Validation of heart rate measurements in horses using the Seaver® connected system

A comparative, test-retest and single blinded study

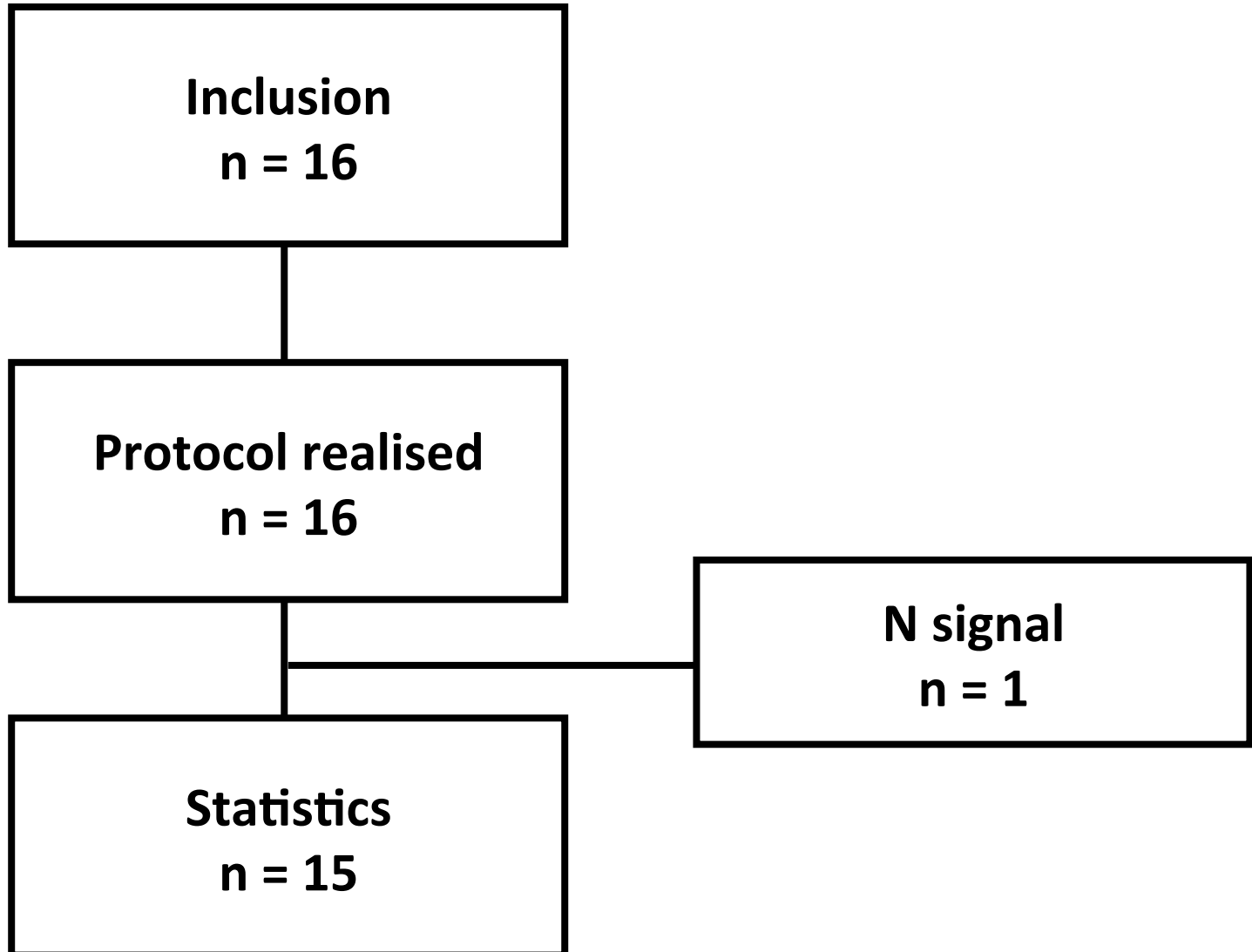**N. Babault, J. Fortier Guillaume**

Aim of the study:

To test the validity and reproducibility of heart rate measurements in horses using the Seaver® connected system

Seaver® vs. Polar

15 horses

Age: 8 ± 2 years

Race: French race (n=13), other (n=3)

Discipline: Jump (from 125 to 145 cm)

Training status: daily (1h/d − 4-10hrs including 2 aerobic training/wk)

Comparative, randomised, single blinded, test-retest

2 visites:

S1, S2	Installation, rest, 3 different speeds

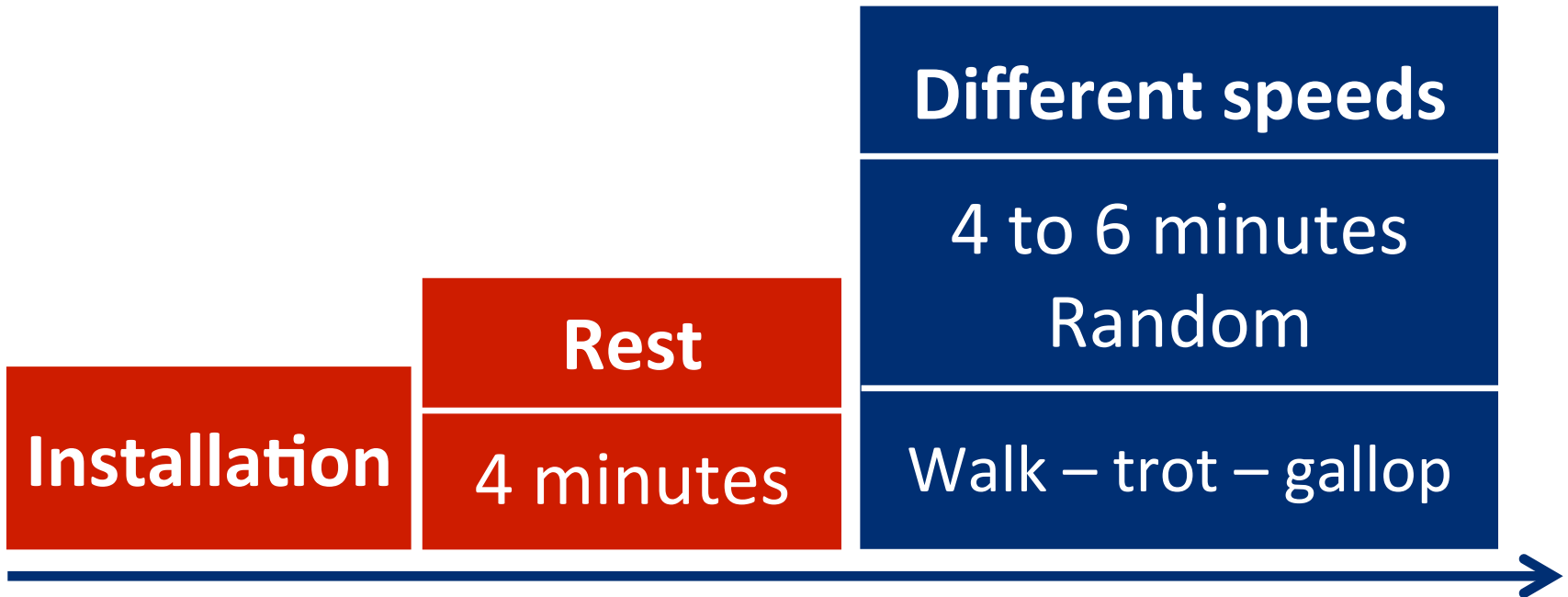# Seaver®   vs.   Polar

Polar has already been used in horses and has been validated

Vermeulen and Evans (2006), Caminal et al. (2018)

Pictures from Internet

Installation

Rest

4 minutes

Different speeds

4 to 6 minutes
Random

Walk – trot – gallop

Installation

Rest

4 minutes

Different speeds

4 to 6 minutes
Random

Walk – trot – gallop
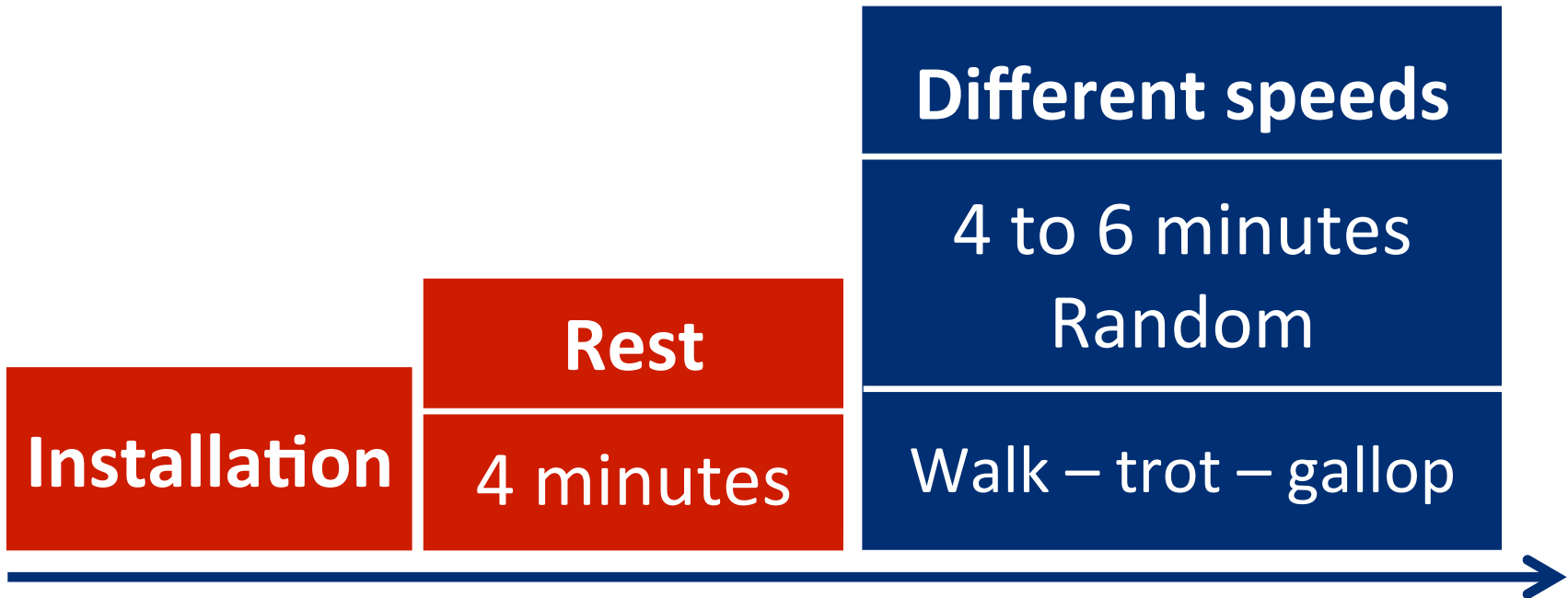
Different speeds ➡️ **Heart rate (10 sec. intervals)**

Mean, maximum, minimum, standard deviation, coefficient of variation

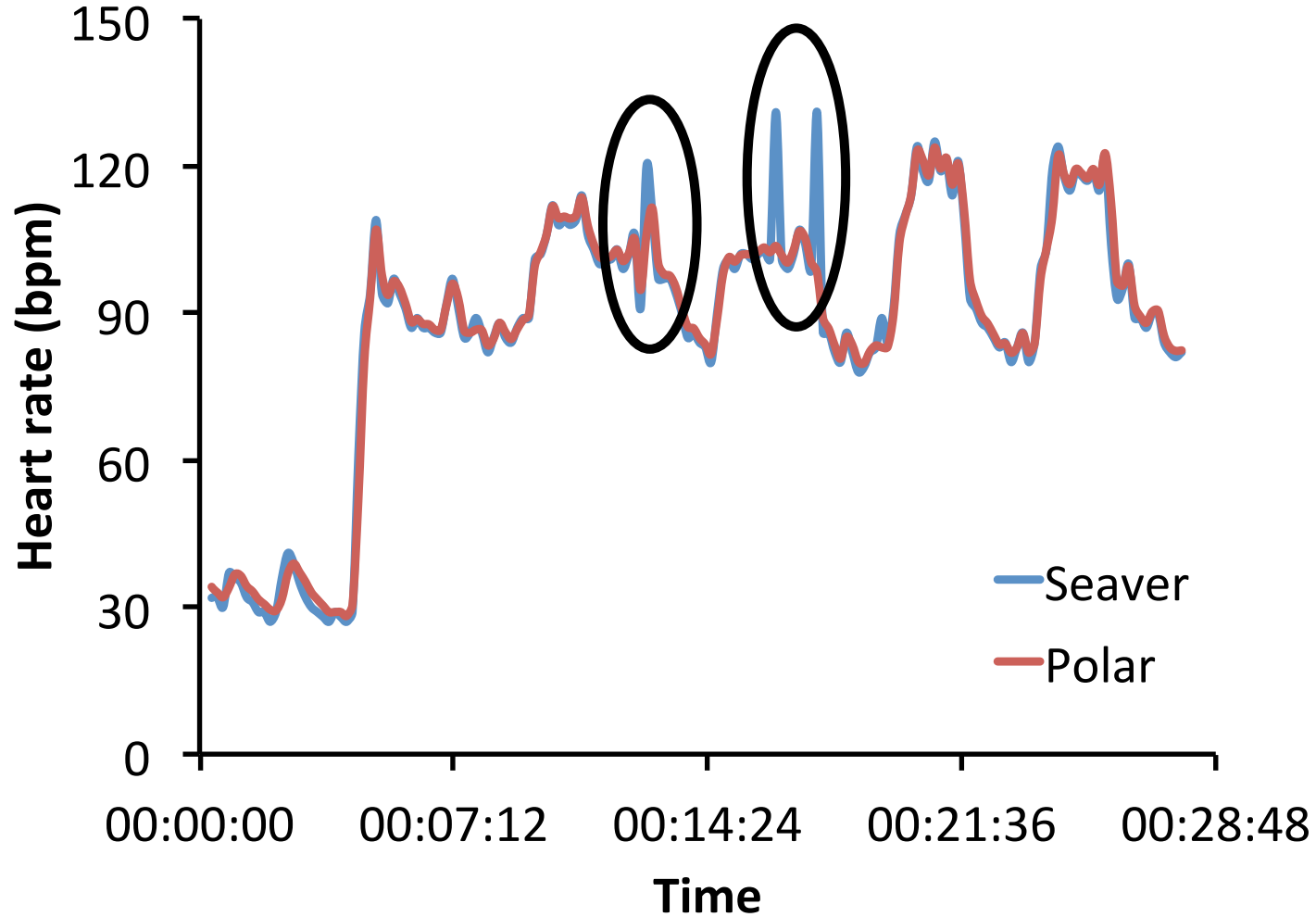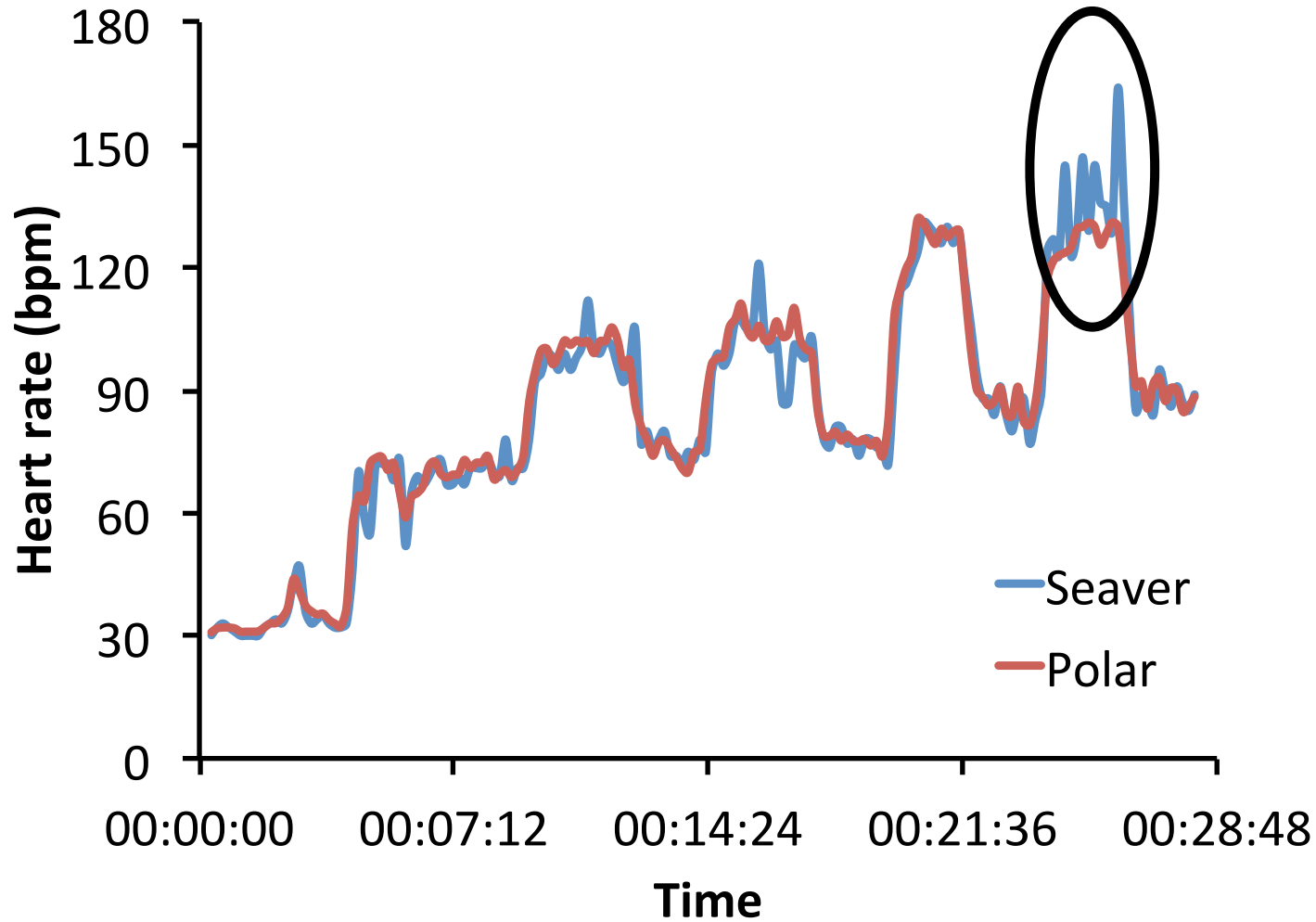# Example #1

Example #2

Example #3
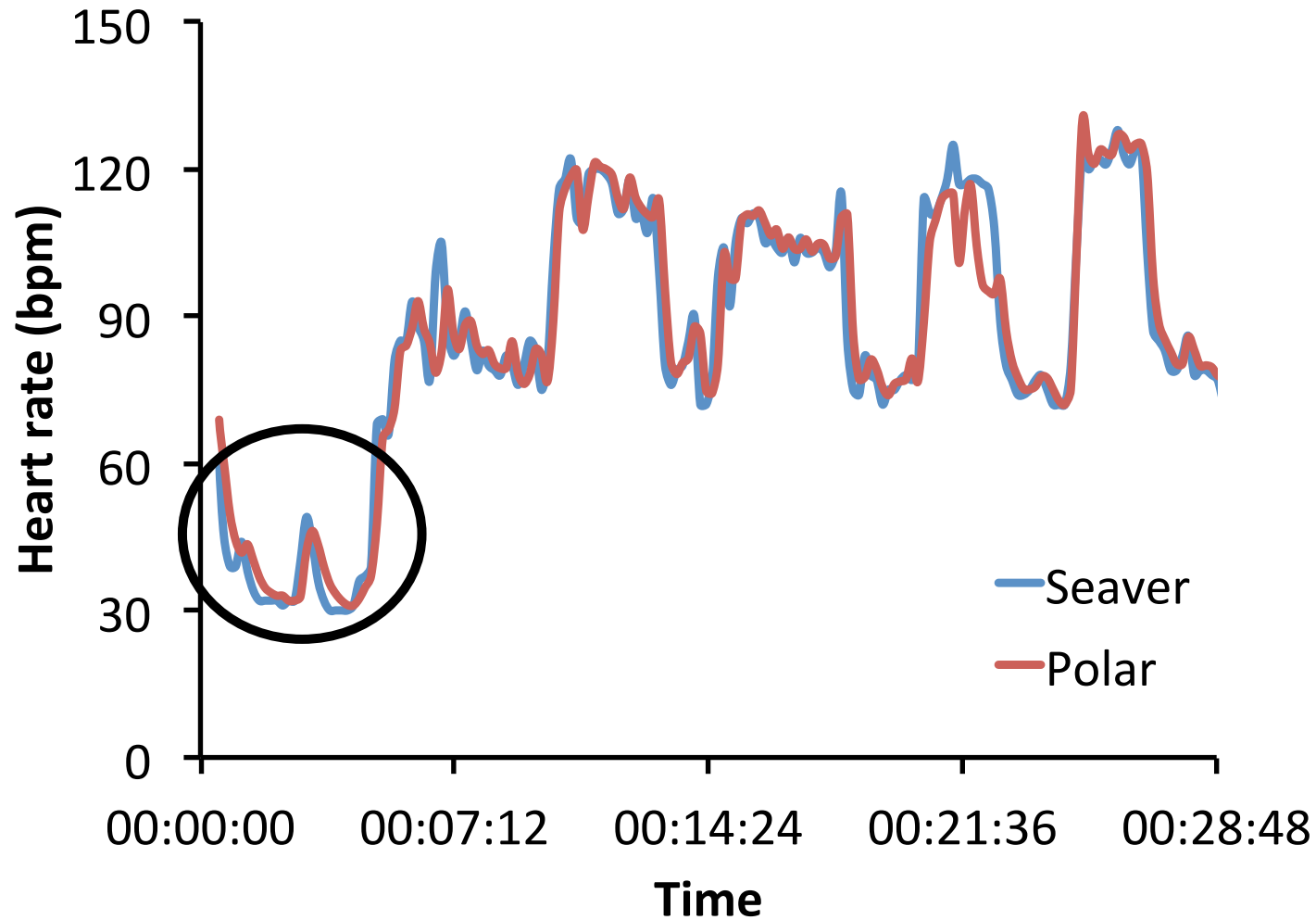
Heart rate: mean values

	Seaver S1	Polar S1	Seaver S2	Polar S2
Rest	32.4 ± 2.2	33.3 ± 2.1	33.1 ± 1.9	33.9 ± 2.0
Walk	72.6 ± 2.2	73.0 ± 2.1	74.5 ± 1.9	75.3 ± 2.0
Trot	98.0 ± 2.2	100.5 ± 2.1	98.3 ± 1.9	99.6 ± 2.0
Gallop	118.8 ± 2.2	112.9 ± 2.1	116.7 ± 1.9	113.6 ± 2.0

First step of statistical analysis

Effect	Probability	Result	Interpretation
Session	0.568	No difference between S1 and S2	S1 = S2
Speed	0.0000	Heart rate is dependent of the speed	Walk < Pas < Trot < Gallop
Cardio	0.587	No difference between Seaver and Polar	Seaver = Polar

Heart rate: mean values

	Seaver S1 & S2	Polar S1 & S2
Rest	32.7 ± 1.9	33.6 ± 1.8
Walk	73.5 ± 1.9	74.2 ± 1.8
Trot	98.2 ± 1.9	100.8 ± 1.8
Gallop	117.7 ± 1.9	113.2 ± 1.8

Detailled statistical analysis

Effect	Probability	Result	Interpretation
Speed	0.0000	Heart rate is dependant upon speed	Rest < Walk < Trot < Gallop
Cardio	0.587	No difference between Seaver and Polar	Seaver = Polar
Speed x cardio	0.0000	Some specific differences between Seaver and Polar	Rest, Walk, Trot : Seaver = Polar Gallop : Seaver > Polar

Heart rate: standard deviation

	Seaver S1	Polar S1	Seaver S2	Polar S2
Rest	3.5 ± 1.0	2.4 ± 0.8	2.4 ± 1.1	2.0 ± 0.8
Walk	11.4 ± 1.0	10.0 ± 0.8	12.5 ± 1.1	11.4 ± 0.8
Trot	8.8 ± 1.0	6.9 ± 0.8	9.6 ± 1.1	7.6 ± 0.8
Gallop	13.5 ± 1.0	9.4 ± 0.8	14.4 ± 1.1	8.2 ± 0.8

First step of statistical analysis

Effect	Probability	Result	Interpretation
Session	0.667	No difference between S1 and S2	S1 = S2
Speed	0.0000	Variability is dependant upon speed	Walk & Gallop > Trot > Rest
Cardio	0.0000	Differences Seaver and Polar	Seaver > Polar

Heart rate: standard deviation

	Seaver S1 & S2	Polar S1 & S2
Rest	2.9 ± 0.7	2.1 ± 0.6
Walk	11.9 ± 0.7	10.7 ± 0.6
Trot	9.2 ± 0.7	7.3 ± 0.6
Gallop	13.9 ± 0.7	8.8 ± 0.6

Detailled statistical analysis

Effect	Probability	Result	Interpretation
Speed	0.0000	Variability is dependant upon speed	Walk & Gallop > Trot > Rest
Cardio	0.0000	Differences between Seaver andPolar	Seaver > Polar
Speed x cardio	0.0004	Some specific differences between Seaver and Polar	Rest & Walk: Seaver = Polar Trot & Gallop : Seaver > Polar

Heart rate: maximum

	Seaver S1 & S2	Polar S1 & S2	Probability	Interpretation
Rest	41.2 ± 3.5	39.2 ± 2.5	0.4949	
Walk	115.6 ± 3.5	108.3 ± 2.5	0.0357	Seaver > Polar for walk, trot and gallop
Trot	120.8 ± 3.5	112.9 ± 2.5	0.0211	
Gallop	148.3 ± 3.5	125.2 ± 2.5	0.0001	

Heart rate: minimum

Conclusion
Seaver (56.4 ± 1.1) < Polar (59.9 ± 1.0); Probability = 0.0004

Heart rate: Coefficient of variation (CV)

	Seaver S1 & S2	Polar S1 & S2	Interpretation
Rest	8.7 ± 0.7	6.2 ± 0.7	A 15% threshold (or less) is recommanded. S1=S2
Walk	16.3 ± 0.7	14.5 ± 0.7	
Trot	9.3 ± 0.7	7.1 ± 0.7	Walk is greater than the threshold
Gallop	11.8 ± 0.7	7.8 ± 0.7	Seaver > Polar

Heart rate: Intraclass Correlation Coefficient (ICC)

ICC inter-session	Seaver	Polar
S1 et S2	0.9983	0.9990

ICC intra-session	Seaver	Polar
S1	0.9833	0.9817
S2	0.9856	0.9842

Interpretation
ICC > 0.9 corresponds to a high reproducibility

Heart rate: Values

1. Few differences with Polar
2. Observable differences for Gallop
3. Greater variability (standard deviation) with Seaver
4. Variability partly due to a greater dispersion of max. and min. values

➡ **Filter???**

Heart rate: Reproducibility

Good despite a greater intra-session coefficient of variation as compared to polar