

# Foundations of Psychophysiology

Part 1: Introduction

Dr. Laurens R. Krol

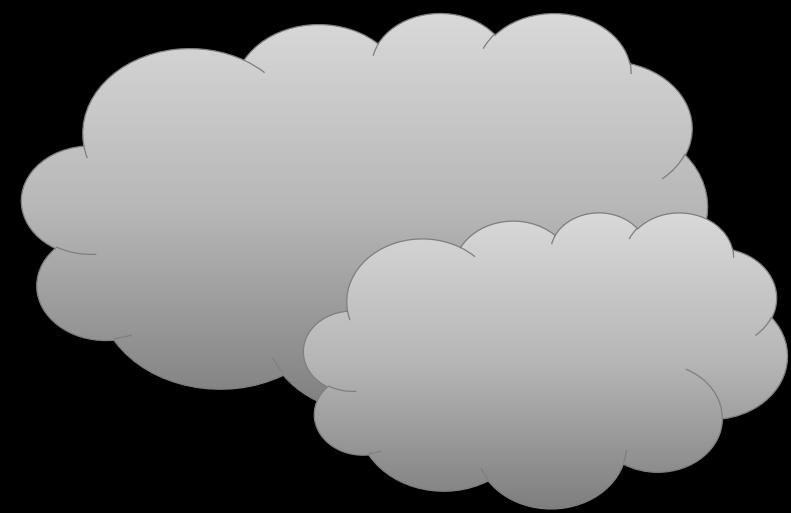
2023-11-07



NEUROADAPTIVE  
HUMAN-COMPUTER  
INTERACTION



Brandenburg  
University of Technology  
Cottbus - Senftenberg



# Psychophysiology

## Introduction

History

Definition and scope

Sample study

# Psychophysiology

## History

# Psychophysiology: History

## Mind-body problem

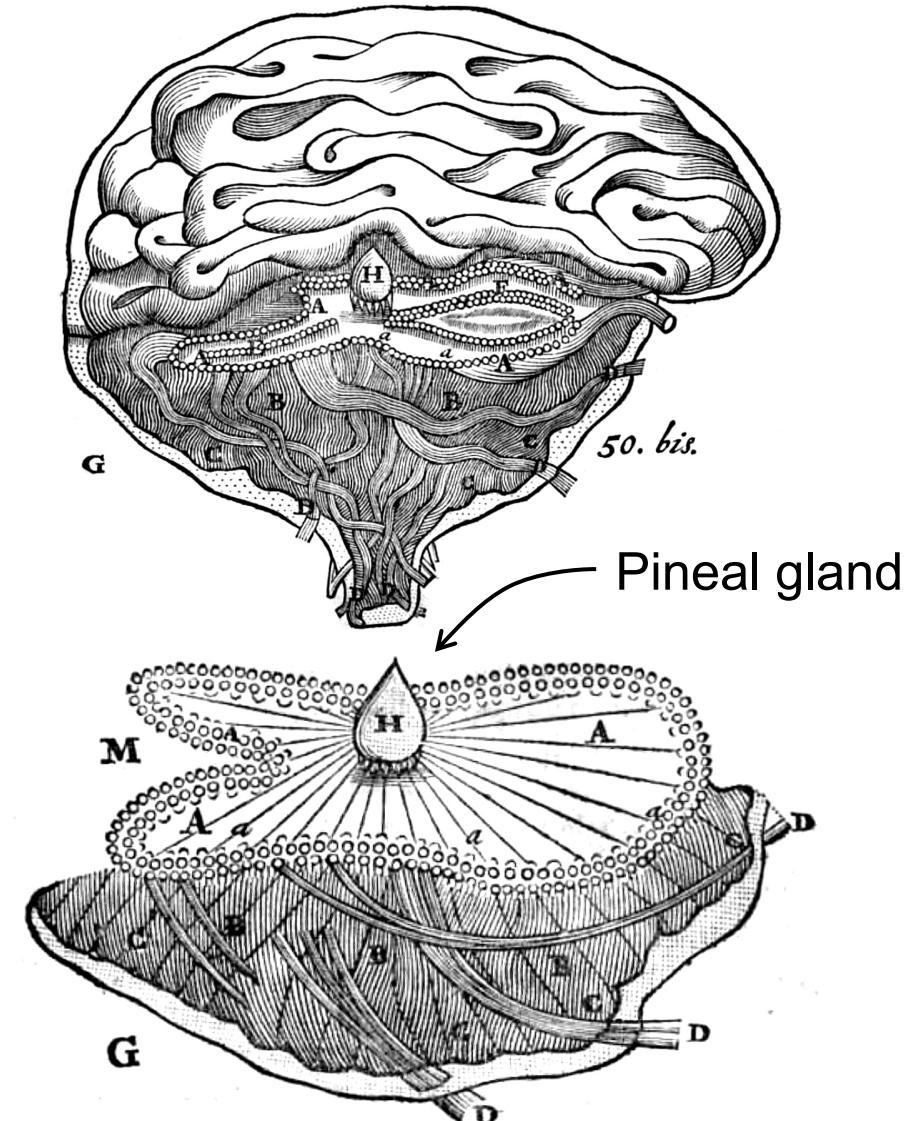
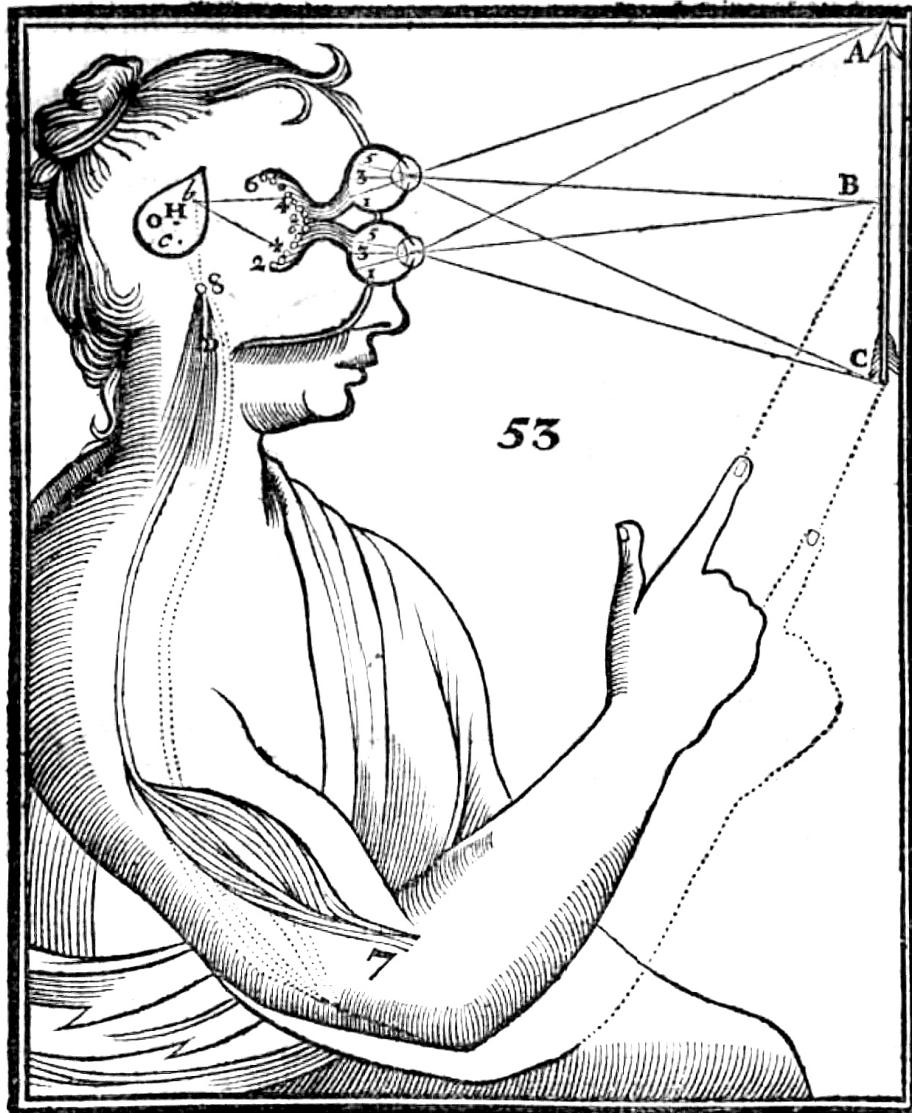
Philosophical debate about the relationship between (conscious) experiences and the physical body

Monists: No distinction needed; one *thing* can explain both

Dualists: Separate *things* needed to explain mind and body

# Psychophysiology: History

## Mind-body problem



# Psychophysiology: History

## Four humours, four temperaments

Phlegm – relaxation

Blood – enthusiasm

Yellow bile – anger

Black bile – sadness

Attempt to systematically link (mental) health to physical factors



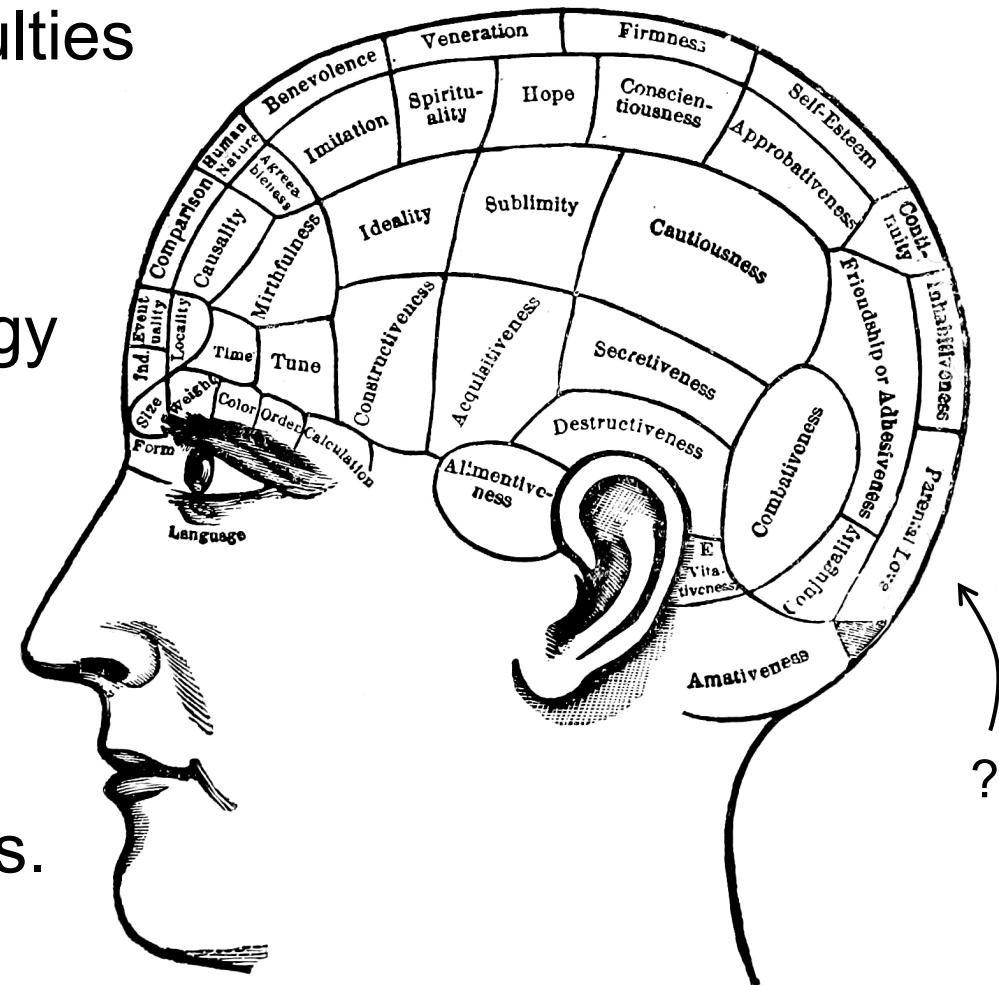
# Psychophysiology: History

## Focus on the brain

Assumption that mental faculties and personality traits are localised in the brain

→ Pseudoscience phrenology

Controlled lesion studies on animals and humans provided clear evidence against phrenology, and in favour of more serious localisation of brain functions.



# Psychophysiology: History

## Psychology and emotions

Cannon-Bard theory:

Emotions are experienced in the brain first, and subsequently result in physiological changes.

*“We feel afraid, therefore we start sweating.”*

James-Lange theory:

Emotion is the result of physiological experiences. Different specific patterns of physical bodily activity are interpreted by the brain as different emotions.

*“We feel afraid, because we are sweating.”*

# Psychophysiology: History

## Emotions and physiology

Moreover, the patient's pulse and disposition are altered when mention is made of the person he loves, and especially when this occurs suddenly. It is possible in this way to ascertain whom he loves, when he will not reveal it himself.

The nature of the cure is this: let several names be pronounced, **repeating them many times**, and place your finger on the patient's pulse. When it varies by a large fluctuation and then returns to normal, and this is repeated thereafter, and is put to the test many times, then the name of the one he loves will be known.

”

– Ibn Sina (1025). *The canon of medicine*.

Mesulam, M.-M., & Perry, J. (1972). The diagnosis of love-sickness: Experimental psychophysiology without the polygraph.  
*Psychophysiology*, 9(5), 546–551, as cited by

Andreassi, J. (2007). *Psychophysiology: Human Behavior and Physiological Response* (5th Edition). New York, USA: Psychology Press.

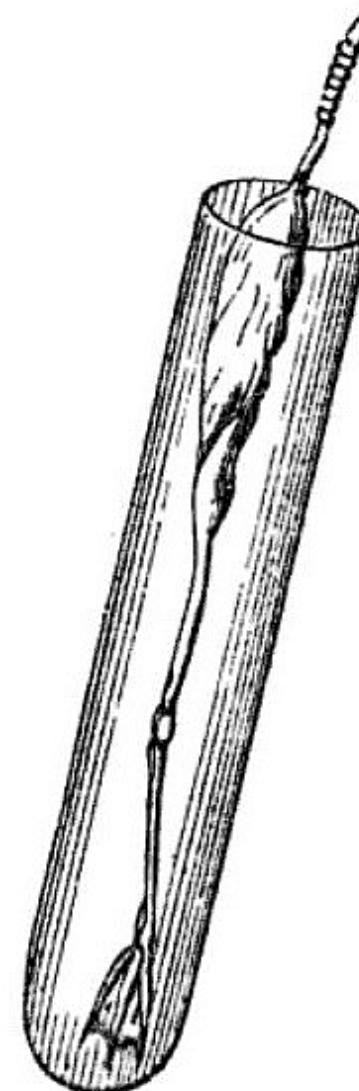
# Psychophysiology: History

## Physiological measurement

In 1791, Luigi Galvani discovered that frog legs twitched when subjected to electrical current.

This led to the *frog galvanoscope*, a device to detect electricity.

With this, electrical currents were also found in human bodies.

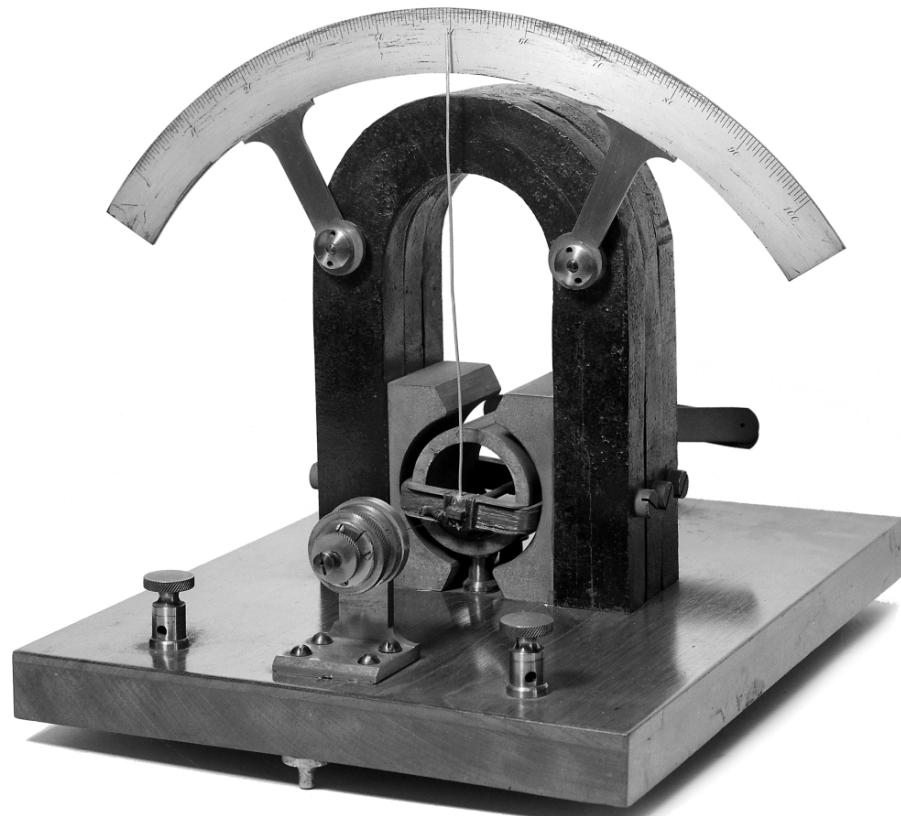


# Psychophysiology: History

## Physiological measurement

Richard Caton used a galvanometer to observe electrical impulses from the surface of living rabbit and monkey brains.

“... currents ... were found to be ... influenced by stimulation of the ... retina by light.”



Caton, R. (1875). The electric currents of the brain. *British Medical Journal*, 2(765), 278.

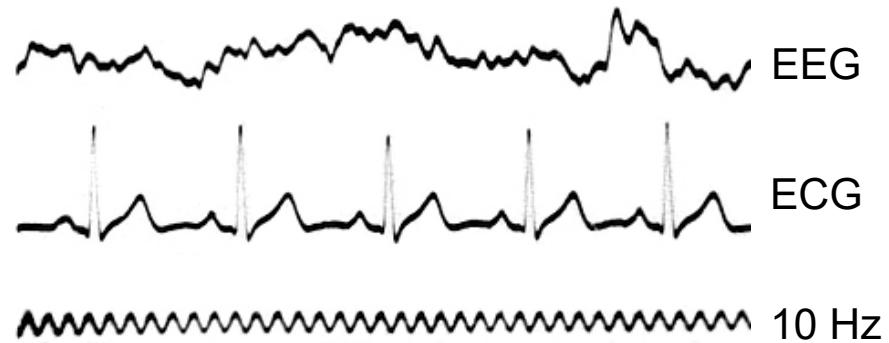
Photo: “A moving coil galvanometer” by Wellcome Collection is licensed under CC BY 4.0 / Removed background from original

# Psychophysiology: History

## Physiological measurement

In 1924, Hans Berger performed the first measures on a living human brain.

Later measurements revealed first indications that different intensities of mental activity led to visible changes in the recorded curves.



# Psychophysiology: History

## The field of psychophysiology

In 1960, the Society for Psychophysiological Research was founded

“... to foster research on the interrelationships between the physiological and psychological aspects of behavior.”



# Psychophysiology

## Introduction

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# Psychophysiology

## Definition and scope

# Psychophysiology: Definition and scope

## Related fields

- Psychology
- Physiology
- Anatomy
- Biological psychology
- Physiological psychology
- Psychophysics
- Psychophysiology

# Psychophysiology: Definition and scope

## Related fields

- Psychology
  - studies the human mind and behaviour.
- Physiology
  - studies the chemical and physical functioning of living systems.
- Anatomy
  - studies the structure of living systems.

# Psychophysiology: Definition and scope

## Related fields

- Biological psychology

aka behavioural neuroscience, studies the biological basis of human behaviour and psychology.

- Physiological psychology

is essentially the same thing.

- Psychophysics

studies the sensation and perception of physical stimuli.

# Psychophysiology: Definition and scope

## Psychophysiology

In psychophysiological research ...

“... the dependent variable is a physiological measure and the independent variable a ‘behavioral’ one ...”

Stern (1964)

Psychophysiology is ...

“... the scientific study of social, psychological, and behavioral phenomena as related to and revealed through physiological principles and events in functional organisms.”

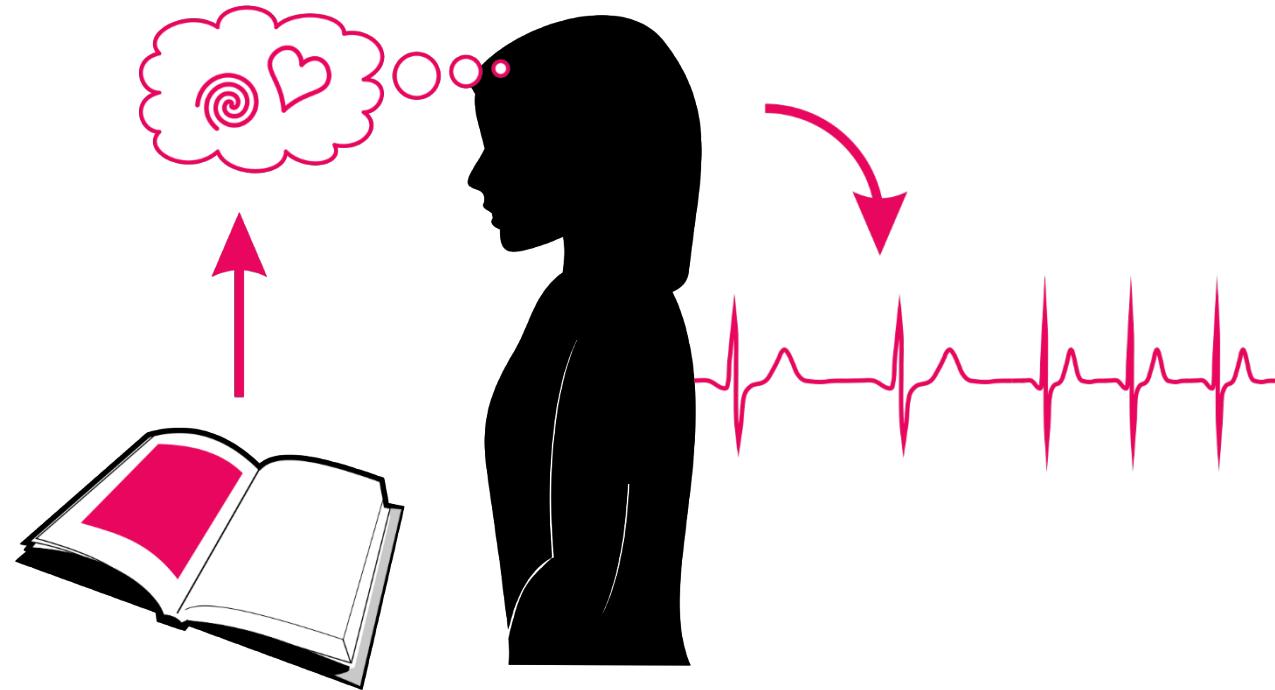
Cacioppo *et al.* (2007)

Stern, J. A. (1964). Toward a definition of psychophysiology. *Psychophysiology*, 1(1), 90–91.

Cacioppo, J., Tassinary, L. G., & Berntson, G. G. (2007). *The handbook of psychophysiology* (Third ed., p. 4). New York, NY, USA: Cambridge University Press.

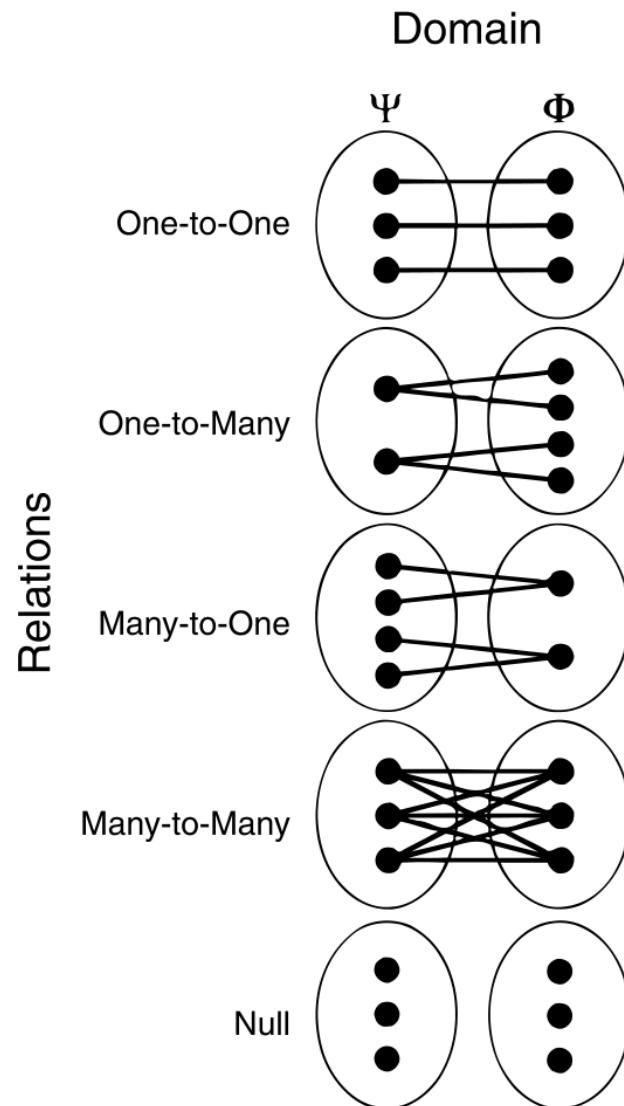
# Psychophysiology: Definition and scope

## Psychophysiological inference



# Psychophysiology: Definition and scope

## Psychophysiological inference



# Psychophysiology: Definition and scope

## Scope

- Cardiac and hemodynamic measures
- Electromyographic measures
- Electrodermal activity
- Electroencephalographic measures
- Oculomotor and pupillometric measures
- Respiration
- Salivary activity
- Gastrointestinal activity
- Genital activity
- ...

# Psychophysiology: Definition and scope

## Scope

- Cognitive psychophysiology
- Social psychophysiology
- Developmental psychophysiology
- Clinical psychophysiology
- Environmental psychophysiology
- Applied psychophysiology
- ...

# Psychophysiology

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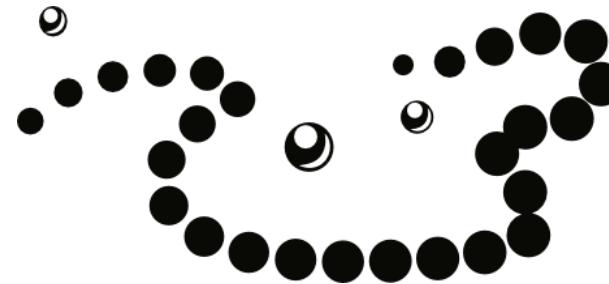
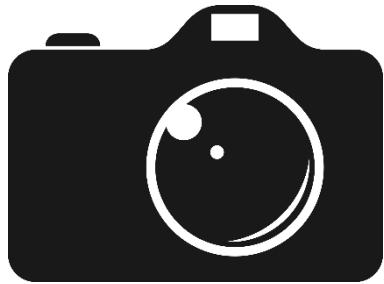
# Psychophysiology

## Sample study

Rosenfeld, J. P., Nasman, V. T., Whalen, R., Cantwell, B., & Mazzeri, L. (1987). Late vertex positivity in event-related potentials as a guilty knowledge indicator: A new method of lie detection. *International Journal of Neuroscience*, 34(1-2), 125–129.

# Psychophysiology: Sample study

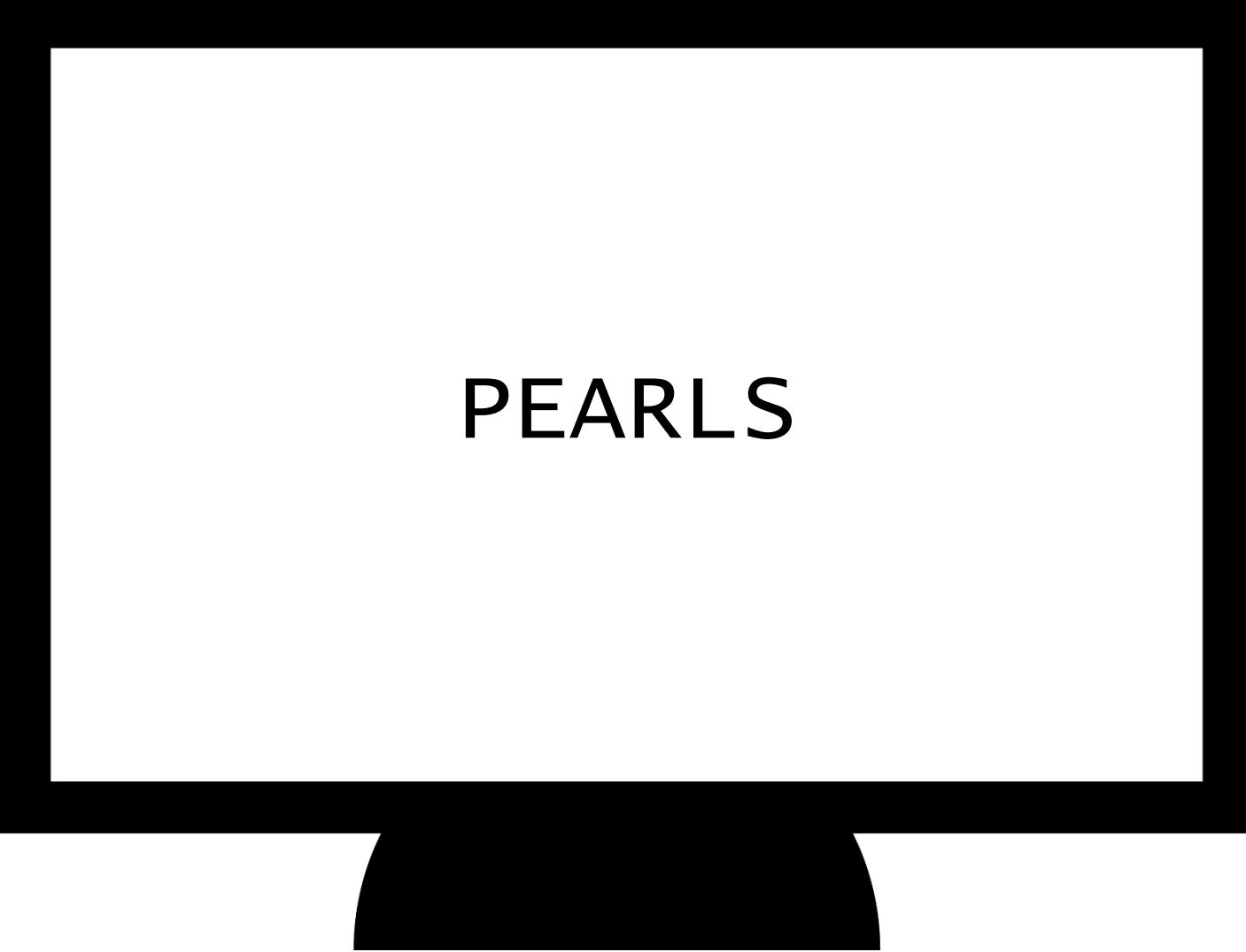
## Methods



Rosenfeld, J. P., Nasman, V. T., Whalen, R., Cantwell, B., & Mazzeri, L. (1987). Late vertex positivity in event-related potentials as a guilty knowledge indicator: A new method of lie detection. *International Journal of Neuroscience*, 34(1-2), 125–129.

# Psychophysiology: Sample study

## Methods



PEARLS

# Psychophysiology: Sample study

## Results

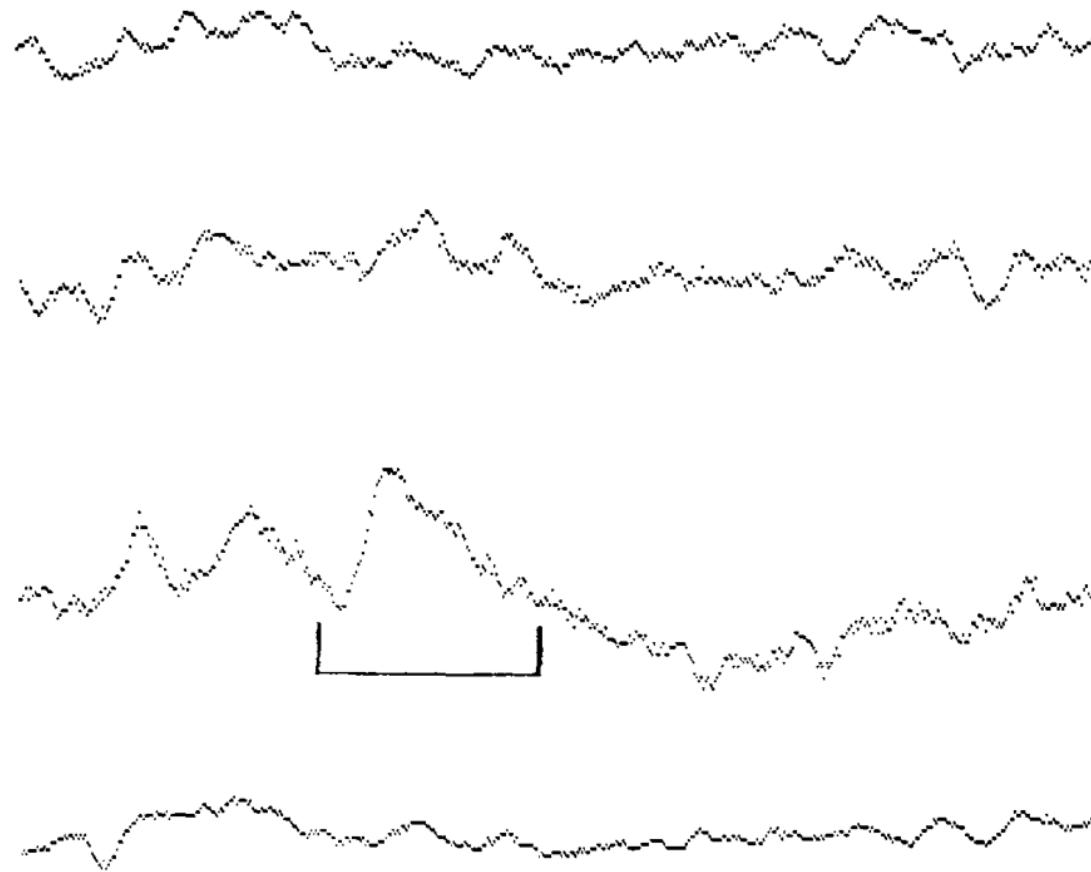


FIGURE 1 Averaged ERPs, for one experimental subject, to the novel word “RADIO” (top trace,  $N=20$ ), the novel word “DIAMOND” (second trace,  $N=22$ ), the chosen word “CAMERA” (third trace,  $N=21$ ), and to all novel words (bottom trace,  $N=179$ ). Positivity is up. The bracket below the third trace begins at 400 ms poststimulus and endures to 700 ms. The height of the sides of this indicator corresponds to 3  $\mu$ V. Stimulus onset is coincident with trace onset.

# Psychophysiology

## Introduction

Psychophysiology studies the relations between psychological phenomena and physiological processes.

These relations are generally non-causal and not one-to-one.

Psychophysiology can reveal things that otherwise cannot, or would not, be revealed.

# Psychophysiology

## Part 1: Introduction



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