



# Experiments with brainwaves

A wind-up

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# What did we learn?

Science, experiments and brains

# What is science?

- ◉ It is a way of thinking
- ◉ Understanding/acquiring knowledge vs. producing knowledge
  - ◉ Understanding: Information
  - ◉ Producing: Research

Can't produce knowledge without having prior knowledge.

“ Stand on the shoulders of giants” --Isaac Newton

# What goes into conducting an experiment?

- ◉ Come up with a question
- ◉ Come up with a probable answer
- ◉ Design experiment to test the answer
- ◉ Come up with specific hypotheses
- ◉ Conduct experiment
- ◉ Analyze data
- ◉ Conclusions

# Coming up with questions

- What are some of the broad questions you have about life and how things work?
- What has been done so far in answering those questions? What are the existing theories?
- What aspects *don't* the current theories answer? – Either zoom in or zoom out

# Come up with probable answers and ways to test them

- ◉ What other information can you use?
- ◉ What other information do you need?
- ◉ How will you find this information?

Experimental design!

- ◉ Operational definitions
- ◉ Tasks

# Data collection and analysis

All the things that can go wrong!

# Data collection

Failing equipment

Participants lying

No grants

No participants

Other disturbances

Participant's state  
of mind



# Data analysis

Things didn't get recorded

Software crashed

No time

Slow computers!

I don't understand what this means!

# How can we be certain?

- ◉ Things will almost never be perfect
- ◉ Reason it out, compromise, make it work
- ◉ Costs of compromise?
- ◉ Can I live with that? Is the science still accurate?

Be aware. Reflect. Include this in the paper.



People have the right to know under what circumstances you reached the conclusions.

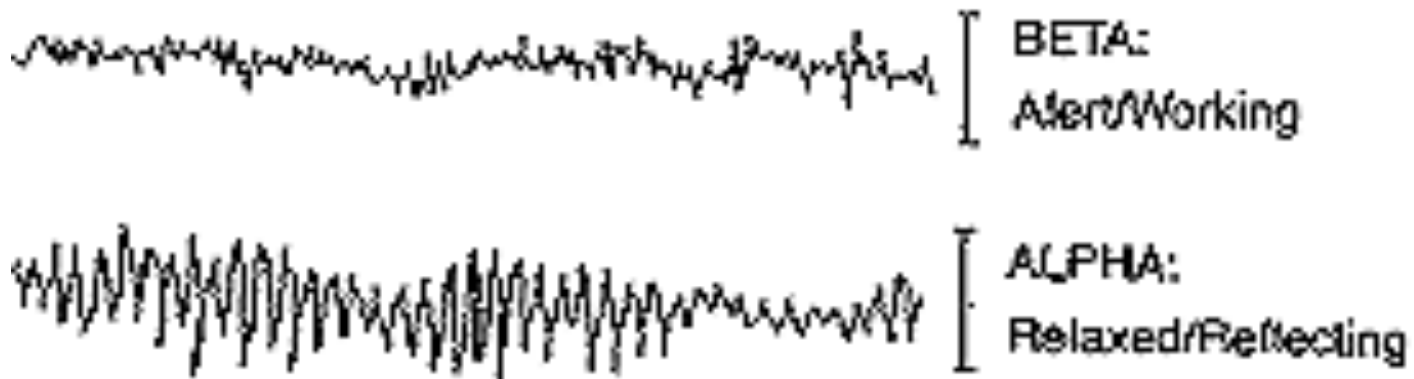
They might not agree with your assessment of the costs. Interpretation is up to them. But data doesn't lie

# So does sleep affect attention?

Our data

# Some background information

- Alpha waves: 8Hz to 12Hz. High when you are relaxed
- Beta waves: 14Hz to 30 Hz. High when you are performing conscious thinking



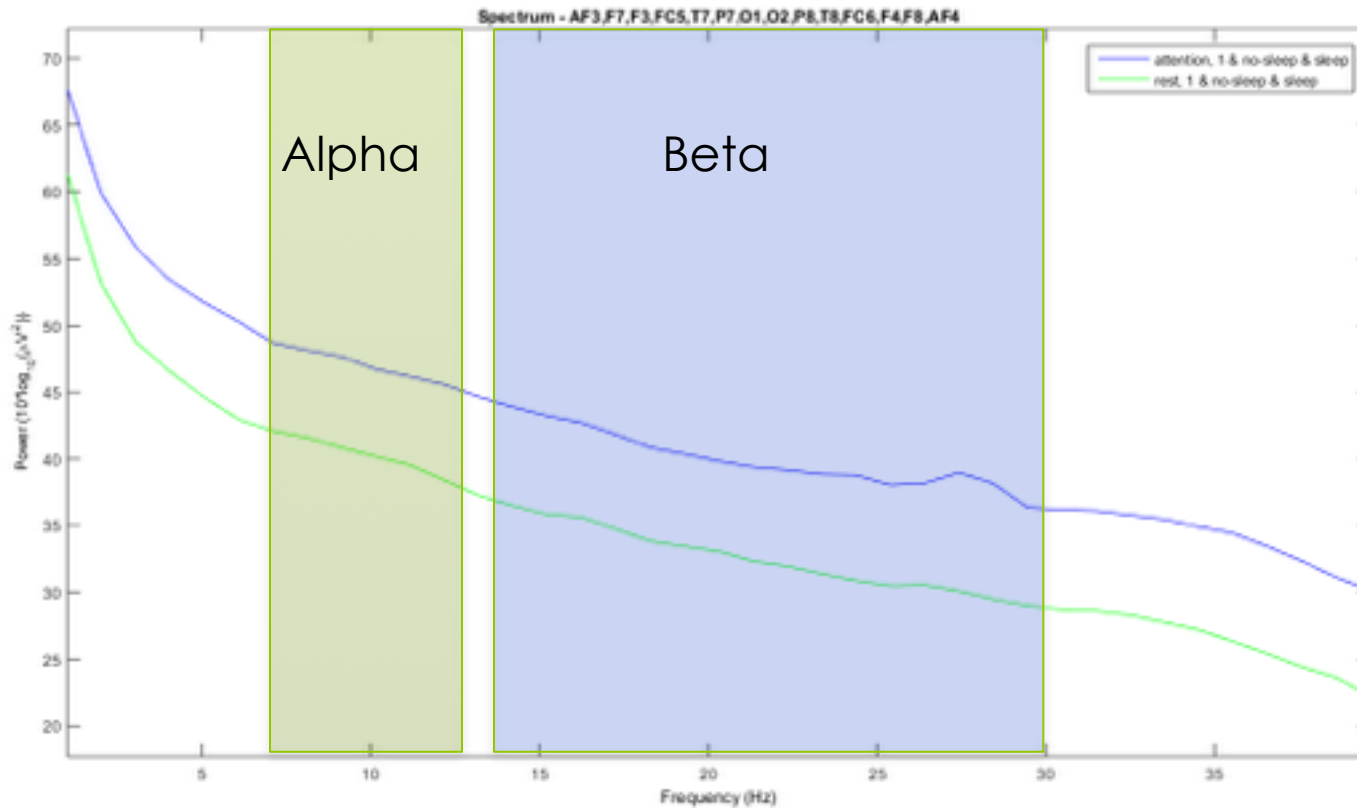
# Our expectations

- ◉ Alpha > Beta : Rest
- ◉ Alpha < Beta : Attention
  
- ◉  $\text{Alpha}_{\text{sleep}} < \text{Alpha}_{\text{no-sleep}}$  : Attention
- ◉  $\text{Beta}_{\text{sleep}} > \text{Beta}_{\text{no-sleep}}$  : Attention
  
- ◉ Not much difference between alpha and beta waves between sleep and no-sleep in rest condition



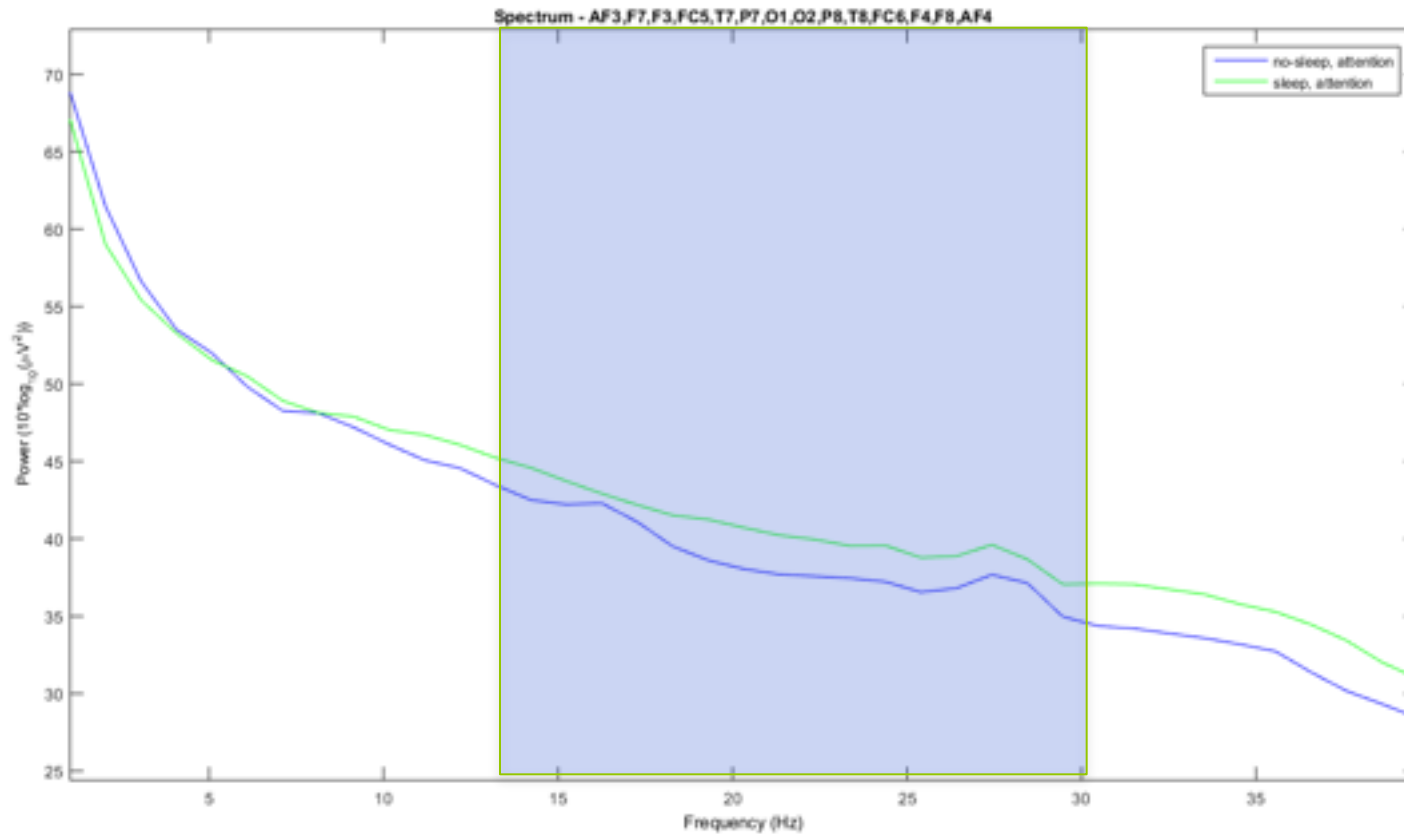
What did we find?

# Comparing attention with rest

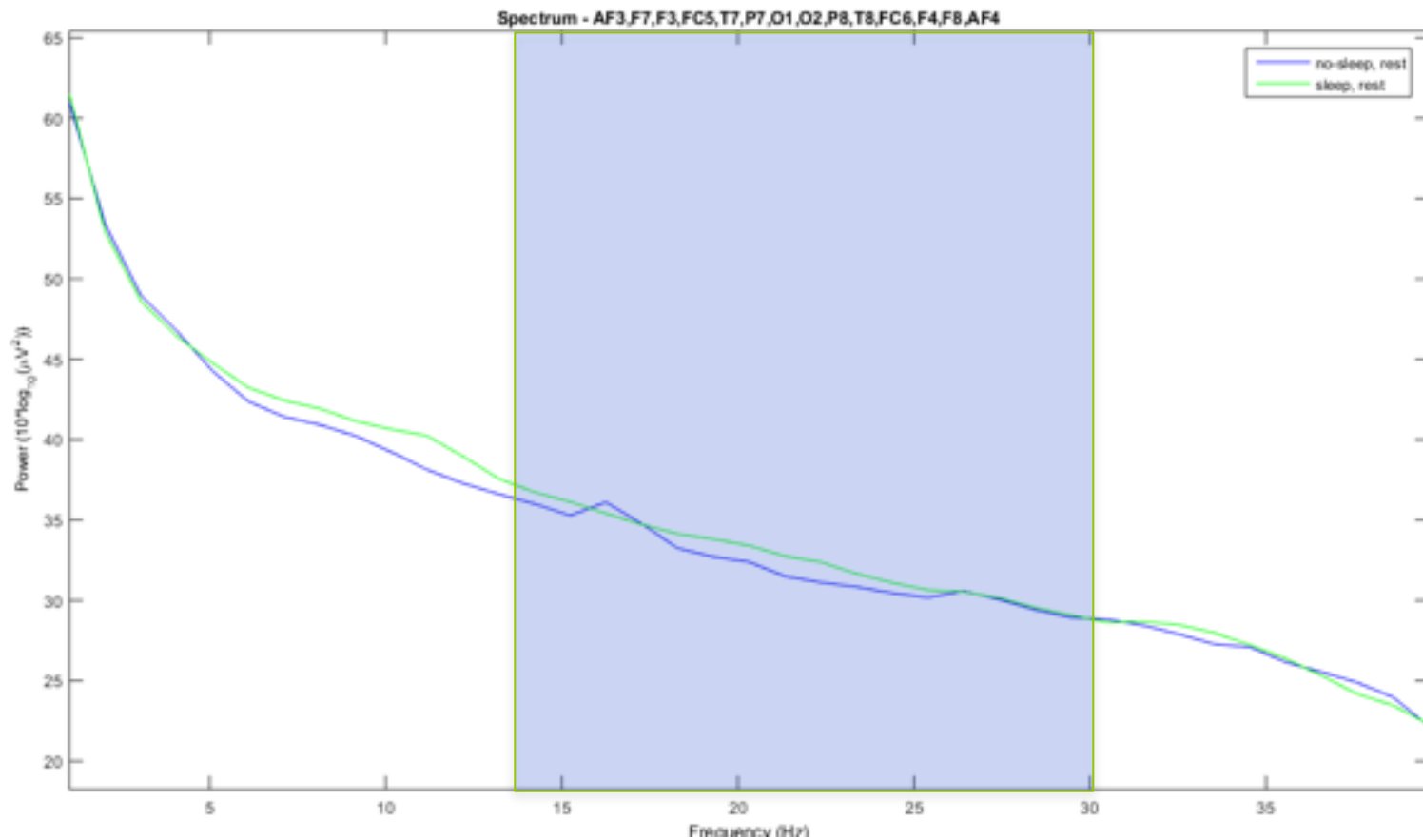




# Sleep and attention



# Sleep and rest



# Why can't we see Alpha?

- Data was messy
- Some nuances of when we see alpha was not reflected in experimental design
- We are discovering something new!

# What can we do?

Evaluate if it is truly a null result

- ◉ Run more participants
- ◉ Reconduct the experiment
- ◉ Redesign the experiment



Hope you had fun!!

(And learnt something along the way)



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