Introduction to Medical Psychology Lecture 2: Methods / Psychophysiology

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https://youtu.be/dk2weH-ffrc

Lecture video at above link.

Health problems related to behavior

Problem for society: Anorexia nervosa
(eating disorder with low weight and intense fear of gaining weight)

Distorted body image often observed
in anorexics ("I am too thin, I must
not eat and exercise more")

Is the fashion industry to blame?

Isabelle Caro (1982-2010)

London fashion week

Purikyua:
Possible cause for anorexia?

"Purikyua" is a TV program for children with

- superslim girls
- who are constantly making sweets.

Does this promote a problematic body image?

Anorexics often engage in preparing food for others while not eating themselves. Possibly this helps them to desensitize to food.

Purikyua:
Possible cause for anorexia?

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- superslim girls
- who are constantly making sweets.

Does this promote a problematic body image?

Anorexics often engage in preparing food for others while not eating themselves. Possibly this helps them to desensitize to food.

How to _SCIENTIFICALLY_ test????

Example Question in Medical Psych

Hypothesis:

Exposing young children (girls) to "Purikyua" affects their body image and eating habits, thus increasing their risk for anorexia nervosa.

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We should simplify. There are 4 "things" to measure here!

1) How much young children are exposed to Purikyua
2) How their body image changes
3) How their eating habits change
4) How their risk for anorexia nervosa changes

Example Question in Medical Psych

Hypothesis:

Exposing young children (girls) to "Purikyua" affects their body image and eating habits, thus increasing their risk for anorexia nervosa.

Most "direct":

[Exposing young children (girls) to "Purikyua"] → [increasing their risk for anorexia nervosa]

Example Question in Medical Psych

Specific Hypothesis 1:

[Exposing young children (girls) to "Purikyua"] →
[increasing their risk for anorexia nervosa]

However, this may require a long time…
→ To do a proper experiment, we need to randomly have half of our young girl subjects watch Purikyua, half not, wait 10 years until they grow up, and measure relative risk of anorexia.

Controlled Experiment, Cohort Study, Case Control Study...

Better

Worse

There are several ways to collect evidence for a hypothesis:

1) **Double-Blind, Randomized, Controlled Trials**

   → Randomly select 1000 young girls from population, randomly force half of them to watch purikyua 1 hour per day, half to not. 10 years later, measure how many of the original are anorexic.

2) **Prospective Cohort Study**

   → Randomly select 1000 young girls now, measure how many watch purikyua. 10 years later, measure how many are anorexic.

3) **Retrospective Cohort Study**

   → Randomly select 1000 grown women now, measure how many are anorexics and how many watched purikyua 10 years ago.

4) **Case-controlled Study**

   → Select 100 Anorexics now and select 900 non-anorexics, see how many in each group watched purikyua 10 years ago.

Controlled Experiment, Cohort Study, Case Control Study...

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   → Randomly select 1000 young girls from population, randomly force half of them to watch purikyua 1 hour per day, half to not. 10 years later, measure how many of the original are anorexic.

2) **Prospective Cohort Study**

   → Randomly select 100[...] purikyua. 10 years late[...]

3) **Retrospective C[...]**

   → Randomly select 100[...] anorexics and how ma[...]

4) **Case-controlled[...]**

   → Select 100 Anorexics[...] in each group watched [...]

Worse

> Non randomized studies are *weaker* evidence because since we do not randomly choose who gets the treatment (i.e. who watches purikyua and who doesn't), there may be a **self-selection** bias due to some **latent variable**.
>
> For example, due to genetics, some children who have a higher prior risk of anorexia may also be more likely to watch purikyua!

But, we don't have 10 years...

Let's assume:

1) We don't have 10 years to wait (we only have 2 months)

2) Purikyua is a new anime, so we can't use retrospective cohort (it did not exist 10 years ago)

But, we don't have 10 years…

Let's assume:

1) We don't have 10 years to wait (we only have 2 months)

2) Purikyua is a new anime, so we can't use retrospective cohort (it did not exist 10 years ago)

What can we do now?

Original "Theory"

Exposing young children (girls) to "Purikyua" affects their body image and eating habits, thus increasing their risk for anorexia nervosa.

Maybe someone else (in another experiment) has already shown that in general:

body image and eating habits, → increased risk of anorexia nervosa

Our hypothesis

Exposing young children (girls) to "Purikyua" affects their body image and eating habits, thus increasing their risk for anorexia nervosa.

So, we only have to show:

Exposing young children (girls) to "Purikyua" → body image and eating habits

Chaining inferences…

Exposing young children (girls) to "Purikyua" affects their body image and eating habits, thus increasing their risk for anorexia nervosa.

So, we only have to show:

Exposing young children (girls) to "Purikyua" → body image and eating habits

Then, the inference can be made that exposure to purikyua will increase risk of anorexia, via modification of their body image and eating habits.

(though, this is of course not the **best** evidence…can you think why?)

(hint:
how would you falsify
this hypothesis?)

Example Question in Medical Psych

How can we **measure** :
→ How much someone watches Purikyua
→ (Changes to) body image
→ (Changes to) eating habits
→ Is someone anorexic

Some of these are objective/empirical:
→ We can easily measure how much someone watches Purikyua (how many hours per day?)
→ We can measure if someone is anorexic (BMI – body mass versus body height)

Example Question in Medical Psych

How can we **measure** :
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→ (Changes to) body image
→ (Changes to) eating habits
→ Is someone anorexic

Some of these are objective/empirical:
→ We can easily measure how much someone watches Purikyua
(how many hours per day?)

→ **How do you measure someones** *body image?!*

(it is secret, inside their head, psychological!)

Objective Psychological Tests

How can we measure psychological states *objectively*.

→ Via *behavior* of the physical system, which changes if the psychological state changes.

Actions:

Calories consumed (ask in survey?)

Responses to verbal/written questions (survey or interview?)

Physiological Changes:

Change in brain activity when shown a picture of food.

Topics Today

Psychological Tests

Test criteria:

Objectivity
Reliability
Validity

Psychophysiology

Autonomic nervous system
Pupil width
ECG: electrocardiogram
GSR: Galvanic skin response
EEG: electroencephalography

Test Criteria

A good test must be:

Objective
→ The result does not change if a different scientist administers the test.

Reliable
→ The result does not change when done multiple times.

Valid
→ The test measures what it is supposed to measure.
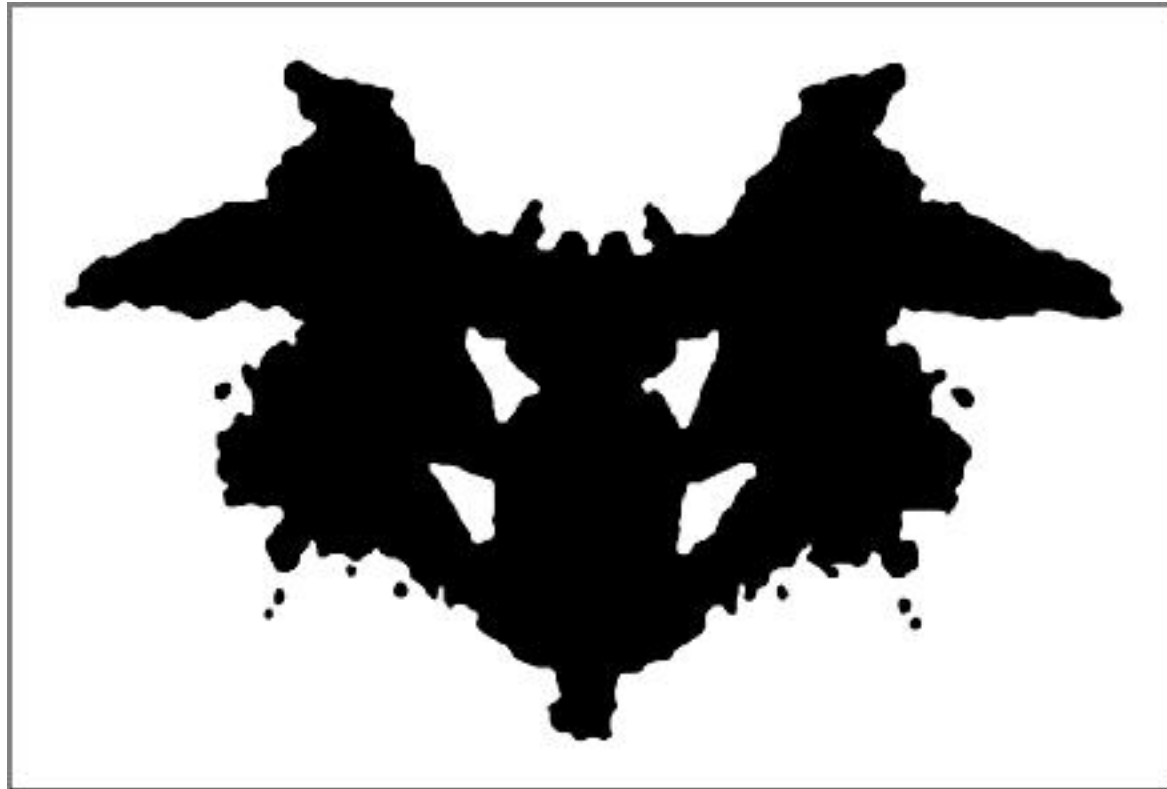
Criteria 1: Objectivity

1) Objectivity

What makes a test objective?

When there is no subjective influence → Different observers will come to the same result.
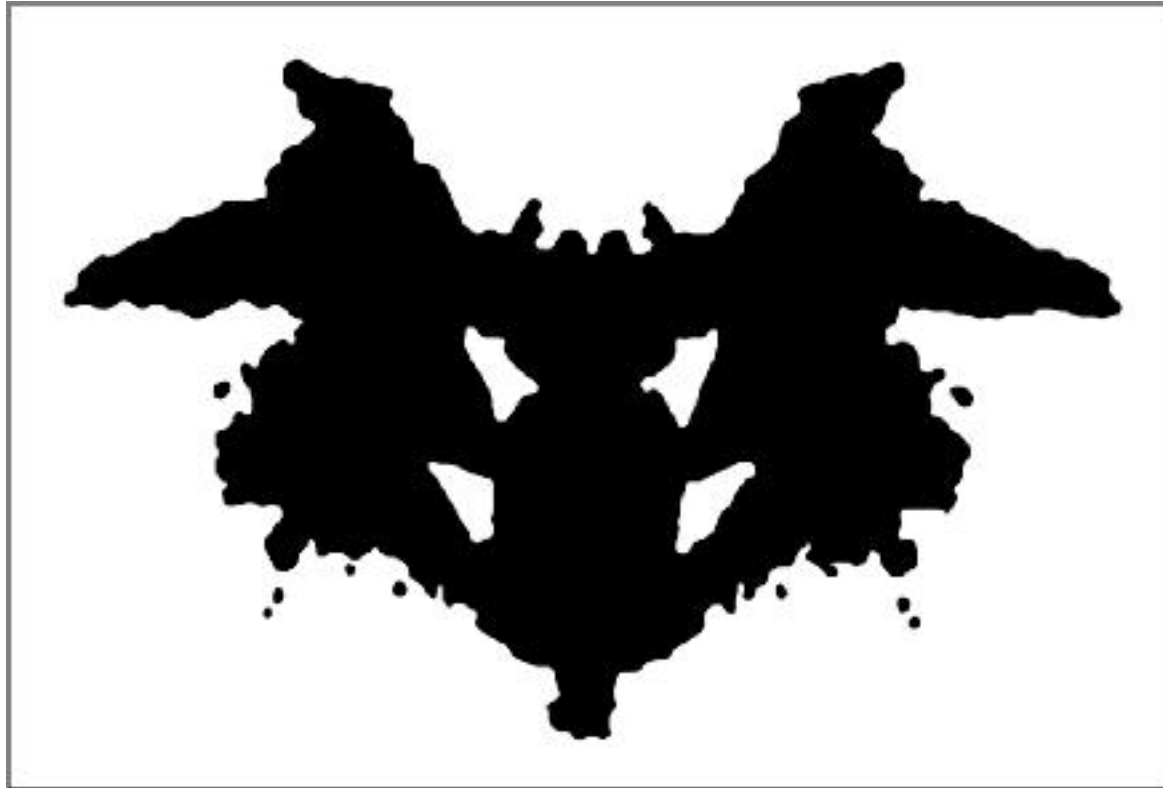
Objectivity

Example: Projective tests

What do you see?

Rorschach Test

The Rorschach test was developed 1921 by Herrmann Rorschach (Swiss Psychiatrist).
The test consists of 10 pictures, the examinees have to guess what a picture could be. Objective evaluation of patient's response is difficult (even though scoring systems exit), and because of this the test has been criticized.

Attractiveness: Objective?

Example: Attractiveness

We might expect attractiveness to be rather subjective.

Two raters might come to very different conclusions.

Judge1: 4
Judge2: 1

Judge1: 6
Judge2: 8

Attractiveness: Objective?

We can measure objectivity of a test/procedure by computing how similar different examiner's judgment was (correlation, intra-class correlation, etc.).

Judge1: 4
Judge2: 1

Judge1: 6
Judge2: 8

Beck's Depression Inventory

The previous example (Rorschach test) had questionable objectivity. A test like the Beck depression inventory (Beck et al., 1961) is easy to administer and to score.

21 questions like:

1. Sadness
0 I do not feel sad.
1 I feel sad much of the time.
2 I am sad all the time.
3 I am so sad I can't stand it.

9. Suicidal thoughts or wishes
0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

Beck's Depression Inventory

Other questions are:
Feelings of guilt, loss of interest, appetite, sexual drive, concentration, weight.

Maximum: 63 points, scores above 13 can be considered mild depression.

Patient's collaboration is needed.

Requirements for Objective Test

So, a test should be objective in terms of how it is
<u>conducted</u>,
<u>scored</u> and
<u>interpreted</u>.

<u>conducted</u>: e.g., if a test is sometimes done with heavy traffic noise and sometimes in silent conditions, objectivity is not given.

<u>scored</u>: e.g., if one examiner is more generous with errors (e.g., intelligence test) than others, objectivity is not given.

<u>interpreted</u>: e.g., if one examiner arbitrarily interprets a score of >24 in the BDI as depression, the other >18, objectivity is not given.

Criteria 2: Reliability

2) Reliability

What makes a test reliable?

How reliable are the results, i.e., under similar conditions, can we get the same results?

Requirements for Reliable Test

Internal consistency:

i.e.,   The different items/parts of the test should lead to the same results, correlate with each other.

e.g., in the Beck Depression Inventory, the responses should be correlated with each other all indicating presence or absence of depression.

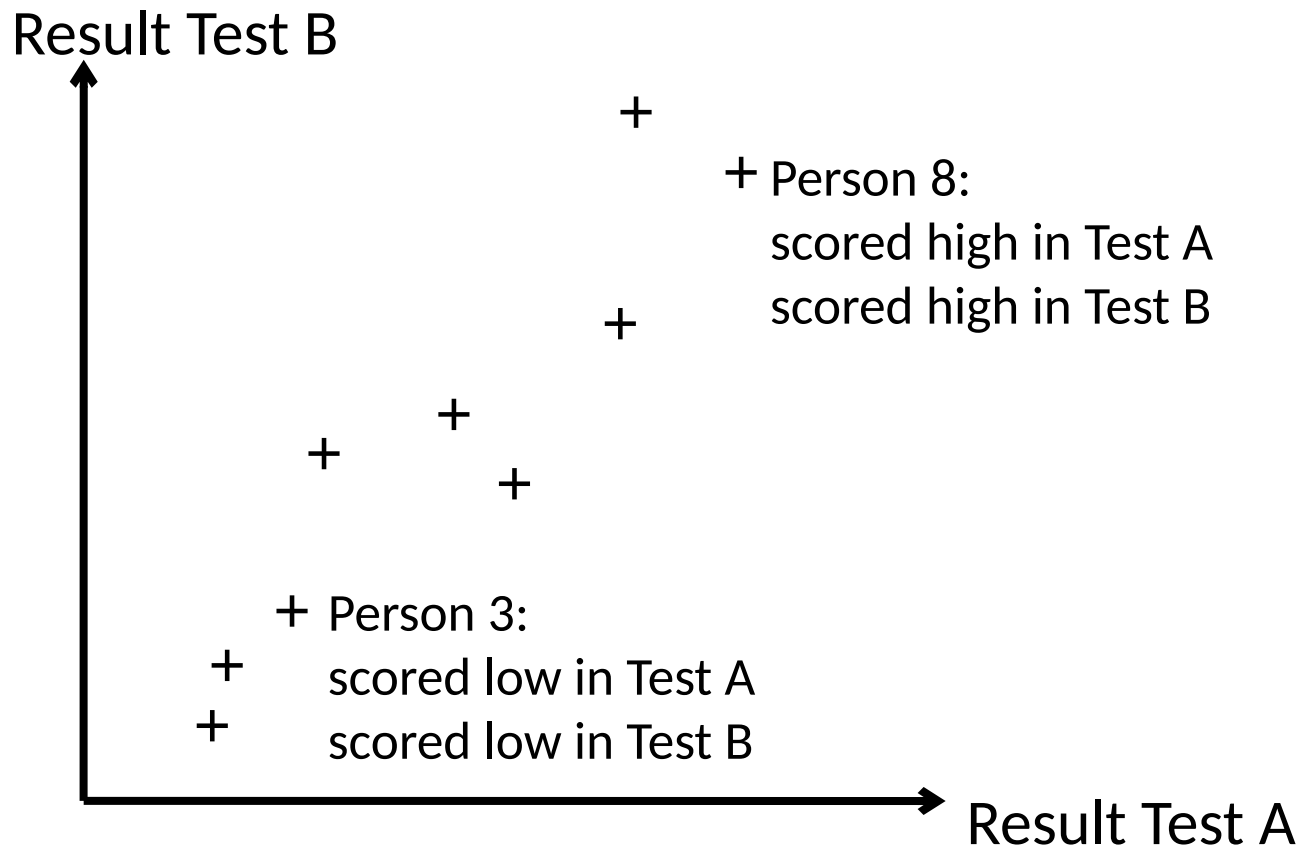Test-retest reliability

The measurement should be stable over time.

e.g., intelligence should not change much over time (short-term).
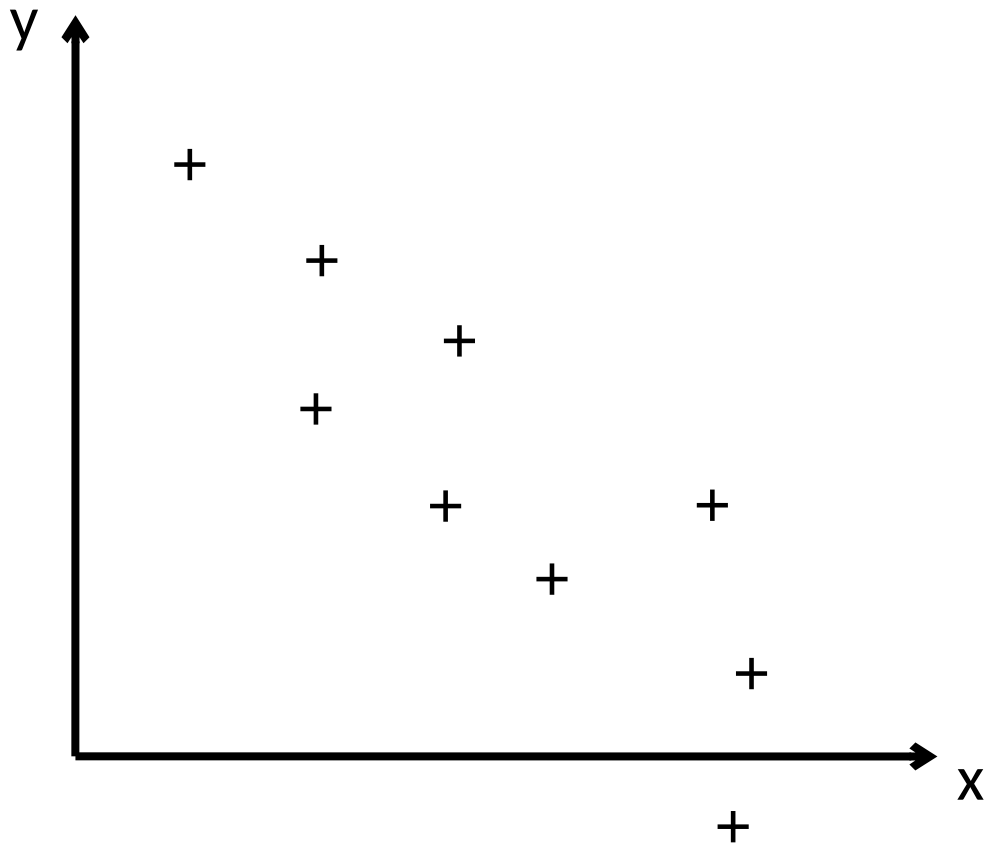
Satisfactory values: correlation above 0.7 (max:1)
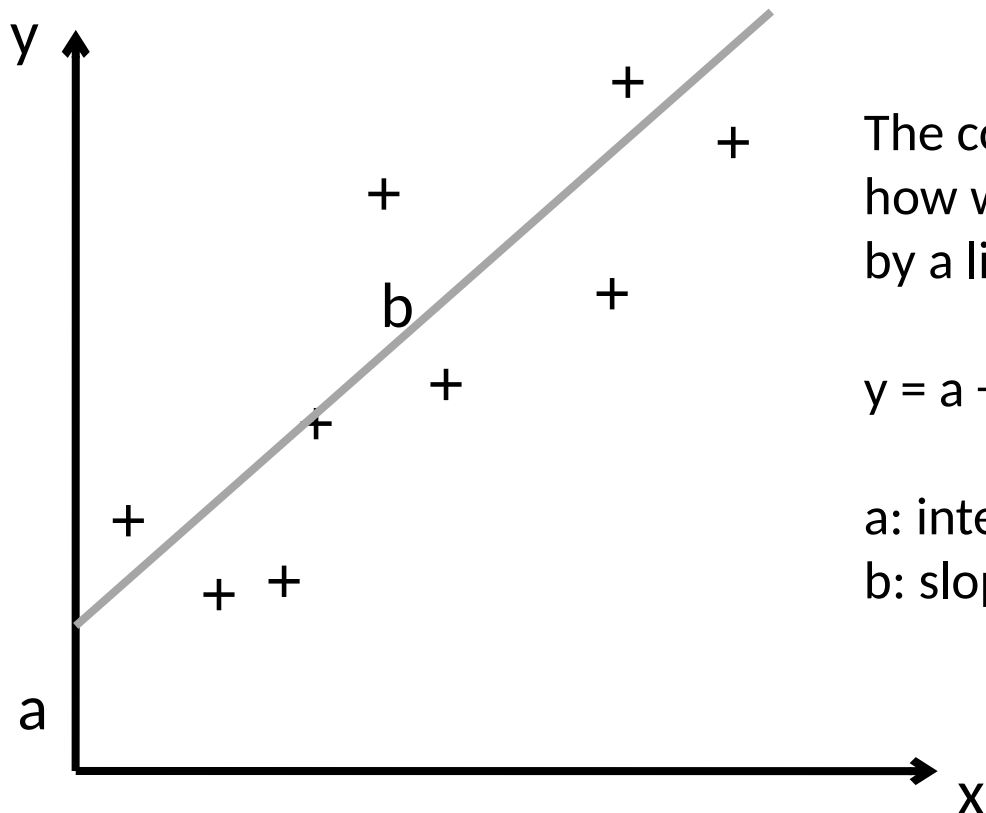
Correlation

Positive correlation
r > 0

Result Test B

+

+ Person 8:
scored high in Test A
scored high in Test B

+

+

+

+

+ Person 3:
scored low in Test A
scored low in Test B

+

+

Result Test A

Correlation

Negative correlation
r < 0

Correlation Coefficient (*r*)

$$cov(x,y) = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})$$

$$r = \frac{cov(x,y)}{s_x s_y} = \sum_{i=1}^{n} \frac{(x_i - \bar{x})(y_i - \bar{y})}{(n-1) s_x s_y}$$

The correlation coefficient **r** quantifies how well a relationship can be described by a linear model:

y = a + bx

a: intercept
b: slope

3) Validity

What makes a test valid?

Do we measure what we want to measure?

A (silly) example

This is exteme example, but how about this:

Goal:

Measure subject X's **body image**.

Test:

How many glass windows broke in Tokyo yesterday?

More glass windows = better body image

A (silly) example

This is extreme example, but how about this:

Goa

Mea

Test

How

Mor

This test is:

1) **Objective:** It is very objective to count the number of windows that broke (need to define "broke" though)

2) **Reliable:** Even if we make small mistakes each time, we will get similar number of windows that broke in Tokyo yesterday.

3) However, test is *not Valid!*
Number of windows that broke in Tokyo has *no relation* to X's body Image! Probably does not predict anything!

Requirements for Validity

Face validity:

Is the test directly related to what we want to measure?

e.g., a test that measures the ability to multiply in the range of 0-10 obviously predicts the capability to multiply in the range of 0-10.

Convergent validity

The measurement should correlate with other expected measures.

e.g., Beck depression inventory might correlate with time spent alone at home, or intelligence with time spent reading books

Predictive validity

The measurement should predict other expected measures.

e.g., Beck depression inventory might predict suicide, or intelligence academic success

More requirements for Validity

Concurrent validity:

The measurement should correlate with other tests.

e.g., Beck depression inventory should correlate with the Hamilton depression scale.

Discriminant validity

The measurement should not correlate with measures which would not make sense.

e.g., Beck depression inventory should not correlate (much) with personality traits

Relationship between criteria

Objectivity > Reliability > Validity

Objectivity limits the reliability, reliability the validity of a test.

Relationship between criteria

Objectivity > Reliability > Validity

Objectivity limits the reliability, reliability the validity of a test.

→ You can have an objective and reliable test that is not valid (like the example with broken windows)
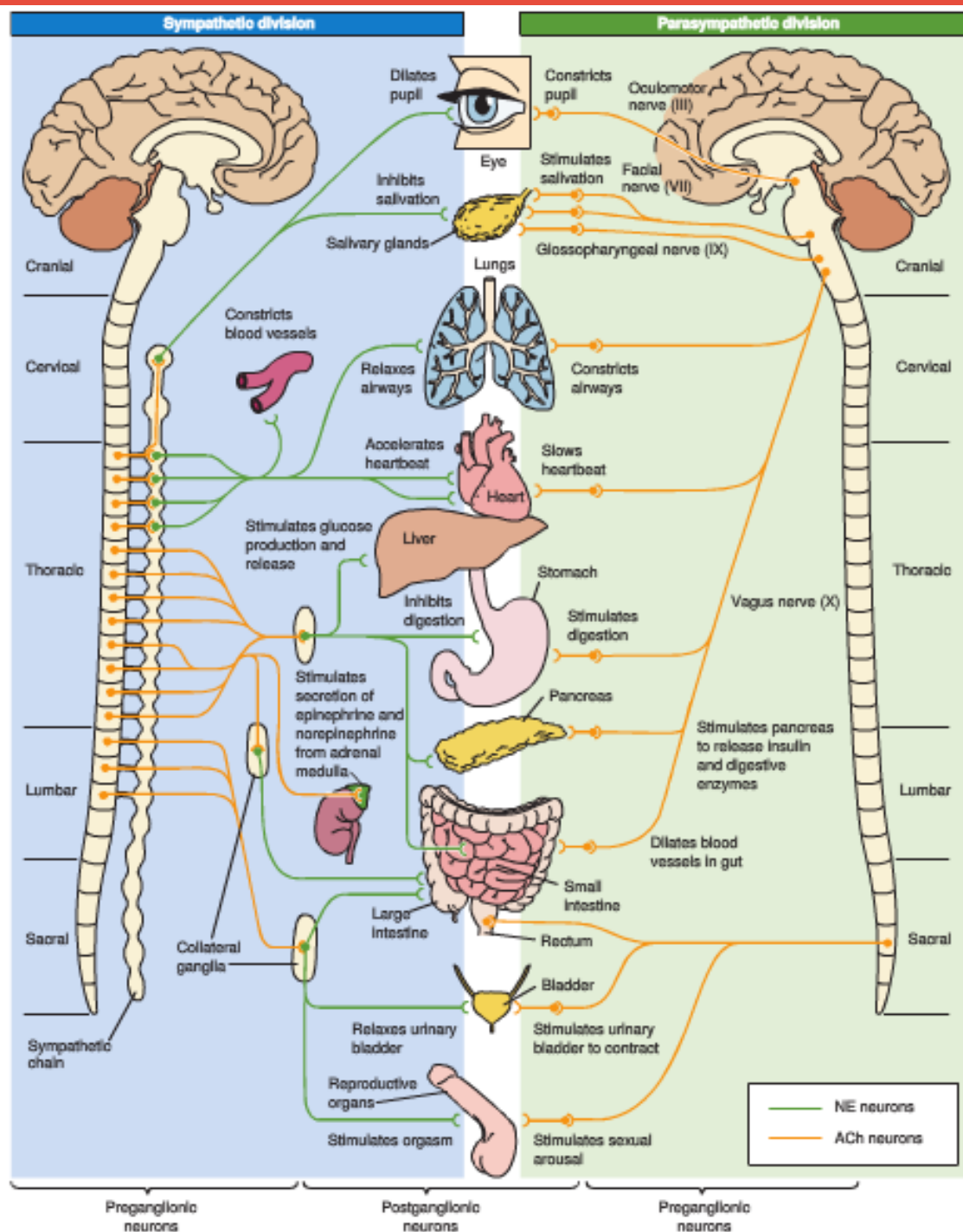
→ But, a valid test that is *not* objective/reliable is dificult…

Psychophysiology

Can we measure psychological "events", emotions/fear/stress?

→ Psychophysiology

Autonomic nervous system (ANS)

Sympathetic division

Parasympathetic division

Dilates pupil

Eye

Constricts pupil

Oculomotor nerve (III)

Inhibits salivation

Stimulates salivation

Facial nerve (VII)

Salivary glands

Glossopharyngeal nerve (IX)

Constricts blood vessels

Lungs

Relaxes airways

Constricts airways

Accelerates heartbeat

Slows heartbeat

Heart

Stimulates glucose production and release

Liver

Stomach

Inhibits digestion

Stimulates digestion

Vagus nerve (X)

Stimulates secretion of epinephrine and norepinephrine from adrenal medulla

Pancreas

Stimulates pancreas to release insulin and digestive enzymes

Dilates blood vessels in gut

Small intestine

Large intestine

Collateral ganglia

Rectum

Bladder

Relaxes urinary bladder

Stimulates urinary bladder to contract

Reproductive organs

Stimulates orgasm

Stimulates sexual arousal

Sympathetic chain

Cranial

Cervical

Thoracic

Lumbar

Sacral

Preganglionic neurons

Postganglionic neurons

Preganglionic neurons

NE neurons

ACh neurons

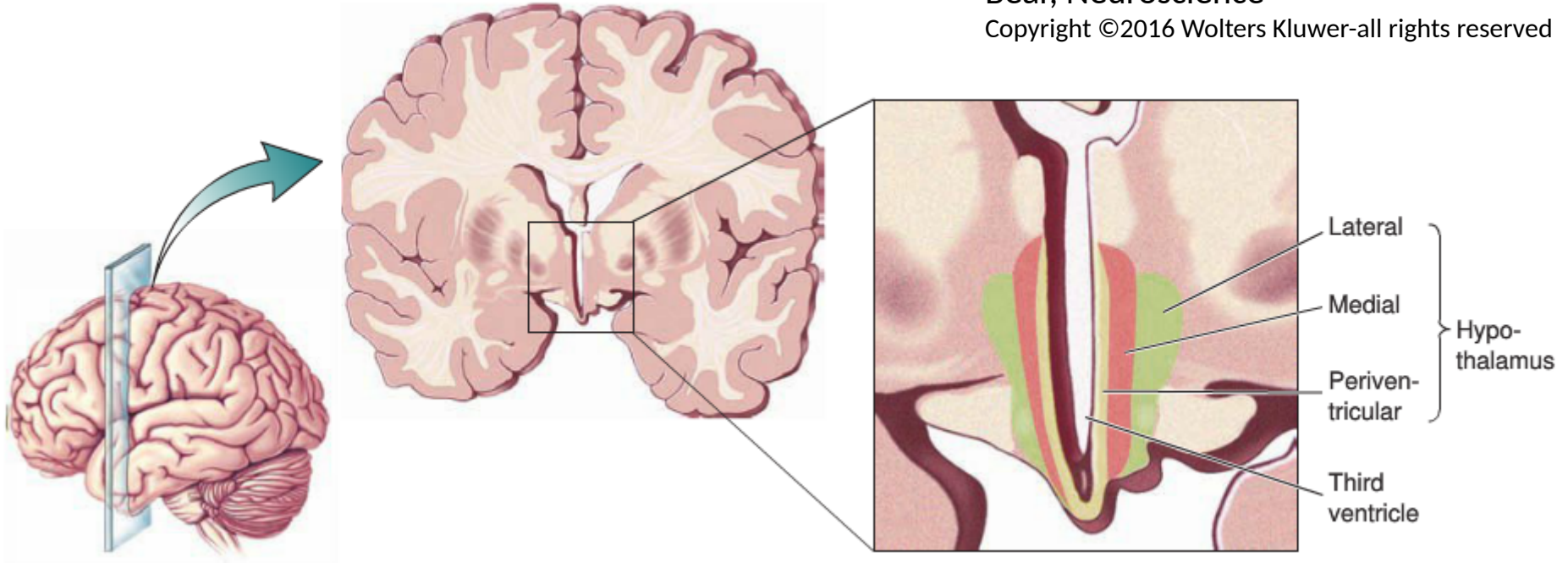The **Autonomic nervous system** (ANS) is divided into two parts:

Sympathetic division: activated in crisis, i.e., Fight, Flight, Fright, Sex (orgasm)

Parasympathetic division: Relaxation, Digestion, Sex (swelling of genitals, arousal)

Bear, Neuroscience

Hypothalamus

Lateral ⎫
Medial   ⎬ Hypo-
Periven- ⎮ thalamus
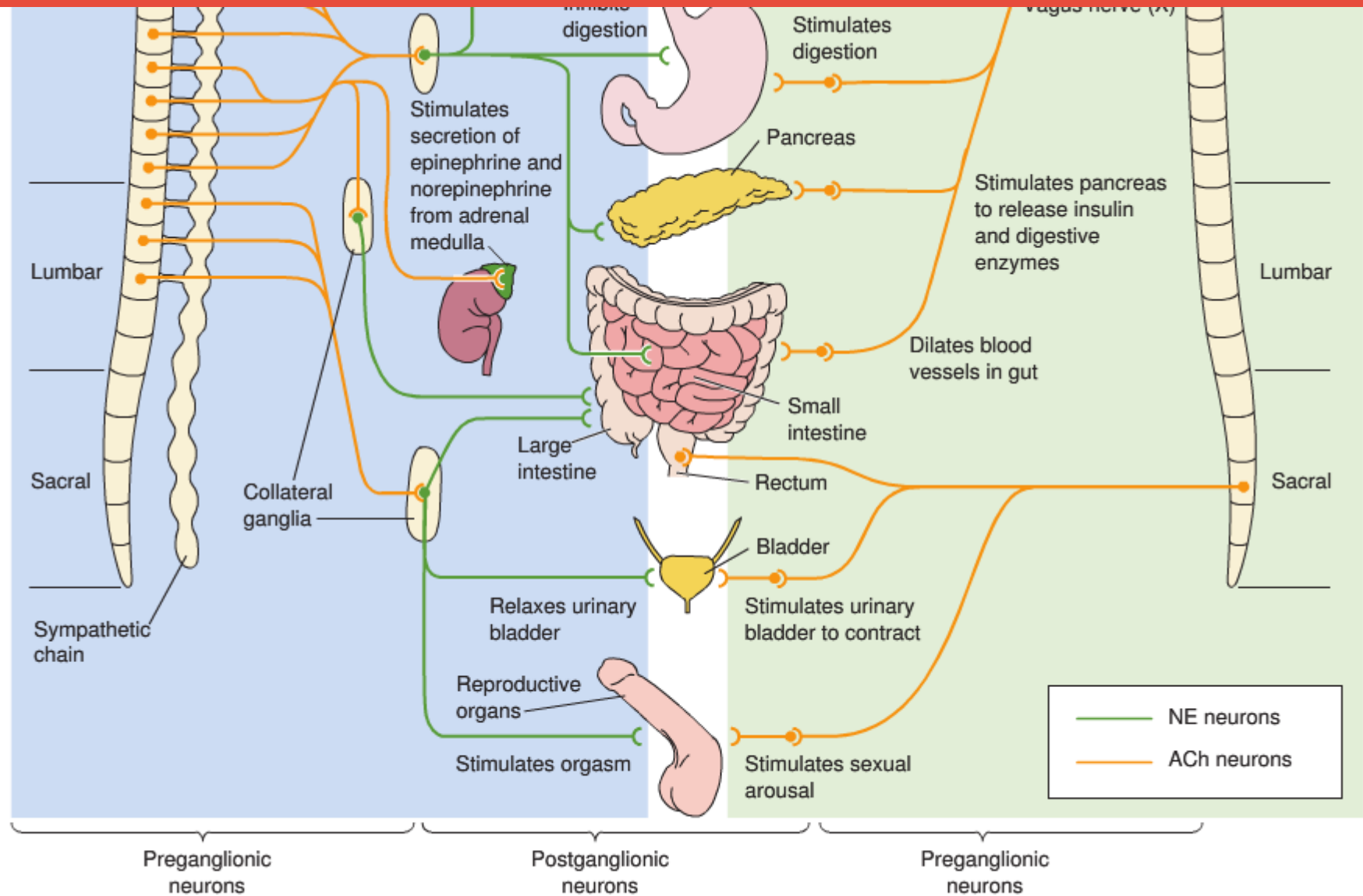tricular ⎭

Third
ventricle

The autonomic nervous system (ANS) is to a large extent controlled by the hypothalamus.

The hypothalamus is generally involved in keeping the homeostasis of the organism, i.e., it keeps the organism in working condition.
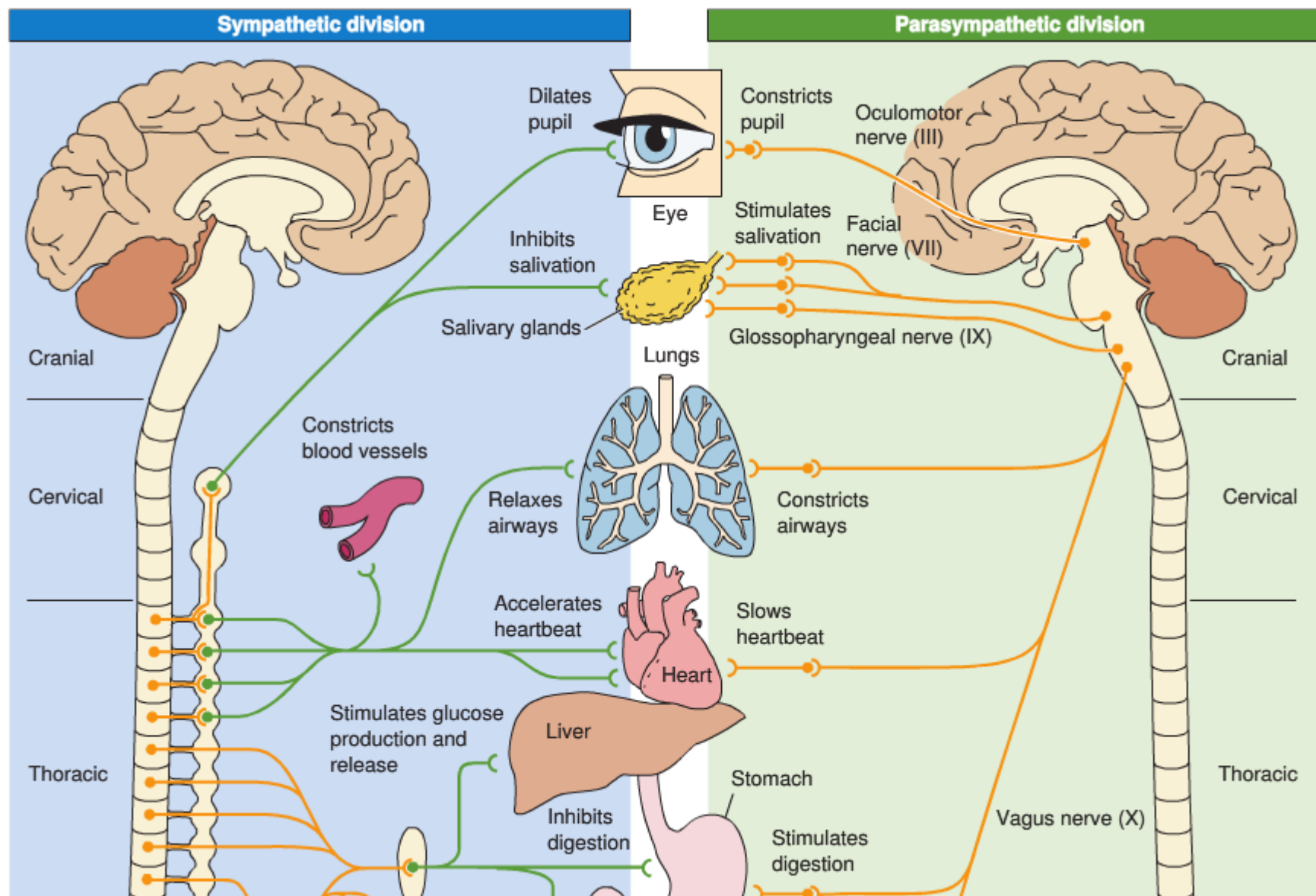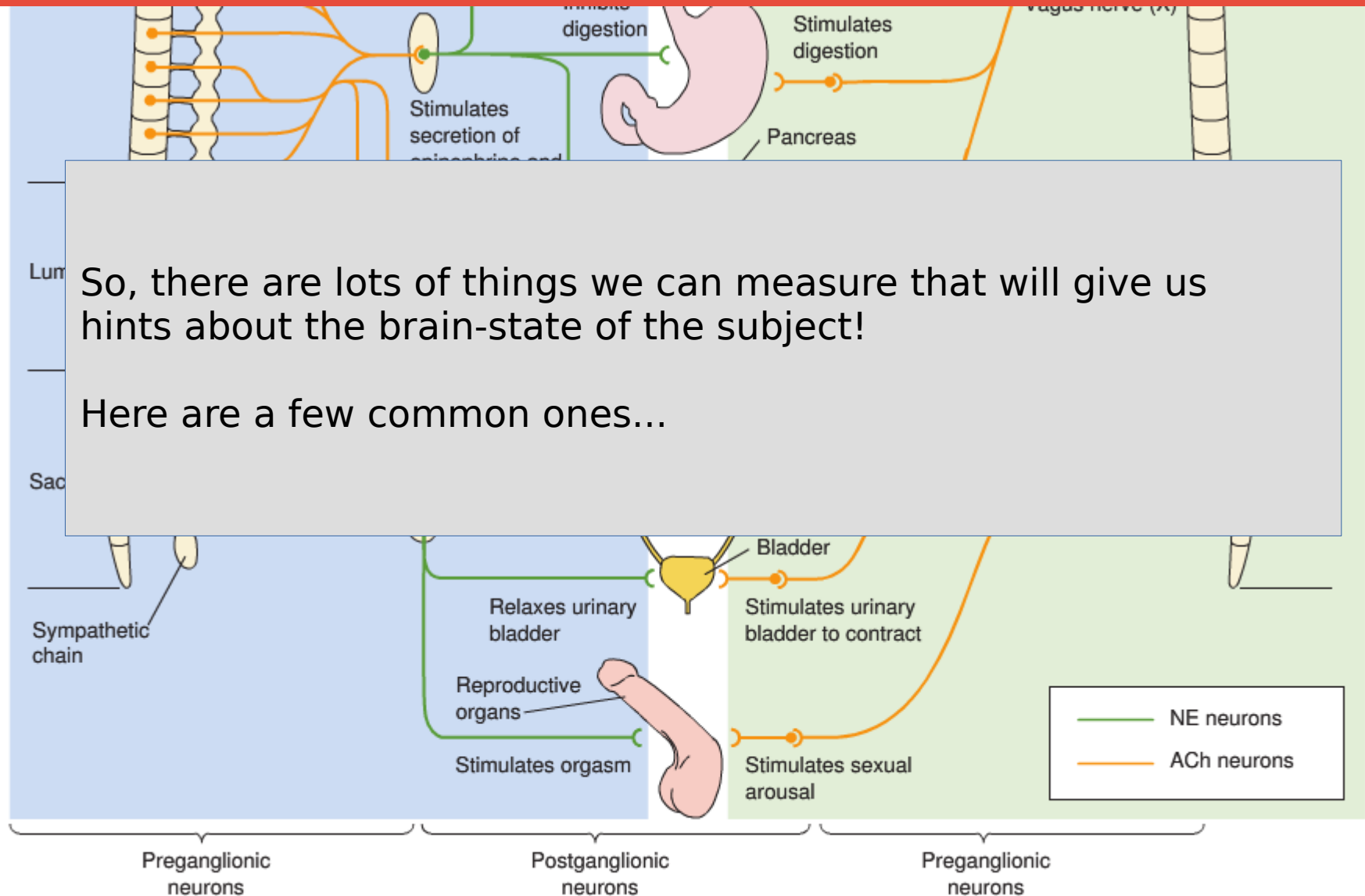
Green lines: norepinephrine (NE), orange lines: acetylcholine (ACh)
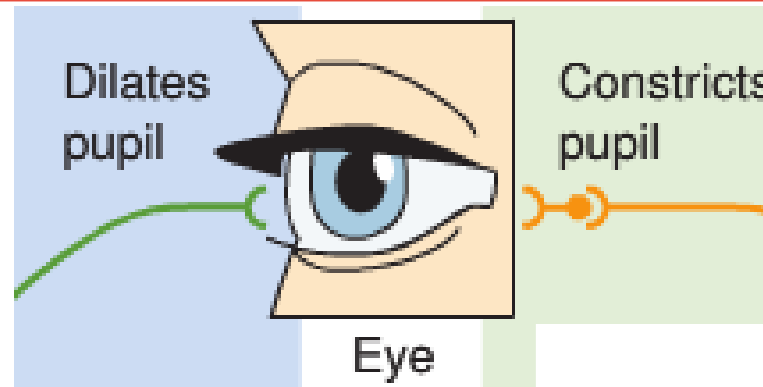
Autonomic Nervous System

Autonomic Nervous System

So, there are lots of things we can measure that will give us hints about the brain-state of the subject!

Here are a few common ones...

Inhibits digestion

Stimulates digestion

Stimulates secretion of epinephrine and

Pancreas

Vagus nerve (X)

Lum

Sac

Bladder

Sympathetic chain

Relaxes urinary bladder

Stimulates urinary bladder to contract

Reproductive organs

Stimulates orgasm

Stimulates sexual arousal

NE neurons

ACh neurons

Preganglionic neurons

Postganglionic neurons

Preganglionic neurons

Bear, Neuroscience

Pupil Width

The sympathetic system dilates the pupil.

The parasympathetic system constricts the pupil.

-> Arousal will lead to widened pupils

-> More light enters the eye and hits the retina

We can measure pupil width with a camera.

Other factors that can affect pupil width: light condition, drugs.
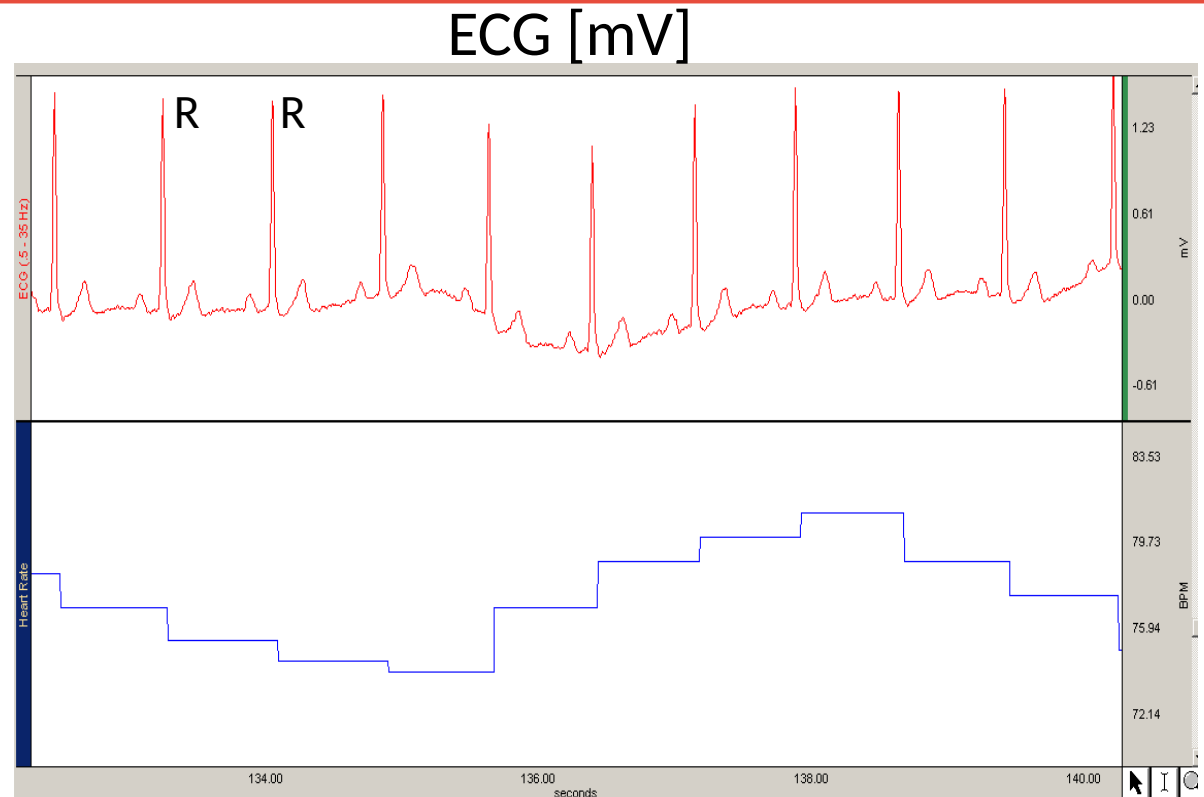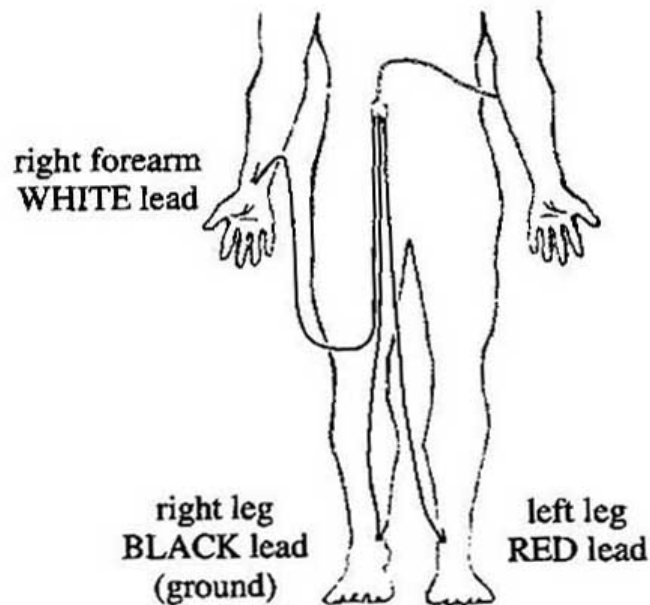
Electrocardiogram (ECG)
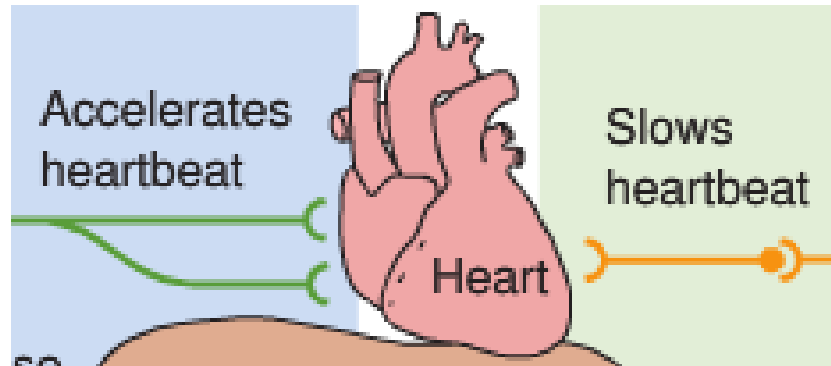
The sympathetic system accelerates heartbeat.

The parasympathetic system decelerates heartbeat.

-> Arousal will increase heartrate
-> More blood is pumped through body (provides oxygen, nutrients)

We can measure heart rate with an electrocardiogram (ECG), with electrodes connected to the body.
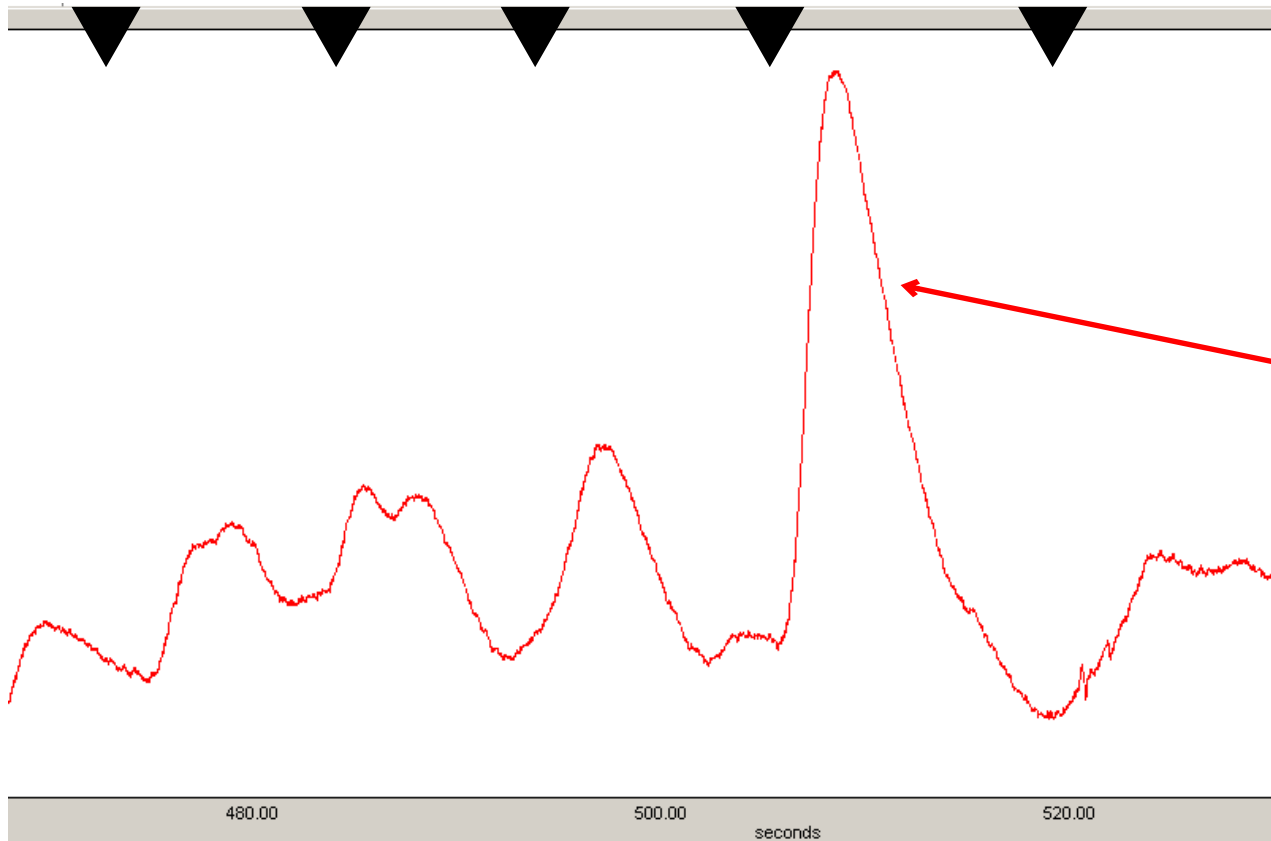
Electrocardiogram (ECG)

ECG [mV]

Heart rate [beats per minute]

Heart rate is computed from the time difference between peaks (R deflections).
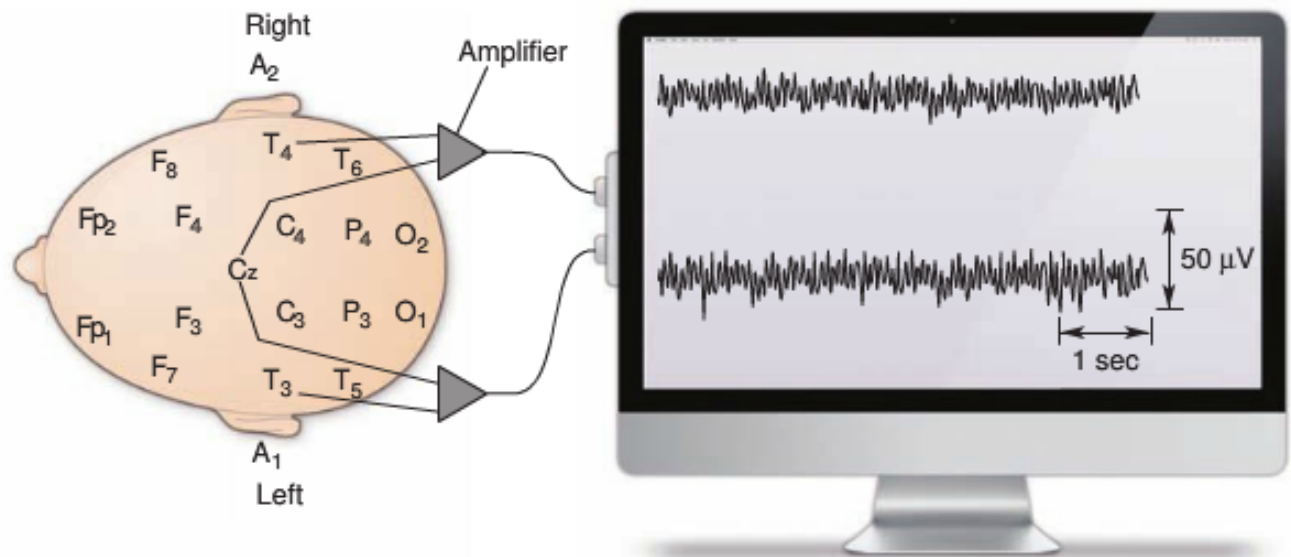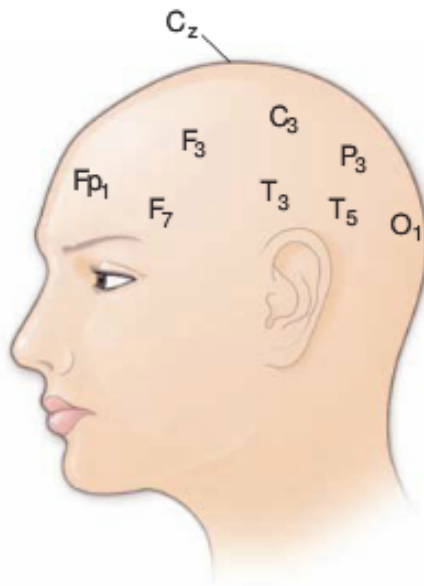
Electro-dermal activity (EDA)

www.BioPac.com

"Lie detector":
arousal (due to lying)->
more sweat->
higher conductivity

480.00   500.00   520.00

seconds

Electroencephalogram (EEG)

"Ongoing" EEG is brain activity recorded without specific stimulation. Of interest are the EEG amplitudes in different frequency bands.

Electroencephalogram (EEG)

Slower rhythm:

Alpha: 8-12 Hz

Characteristic for the awake, relaxed state or when eyes are closed

Faster rhythms:

Beta: 12-30 Hz
Gamma: >30Hz

Characteristic for the awake, attentive state

Awake

Alpha rhythms   Beta and gamma rhythms

Other psychophysical measures

Apart from these measures, we can also take other measures such as:

- Respiration rate (breathing)
- Startle reflex (motor reaction to an unexpected event)
- Muscle activity

The pattern of psychophysiological activity is rather unspecific
-> we cannot infer the underlying event/emotion.

Summary: What we did today

Psychological Tests

Test criteria:

Objectivity: does the test result depend on the examiner?

Reliability: is there a measurement error?

Validity: do we measure what we want to measure?

Psychophysiology

Autonomous nervous system

Sympathetic and parasympathetic nervous systems affect for example:
- Pupil width
- ECG: electrocardiogram
- EDA: electrodermal activity
- EEG: electroencephalography