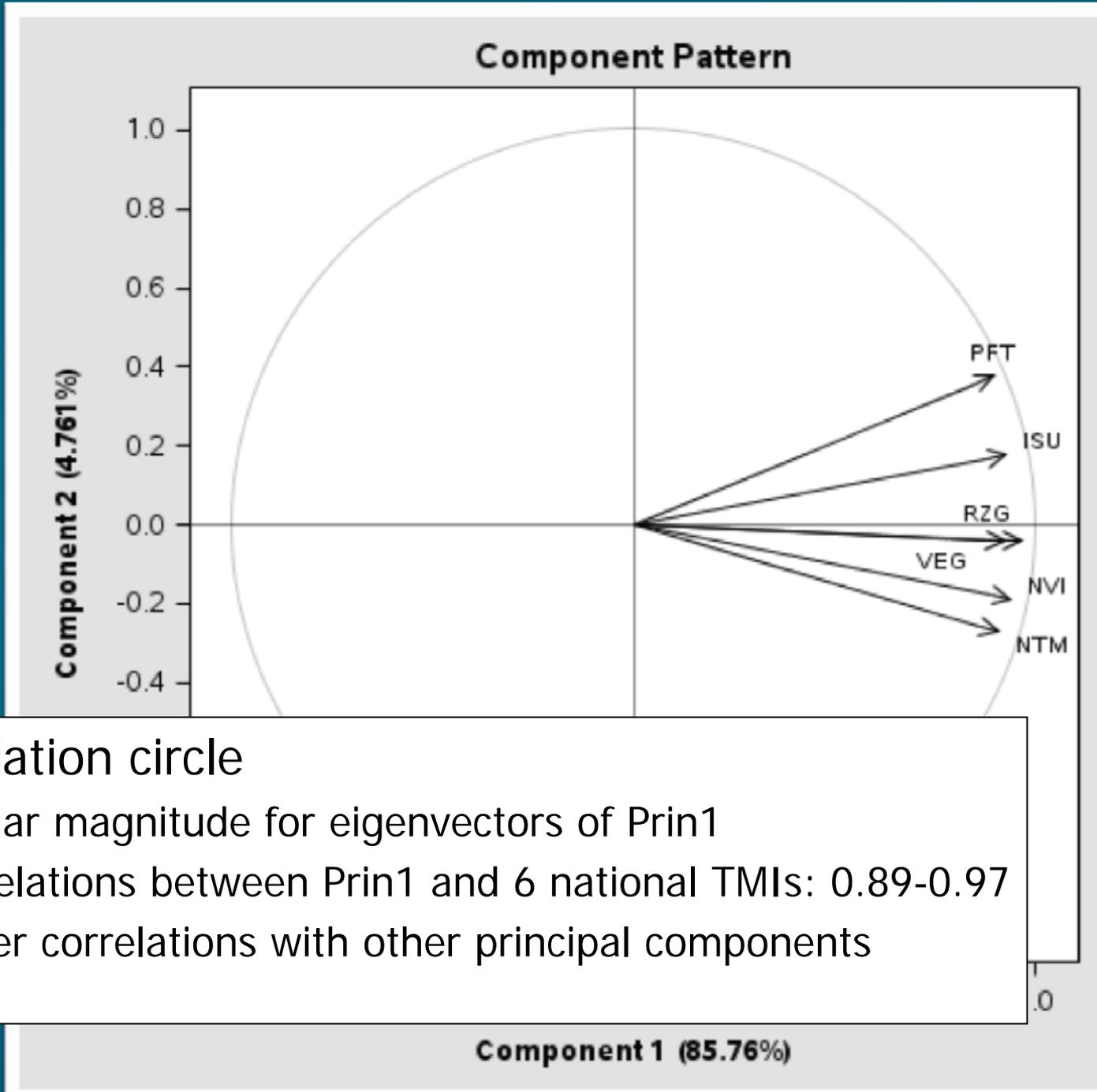
Correlation circle

- – Similar magnitude for eigenvectors of Prin1
- – Correlations between Prin1 and 6 national TMIs: 0.89-0.97
- – Lower correlations with other principal components

Results (PCA)

- **Correlations of Prin1 and Prin2** with all available combined proofs on phantom scale

	Prin1	Prin2		Prin1	Prin2
Milk					.28
Fat					.12
Prote…					.12
Udde…					.41
Fema…					-.07 NS
Milki…					.08 NS
Temp…					-.03 NS
Angularity	.02 NS	.41	Rear Teat placement	.12	.30
Body Condition Score	.14	.46	Rear Udder Height	.35	.42
Body Depth	-.20	.42	Rump Width	.04 NS	.33
Chest Width	-.09 NS	.32	Stature	.10	.49
Foot Angle	.23	.29	Udder Depth	.32	.37
Fore Teat Length	.02 NS	.06 NS	Udder Support	.28	.34
Fore Teat Placement	.28	.24			

Phantom scale (Täubert et al., 2008 Interbull Bulletin 38:152-157)
- Method for optimal combining of MACE proofs
- Based on selection index
- Results showed no bias and no double-counting

NS: Not Significant

Results (PCA)

- Correlations of Prin1 and Prin2 with all available combined proofs on phantom scale

	Prin1	Prin2		Prin1	Prin2
Milk	.44	.00 NS	Fore Udder Attach.	.15	.28
Fat	.55	.06 NS	Locomotion	.37	.12
Protein	.68	-.12	Overall Feet & Legs	.42	.12
Udder Health (SCC)	.38	.22	Overall Udder Score	.40	.41
Female Fertility (C2)	.20	-.25	Rump Angle	.08 NS	-.07 NS
Milking Speed	.06 NS	.00 NS	Rear Leg Rear view	.28	.08 NS
Temperament	.06 NS	.00 NS	Rear Leg Set	-.26	-.03 NS
Angularity	.02 NS	.41	Rear Teat placement	.12	.30
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Prin1 ~ good compromise to express common breeding goal across these 6 European countries or regions
➔ Prin1 = draft for the European TMI

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Results (Multiple Regressions)

- Estimated regression coefficients permitted to define 3 groups of traits:
    - Production: milk, fat and protein yields
    - Functionality: udder health based on SCC and female fertility (cow's ability to conceive)
    - Conformation: only 9 of the 19 morphological traits presented significant effects
        - BCS, body depth, fore teat placement, locomotion, overall feet & legs, rear leg rear view, rear teat placement, rear udder height and udder support
- Combination of these 3 groups
    - Using multiple regressions to estimate a European TMI expressing the common breeding goal

Results (Relative Index Weights)

- Relative emphases (%) on traits in European TMI

Production	37	Conformation	26
Milk	-8	BCS	1
Fat	7	Body Depth	-4
Protein	23	Fore Teat placement	2
Functionality	*37*	Locomotion	3
Udder Health (only SCC)	30	Overall Feet & Legs	3
Female Fertility	7	Rear Leg Rear view	-4
		Rear Teat placement	-4
		Rear Udder height	2
		Udder support	3

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			Rear Teat placement	-4
			Rear Udder height	2
			Udder support	3

- **Relative emphases (%) in the 6 national TMIs (2011/06)**

	ISU	RZG	V€G	PFT	NVI	NTM
Production	50	45	48	49	33	31
Functionality	37.5	40	28	28	45	54
Conformation	12.5	15	24	23	22	15

Conclusions

- Extracting common variation by PCA
  - Straightforward method
  - Confirmed similarity of TMIs, but also differences
- Proposition of a European TMI based on currently available combined proofs on phantom scales
  - Attractive results
  - If desired, potentiality useful to establish European bull list
  - Representing dairy selection in Europe on the international market

Conclusions

- Currently:
  - Some important traits are missing (e.g. longevity, calving traits, other health traits)
- Also many other issues must be considered:
  - Participation of other European countries
  - Availability of combined proofs for all traits
- Finally:
  - European TMI can never completely replace country specific TMIs
  - As they represent local differences

Thank you for your attention!

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