Diving physiology

- Background
- Diving Physiology & Humans
- Protocol and data
- Learning how to use the software

Background

Predicting maximum dive time

Weight of the seal: 450kg

Lung O2 stores	**5.3 L**
Blood O2 stores	**21.6 L**
Muscle O2 stores	**8.1 L**
TOTAL O2 STORES	35.1 L

Measured O2 consumption: 1.575 L/min

Predicted maximum Dive Duration = 35.1 / 1.575 = 22 min

Maximum dive time performed by animal when all the tissues in their body are supplied with, and consume oxygen.

Comparing predicted maximum dive time with observation

Weight of the seal: 450kg

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Maximum dive time performed by animal when all the tissues in their body are supplied with, and consume oxygen.

22 min <<< 1h20 min
What is going on?

Repeat! With other species

Muskrat:

1 kg
Predicted dive duration 45 sec

15 min

Sea lion

40 kg
Predicted dive duration 3.5 min

20 minutes

Emperor Penguins

25k
Predicted dive duration 4.1 min

18 min

Elephant seal

379 kg
Predicted dive duration 40 min

2 Hours

Mallard ducks

3kg
Predicted dive duration 4 min

24 minutes

What's going on?

During diving,

- **oxygen stores are kept for the organs (brain and heart) that absolutely need oxygen.**
- **the other organs (gut, kidneys, muscles etc…) that can do without oxygen for a while will not get oxygen.**

Mechanisms:

In the body, oxygen is transported by the blood from one place to another. Therefore during diving:

- **There is a decrease of blood flow, in the peripheral organs (gut kidneys, muscles..) -> no oxygen goes there.**
- **Blood goes to the brain and heart -> they get the oxygen.**
- **Less blood to move around -> heart rate decreases**

"Diving response"!

Diving Physiology & Humans

To detect the dive response we monitor heart rate. A significant decrease of heart rate indicates the presence of a diving response.

How long can these men (and woman) hold their breath for?

Natalia MOLCHANOVA

Official attempt (August 2008): 8 min 23 sec

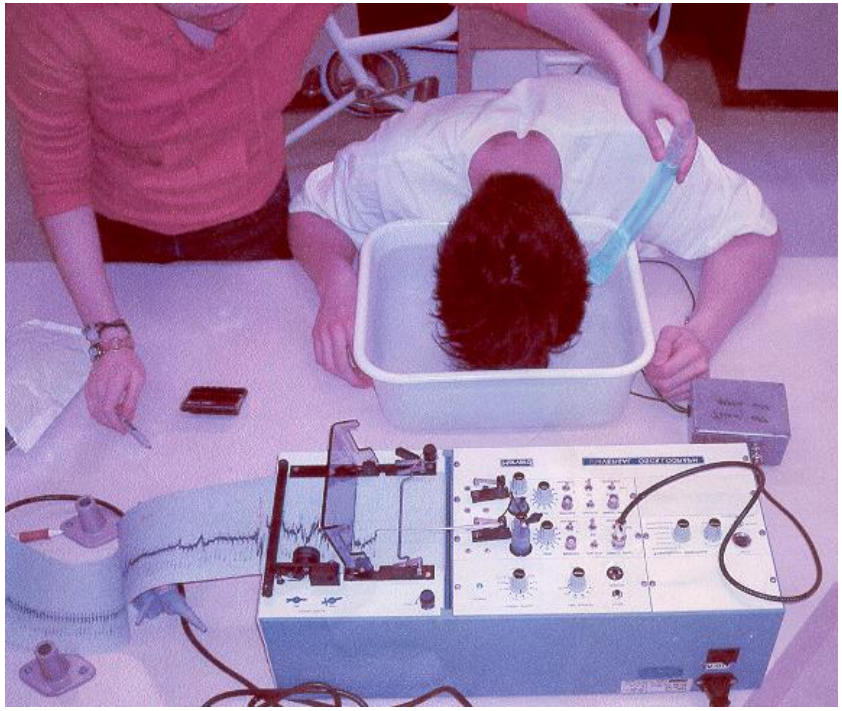
Tom SIETAS

Official attempt (June 2008): 10 min 12sec

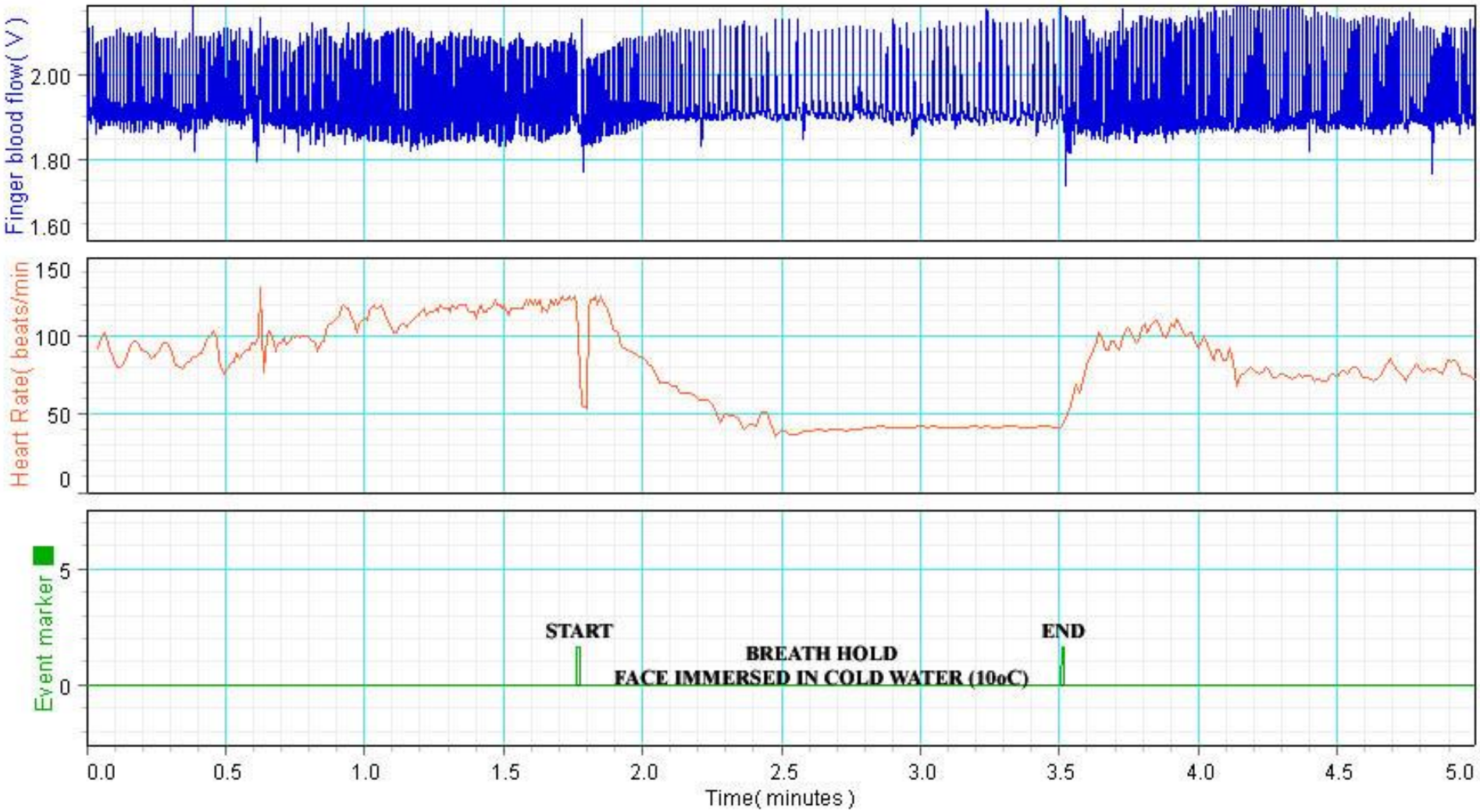
Stephane Mifsud:

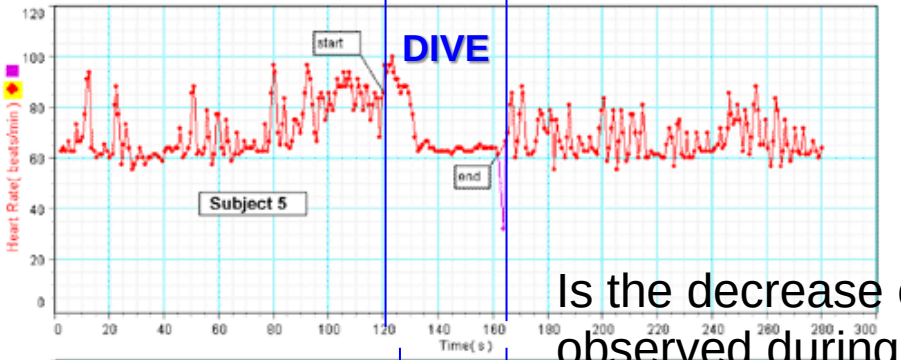
Official attempt (June 2009): 11 min 35 sec

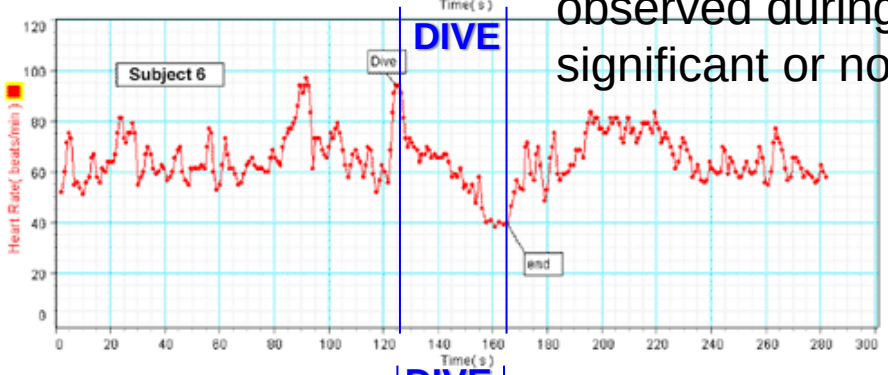
Do humans have a “diving response”?

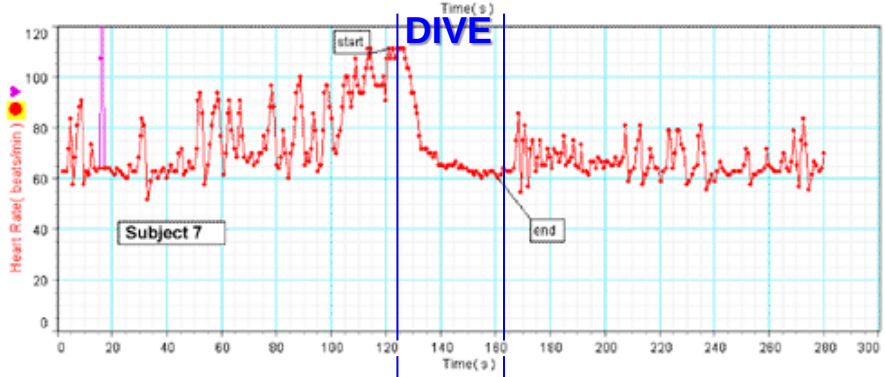


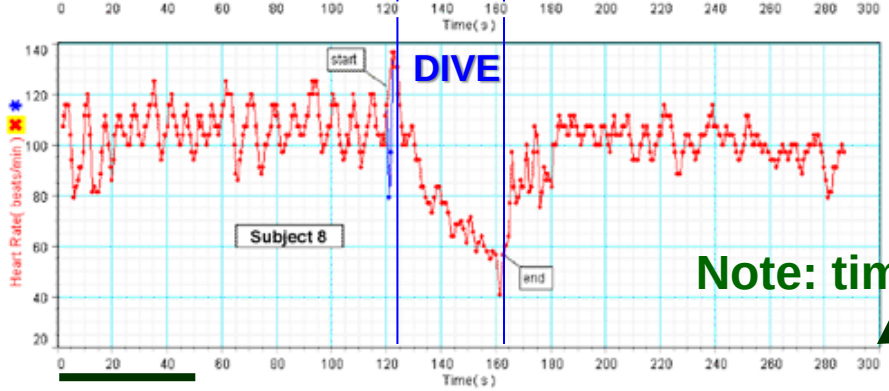
Experiments done the previous years:



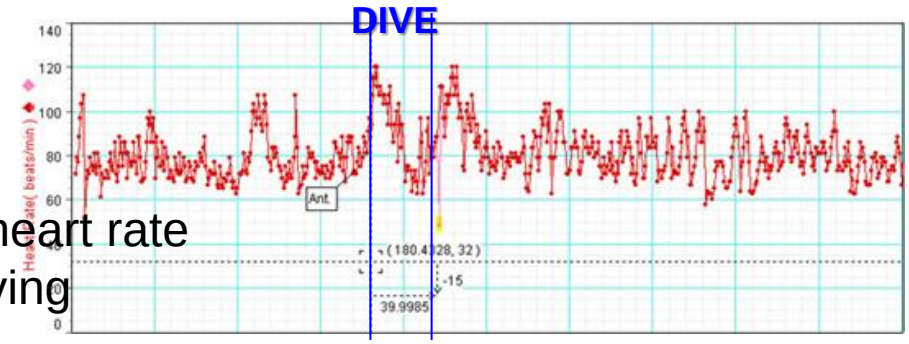


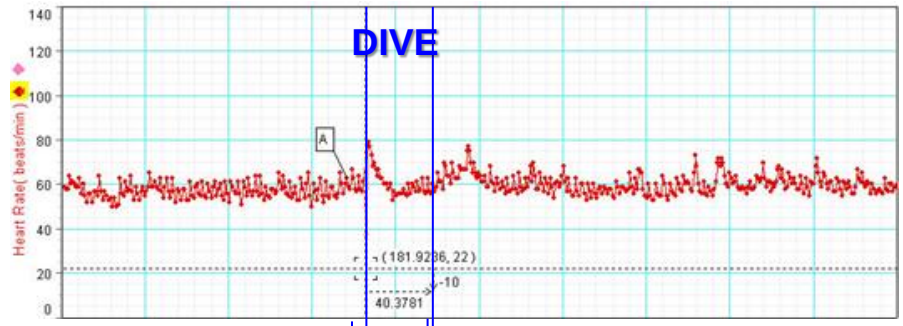


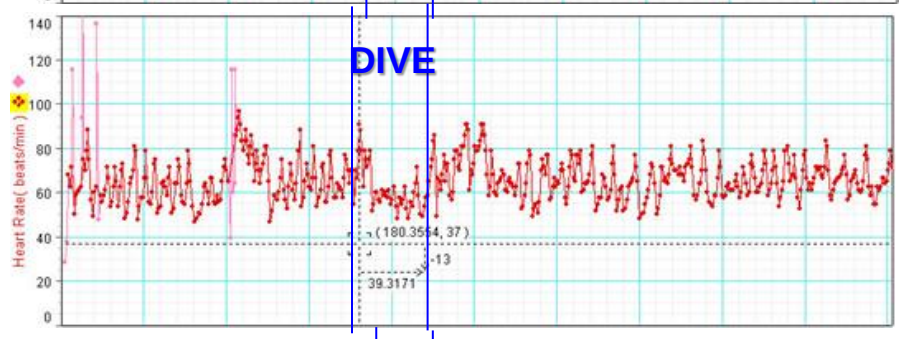


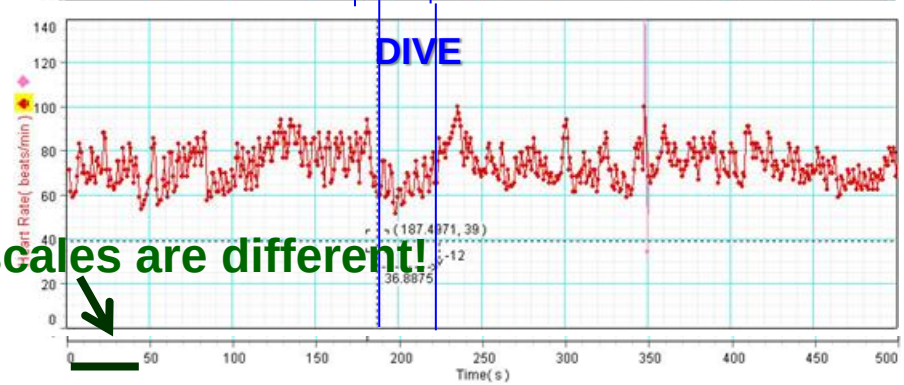


Is the decrease of heart rate observed during diving significant or not?









Note: time scales are different!

Is the decrease of heart rate observed in human subjects during "breath-holding in cold water" really significant compared with proper control values?

Question:

Do humans really have a "diving response"?

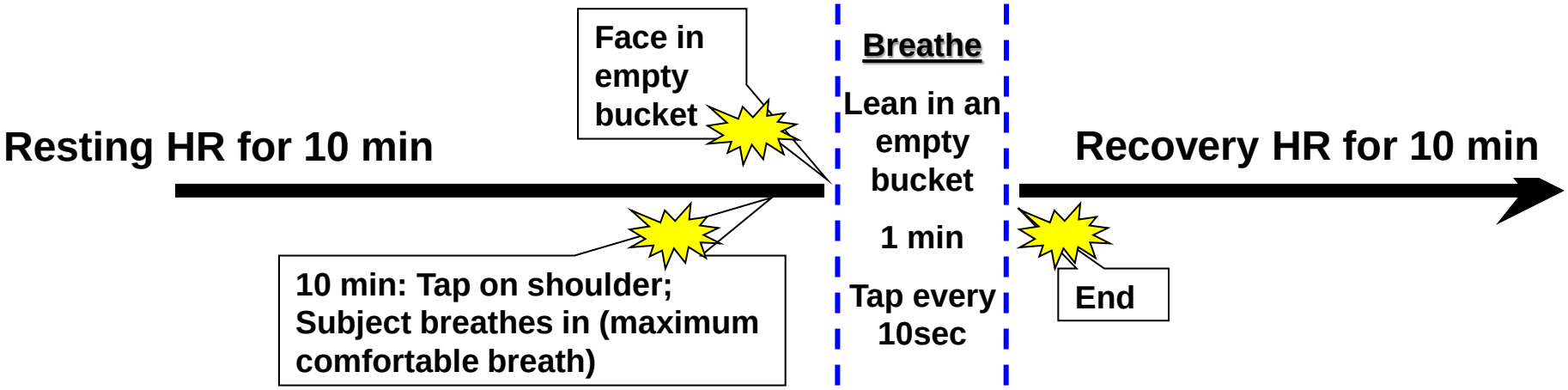
Protocol and Collecting data

Trial #1: Subject aware no dive - (eyes closed; lab has to be quiet!)

Color coded black

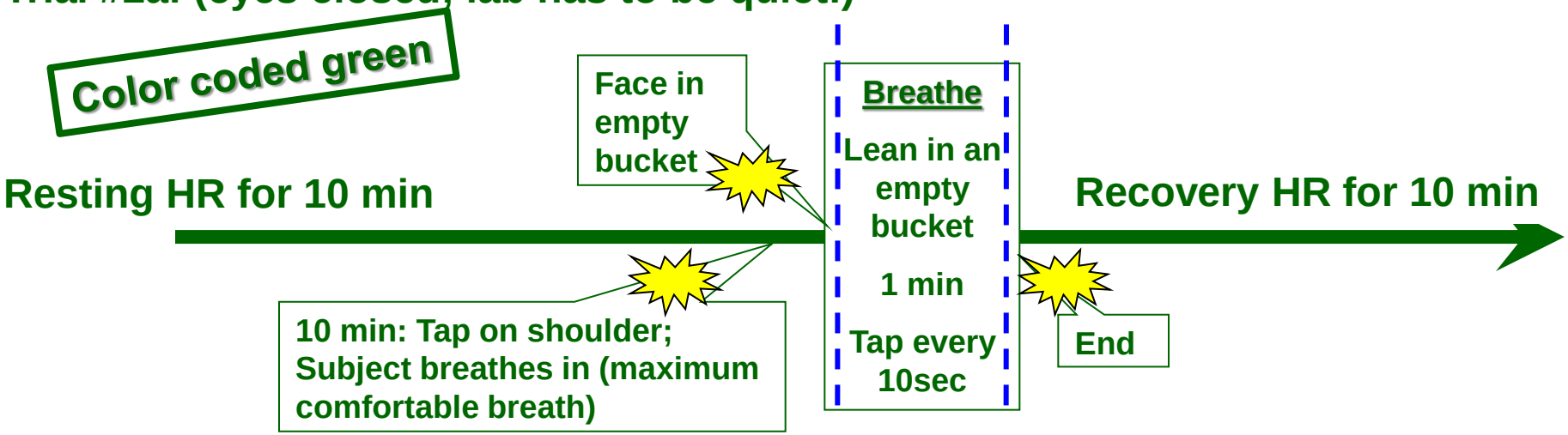
ALL subjects

TRIAL #1: Subject aware no dive - (eyes closed; lab has to be quiet!)

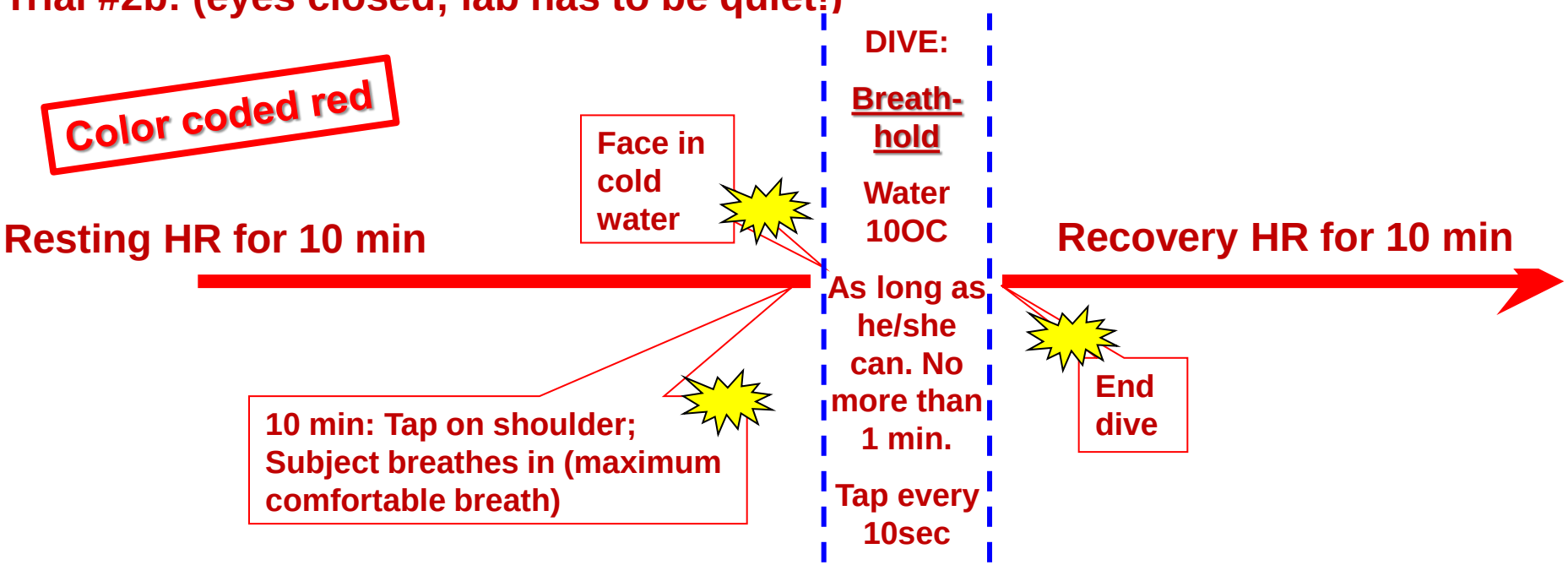


EITHER TRIAL 2a OR TRIAL 2b (Subject is not aware which one)

Trial #2a: (eyes closed; lab has to be quiet!)



Trial #2b: (eyes closed; lab has to be quiet!)

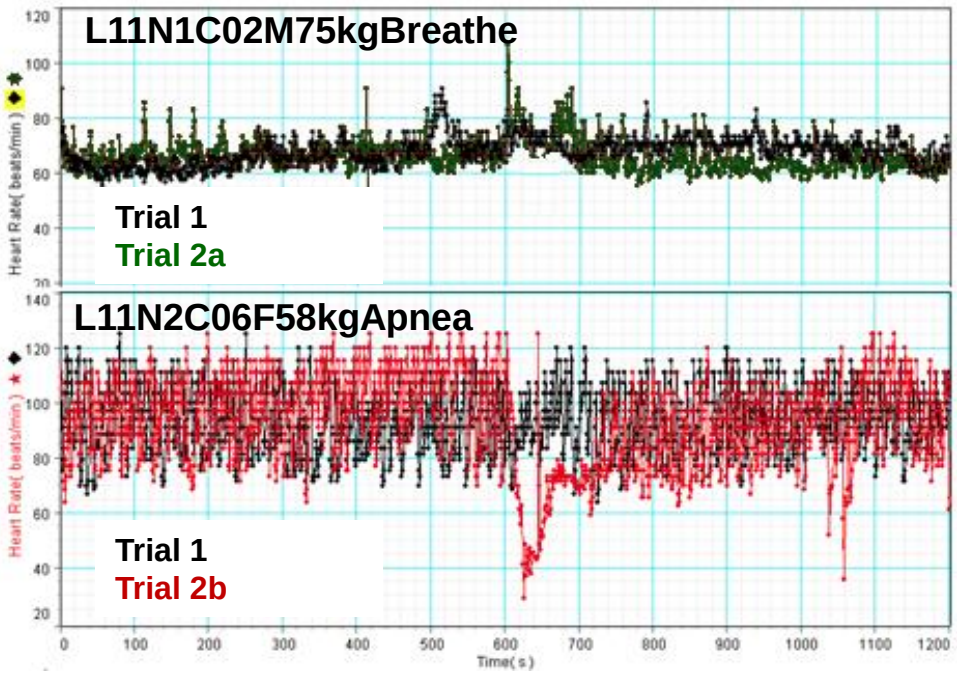


Files name

Save the file as

L##N## S## Gender(M or F) Age(Years) Weight (Kg)Trial type?

Subject #



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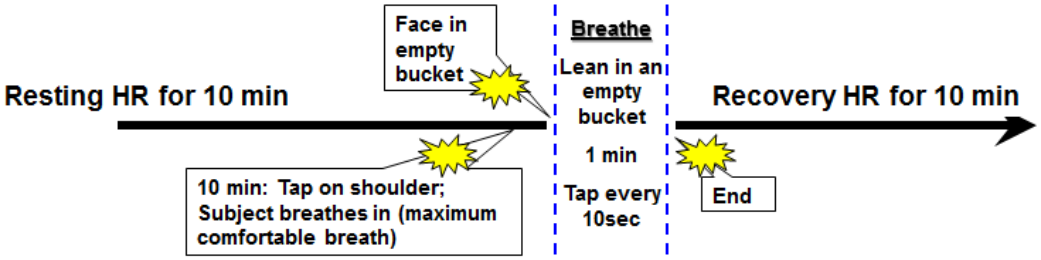
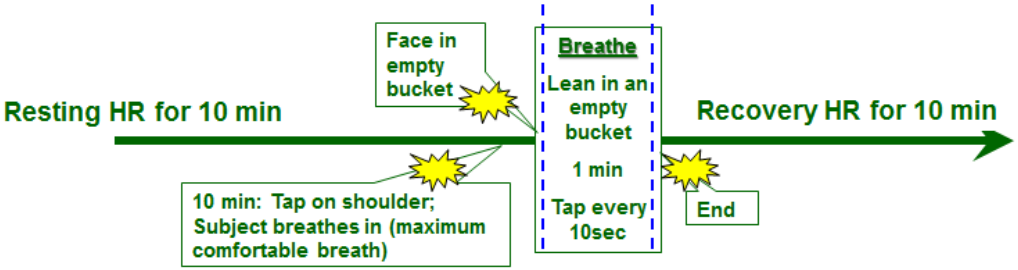


Trial #2a: (eyes closed; lab has to be quiet!)



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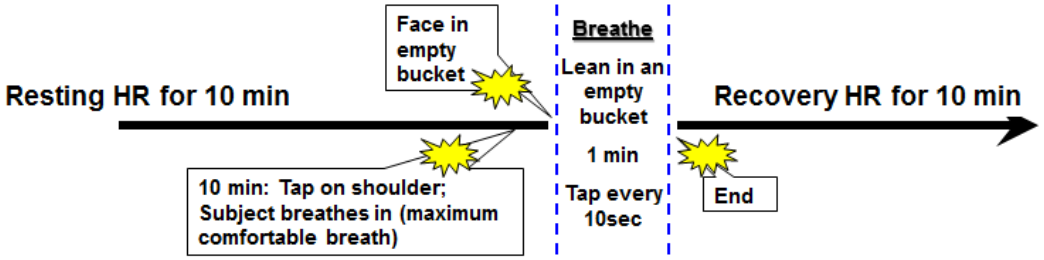
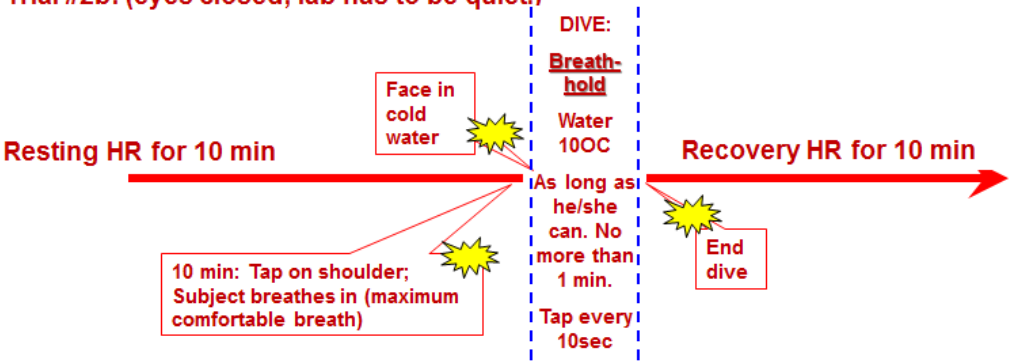
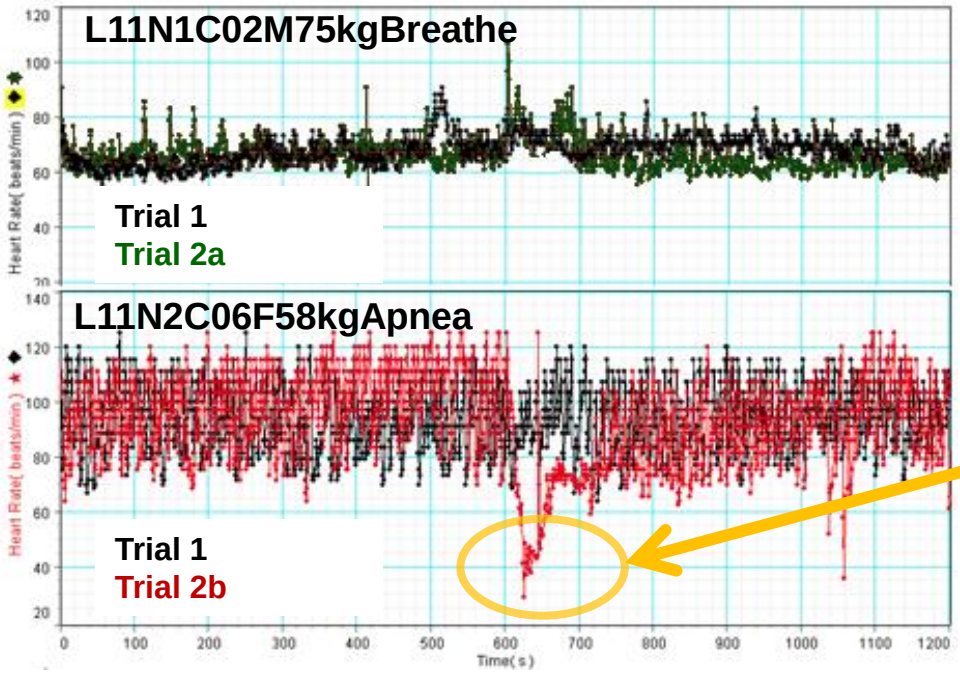


Trial #2b: (eyes closed; lab has to be quiet!)



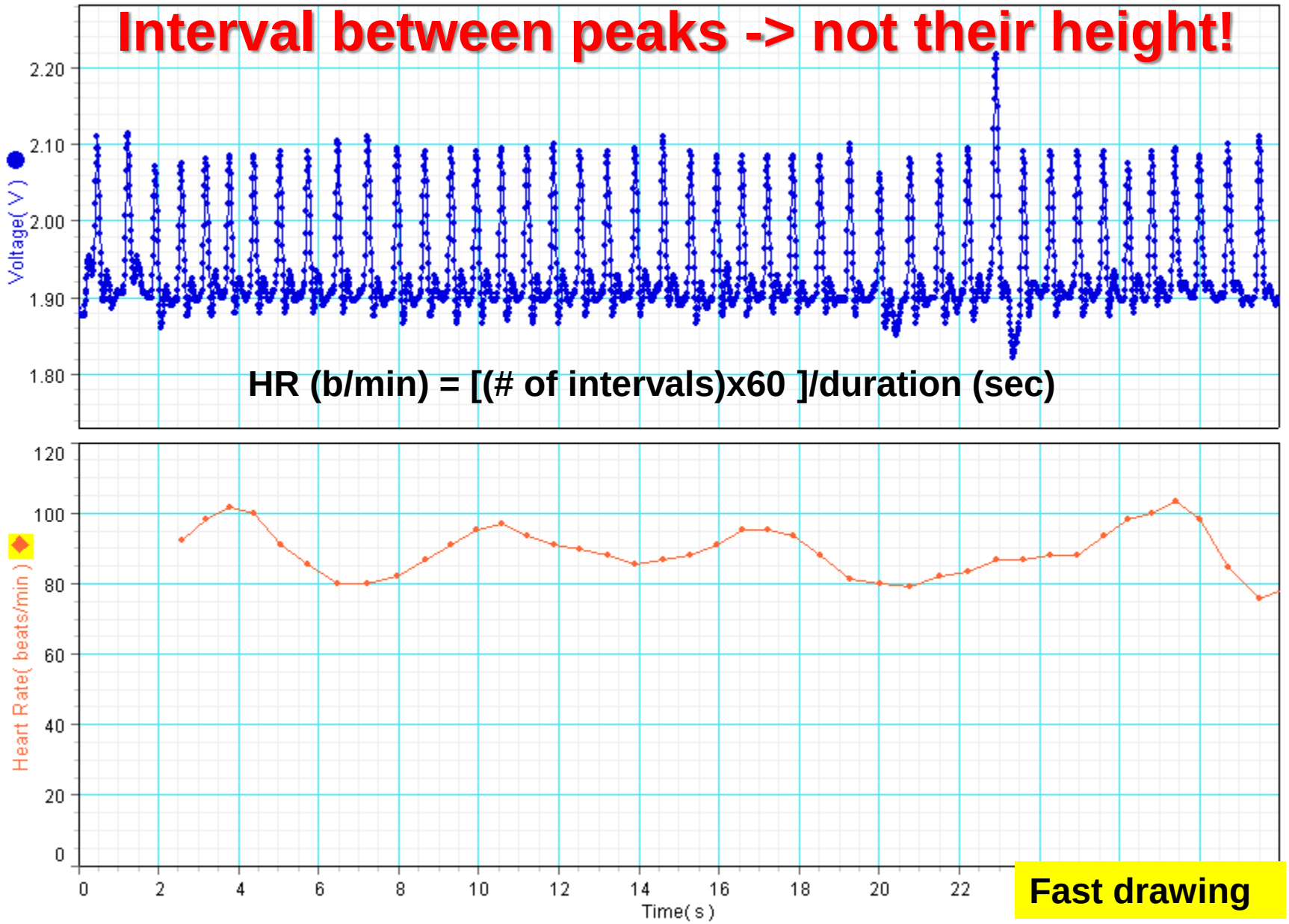


Significantly lower ???

Learn the Data acquisition software – Datastudio

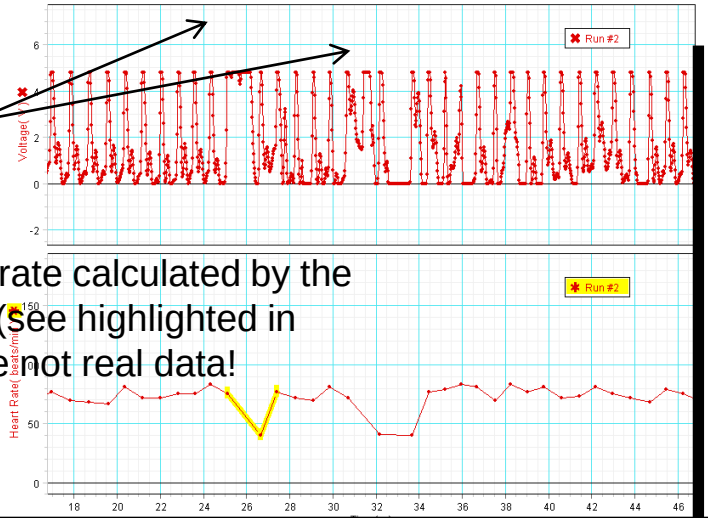
Download and install the software and read the tutorial included on this website

Collecting Heart rate values:
measuring blood flow -> calculating heart rate

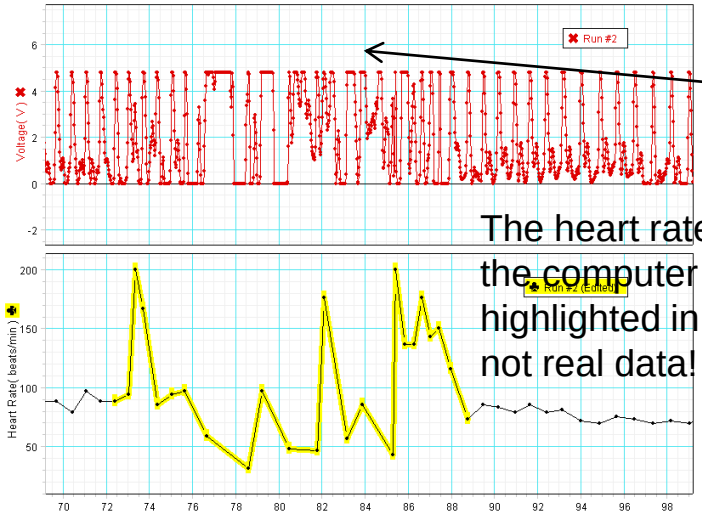


4 examples of artefacts you may encounter in recordings or Heart rate

The blood flow is not recorded properly!



The heart rate calculated by the computer (see highlighted in yellow) are not real data!



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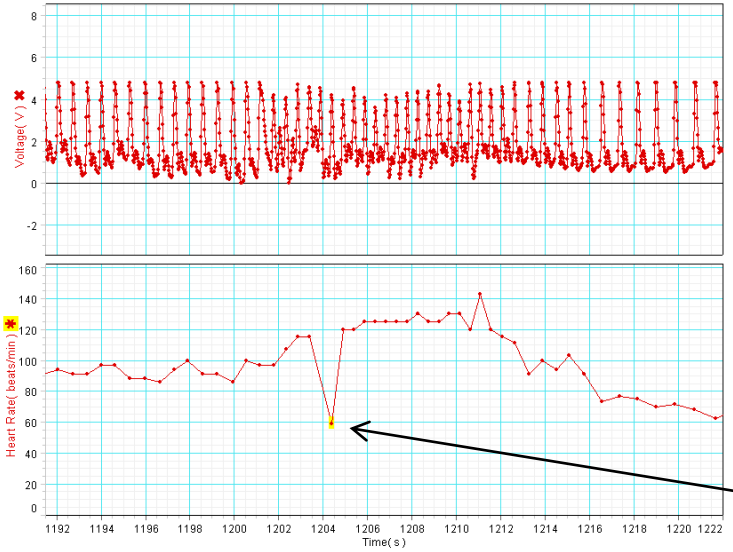

What is an artefact? See tutorial on Datastudio!

The heart rate drops by half (from 120 to 60 beats/min). This is not what happens in the subject: you do not have the time interval between 2 peaks doubling value (look at the flow trace above)!