

The Velocity and Fatigue Index of Various Leg Kicks in Rescue Towing

JA Abraldes¹, R Stallman², S Soares³, Ana Catarina Queiroga⁴

¹University of Murcia, ²Norwegian School of Sport Science, ³Porto University,
⁴Portuguese Lifesaving Association

XII International Symposium for Biomechanics and Medicine
in Swimming - Canberra, Australia - April 28 - May 2

UNIVERSIDAD DE
MURCIA



NORWEGIAN SCHOOL OF SPORT SCIENCES

Background

- Lifeguards frequently engage in direct body contact rescue
- Rescue towing is more efficient with fins than without
- After exiting the water, lifesavers often need to continue assisting the victim (hence, fatigue is very important)
- **BUT, many times neither fins nor rescue equipment are available to perform a water rescue**



Background

- While direct body contact rescues are not recommended, they may *rarely* be indicated
- Traditionally, several leg kicks have been recommended in the context of swimming rescues, with or without equipment
- The advent of events requiring fins in lifesaving competition has introduced the need to also examine other kicking techniques

Aims

- **To determine which leg stroke technique, when (&/if necessary) performing a direct body contact rescue without fins, results in:**
 - shorter rescue time (higher velocity of displacement)
 - less fatigue (lowest Fatigue Index)



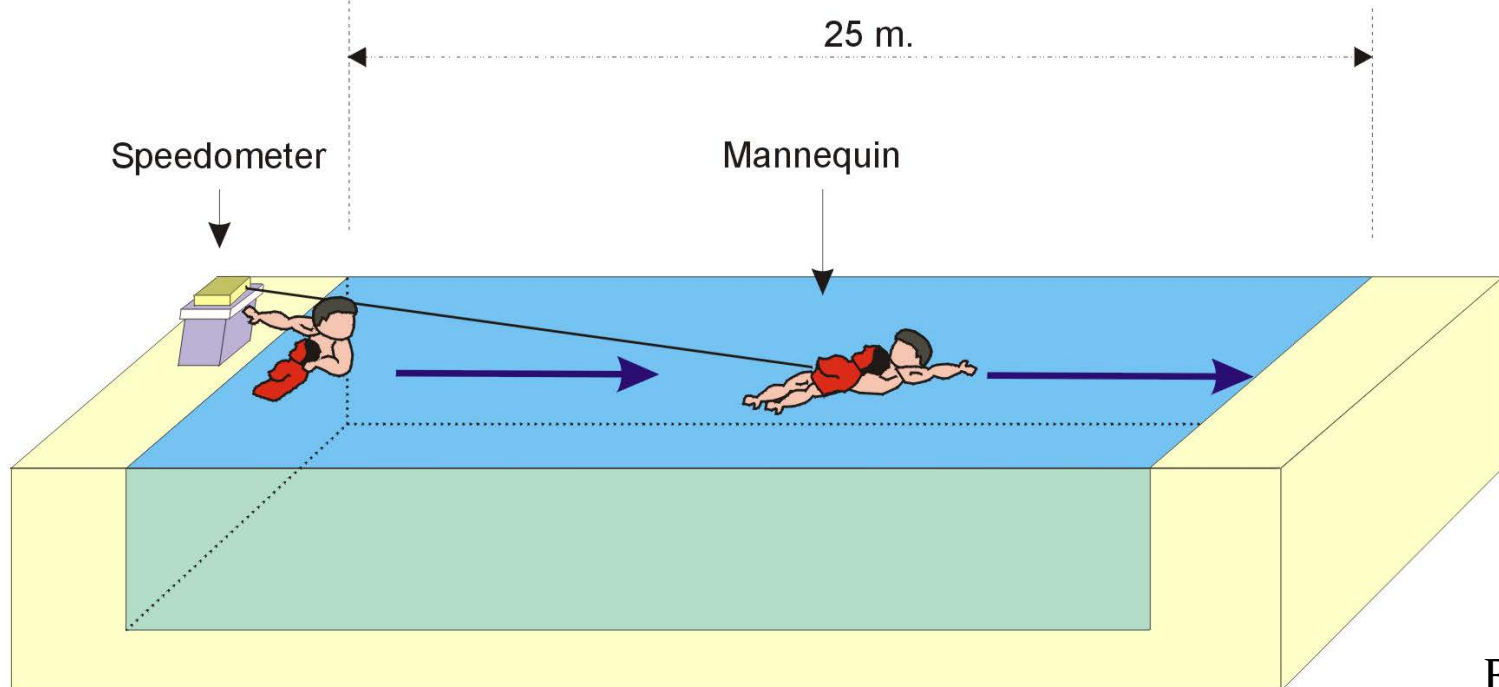
METHODS

Methods

- **Experienced lifeguards (N=11)**
- **Anthropometric measures**
- **Trial:**
 - **Randomized 4 X 25 m rescue tow (ILS standard rescue mannequin)**
 - **4 leg kick techniques without fins:**
 - **breaststroke**
 - **crawl**
 - **scissors**
 - **dolphin**

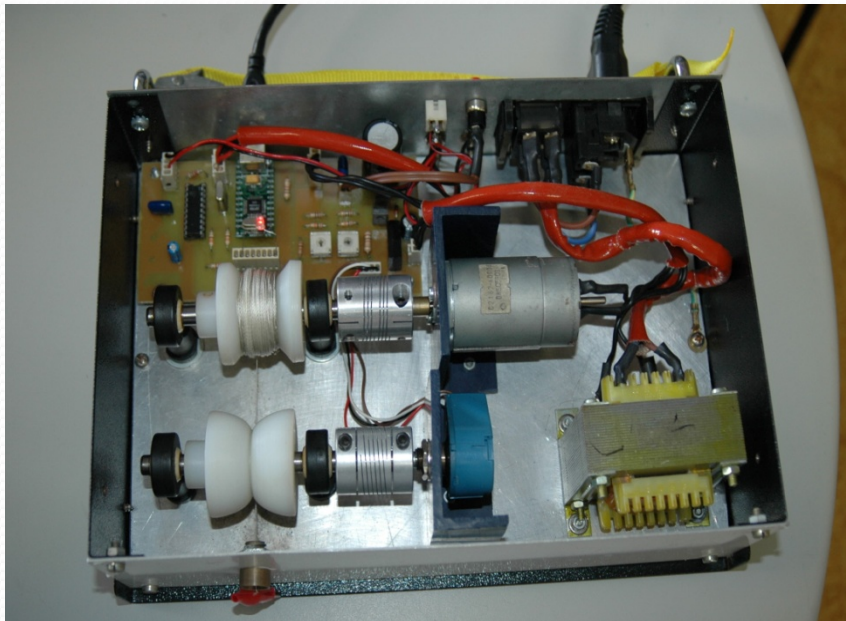
Trial layout

1. Speedometer tied to mannequin
2. 15 min between trials
3. Randomized technique order
4. Towing trials were recorded from under water
5. Only subjects successful on all four trials were included
6. Trials where technique was be too poor were excluded

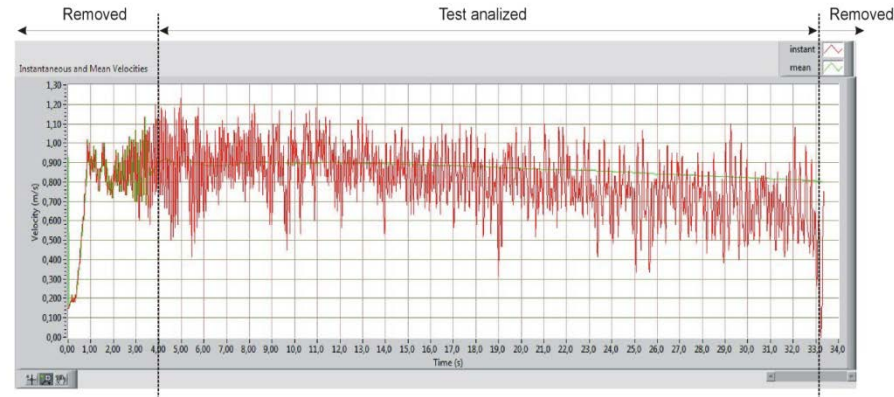


Measuring velocity

- Speedometer



Instantaneous velocity-time curve
(note noise introduced by speedometer being tied to mannequin and not to swimmer)



Subject characteristics

Height

height	weight	age	BMI
177±7 cm	75±11 kg	27±6 years	23.9±3.0

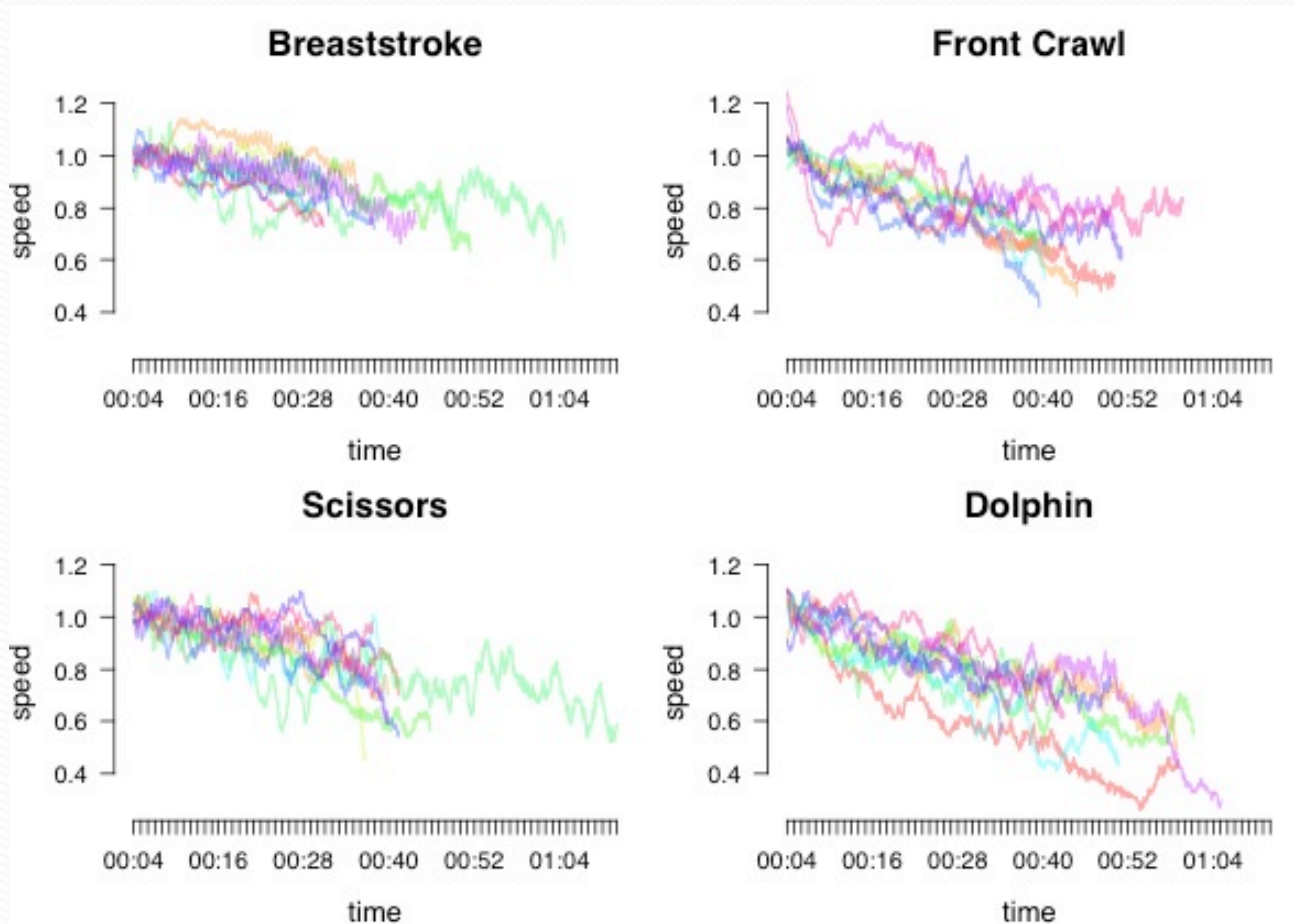
25m Front Crawl

15.00±1.56 s

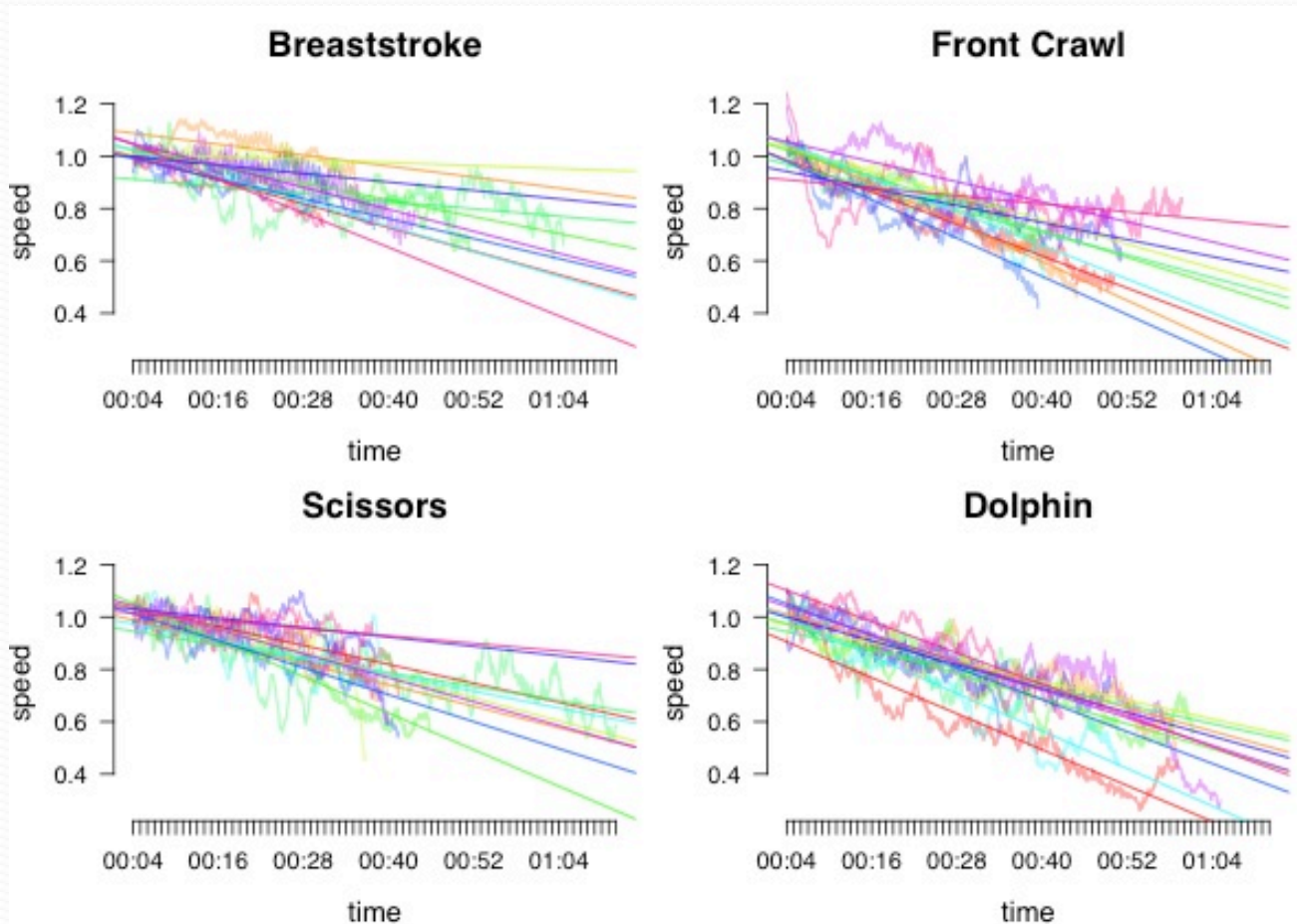


RESULTS

Velocity over time



Velocity over time (normalized)



Fatigue index

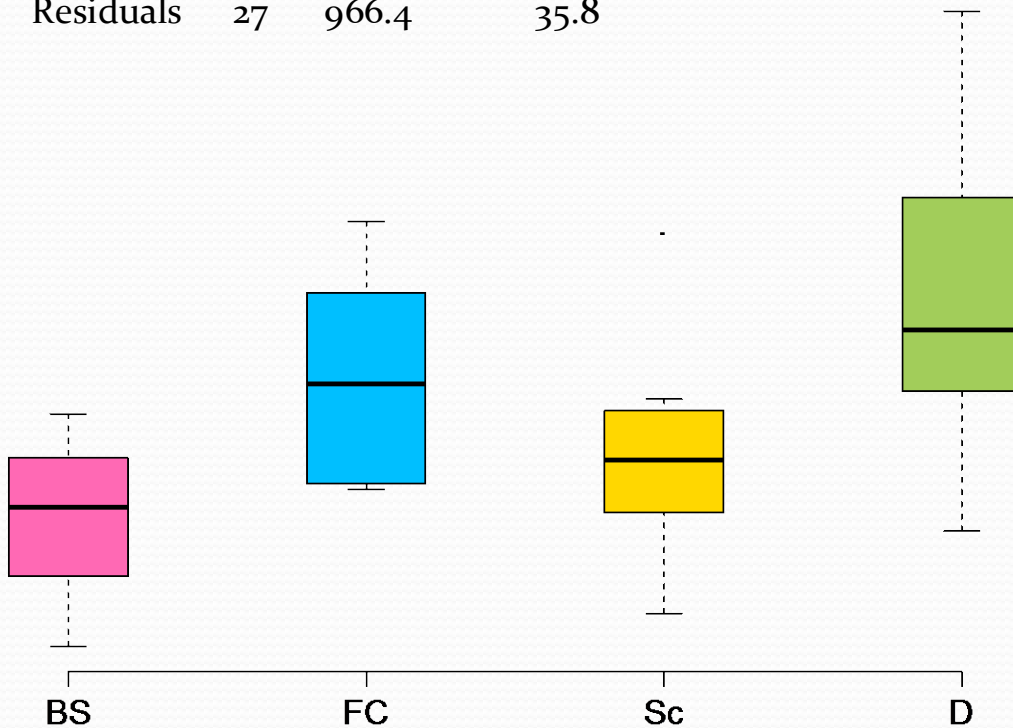
The fatigue index indicates the rate at which the subject's velocity declines throughout the trial

$$FI = \frac{\bar{X}_{iv} - \bar{X}_{fv}}{\bar{X}_{iv}}$$

Fatigue index: 1st half vs 2nd half

ANOVA repeated measures:

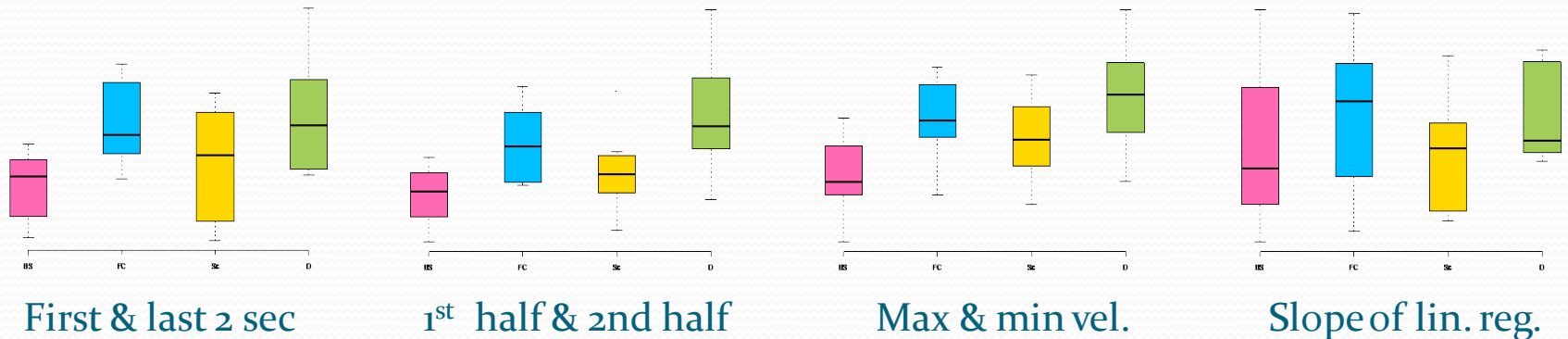
	Df	Sum Sq	Mean Sq	F value	Pr(>F)
style	3	1126.0	375.3	10.49	9.51e-05 ***
Residuals	27	966.4	35.8		



Pairwise comparisons using Paired t - tests

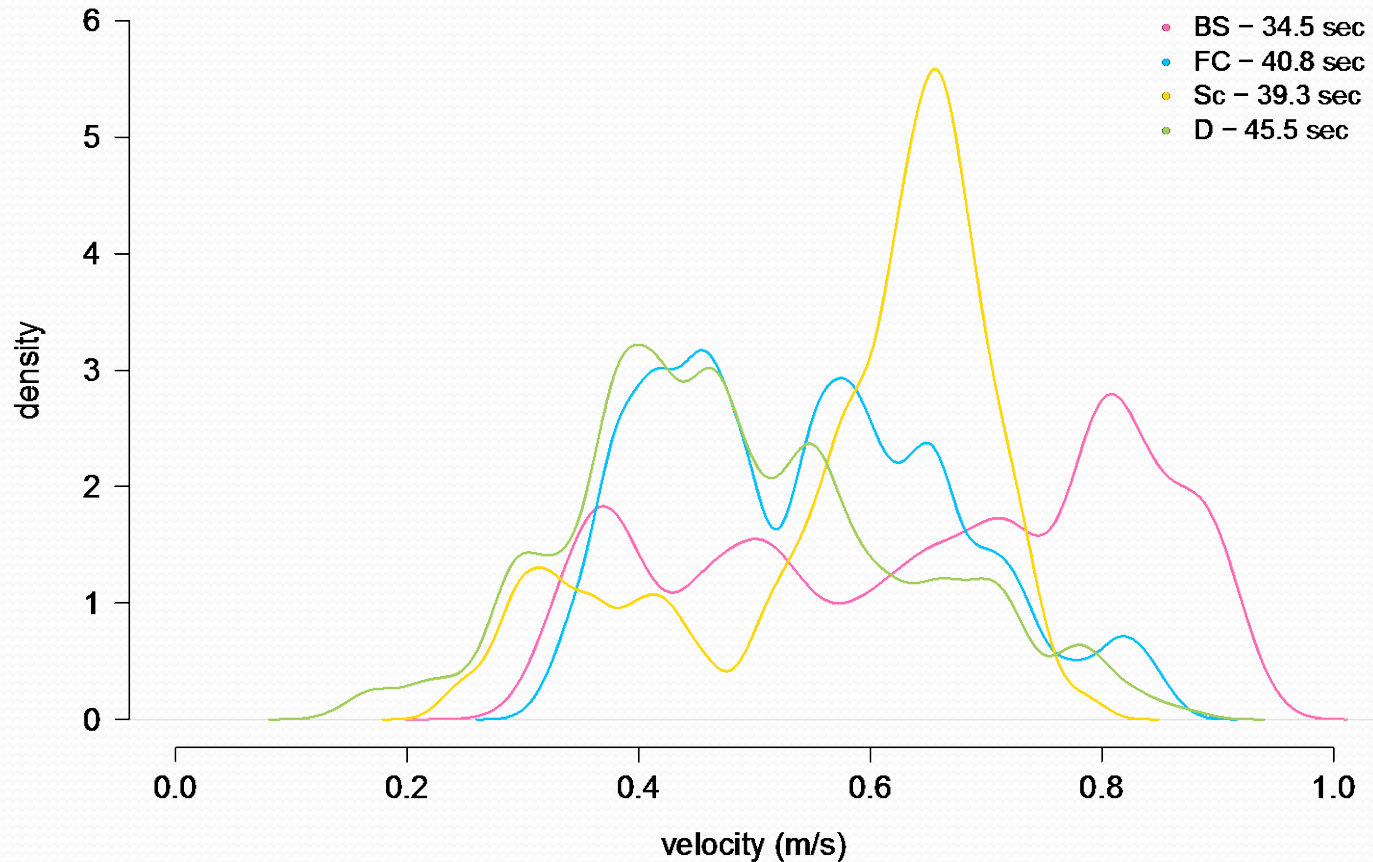
	BS	D	FC	
D		0.0035**		-
FC	0.0180*		0.1858	-
Sc	0.1858	0.0605		0.1858

Fatigue Index: summary

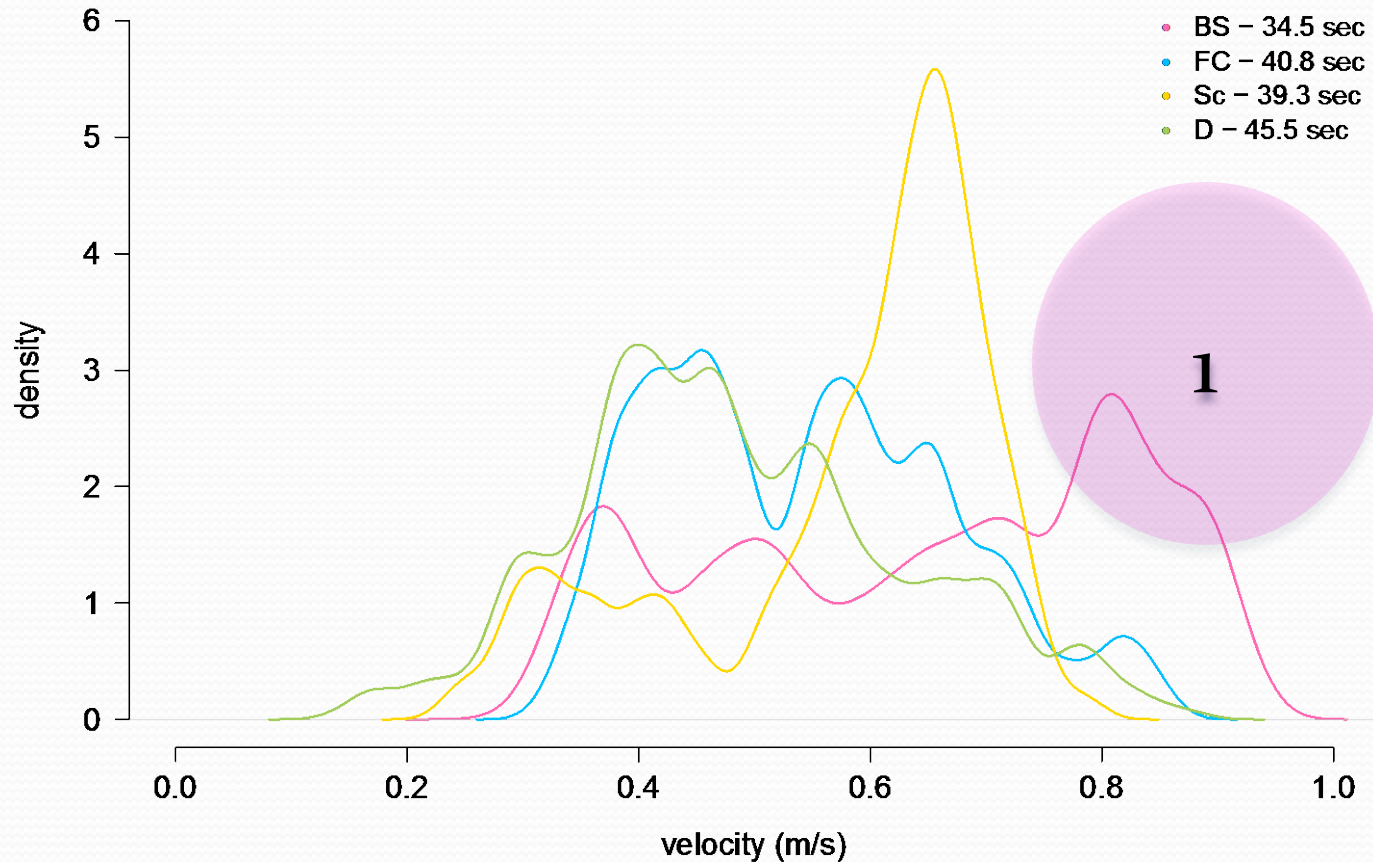


- Qualitatively, all 4 Fatigue Indexes reveal the same pattern
- The statistical significance of the differences observed changes (lowest with slope of linear regression)
- Breaststroke consistently results in the lowest FI
- Dolphin kick had the highest FI in most formulas

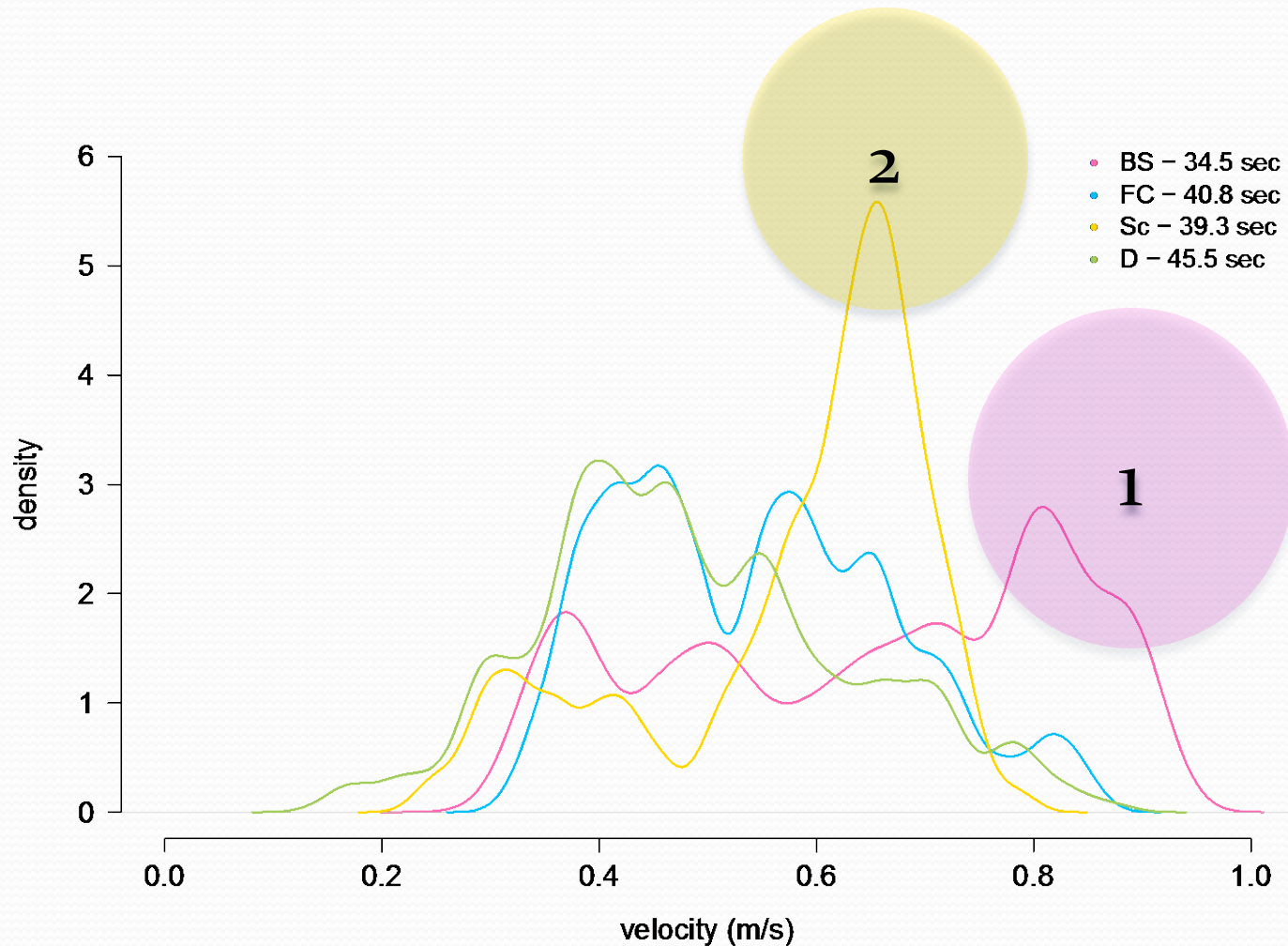
Density distribution of velocity



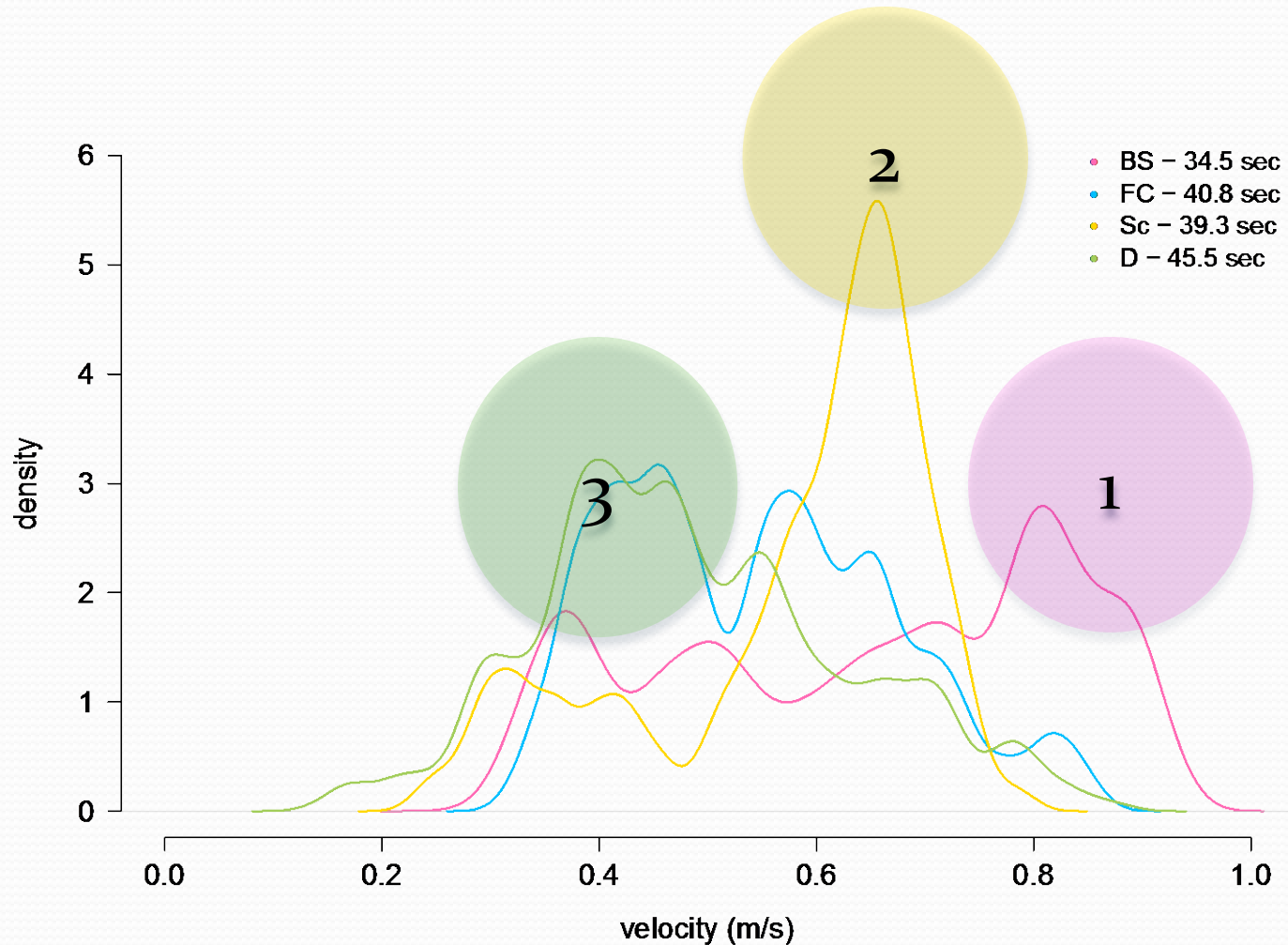
Density distribution of velocity



Density distribution of velocity



Density distribution of velocity



Limitations

- Some subjects failed to give maximum effort while towing the mannequin, thus velocity curves are less accurate than desired.
- The subjects were less familiar with scissors kick than breaststroke kick, thus less skilled, distorting the comparison.
- Both of the above reduce the accuracy of the calculated fatigue index in this pilot project.
- Some subjects failed to maintain the side lying position when using the breaststroke kick.

Major outcomes

- Differences in leg stroke performance were found to be statistically significant
- Breaststroke kick seems to be the most efficient technique providing the highest velocities while keeping fatigue at a minimum
- Scissors kick appears to be as good as BS with only slightly lower velocities (but the technique was less well known by the subjects than BS)
- Crawl and dolphin kicks were clearly outperformed resulting in lower velocities and a faster onset of fatigue

Acknowledgements

U.PORTO



FACULDADE DE DESPORTO
UNIVERSIDADE DO PORTO



Department of Physical Activity and Sport
Faculty of Sports Sciences.
University of Murcia, UMU.



NORWEGIAN SCHOOL OF SPORT SCIENCES



Thank
You!

Any
Questions