"Our thoughts are at least our own." Are they though?

EEG-based neuroimaging under the GDPR

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Mind reading via EEG – legal, ethical and practical matters

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OUTLINE

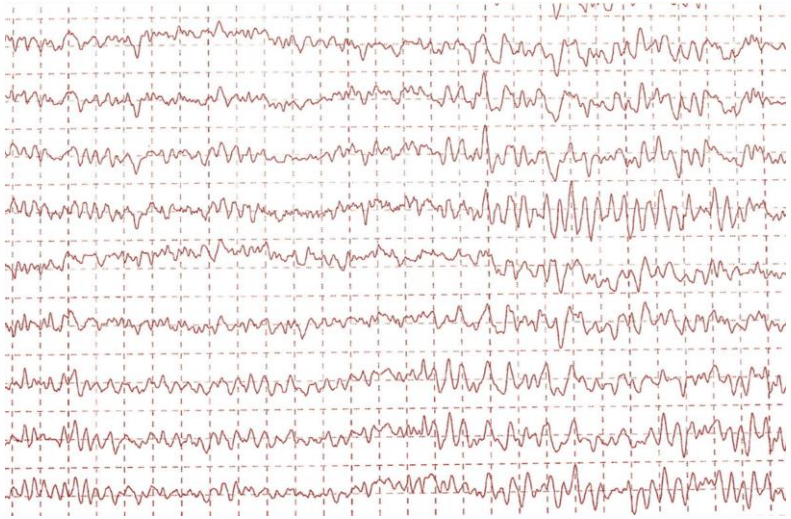
1. **Personal data under the GDPR**
2. Factors for direct identification
3. Further types of personal data
4. Versatility of EEG data

Use of EEG data

- Detection of brain disorders
  - seizure disorders
  - brain tumour
  - encephalopathy
  - dementia
- Authentication/identification
- Meditation
- Education
- Creating immersive and emotion-adaptive ‘neuro-environments’

EEG data under the GDPR

- No separate category for brain data
- No direct mention or reference (mental health, mental identity)
- Possible options:
  - Personal data
  - Biometric data
  - Data concerning health
  - Special category of data



Personal data

- 'Personal data' means any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly…
  - **Any information**: objective and subjective information, regardless of its format and way of storage
  - **Relating to:**
    - „About" the individual
    - Content (information is about a particular person)
    - Purpose (treat or influence the status or behaviour of an individual)
    - Result (information is likely to have an impact on the individual's rights and interest)
  - **Identified or identifiable**:
    - Identified: he or she can be distinguished from all other members of a group
    - Identifiability: the possibility thereof (threshold condition)
    - Identification can occur directly or indirectly
  - **Natural person**: living individuals

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Factors for direct identification

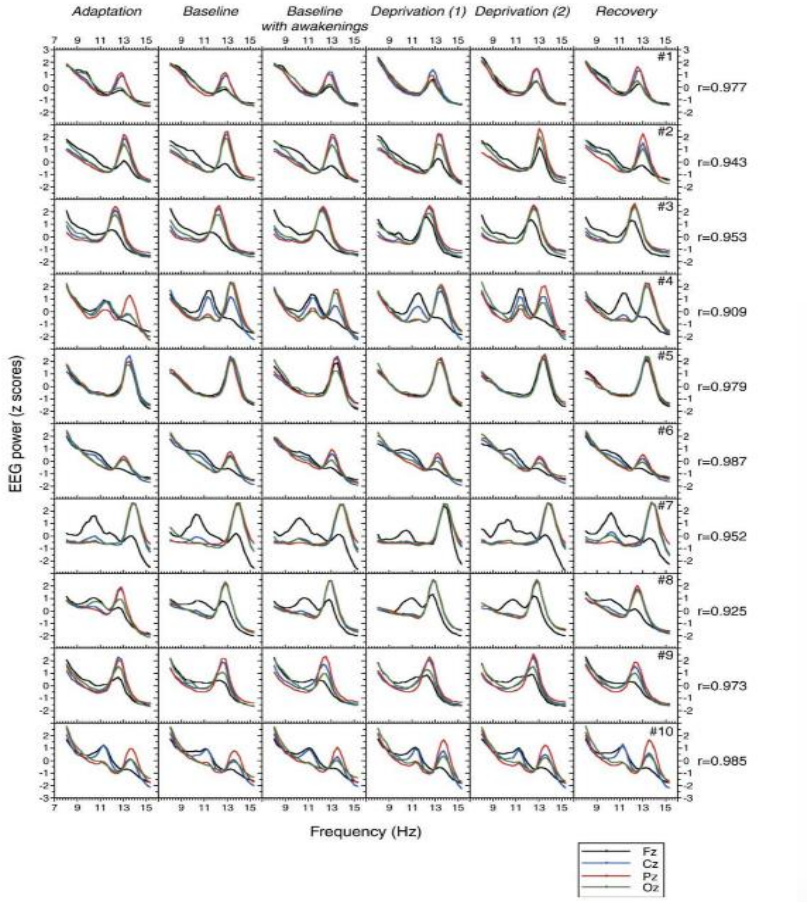
1. Adequacy of the neuroimaging tool
2. Accuracy of the method used to understand EEG data
3. Changes evoked in the data comparison by time

1. Adequacy of the neuroimaging tool

- Application of electrode arrays (wet/dry)
- Number of electrode arrays
- Placing of electrode arrays (10-20 system)
- Biological traits
  - Head's shape
  - Skull's thickness
  - Scalp's thickness
  - Anisotropy
  - Inhomogeneity

2. Accuracy of the method used to understand EEG data

- 2005, De Gennaro et al.
- Individual's profile of electroencephalographic power spectra at the 8 to 15.5Hz frequency during non–rapid eye movement (NREM) sleep is unique
- 10 research participants
- Slow-wave sleep deprivation study over 6 nights
- Profile remained invariant
- Subsequent study in 2008 showed that certain personal features relating to the EEG profile during NREM sleep are genetically determined and are heritable.



Accuracy of the method used to understand EEG data (2)

- March 2020 Nishimoto et. al.
- Use of EEG as a basis for authentication via brain signals
- 20 research participants in 4 rounds
- *"**Brain activity (EEG) signals include personal features, which are consistent** throughout different times of the day, even after reinstalling the EEG caps, and throughout different days, even with possible changes in the physiological states of the subjects"*
- They achieved a ~40% accuracy, proving that their proposed method is applicable in personal authentication, even though the variability in EEG data affected the personal features used for identification.

Overfitting

- Revett et al., Poulos et al., or Paranje et al.
- Revett K, de Magalh˜aes ST (2010) Cognitive biometrics: Challenges for the future. In: Global Security, Safety, and Sustainability, Springer. pp. 79–86.

- **Identification accuracy of EEG-based techniques can achieve 80 or even 100%**

3. Changes evoked in the data comparison by time

- Neuromodulation
- Neuroplasticity

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A higher protective regime

- Some data are more sensitive than other data
- Specific regime
- Barrier protection:
  - Closed category (article 9 (1) GDPR)
  - More restrictive and less available legal bases (article 9 (2) GDPR)
  - Automated decision-making only upon explicit consent (article 22 (4) GDPR)
- Administrative requirements:
  - Data Protection Officer (Article 37(1)(c)
  - Data Protection Impact Assessment (Art. 35(3)(b)

Biometric data

- "Personal data resulting from specific technical processing relating to the **physical, physiological or behavioural characteristics** of a natural person, which allow or confirm the unique identification of that natural person..."
- „Actions and mannerisms made by individuals, organisms, systems or artificial entities in conjunction with themselves or their environment, which includes the other systems or organisms around as well as the (inanimate) physical environment. It is the **computed response of the system or organism to various stimuli or inputs**, whether internal or external, conscious or subconscious, overt or covert, and voluntary or involuntary."
- Behavioural characteristic, recorded and interpreted brain activity, can allow or confirm the unique identification of that natural person
- Brain data can be understood as biometric data

Biometric data 2

- Four types of biometric data (Kindt, 2017):
  - **Non-biometric data**
    - data relates unique human characteristics, but other elements of the definition (i.e. specific technical processing which allow or confirm identification) are not met
    - emotional and behavioural data are considered personal data *"if and in so far it may not be sufficiently distinctive to allow or confirm identification"*
  - **Biometric data as defined in the GDPR**
    - the purpose of actually using this data is missing
    - same protective level as personal data. Respectively, the can be used for example for verification instead of identification
  - Biometric data processed **for purposes of uniquely identifying** a natural person
    - Art 9. special category of data
  - Biometric data processed for the purposes of uniquely identifying natural persons on a **large scale**
    - Special category of data + DPIA

Data concerning health

- "personal data related to the physical or mental health of a natural person, including the provision of health care services, which reveal information about his or her health **status**".
- "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." (1946 Constitution of the World Health Organization (WHO)
- „The right to the enjoyment of the highest attainable standard of physical and mental health." (International Covenant on Economic, Social and Cultural Rights)
- Mental health:certain level of psychological well-being or the absence of mental illness
- mental health entails *"subjective well-being, perceived self-efficacy, autonomy, competence, inter-generational dependence, and self-actualization of one's intellectual and emotional potential, among others*". (WHO)

Data concerning health 2

- Personal data are health data (data concerning health under the terminology of the GDPR), when:
  - *the data are inherently/clearly **medical data***
  - *The data are **raw sensor data** that can be used in itself or in combination with other data to draw a conclusion about the actual health status or health risk of a person*
  - ***Conclusions** are drawn **about** a person's **health status** or health risk (irrespective of whether these conclusions are accurate or inaccurate, legitimate or illegitimate, or otherwise adequate or inadequate). (*Article 29 Working Party, letter to the European Commission, 2015*)*
- Brain data can fall into all of the categories

Special category of data

- Personal data revealing
  - racial or ethnic origin,
  - political opinions,
  - religious or philosophical beliefs, or
  - trade union membership or
  - data concerning a natural person's sex life or sexual orientation
- P300 paradigm
- Event-Related Potential (ERP) is a pattern of voltage change, induced by an auditory or visual stimulus within a known timeframe.
- „The most prominent ERP component which is sensitive to complex cognitive processing is the P300, because it can be detected as an amplitude peak in the EEG signal at ≈ 300 ms after the stimulus”

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Versatility of EEG data

EEG data	Category	Level of protection
Any information relating to an identified or identifiable natural person	Personal data	Baseline
Relates to behavioural characteristics of a natural person	Personal data	Baseline
Results from a specific technical processing relating to physical, physiological or behavioural characteristics of a natural person, and which is capable to allow or confirm unique identification	Biometric data	Baseline
Results from a specific technical processing relating to physical, physiological or behavioural characteristics of a natural person, and which is capable to allow or confirm unique identification, for the purposes of uniquely identifying a natural person	Special category of data	Higher level
Results from a specific technical processing relating to physical, physiological or behavioural characteristics of a natural person, and which is capable to allow or confirm unique identification, for the purposes of uniquely identifying a natural persons on a large scale	Special category of data	Higher level + mandatory DPIA
Processed for medical purposes	Data concerning health	Higher level
Raw sensor data that can be used in itself or in combination with other data to draw a conclusion about the actual health status or health risk of a person	Data concerning health	Higher level
(Accurate or false) conclusion drawn about health status	Data concerning health	Higher level
Reveals racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing data concerning a natural person's sex life or sexual orientation	Special category of data	Higher level

Conclusion

- Brain data is personal data through the unique combination of information
- Direct identification is not yet sufficient
- Blanket retention is a threat
- EEG data can qualify as multiple types of data simultaneously
- Context, purpose, format of data should be taken into consideration
- Categories should be distinguished
- Upon wrong categorisation: utilisation of wrong protective regime

Thank you!

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