

**Studying the
human brain before
we could image it:
The deficit-lesion
method**

Where does our knowledge about the brain mostly come from?

- **Animal research**
- Techniques used with animals yield powerful data that we cannot ethically collect from humans.
 - **Genetic engineering**
 - **Lesion studies**
 - **Direct brain recordings from implanted electrodes**



- But animals do not have language.
 - **The foundations of the neurobiology of language are different from most other branches of cognitive neuroscience.**

PHINEAS GAGE

THE WORLD'S WONDER

Woburn Doctor Won Fame by
Cure of Man Shot Through
Head by Crowbar.

**A Huge Iron Bar
Shot Through His Head**

Gage's Recovery Wonder of
Medical World—Man Went
with Barnum.

SKULL AND IMPLEMENT
PRIZED AT HARVARD

Traumatic Brain Injury • Emotional Disturbance • Personality Disorder

E.F. Barnes (script), L.B. Lee (art)



<https://medium.com/@rossfloate/the-terrible-horrible-no-good-treatment-of-phineas-gage-496121282cab>

Neurolinguistic research before the invention of brain imaging (in the late 70's)

1. Patient suffers stroke (or other unfortunate incident) leading to brain damage
2. Patient's (altered) behavior is studied
3. Patient dies
4. The location of the damage is assessed in a post-mortem analysis
5. Hypotheses are developed about the functional contribution of the damaged area on the basis of behavioral data collected in vivo

Problems with this method:

- Slow
- At the time of theorizing (step 5), no more data can be collected.
- One could test hypotheses in the next relevant patient, but it's impossible to know who might be relevant (i.e., exhibit a lesion in the same site) until they're also dead.
 - **Plus: there likely will never be another patient with *exactly the same lesion***

The deficit-lesion method for studying brain function

- Examining the behavior of an individual with brain damage in order to form theories about the function of the damaged area.
 - **Logic: If the individual cannot do X, then the execution of X must depend on the lesioned area.**
- In animal research, the experimenter is in control of the lesion location (since the experimenter creates it). Consequently, for animals, the deficit-lesion method can be the basis of a systematic research program.
- But language is a uniquely human capacity.
- For humans, the lesions are given by nature, so a targeted investigation of a particular region is much harder with the deficit lesion method.

The deficit-lesion method for studying brain function

- Since language is a uniquely human capability, the history of the cognitive neuroscience of language is deeply rooted in deficit-lesion studies.
- Language problems as a result of brain damage: **APHASIA**.
- Study of aphasic patients: **APHASIOLOGY**.