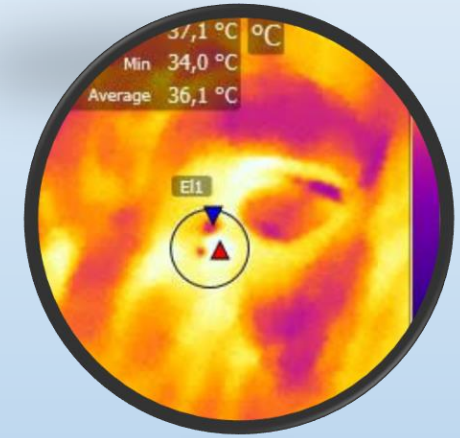

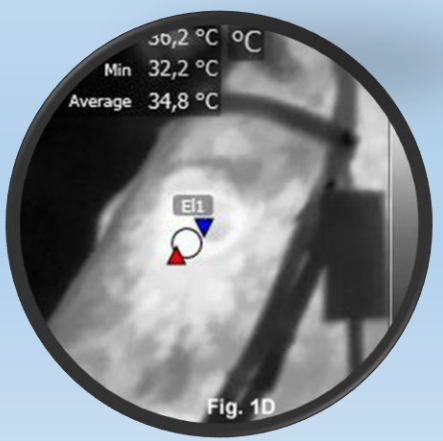

Session 21
Abstract 31934

Influence of intrinsic effects on Effort and Recovery stress assessed with Infrared Thermography

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Introduction

Sport event
- Environmental stimuli

Hostile situations
- Fear reaction

Stress response
- Effort to adapt
- Recover the homeostasis

- Previous studies have reported that the **stress response of a horse** is influenced by several factors, some of them are genetically determined, as **sex** and **breed**.
  (*Bartolomé and Cockram, 2016*; *Lloyd et al., 2008*)

- Recent studies has shown a **good potential of the infrared thermography technology to measure eye temperature (ET) as a means to detect acute stress** in horses during competitions.
  (Valera et al., 2012; Cook et al., 2001).

SPANISH SPORT HORSE BREED (CDE)

- Breed created in 2001
- Included in the Official Spanish Breeds Catalogue
- Integrated by all those horses from 2 or 3 **different breeds** with **good sport aptitudes** but that could not participate at international competitions because they did not belong to any official Studbook.
  - Arabian Purebred
  - Spanish Purebred
  - Spanish Trotter
  - Thoroughbred
  - Anglo-Arabian
  - Menorquina Purebred
  - Hispano-Arabian
  - Other European sport horse breeds
- Participates in different equestrian disciplines: **Show Jumping**, Dressage, Eventing, Endurance, etc.

ANCADES
ASOCIACIÓN NACIONAL DE CRIADORES DEL CABALLO DE DEPORTE ESPAÑOL

Spanish Sport Horse Breeders' Association (ANCADES)

Objectives

1. To test the influence of sex and breed intrinsic effects on the stress due to effort and recovery in CDE horses.

2. Estimate heritability and correlations between these stress variables due to the intrinsic effects evaluated.

Materials and Methods

- **495 CDE** horses (332 males and 163 females)
- From **2 to 13** years old

SPANISH SPORT HORSE BREED (CDE)

L1 – German genetic line

(>50% HANN, OLD, etc)

L2 – Thoroughbred genetic line

(>50% PSI, TH)

L3 – Trotter genetic line

(>50% Trotter Horse)

L4 – Spanish Purebred genetic line

(>50% PRE)

L5 – Others

(>50% Other Breeds and <50% of previous genetic lines)

Pedigree matrix was built up to the 3^{rd} generation, to a total of 7907 animals (3000 males and 4907 females)

Spanish Sport Horse Breeders' Association

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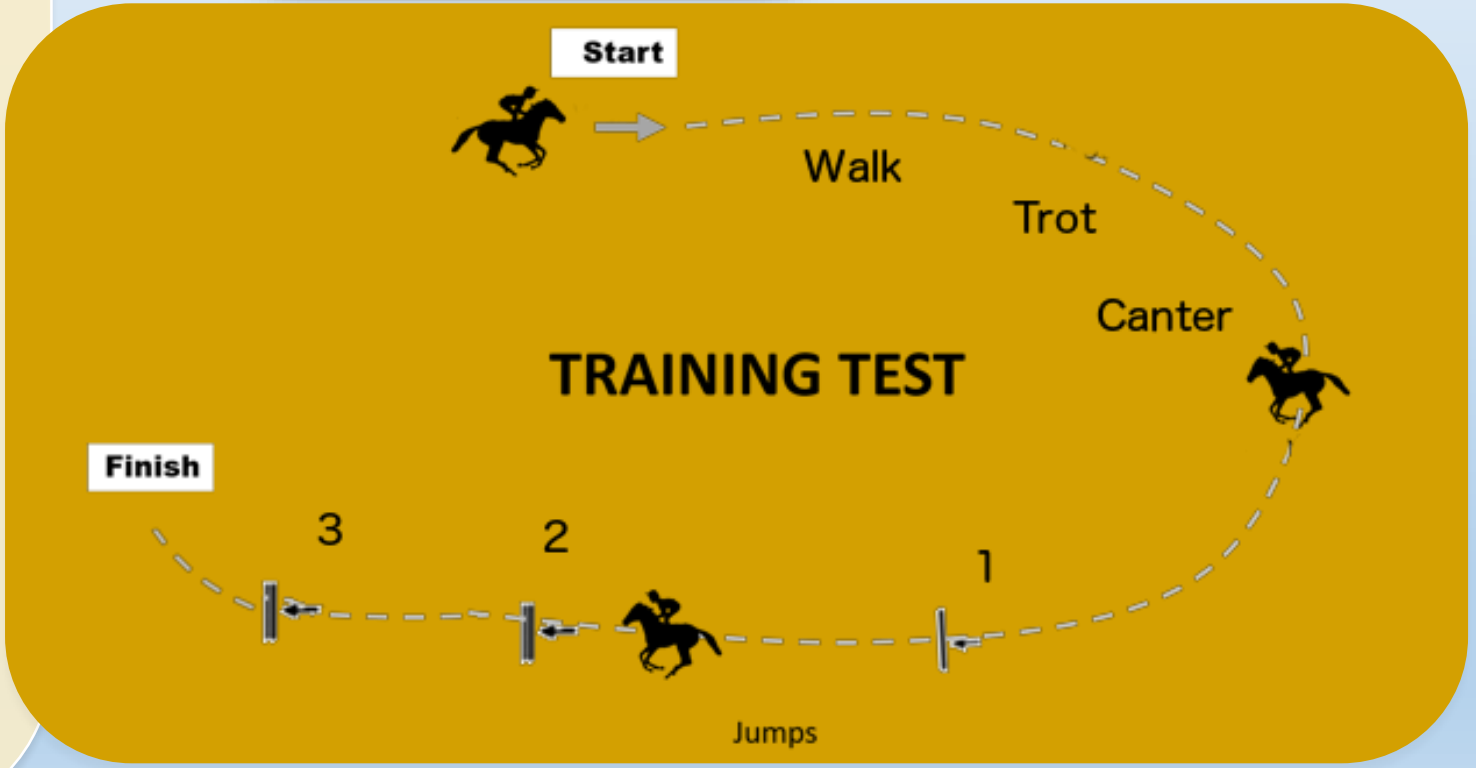
- Study Design -

Materials and Methods

- Same equestrian centre from 2014 to 2018
- Training test:
  - Walk
  - Trot
  - Gallop
  - 3 Jumps over 1m high crossed fence
- Professional riders



- Physiological data -

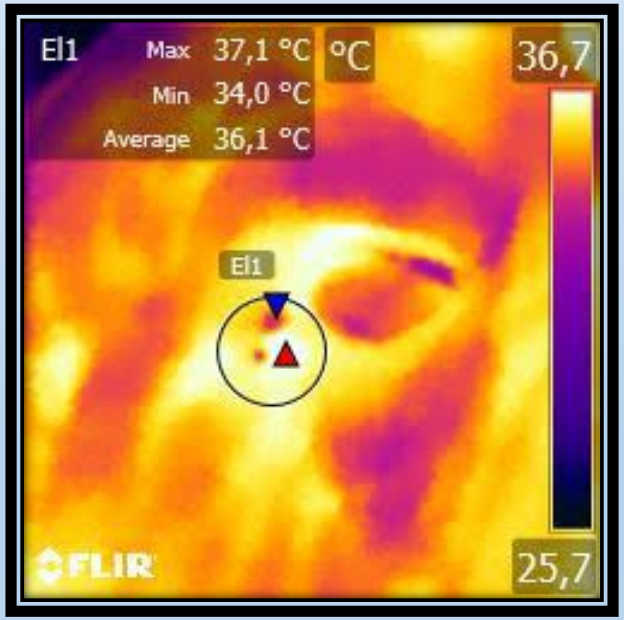
Materials and Methods

- Eye temperature assessed with Infrared Thermography

Portable infrared thermography camera (FLIR E60®)

- **Flir Tools software®.**
- Maximum temperature within an oval area traced around the **caruncle of the left eye**, from a 90º angle and at a distance of 1 meter.

Digital thermo hygrometer (Extech 44550®)



Analysed Infrared Thermography photograph

- Physiological data -

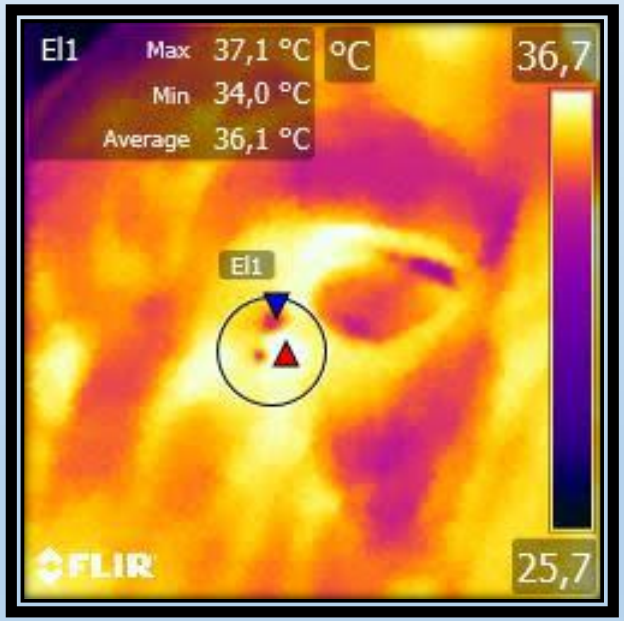
- Samples were collected three times during the test day

Materials and Methods

- One hour before the test (BT)
- Just after the test (JAT)
- One hour after the test (AT)

$$\textbf{Effort Phase}(\textbf{EP}) = \textbf{JAT} - \textbf{BT}$$

$$\textbf{Recovery Phase}(\textbf{RP}) = \textbf{JAT} - \textbf{AT}$$



Infrared Thermography analysed photograph

Effort phase (EP): Between the moment when the animal was calm and the novel situation that caused stress.

Recovery phase (RP): Between the stress moment peak and the moment when body homeostasis was restored.

- Statistical Analyses -

Materials and Methods

- **Normal distribution** for EP and RP variables *(results not shown)*
- Previous **General Linear Model** for EP and RP, with Sex and Genetic Line effects *(results not shown)*.

Sex and **Genetic Line** statistically significant for both variables

- **Least Square Means** and Post-hoc **Duncan's test**
- **Pearson's intra-class correlations** between EP and RP due to **Sex** and **Genetic Line** effects.

StatSoft® STATISTICA

- Genetic model and genetic parameters' estimation -

Materials and Methods

- Heritability coefficients and genetic correlations were estimated using **BLUP** evaluation based on a **bivariate animal model** using a **Bayesian approach with TM software**:

$$\mathbf{y} = \boldsymbol{Xb} + \boldsymbol{Zu} + \boldsymbol{e}$$

Where ***y*** *= vector of observations*
X *= incidence matrix of systematic effects*
Z *= incidence matrix of animal genetic effects*
b *= vector of* ***systematic effects***
u *= vector of* ***animal genetic effects***
e *= vector of* ***residuals***

- **Effort phase** and **Recovery phase** as continuous variables.
- **Age** as covariate.
- **Sex** (2 levels) and **Genetic line** (5 levels) as fixed effects.
- **Rider** (182 levels) and **Horse-rider interaction** (275 levels) as random effects.

Influence of Intrinsic Effects

Table 1. Least square means analysis and post-hoc Duncan's Test for EP and RP variables, according to sex and genetic line. Different **CAPITAL** letters indicate statistically significant differences ($p<0.05$) between **sexes** and within variables, whereas different **lowercase** letters indicate statistically significant differences ($p<0.05$) between **genetic lines** and within variables.

	Males					Females				
	L1	L2	L3	L4	L5	L1	L2	L3	L4	L5
Effort (EP)	1.6^{Aa}	1.6^{Aa}	1.6^{Aa}	1.1^{b}	1.3^{Ab}	0.7^{Bc}	0.7^{Bbc}	1.8^{Aa}	-	1.0^{Ab}
Recovery (RP)	0.6^{Ab}	0.8^{Ab}	1.2^{Aa}	0.2^{c}	1.1^{Aa}	-0.4^{Bb}	-0.2^{Bb}	1.4^{Aa}	-	0.0^{Bb}

Highest Δ ET

Lowest Δ ET

Greatest recovery

Greatest recovery

Where L1= German genetic line; L2 = Thoroughbred genetic line; L3= Trotter genetic line; L4= Spanish Purebred genetic line; L5= Other genetic lines;

Results and Discussion

L3 Trotter → great reaction and high recovery *(Thiruvenkadan et al., 2009)*

L4 PRE → low effort and low recovery *(Sanchez-Guerrero et al., 2016)*

Males L1, L2 and L5 → good reaction and medium recovery
Females L1, L2 and L5 → low effort stress and bad recovery *(Moberg, 2000)*

Phenotypic Intra-class Correlations

Table 2. Phenotypic intra-class correlations between Effort and Recovery variables, for sex and genetic line effects.

	Recovery phase		
	Sex	Genetic line	
Effort phase	**M 0,46*** **F 0,65***	**L1 GE 0,82*** **L2 TH 0,63*** **L3 TR 0,53*** **L4 PRE 0,41*** L5 OT $0{,}28^{n.s.}$	

***p<0,001; n.s. not statistically significant

Exist a **tendency within breeds and sexes** to react and **recover** from a stressful situation with a **similar magnitude**.
(Bartolomé and Cockram, 2016; Lloyd et al., 2008)

Results and Discussion

Genetic parameters

Table 3. Heritability (h2) ± standard deviation (SD) and genetic correlation (r) between Effort (EP) and Recovery (RP) variables.

	h^2 ±SD	r
EP	**0.26**±0.158	0.23
RP	**0.52**±0.073	

Medium to high

Results and Discussion

- Slightly **higher** in young **PRE** horse
  (Sanchez-Guerrero et al., 2016)
- **Similar** to results for different **behavioural traits**
  (Hausberger, et al., 2004)

1. **Breed genetic lines and sex** affect the **stress perceived** by CDE horses during the exercise, with **males** showing **greater effort and recovery** than females, **L3 CDE** horses showing the **highest effort and recovery** values and **L4 CDE** horses the **lowest**.

2. Effort and recovery stress variables showed **medium to high phenotypic correlations regardless** the sex and most genetic lines, indicating a tendency to **react and recover** from a stressful situation with a **similar magnitude**.

3. Effort and recovery stress variables showed **medium heritabilities and genetic correlations**, making them **suitable** to be included in the **Spanish Sport Horse Breeding Program**.

4. **More research is required** including more animals before any precise measures concerning the influence of the genetic and environmental effects can be determined.

Conclusions

Thank you!

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